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Ecology in relation to an Environmental Impact Assessment

Undertaking of the permitting activities including environmental impact studies and related actions for the Malta-Italy Gas pipeline interconnection

Technical Study

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1.0 Introduction

The ecology study will look at the impacts which could potentially result from the laying of a gas pipeline between the Delimara Power Station (DPS) and Gela in Italy, hereinafter being referred to as the Scheme. The study will however only look at the impacts resulting from the Scheme within the Maltese Territorial Waters (up to the Malta-Sicily Median line). Most of these potential impacts will take place at sea since the only constructions which will take place on land will be in an area adjacent to the existing DPS which still has to be reclaimed. Any impacts resulting from this minor addition will also be studied.

The pipeline will cross the following Marine Protected Areas (MPAs):

» *Żona fil-Baħar fil-Grigal* (MT 0000107) designated as an SPA via GN No. 1311 of 2016, in accordance with the FLORA, FAUNA AND NATURAL HABITATS PROTECTION REGULATIONS, 2016 (S.L. 549.44);
» *Żona fil-Baħar fil-Lvant* (MT 0000108) designated as an SPA via GN No. 1311 of 2016, in accordance with the FLORA, FAUNA AND NATURAL HABITATS PROTECTION REGULATIONS, 2016 (S.L. 549.44);
» *Żona fil-Baħar fil-Lbiċ* (MT 0000111) designated as an SPA via GN No. 1311 of 2016, in accordance with the FLORA, FAUNA AND NATURAL HABITATS PROTECTION REGULATIONS, 2016 (S.L. 549.44).

The Terms of Reference (ToRs) for this baseline report were issued by the Environment and Resources Authority (ERA) in March 2018. Section 3 of these ToRs concern the ecology part of the EIA. In accordance to these ToRs, the screening process of the scheme determined that an AA is required as per Article 19(1) of THE FLORA, FAUNA AND NATURAL HABITATS PROTECTION REGULATIONS, 2006 (SL 549.44), given that the scheme may cause significant impacts on the abovementioned Marine SPAs (Natura 2000 sites).

This document describes the full details of the Scheme together with an assessment of all relevant ecological receptors in the area under consideration, the potential impacts presented by the scheme and possible mitigation measures, residual impacts and alternative solutions, in order to satisfy the requirements of the ToRs.

1.1 Description of Scheme

The Government of Malta intends to connect Malta with the Trans-European Natural Gas Network via a 158km long pipeline connecting Malta (Delimara) with Italy (Gela, Sicily) of which 151km will be below water (Figure 1).[1] Once installed, the pipeline would provide a more reliable source to supply natural gas to Malta and at the same time eliminating the need for the Floating Storage Unit (FSU) which was recently installed on site to supply natural gas to the DPS.

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[1] *KP numbers in this figure relate to the kilometre point of the project with KP 0 being the position of the terminal station in Gela. Figures produced by Lighthouse SpA consider KP 0 as the shoreline in Gela. There is a difference of approximately 7.1km between the two systems.*

The gas pipeline is designed to operate in bidirectional mode with the first phase supplying gas from Sicily to Malta and depending on market developments, can in the future be able to supply gas from Malta to Italy. The terminal in Sicily will be situated in an area at 37^{0}04’51.80”N, 14^{0}19’01.00”E, where a 7km onshore pipeline which will be buried will pass through various rural areas until it reaches the shores. Three block valve stations will be connected onshore *en route*.

The pipe which will be made from steel and have a diameter of 22” will be buried in shallow waters while in deeper waters it will be laid on the seabed. Laying of the pipeline in water will take place from special barges and vessels whereas on land, equipment will depend on the circumstances under which the pipes will be laid. The pipeline is constructed in situ by welding pipes together and laying them as a whole. On the Malta side the land based pipeline will reach land several meters below sea level and enter through an excavated tunnel until it surfaces at the terminal at DPS (Figure 2 and Figure 3). The area where the proposed land-based installations will be located on a reclaimed patch of land adjacent to the pier of the FSU.

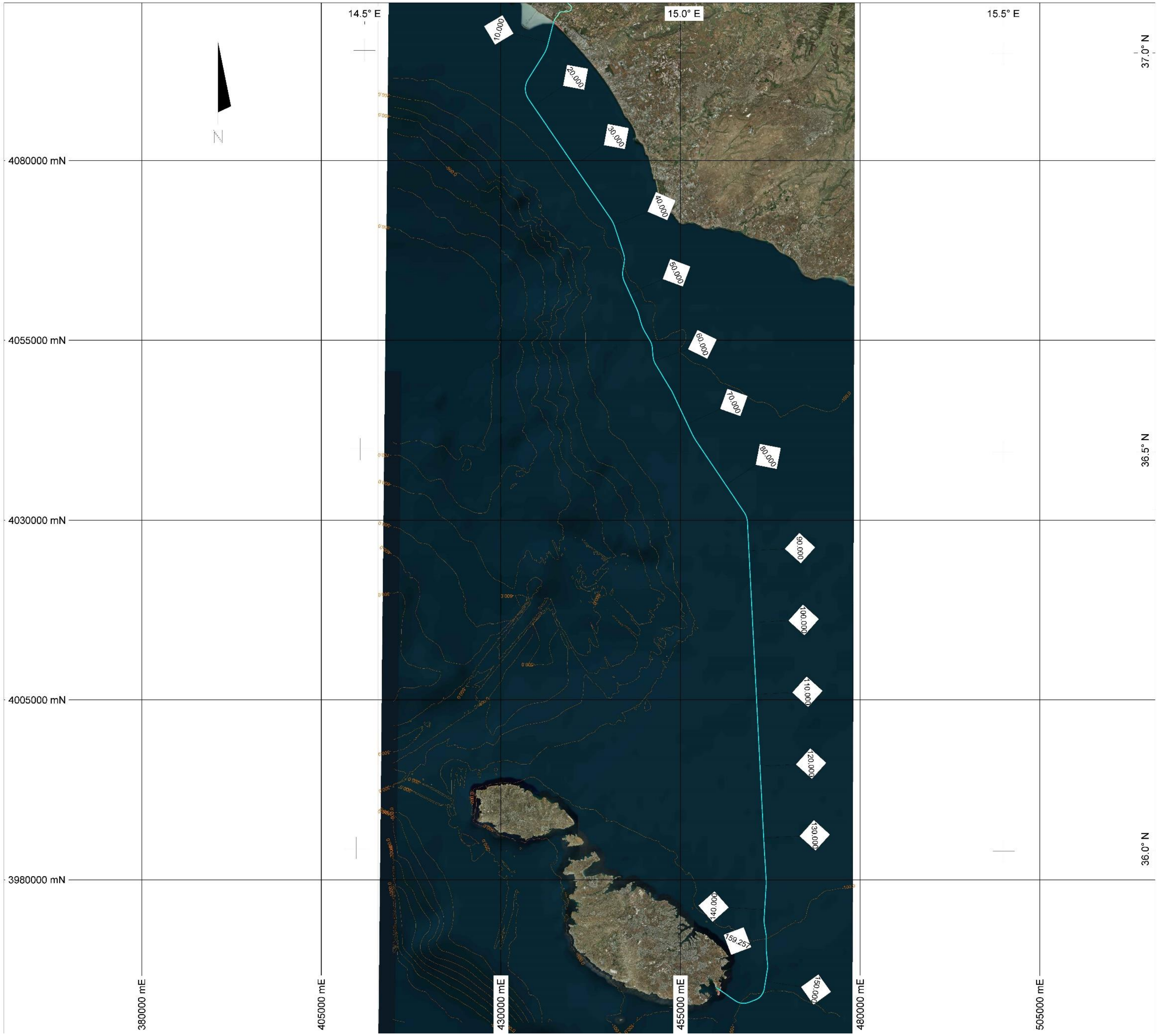


Figure 1: Offshore pipeline general route

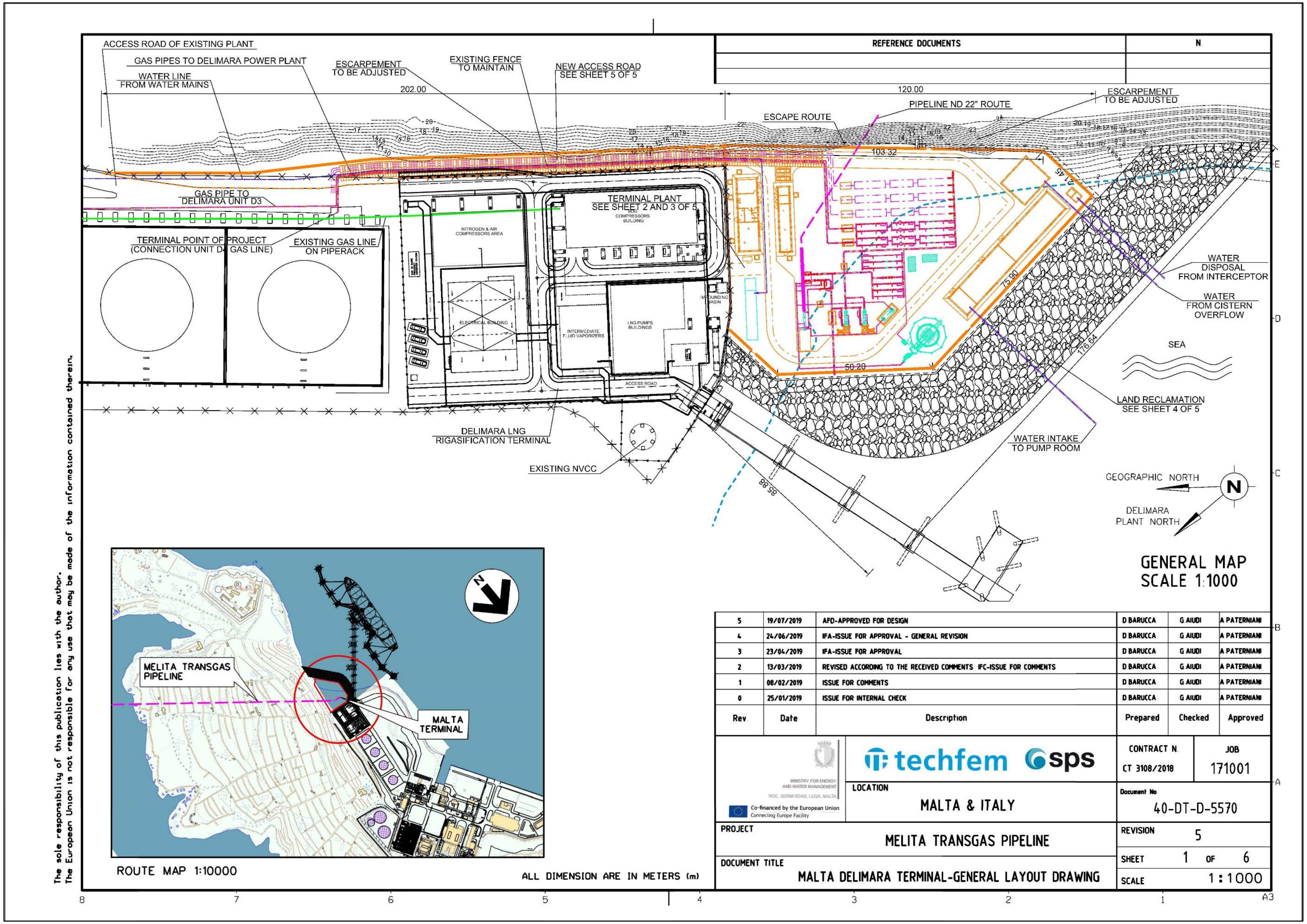


Figure 2: Plan showing layout of Terminal facility.

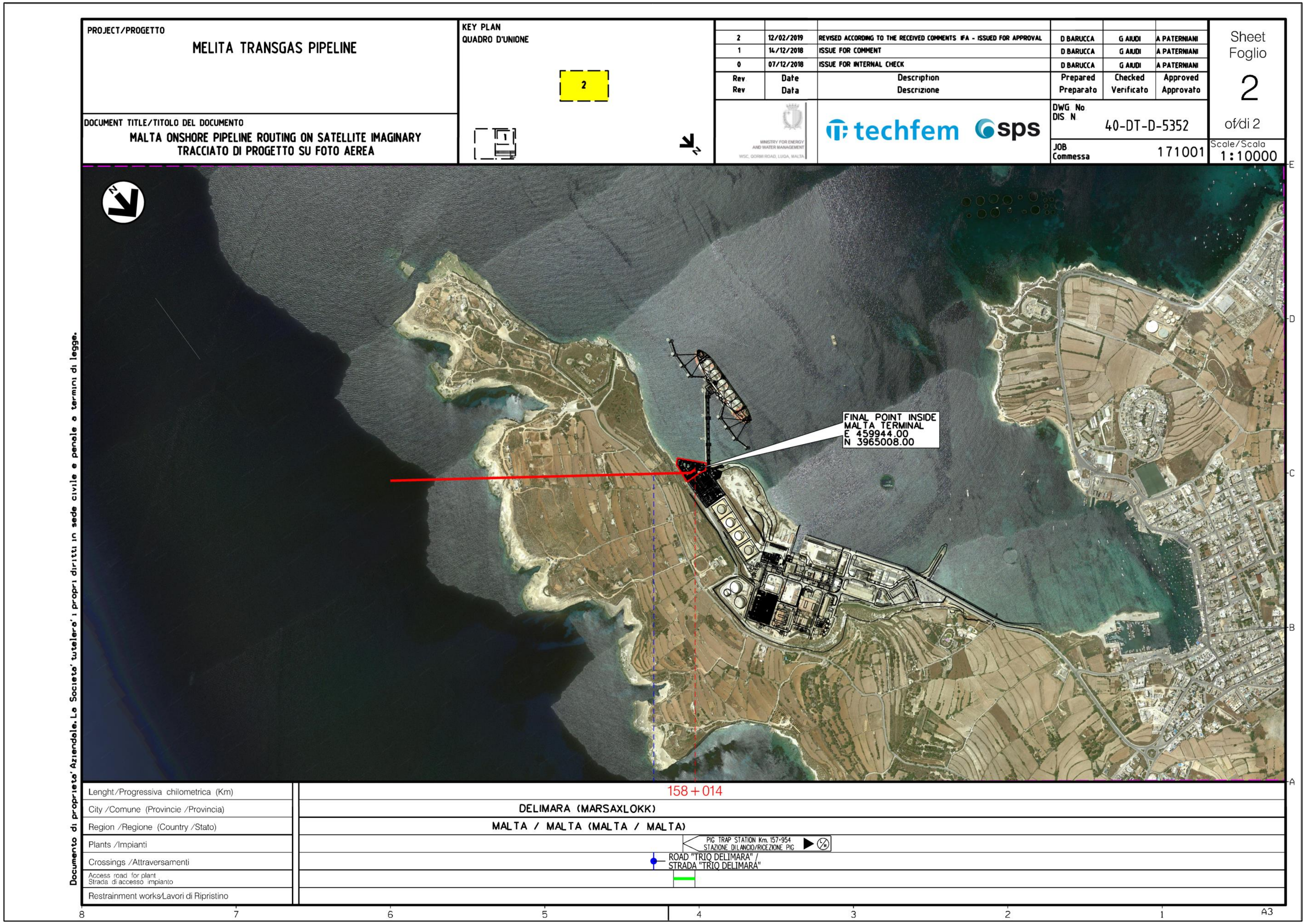


Figure 3: Area image showing location of underground pipeline crossing Delimara peninsula and Terminal site.

2.0 Area of Study

The site description will only concern the part relevant to the Malta side.

2.1 Marine ecology

The Area of Influence (AoI) for the marine component of the ecology study will encompass ten individual sampling stations, as mapped in Figure 4. The offshore corridor is 2km wide (1km on each side of the route) for the first nautical mile and 1.2km wide (600m on each side of the route) for the remaining offshore section.

The proposed locations for the various pelagic and benthic metrics have been formulated in order to ensure partial coverage of the confines of the designated *Baħar tal-Grigal* (MT0000107), *Baħar tal-Lbiċ* (MT 0000111) and *Baħar tal-Lvant* (MT0000108) Special Protection Areas (SPAs, as identified within the FLORA, FAUNA AND NATURAL HABITATS PROTECTION REGULATIONS, 2006 [S.L. 549.44]), as well as locations positioned outside these two MPAs and locations putatively harbouring seagrass meadows (gauged along bathymetric lines).

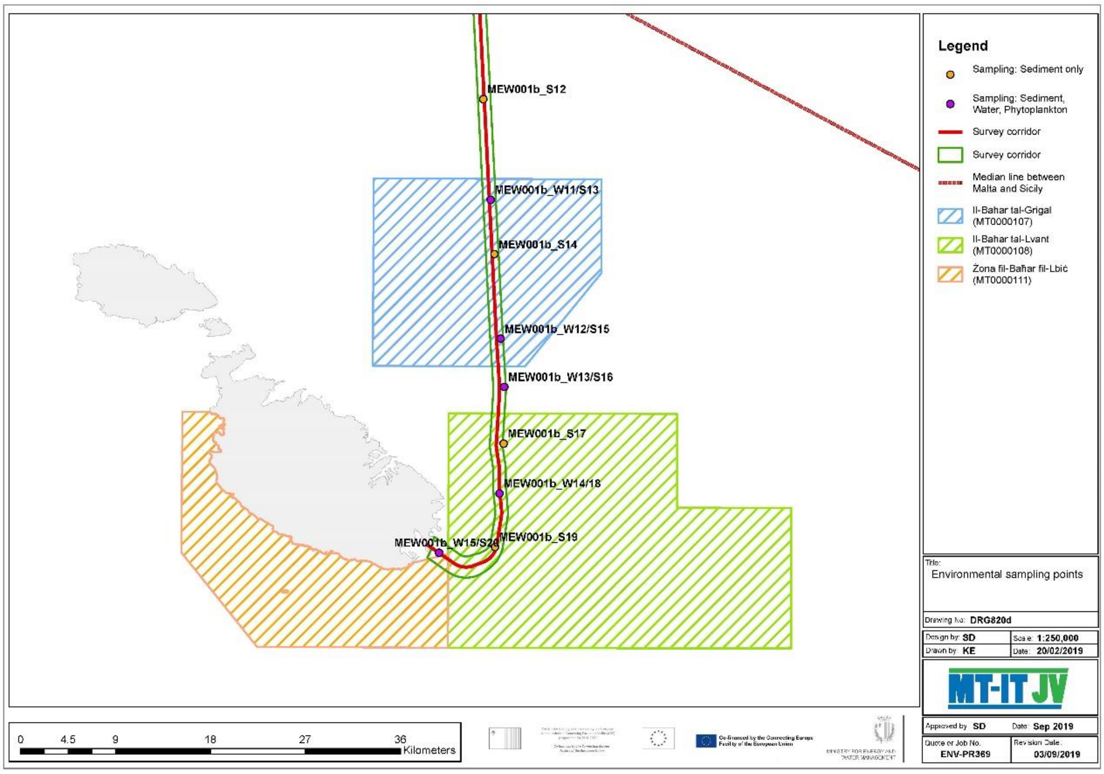


Figure 4: Locations of the ten environmental sampling stations for the water column and benthic metrics

2.2 Terrestrial ecology

The AoI for the terrestrial ecology aspect of this project was limited to the footprint of the proposed Delimara Terminal Plant and access road, since these areas will be directly affected by the proposed works. No effects on the terrestrial ecology of the onshore pipeline area are envisaged since the works will be entirely subsurface through trenchless technology.

2.3 Avifauna

The pipeline will cross the following Marine Protected Areas, as shown in Figure 5:

- Żona fil-Baħar fil-Grigal (MT 0000107) designated as an SPA via GN No. 1311 of 2016, in accordance with the Flora, Fauna and Natural Habitats Protection Regulations, 2016 (S.L. 549.44);
  Żona fil-Baħar fil-Lvant (MT 0000108) designated as an SPA via GN No. 1311 of 2016, in accordance with the Flora, Fauna and Natural Habitats Protection Regulations, 2016 (S.L. 549.44); and
  Żona fil-Baħar fil-Lbiċ (MT 0000111) designated as an SPA via GN No. 1311 of 2016, in accordance with the Flora, Fauna and Natural Habitats Protection Regulations, 2016 (S.L. 549.44).

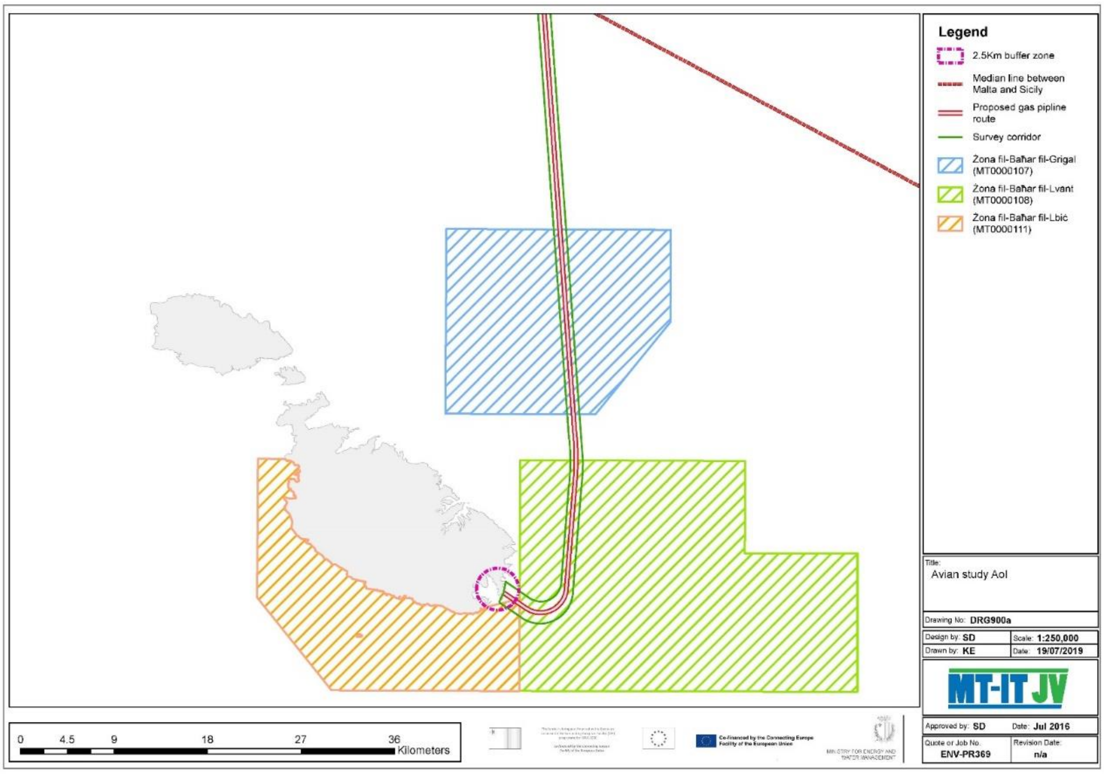


Figure 5: Area of Influence for avian ecological study

3.0 Terms of Reference

The Terms of Reference related to the study on ecology for the EIA issued by ERA in March 2018 are:

3.0 A DESCRIPTION OF THE SITE AND ITS SURROUNDINGS (I.E. ENVIRONMENTAL BASELINE)

This description is identified by the area of influence depicted in Figure 4 *and* Figure 5. *This description shall include:*

3.5 Ecology (including Terrestrial and Marine Ecology and Avifauna)

1. *A full bathymetric survey of the existing environment on and around the area likely to be affected, include:*
    a. *Offshore bathymetric maps;*
    b. *Aerial imagery of the area;*
    c. *Details and maps of any services / utilities;*
    d. *Description of the sea-bed morphology and of the sediment characteristics of the site;*

2. *An investigation of the ecology of the site and its surroundings (including, as relevant: flora, fauna, avifauna, fish and other aquatic organisms (including marine mammals and turtles), benthic, burrowing and pelagic organisms, their habitats and ecosystems), duly covering the relevant seasons to ensure adequate coverage of all relevant species and ecosystem components;*

3. *A reporting of the conservation status and ecological condition of the area and the state of health of its habitats, species and ecological features;*

4. *A reporting of all protected, endangered, rare, unique, endemic, high-quality, keystone, invasive/deleterious, or otherwise important species, habitats, ecological assemblages, and ecological conditions found in the area under study;*

5. *A prediction of the potential impacts of the proposed project on the ecology of the site and its surroundings, including loss, damage or alteration of habitats and species populations (including potential increases in ambient noise levels in the marine environment) including alteration in the habitats and species' condition/state of health as measured through indicators used/specified for assessment of status in relevant EU policy;*

6. *Identification of all relevant species and assemblages (e.g. protected species or habitats, key species relevant to habitat characterisation, and monitoring indicators), and assess their abundance and distribution patterns as well as the species' ecological niches. The findings should be supported by adequate maps and photographs. Classification of habitat types and species should be conducted in accordance with recognised classification systems (e.g. EUNIS and Palaearctic), to ERA satisfaction;*

7. *A Noise and vibration study providing sufficient detailed information on any impacts on sensitive receptors (fauna and avifauna, natural ecosystems) due to increase in pressure in the area, and the cumulation with other existing sources including maritime vessel traffic and with other predicted sources such as new developments;*

8. *The nature of the changes (whether temporary or permanent) and effects of such changes on the ecological features; and*

9. *Other relevant environmental features.*

In particular, the study should identify all relevant species and assemblages (e.g. protected species or habitats, key species relevant to habitat characterisation, and monitoring indicators), and assess their abundance and distribution patterns as well as the species' ecological niches. The findings should be supported by adequate maps and photographs. Classification of habitat types and species should be conducted in accordance with recognised classification systems (e.g. EUNIS and Palaearctic), to ERA satisfaction;

Note 1: *Separate Terms of Reference are being referred by ERA for the Appropriate Assessment required in terms of the Flora, Fauna and Natural Habitats Protection Regulations (S.L. 549.44).*

4.0 ASSESSMENT OF ENVIORNMENTAL IMPACTS AND ENVIRONEMENTAL RISKS

All likely significant effects and risks posed by the proposed project on the environment during all relevant phases (including construction/excavation/demolition, operation and decommissioning) should be assessed in detail, taking into account the information emerging from Sections 1, 2 and 3 above. Apart from considering the project on its own merits (i.e. if taken in isolation), the assessment should also take into account the wider surrounding context and should consider the limitations and effects that the surrounding environmental constraints, features and dynamics may exert on the proposed development, thereby identifying any incompatibilities, conflicts, interferences or other relevant implications that may arise if the project is implemented.

In this regard, the assessment should address the following aspects, as applicable for any category of effects or for the overall evaluation of environmental impact, addressing the worst-case scenario wherever relevant:

1. *An exhaustive identification and description of the envisaged impacts;*
2. *The magnitude, severity and significance of the impacts;*
3. *The geographical extent/range and physical distribution of the impacts, in relation to: site coverage; the features located in the site surroundings; whether the impacts are short-, medium- or long-range; and any transboundary impacts (i.e. impacts affecting other countries);*
4. *The timing and duration of the impacts (whether the impact is temporary or permanent; short-, medium- or long-term; and reasonable quantification of timeframes);*

5. *Whether the impacts are reversible or irreversible (including the degree of reversibility in practice and a clear identification of any conditions, assumptions and pre-requisites for reversibility);*
6. *A comprehensive coverage of direct, indirect, secondary and cumulative impacts, including:*
   - *interactions (e.g. summative, synergistic, antagonistic, and vicious-cycle effects) between impacts;*
   - *interactions or interference with natural or anthropogenic processes and dynamics;*
   - *cumulation of the project and its effects with other past, present or reasonably foreseeable developments, activities and land uses and with other relevant baseline situations; and*
   - *wider impacts and environmental implications arising from consequent demands, implications and commitments associated with the project (including: displacement of existing uses; new or increased pressures on the environment in the surroundings of the project, including pressures which may be exacerbated by the proposal but of which effects may go beyond the area of influence; and impacts of any additional interventions likely to be triggered or necessitated by situations created, induced or exacerbated by the project);*
7. *Whether the impacts are adverse, neutral or beneficial;*
8. *The sensitivity and resilience of resources, environmental features and receptors vis-à-vis the impacts;*
9. *Implications and conflicts vis-à-vis environmentally-relevant plans, policies and regulations;*
10. *The probability of the impacts occurring; and*
11. *The techniques, methods, calculations and assumptions used in the analyses and predictions, and the confidence level/limits and uncertainties vis-à-vis impact prediction.*

The impacts that need to be addressed are detailed further in the sub-sections below.

4.1 Effects of the environment aspects identified in Section 3

The assessment should thoroughly identify and evaluate the impacts and implications of the project on all the relevant environmental aspects identified in Section 3 above, also taking into account the various considerations outlined in the respective sections.

With regards to Section 3.4 and 3.5 above, the ecological status of the area in question is to be evaluated, taking into consideration the definition of status by relevant EU Policy, and assessing the extent to which the project will cause deterioration in status or compromise the achievement of good status in line with Article 4(7) of the EU Water Framework Directive.

4.2 Impacts related to Climate Change and Climate Change Adaptation

The assessment should address the following aspects, as relevant:

1. *The contribution of the project to greenhouse gas (GHG) emissions and climate change, including:*

i. The direct, indirect and off-site GHG emissions and related impacts during all relevant phases of the project, including those arising as a result of the electrical power demand of the project;
ii. Any massive GHG emissions that may occur as a consequence of accidents or malfunctions;
iii. The impacts of the proposal on carbon sinks (e.g. wooded/afforested areas, agricultural soils, landfills, wetlands, and marine environments);
iv. The components of the project that are expected to contribute to renewable energy generation on site or to a reduction in GHG emissions through substitution of current generation facilities, including a quantification and critique of their reliability and actual net contribution to climate change mitigation as well as an identification of the impacts of such components on other aspects of the environment (e.g. landscape, land take, avifauna); and
v. The implications of the project and its operations and ancillary demands on National GHG emission targets.

2. *The implications of climate change on the proposal, including:*
    i. The aspects/elements of the project that are likely to be affected by changes or variability in climate-related parameters (e.g. temperature, humidity, weather patterns, sea level, etc.);
    ii. The potential impacts that such changes may have on the proposal, including any possible impacts resulting from changes to multiple parameters; and
    iii. The adaptability of the project and its components and operations vis-à-vis the relevant climate change parameters and trends.

4.3 Environmental Risk

The assessment should also address, in sufficient detail, any relevant environmental risk (including major-accident scenarios such as contamination, emissions, blast, flooding, major spillages, etc.) likely to result in environmental damage or deterioration. The range of accident scenarios considered should exhaustively cover, as relevant:

1. *one-time risks (e.g. during construction or decommissioning works);*
2. *recurrent risks during project operation; and*
3. *risks associated with extreme events (e.g. effect of earthquakes or natural disasters on the project).*

The assessment should include, as relevant: a quantification of the risk magnitude and probability; and risk analysis vis-à-vis any hazardous materials stored, handled, or generated on site or transported to/from the site.

Note: *Should the proposal fall within the scope of the Seveso/COMAH regulations, a stand-alone Risk Assessment may be required, to the satisfaction of the relevant Competent Authority. In such instances, separate Terms of Reference are issued for the Risk Assessment.*

Following a formal request to CPD by MEW dated 20th March 2018, CPD indicated that at EIA stage, it is premature to request an update to the safety report, risk assessments and internal emergency plan.

4.4 Effects on Human Populations resulting from impacts on the environment

This assessment should also identify any impacts of the development on the surrounding and visiting population (e.g. effects on public health or on socio-economic considerations), that may result from impacts on the environment. In the case of health-related effects, reference should be made to published epidemiological and other studies, as relevant, and the views of the Environmental Health Directorate should be sought.

4.5 Transboundary Impacts and Other Environmental Effects

The impacts whose area of influence reaches one or more neighbouring countries (affected country, i.e. Italy), should be described and assessed according to their nature and characteristics (e.g. direct and indirect, temporary or permanent, continuous or intermittent, reversible or irreversible, positive or negative, short- medium- or long-term, their magnitude, their mitigation and compensability, their transboundary nature, accumulation and synergies with other impacts).

Impacts should be identified for the construction, operation and decommissioning phases of the project, including all ancillary developments.

Any other environmental effects deemed relevant to the project but not fitting within any of the above sections should also be identified and assessed.

5.0 REQUIRED MEASURES, IDENIFITICATION OF RESIDUAL IMPACTS, AND MONITORING PROGRAMME

5.1 Mitigation Measures

*A clear identification and explanation of the measures envisaged to prevent, eliminate, reduce or offset (as relevant) the identified significant adverse effects of the project during all relevant phases including construction, operation and decommissioning [see **Section 1.2.3** above]. Such measures could include technological features; operational management techniques; enhanced site-planning and management; aesthetic measures; conservation measures; reduction of magnitude of project; and health and safety measures. Particular attention should be given to mitigation of impacts on the marine resources and of conflicts between the different uses on site.*

*As a general rule, mitigation measures for construction-phase impacts should be packaged as a holistic Construction Management Plan (CMP). Whilst the detailed workings of the CMP may need to be devised at a later stage (e.g. after the final design of the project has been approved and/or after a contractor has been appointed), the key parameters that the CMP must adhere to for proper mitigation need to be identified in the EIA. Broadly similar considerations also apply vis-à-vis operational-phase impacts [which may need to be mitigated through an operational permit] and decommissioning-phase impacts [see **Section 5.4** below], where relevant.*

Mitigation measures for accident/risk scenarios should be packaged as a holistic plan that includes the integration of failsafe systems into the project design as well as well-defined contingency measures.

The recommended measures should be feasible, realistically implementable to the required standards and in a timely manner, effective and reliable, and reasonably exhaustive. They should not be dependent on factors that are beyond the developer's and ERA's control or which would be difficult to monitor, implement or enforce. The actual scope for, and feasibility of, effective prevention or mitigation should also be clearly indicated, also identifying all potentially important pre-requisites, conditionalities and side-effects.

5.2 Residual Impacts

Any residual impacts [i.e. impacts that cannot be effectively mitigated, or can only be partly mitigated, or which are expected to remain or recur again following exhaustive implementation of mitigation measures] should also be clearly identified.

5.3 Additional Measures

Compensatory measures (i.e. measures intended to offset, in whole or in part, the residual impacts) should also be identified, as reasonably relevant. Such measures should be not considered as an acceptable substitute to impact avoidance or mitigation.

If the assessment also identifies beneficial impacts on the environment, measures to maximise the environmental benefit should also be identified.

In both instances, the same practical considerations as indicated vis-à-vis mitigation measures should also apply.

5.4 Decommissioning Plan

A decommissioning plan (DP) should also be proposed to address the following circumstances, as relevant:

1. *Removal of any temporary or defined-lifetime development (or of any structures, infrastructure or land use required temporarily in connection with it) upon the expiry of their permitted duration; and*
2. *Removal of the development (or of any secondary developments, infrastructure or land use ancillary to it) in the event of redundancy, cessation of operations, serious default from critical mitigation measures, or other overriding situations that may emerge in future.*

The DP should also include, as relevant, a phasing-out plan, proposals for site remediation or decontamination, and methodological guidance on site reinstatement or appropriate after-use.

5.5 Monitoring Programme

A realistic and enforceable programme for effective monitoring of those works envisaged to have an adverse or uncertain impact. The monitoring programme should include:

1. *Details regarding type and frequency of monitoring and reporting, including spot checks;*
2. *The parameters that will be monitored, their units of measurement, the monitoring indicators to be used; and standard analytical methods in line with relevant EU policy;*
3. *An effective indication of the required action to address any exceedances, risks, mitigation failures or non-compliances for each monitoring parameter;*
4. *An evaluation of forecasts, predictions and measures identified in the EIA; and*
5. *An indication of the nature and extent of any additional investigations (including EIAs or ad hoc detailed investigations, if relevant) that may be required in the event of any contingencies, unanticipated impacts, or impacts of larger magnitude or extent than predicted.*

The programme should address all relevant stages, as follows:

a) *Where relevant, monitoring of preliminary on-site investigations that may entail significant disturbance or damage to site features (e.g. marine environment in terms of the benthos, or any works that require prior site clearance or any significant destructive sampling);*
   *[**Note:** Official written consent from the competent authorities (e.g. Superintendence of Cultural Heritage) may also be required for such interventions.]*
b) *Monitoring of the construction phase, including the situation before initiation of works (including site clearance), during appropriate stages of progress, and after completion of works;*
c) *Monitoring of the operational phase, except where otherwise directed by ERA (e.g. where monitoring would be more appropriately integrated into an operating permit)(including monitoring of the marine environment in terms of the benthos, water quality and other sensitive receptors); and*
d) *Where relevant, monitoring of the decommissioning phase, including the situation before initiation of works, during appropriate stages of progress, and after completion of works.*

5.6 Identification of required authorisations

The assessment should also identify all environmentally-relevant permits, licences, clearances and authorisations (other than the development permit to which this EIA is ancillary) which must be obtained by the applicant in order to effectively implement the project if development permission is granted. Any uncertainty, as to whether any of these pre-requisites is applicable to the project, should be clearly stated.

Note on Sections 5.1 to 5.6 above:
*The expected effects, the proposed measures, the residual impacts, the proposed monitoring etc. should also be summarised in a user-friendly itemised table that enables the reader to easily relate the various aspects to each other. An indicative specimen table is attached in **Appendix 4** - attached to Method Statement as Appendix 1.*

4.0 Methodology

4.1 Marine ecology

The marine study presented in this report contains the following assessments:

- description of the elements of the proposed project which are expected to give rise to significant impacts on site;
- identification of species listed under Habitats and Birds Directives and an accurate mapping out of their distribution within the Area of Study shown in Figure 4, besides benthic assemblages of conservation importance, including seagrass meadows, coral formations, underwater caves, reefs and maerl assemblages. The occurrence of indicator species, useful for defining the ecological quality and conservation status of the marine area under study, will be noted. Classification of recorded species and habitats will be made according to recognised conventions, including the EUNIS, Palaearctic and the RAC/SPA classification systems of Mediterranean marine benthic habitats, as adapted for the Maltese context within Borg et al. (2013).

4.1.1 ROV surveys and water sampling

Field sampling was carried out by Lighthouse SpA as described below:

- given the anticipated sea depths encountered during the survey and given the sheer extent of the AoI, most of the proposed marine ecology field sampling exercise was conducted via Remotely-Operated Vehicle (ROV) transects;
- a total of eight ROV transects were implemented at nearshore Malta, in a staggered fashion (at 200m intervals), whose exact length and positioning was determined during the preliminary marine route survey. Additional ROV footage was collected within the benthic communities of conservation importance detailed along the offshore route. Voucher photos from the collected ROV footage was reproduced within the final PMRS report;
- water column samples were collected through the deployment of a 5L Niskin bottle at prescribed sampling locations (5 locations x 3 replicates), pursuant to the characterisation of chlorophyll a and nutrient baseline values in the sampled areas;
- Replicates for each of the samples were as follows: three replicates for sediments, collected at one depth; and three replicates for water, collected at two different depths;
- Both water and sediment samples were analysed by an accredited (UNI CEI EN ISO/IEC 17025:2018 & ISO/IEC 17025:2017) laboratory.

4.1.2 Sediment sampling

As mentioned above, three replicates of sediments were collected at each station. The box corer was deployed a second time in case of insufficient results (i.e. not enough to fulfil requirements from laboratory). If, after the second deployment, the amount of material collected was still not enough to fulfil requirements from laboratory, a grab sampler was used to acquire superficial samples.

Following the baseline survey, the following indicators were used to gauge possible impacts relevant to the ecological status of the marine environment in the AoI, including:

- Species richness counts
- Other diversity counts, such as diversity indices and evenness measures
- The density of keystone species present on site, such as the extent of seagrass meadows and macroalgal species, and of indicator species (to be identified for the site after collection of baseline data)
- The presence of regionally and/or locally protected species, namely those listed in Annexes II-IV of the Habitats Directive and in relevant schedules of LN 311 of 2006 and the RAC/SPA Convention
- The presence of Red Data Book and other protected species
- The presence of regionally and/or locally protected habitats, namely those listed in Annexes I of the Habitats Directive and in relevant schedules of LN 311 of 2006 and the RAC/SPA Convention

4.2 Terrestrial ecology

A broad-brush terrestrial ecology survey was undertaken in the footprint of the proposed Delimara Terminal Plant and access road, since these areas will be directly affected by the proposed works. No effects on the terrestrial ecology of the onshore pipeline area are envisaged since the works will be entirely subsurface through trenchless technology.

4.3 Avifauna

The study was limited to existing literature data and supplemented by birdwatching data collected from local sources in the area of study. This approach has been taken since a wealth of information on avian studies already exists from previous planning applications on the same site and in the immediate surroundings. Birdwatching data that was used for this study includes birdwatching activities taken over a period of four consecutive years from *Xrobb l-Għaġin* and *San Tumas* area, *Marsaskala*. This will also be supplemented with the following sources of data:

- Marine Natura 2000 Standard Data Form and SPA Map for *Żona fil-Baħar fil-Lvant* (MT0000108) (ERA, 20182);
- Data on birds from BirdLife Malta, their journal *Il-Merill* and other local ornithologists;
  The Breeding Birds of Malta (Sultana et al., 2011), Malta Breeding Bird Atlas (Raine et al., 2008) and Important Bird Areas of EU Importance in Malta (Borg & Sultana, 2004);
- European Birds of Conservation concern-populations, trends and national responsibilities (Birdlife International, 2017); and
- Environmental Impact Assessment reports for projects carried on the Delimara Peninsula.

The STRATEGIC PLAN FOR THE ENVIRONMENT AND DEVELOPMENT (SPED) (2015), the MARSAXLOKK BAY LOCAL PLAN (MBLP) and Area Policy Maps (PA, 1995) and the RURAL POLICY AND DESIGN GUIDANCE (RPDG) (MEPA, 2014) were consulted to identify relevant policies and conservation objectives. The designation of species was indicated in accordance to the relevant schedules in CONSERVATION OF WILD BIRDS REGULATIONS (LN 79 of 2006). The SPECIES OF EUROPEAN CONSERVATION CONCERN (SPECs) system found in Birdlife (2017) was used to identfy the status of the species recorded in the area.

5.0 Baseline study – Marine ecology

The AoI is located within the continental shelf area of the Malta plateau within the Malta-Sicily Channel, which is the seaward extension of the Hyblean plateau of mainland Sicily. The Hyblean Plateau, in turn, represents the northernmost extremity of the Tunisian Platform, which is located at the interface between the African and Eurasian plates. Large swathes of the same shelf area consist of a gently-sloping seabed characterised by fine circalittoral muds.

5.1 Desktop literature review

5.1.1 MEDITS trawl surveys

Terribile et al. (2016) have analysed the results of the MEDITS trawl surveys conducted within 43 Malta's Fisheries Management Zone (FMZ) stations over the 2009-2010 period, some of which fall within the proposed gas pipeline trajectory, as indicated in Figure 6.

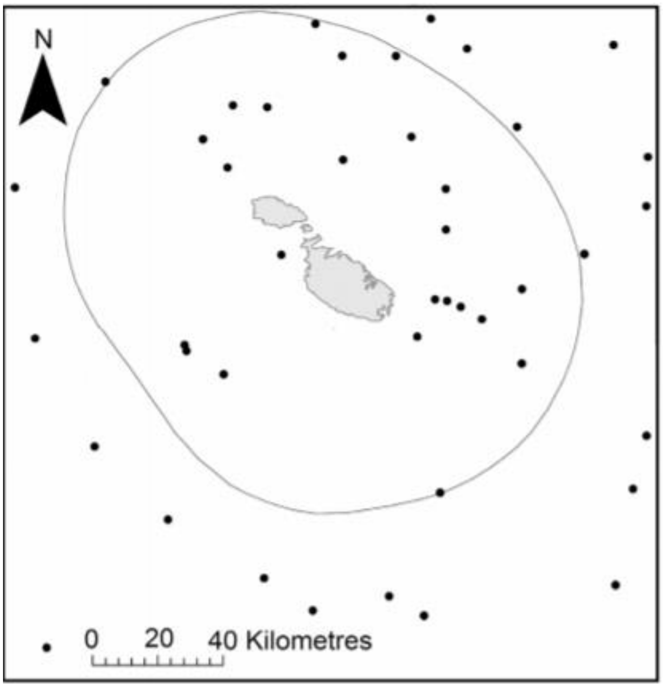


Figure 6: MEDITS trawl surveys assessed by Terribile et al. (2016)

Given that the itemised list of benthic species recorded at each MEDITS station is not provided by Terribile et al. (2016), one can only infer the geographical origin of each recorded species through the water depth range at which it was found. As a result, the following gorgonian species of conservation importance:

- *Callogorgia verticillata*
- *Funiculina quadrangularis*
- *Isidella elongata*
- *Maasella edwardsi*
- *Pennatula rubra*
- *Pteroeides griseum*

could potentially have been recorded at the MEDITS stations which correspond to the gas pipeline AoI. The following gorgonian species:

- *Lophelia pertusa*
- *Desmophyllum dianthus*

which have also been recorded within the same study, all of conservation importance, can be ruled out for the gas pipeline AoI, given their typical water depth of occurrence. Other published studies and anecdotal information on coral species of conservation importance.

Corals of conservation importance known to date from Maltese waters include:

a. Scleractinian (hard coral) species belonging to the *Desmophyllum, Dendrophyllia, Lophelia and Madrepora* genera, as well as
b. Non-scleratinian anthipatharian (black and false black coral) species such as *Leiopathes glaberrima*, *Antipathes* spp. And *Savaglia (=Gerardia) savaglia*, and
c. Gorgonians (sea fans and soft corals) such as *Corallium rubrum, Paramuricea clavata, Callogorgia verticillata, Eunicella* spp., *Isidella elongata*, *Viminella flagellata, Pteroeides griseum* and *Pennatula rubra*
d. Sea pens, including *Funiculina quadrangularis*

Most of these species (example: *Lophelia pertusa*) are bathymetrically excluded from the AoI. One of the few coral species of conservation importance recorded from maerl grounds identified to the north-east of the island of Malta as part of a land reclamation feasibility study is *Eunicella cavolonii*.

Those species whose typical broad-range bathymetric range of occurrence corresponds with the AoI (example: *Corallium rubrum, Paramuricea clavata, Madrepora oculata*) have always, to date, been recorded exclusively from circalittoral areas off the western and south coast of Malta (e.g. Schembri et al., 2007; Freiwald et al., 2009; Knitweiss et al., 2019) and are in fact absent from the species lists cited by Terribile et al. (2016) for MEDITS trawling stations located within the current AoI.

5.1.2 Delimara Power Station extension

The EIA and AA studies conducted in relation to the extension of the Delimara power station (PA 3152/05) provide a benthic habitat map (reproduced below as Figure 7) for the outer reaches of Marsaxlokk Bay, in close vicinity to the infralittoral area identified for land reclamation purposes at the gas terminal facility.

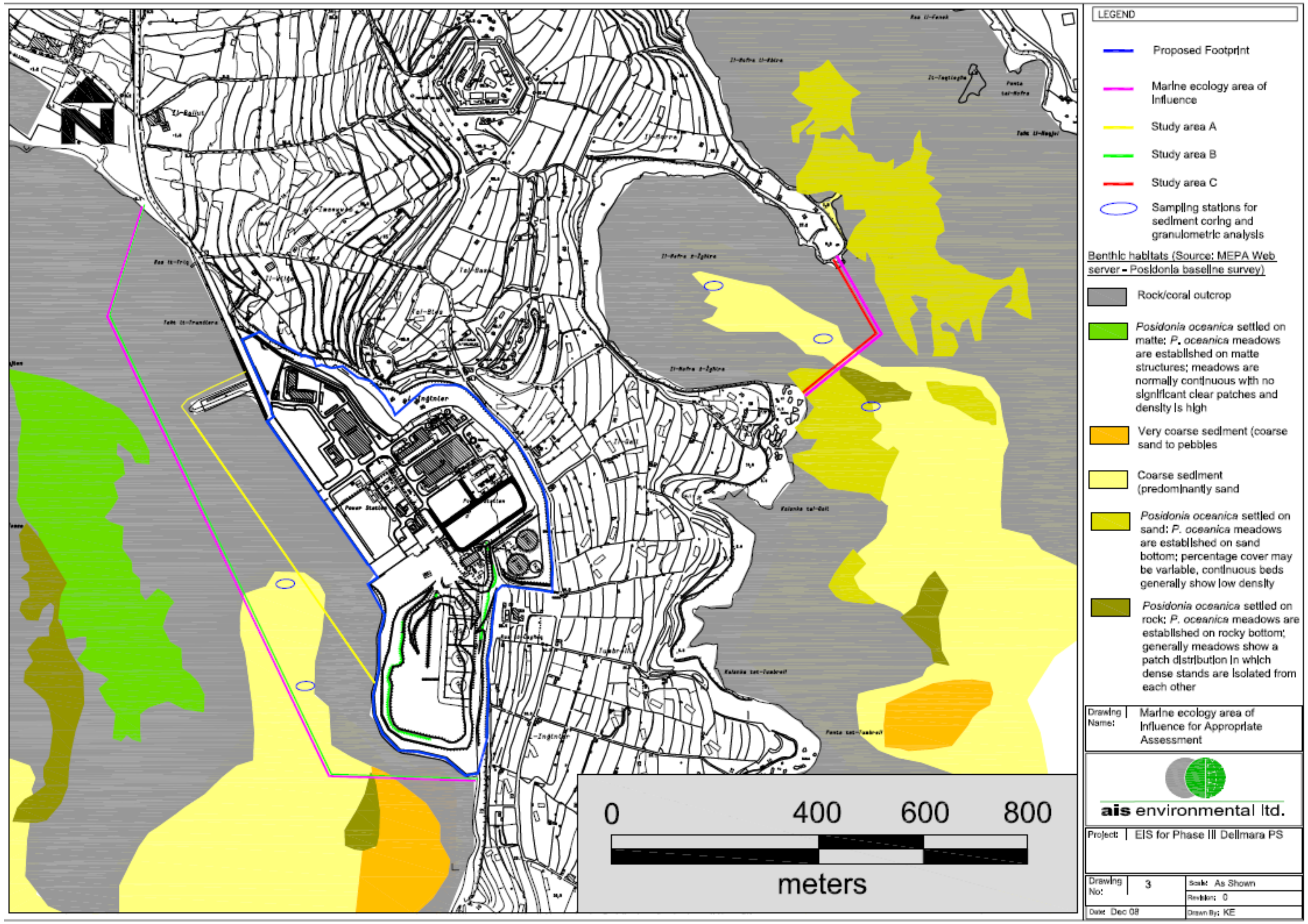


Figure 7: Benthic habitat map for Marsaxlokk Harbour (EIA of PA 3152/05)

5.1.3 Repair and extension of Marsaxlokk coastal defences

The EIA and AA studies conducted in relation to the repair and extension of coastal defences at Marsaxlokk (PA 4576/09) provide a benthic habitat map (reproduced below as Figure 8) for the inner reaches of Marsaxlokk Bay, in close vicinity to the infralittoral area identified for land reclamation purposes at the gas terminal facility.

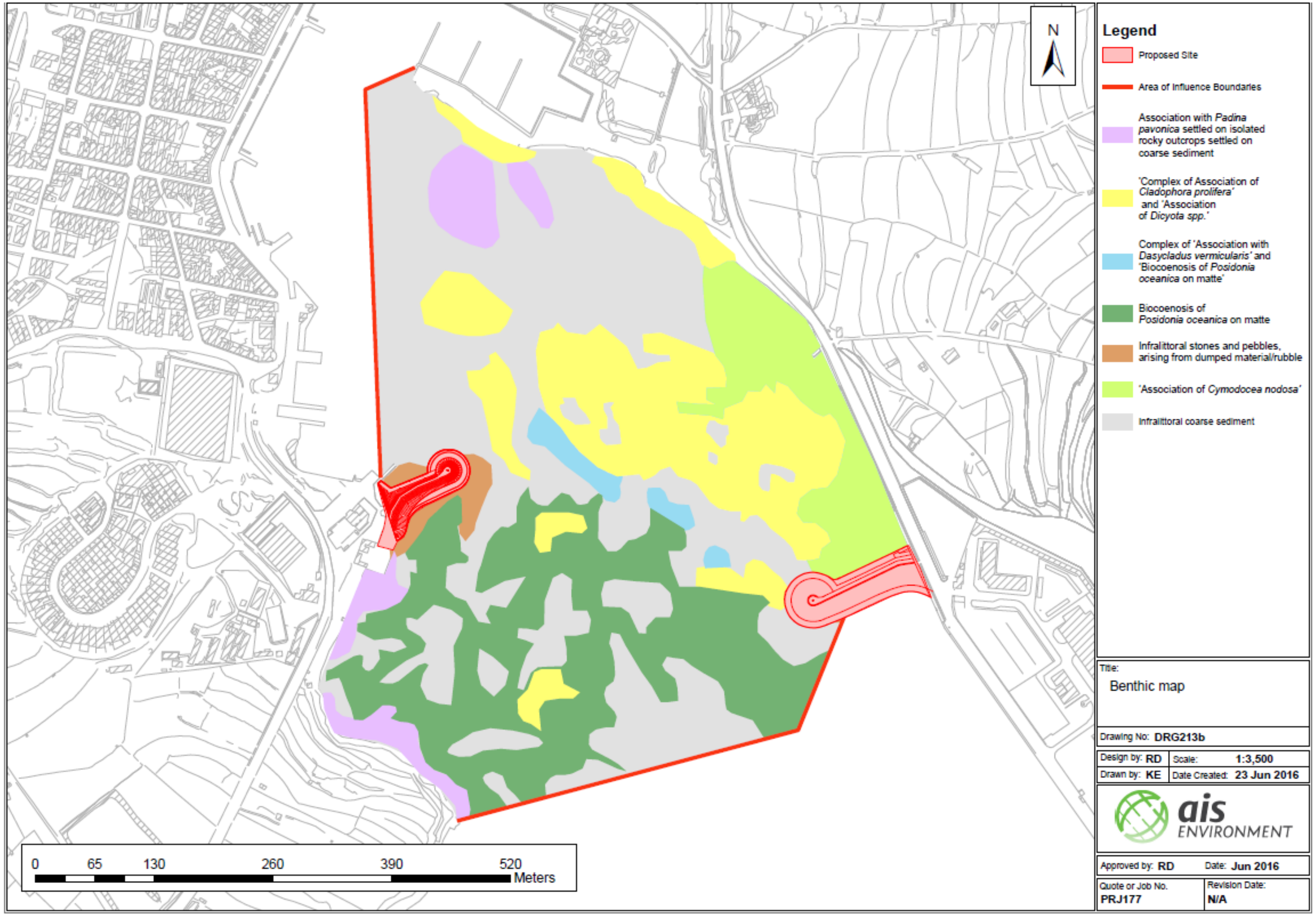


Figure 8: Benthic habitat map for Marsaxlokk Harbour swathes (EIA of PA 4576/09)

5.1.4 EMODNET Seabed Habitats Portal

Benthic habitat data for the Maltese coastal/nearshore locations in close proximity of the landing site was gleaned through this portal,[2] which was specifically queried for such data in November 2019. The distribution of benthic habitats, classified as per EUNIS criteria, as extracted from this portal is reproduced in Figure 9.

[2] https://www.emodnet-seabedhabitats.eu/access-data/launch-map-viewer/

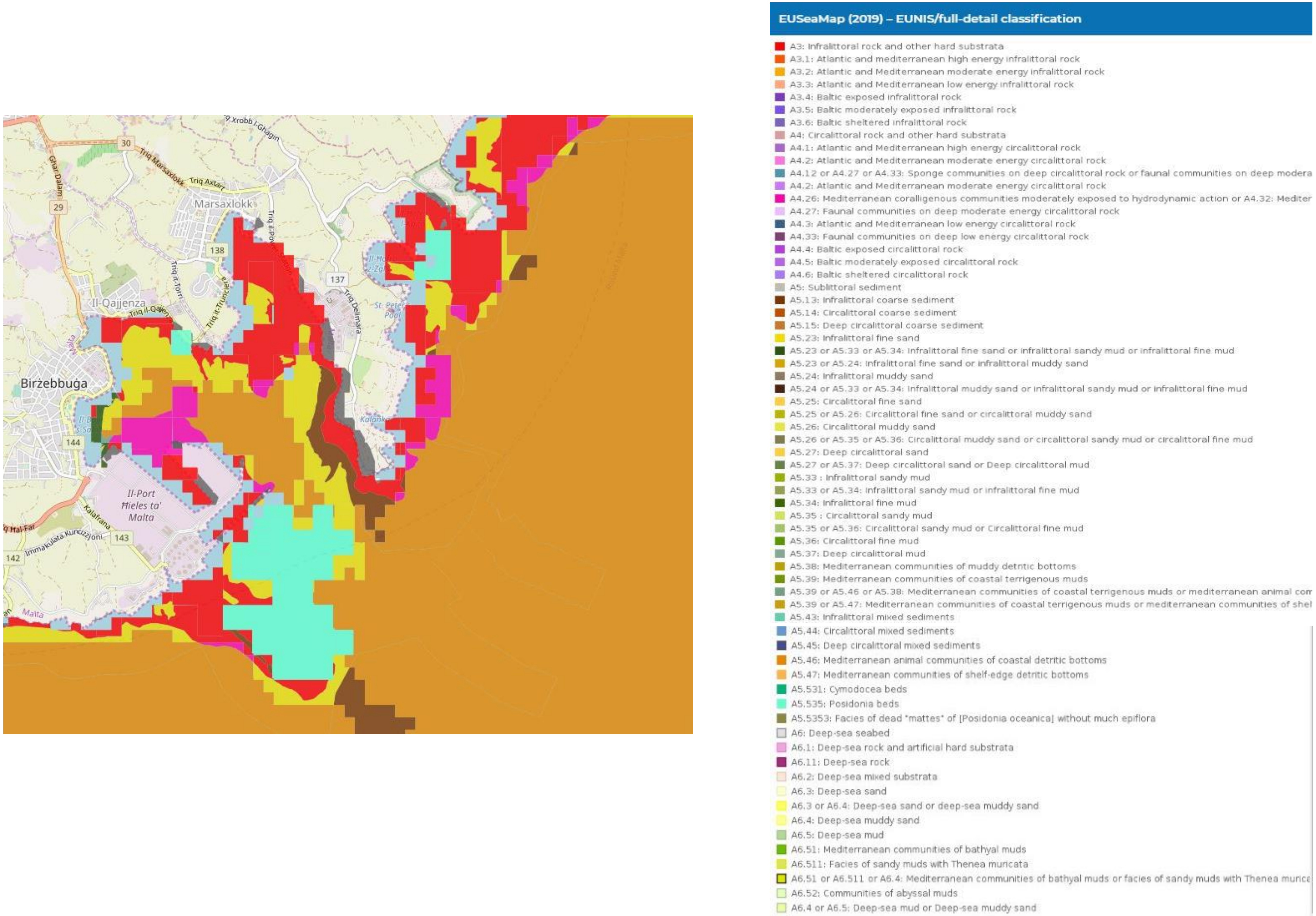


Figure 9: Benthic habitats in the Marsaxlokk area (EMODNET portal)

One observes that the coastal area identified for land reclamation purposes in connection with the development of the gas terminal facility is characterised by the following benthic assemblages (ranked in terms of distance from the shoreline, with the assemblage listed first being the closest to the shore):

» A5.24 – infralittoral muddy sand
» A3 – infralittoral rock and other hard substrata
» A5.13 – infalittoral coarse sediment
» A5.23 – infralittoral fine sand

The eastern flank of the Delimara peninsula, which will support limited trenching activities at the emersion site prior to the complete sub-bottom burial of the pipeline through micro-tunnelling, is characterised by the following benthic assemblages (ranked once again in terms of distance from the shore):

» A5.43 – infralittoral mixed sediments
» A3 – infralittoral rock and other hard substrata
» A4.26 – Mediterranean coralligenous communities moderately exposed to hydrodynamic action
» A3.2 – Atlantic and Mediterranean moderate energy infralittoral rock

5.1.5 *P. oceanica distribution from LIDAR*

Borg et al. (2009) mapping of *P. oceanica* distribution in Maltese waters through LIDAR technology. This study describes the wider Delimara area as supporting scattered *P. oceanica* meadows, with the relevant distribution map reproduced as Figure 10.

Figure 10: P. oceanica *distribution in Malta (Borg et al., 2009)*

5.1.6 *Seabed habitat mapping*

Maltese national seabed habitat mapping exercise conducted within the ambit of the MSFD's Initial Assessment (ERA, 2016). Distribution maps for (a) sublittoral sediment and biogenic reefs and (b) maerl, sand and gravel-based assemblages have been extracted and these are reproduced below as Figure 11.

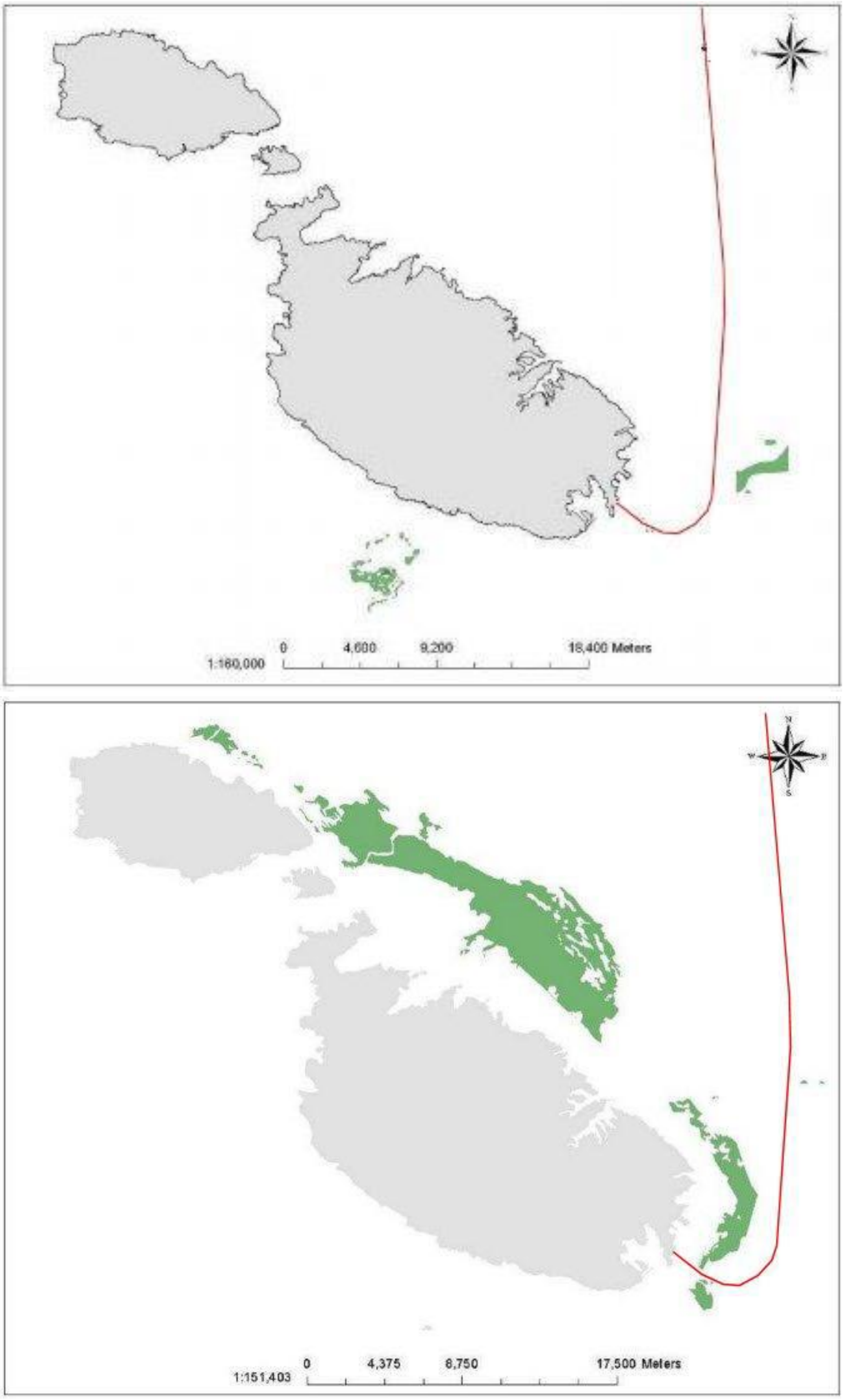


Figure 11: Distribution maps for biogenic reefs (top) and maerl/sand/gravel assemblages (bottom)

5.1.7 SE Aquaculture zone monitoring

Marine ecological monitoring of the South Aquaculture Zone (Aquabiotech, 2013). Aquabiotech was commissioned to conduct a marine ecology monitoring exercise, through benthic grab sampling, in 2013, adopting the same sampling scheme adopted during the previous 3 monitoring seasons on site as devised by Ecoserv. The distribution of the various sampling stations is given in Figure 12 below.

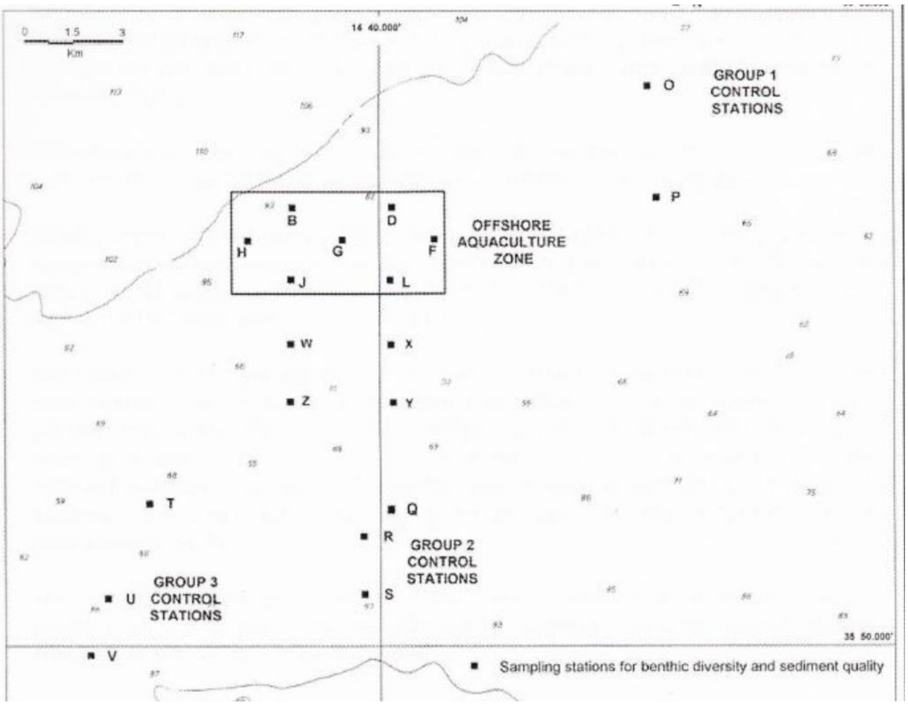


Figure 12: Benthic grab stations for monitoring of SE Aquaculture Zone

Given their proximity to the proposed gas pipeline itinerary/route (and thus its relevance for the current study), as indicated in Figure 13, the benthic sediment typology as assessed through grab sampling for sampling stations B, H, T, U and V is being reproduced. Details are included in Table 1.

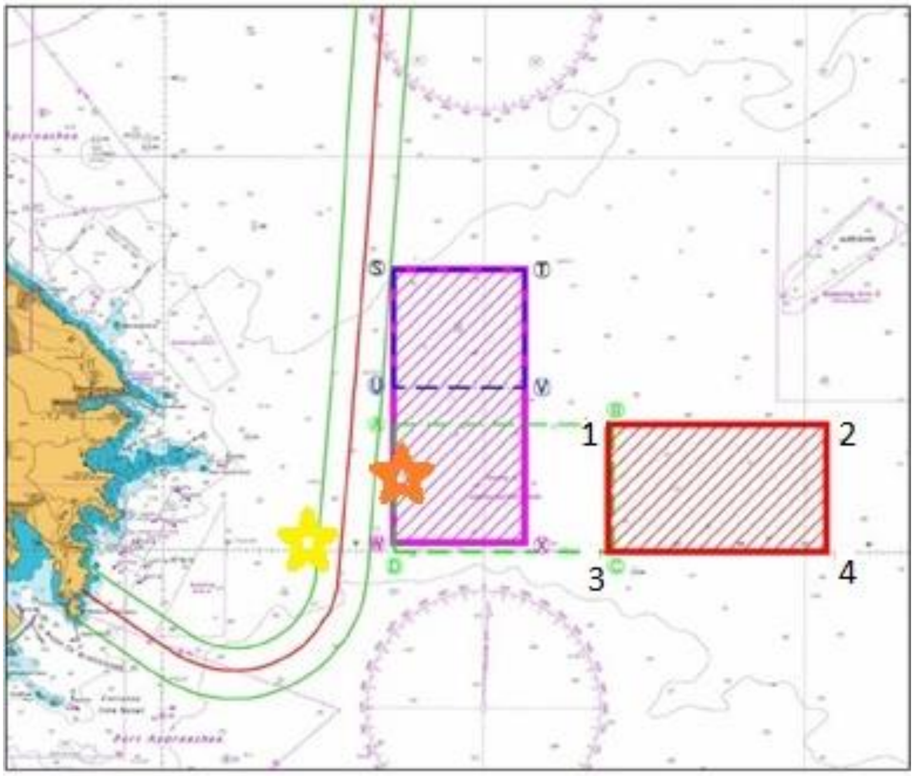


Figure 13: Benthic stations and pipeline route (yellow star = T, U & V; orange star = B & H)

Table 1: Benthic sediment typology for sampling stations

Grab station (Figure 13)	Location	Location relevant to pipeline	Broad description of benthic sediment typology (Aquabiotech, 2013)
B (orange star)	Within current SE Aquaculture Zone	2000m from outer margin of pipeline corridor	Very coarse sand with rhodoliths
H (orange star)	Within current SE Aquaculture Zone	600m from outer margin of pipeline corridor	Very coarse sand with sparse rhodoliths – one replicate was composed solely of *Mytilus galloprovincialis* and *Pinctada radiata* individuals
T (yellow star)	Located to the south-west of the current SE Aquaculture Zone	200m from actual gas pipeline	Muddy sediment devoid of rhodoliths
U (yellow star)	Located to the south-west of the current SE Aquaculture Zone	500m from actual gas pipeline	Very coarse sand with rhodoliths
V (yellow star)	Located to the south-west of the current SE Aquaculture Zone	600m from actual gas pipeline	Very coarse sand with sparse rhodoliths and coralline algae

5.1.8 *P. oceanica distribution from SSS Dataset 2003*

A *Posidonia oceanica* distribution map (reported below as Figure 14) as gleaned from the MAP INFO SSS Dataset 2003 reveals the occurrence of extensive such meadows just outside the mouth of Marsaxlokk Bay and the breakwater to the same embayment.

Figure 14: P. oceanica *distribution from SSS study*

SCUBA dives conducted just offshore the current Delimara power station site, as part of the AA and EIA studies for PA 3152/05, revealed that the small, incipient pocket of *P. oceanica* previously recorded in close propinquity to the site identified for land reclamation purposes (and demarcated by a red circle in Figure 14) had been severely degraded or even obliterated through heightened levels of siltation (possibly through dredging activities) in the area, as observed within Figure 15. This is also confirmed through the seabed habitat data reproduced from the EMODNET portal through Figure 9.

Figure 15: Degraded P. oceanica *(EIA for PA 3152/05)*

Consequently, the closest *P. oceanica* meadows are approximately located at the following distances from the coastal site earmarked for land reclamation:

- 450m to the North-West
- 950m to the South-West

5.2 Surveys undertaken by PMRS contractor

From the 11 swathes lying along the proposed gas pipeline route which have been subjected to further investigation through the collection of geophysical data, seabed samples and ROV footage, only 8 (numbered 4-11) were considered for this assessment given that they extend over Maltese FMZ and territorial waters. The following combined, integrated methodology was deployed for the investigation of sensitive benthic biotic assemblages along the pre-selected 11 swathes:

- geological, geophysical and geotechnical methods together with visual inspection surveys were used;
- bathymetric, morphologic and stratigraphic data have been acquired through the analysis and interpretation of data collected by means of MBES, SSS, SBP and Magnetometer;
- geotechnical samples were collected (piston cores and boreholes) and cone penetration tests were carried out together with box corer samples collected during the environmental survey phase;
- visual inspections have been carried out by means of ROV to characterize marine habitats and archaeological constraint and to ground-truth the geophysical survey results at Client defined positions;
- ROV transects have been performed also in spotted locations along the offshore pipeline section mainly where sonar contacts have been interpreted from the geophysical data (MBES/SSS/SBP), in order to verify the sonar targets, to confirm the geophysical interpretation and to detail the seabed characterisation;
- ROV inspection has been also performed at Client defined locations in the offshore section of the pipeline route.

The results of these localised visual investigations have been extended, wherever possible, to nearby geophysical interpreted areas, in particular where the SSS acoustic response and water depths were similar to the sections investigated with ROV.

The contractor focused on the following benthic biotic assemblages classified as being ‘sensitive’ and thus of high conservation importance:

- *Posidonia oceanica* beds;
- *Cymodocea nodosa* beds;
- Biogenic reefs; and
- Maerl beds.

The attributes of the 8 swathes taken under consideration are summarised in Table 2 below.

Table 2: Attributes of the 8 benthic swathes

ID#	FROM KP – TO KP along the design route	WATER DEPTH RANGE	DESCRIPTION
4	KP129.5 - KP134.	126m - 112m	Biogenic concretions/Bioconstructions (coralligenous)
5	KP137.8 - KP138.7	75m - 83m	Maërl beds and coralligenous biocenoses at the moderate to steep flanks of the northern subcropping area
6	KP139 – KP149.8	96m – 50m	Biogenic concretions/Bioconstructions (coralligenous) at the pinnacles outcrops; possible same interpretation of the subcropping and hardground areas in deeper w.d. not covered by ROV
7	KP149 – KP149.3	70m – 60m	Fine to Coarse SAND occasionally colonised by sparse growths of photophilic algae
8	KP149.5 - KP150.12	57m – 42m	Fine to Coarse SAND occasionally colonised by sparse growths of photophilic algae
9	KP150.156 - KP150.24	46m – 40m	Scattered vegetation (mainly on sand, covering subcropping rock) constituted by *Posidonia oceanica* and photophilic algae
10	KP150.50 – KP 150.54	28-30m roughly 190m SW of the route	Scattered *Cymodocea nodosa* on sand (N.B.: isolated patch, detected only on one ROV line)
11	KP150.24 – KP150.60	40m – 7m	Dense Posidonia oceanica meadows mainly settled on rock, in association with brown and green algae

The geographic location of each of the ROV transects conducted within the selected 8 benthic biotic investigation swathes (coastal and offshore) is given in Figure 16 and described in Table 3. Figure 17 to Figure 22 convey the bathymetric profile and SSS mosaics for staggered stretches of the surveyed seabed enclosed within the Maltese FMZ.

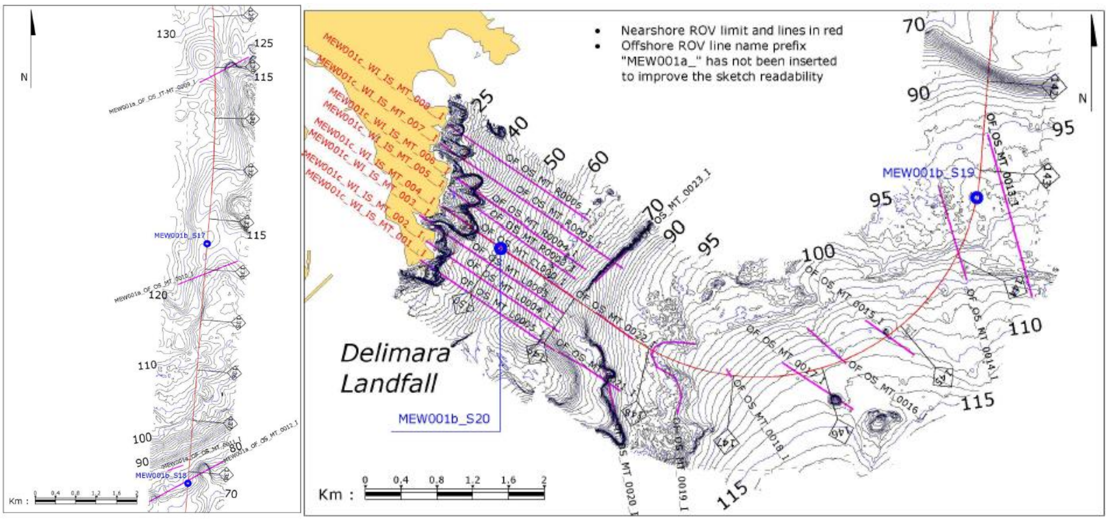


Figure 16: ROV transects conducted in the Maltese FMZ

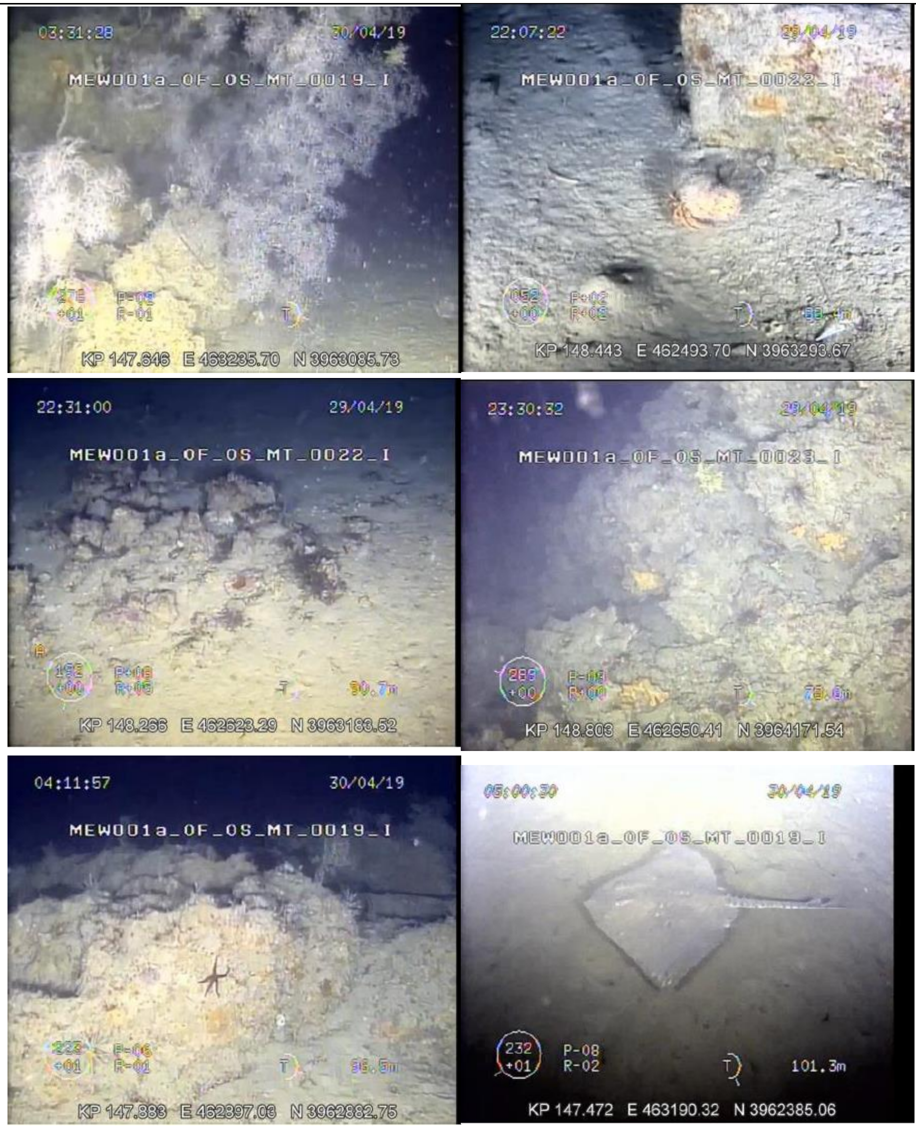
Table 3: Description of the recorded benthic assemblages

Location	Depth/m	Description	Voucher photos
KP129.5-KP134	110-128	Two ROV transects have been acquired, respectively at about KP130.2 (117-128m depth) and at KP134.1 (110-120m), crossing fine sediments, sub-cropping and outcropping areas: the fine sediment domain (soft silty sand) was characterised by extensive bioturbation, such as burrows. This circalittoral biocoenosis featured sparse aggregations of bivalves, with typical low biodiversity values. In the sandy seafloor, a number of sparse Pennatulacea individuals and abundant *Bonellia viridis* individuals were recorded. Demersal fish species observed in the footage included *Zeus faber* and *Triglidae taxum.* Rocky outcrops encountered within this area were colonised by species characteristic of coralligenous assemblages, including bryozoans, sponges (e.g. *Axinella polypoides*) and gorgonians (e.g. *Eunicella cavolinii*).	   

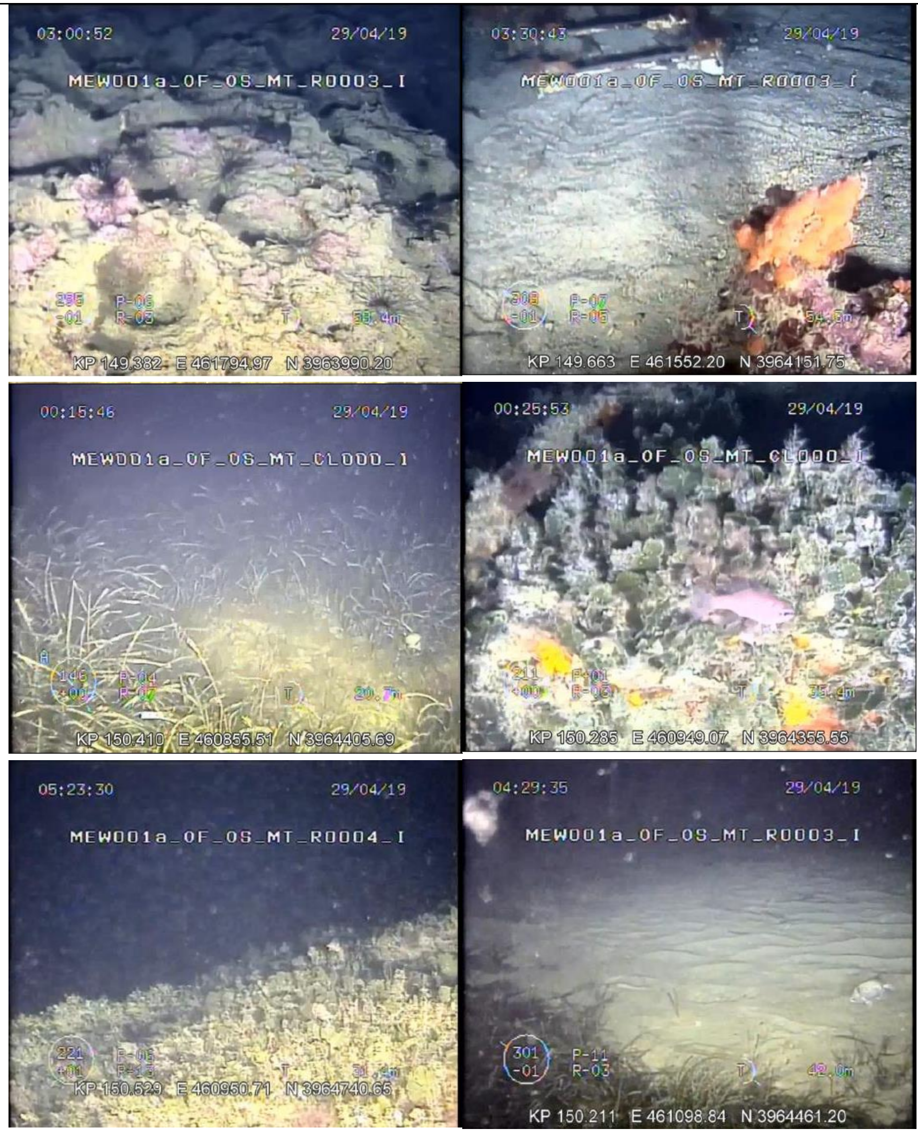
<table>
<tr><th>Location</th><th>Depth/m</th><th>Description</th><th>Voucher photos</th></tr>
<tr><td></td><td></td><td></td><td>
</td></tr>
<tr><td>KP136-141.75</td><td>69-83</td><td>Maerl beds were recorded at depths ranging between 75 and 83m. These were interspersed with fine sediment silty fine sand) which in turn supported isolated sub-cropping areas detected by SSS/SBP at the high’s tops. At the moderate and steepest flanks of the northern sub-cropping area, the coralligenous biocoenosis has also been recorded. Within the later biocoenosis, the echinoid Cidaris cidaris was commonly encountered, along with Sparidae species such as Dentex dentex and Diplodus vulgaris. Unidentified sponge and octacoral species were also common within this biocoenosis.</td><td>


</td></tr>
</table>

Location	Depth/m	Description	Voucher photos
			
KP143-KP149	70-115	This stretch is characterised by a highly complex and heterogeneous seabed, which poses a number of routing challenges as a result of its roughness. For instance, numerous pinnacles and mounds have been recorded, along with an E-W tilt. The pinnacle outcrops have been mainly recorded West of route from approx. KP143.1 to KP144.3 and South of the route from KP145 to KP146. They are the dominant benthic feature within the following stretch: KP147.3 to KP148.3. Their average height is that of 2m and they are abundant in water depths ranging from 90m to 105m. ROV transects have been acquired at the following KP locations: East of the route approximately from about KP142.5 to KP144 and at about KP144; at about KP145.2, KP145.75, KP146.3; between KP147.5 and KP148 and South of KP148.5. ROV analyses	   

Location	Depth/m	Description	Voucher photos
		confirmed the rocky nature of the outcrops ascribable to coralligenous biocenoses. From KP145 TO KP146.5 (water depths ranging between 100m and 115m), the ROV transects highlight the dominance of a sandy seafloor with abundant burrows and bioturbations, broken by isolated outcrops. Associated with the outcrops, one could observe numerous *Bonellia viridis* individuals, as well as unidentified echinoid individuals and single individuals of *Palinurus elephas* and *Cerianthus membranaceus*. Pelagic and demersal species recorded included *Sepia officinalis* and *Symphodus tinca*. Between KP147.5 and KP148, the water depth ranges from about 101m to 92m and the recorded outcrops and rocky pinnacles areas are supported coralligenous assemblages which in turn were characterised by numerous bryozoan, polychaete, sponge and scleractinian coral species. An arborescent colony of *Antipathes dichotoma* was also recorded. Echinoderm species were represented on site by *Cidaris cidaris* and *Ophidiaster ophidianus*, whilst *Bonellia viridis* was once again highly frequent. A number of to Rajidae individuals [probably, *Raja clavata),* as well as *Loligo vulgaris* and Triglidae species were also	

Location	Depth/m	Description	Voucher photos
		observed amongst the pelagic and demersal species. From about KP148 to KP149, two ROV transects have been acquired, characterised by moderate to steep slopes supporting coralligenous outcrops and water depths ranging from 70m to 80m. The biodiversity assets are similar to the KP147.5 – KP148 section with the exception of the green alga [probable *Flabellia petiolata.* Echinoid and species were represented by *Cidaris cidaris* and *Centrostephanus longispinus* whilst occasional *Axinella polypoides* individuals were encountered. Recorded fish species included individuals of *Diplodus vulgaris* and of Triglidae species. One more ROV transect has been acquired along the route approximately from KP148.2 and KP148.7, with the main aim to check the origin of six recorded magnetic contacts. The footage revealed the presence of *Cidaris cidaris, Loligo vulgaris,* Paguridae and Malacostraca.	 

Location	Depth/m	Description	Voucher photos
KP 149-150.836 (nearshore)	7.5-70.2	The closest distance from the shore that the 8 parallel nearshore ROV transects reached was that of 25m, reaching a maximum water depth of 85m. Two prominent bathy-morphological structures were recorded within this area: - from KP149.408 to KP149.442, an NNE-SSW trending, sparsely-rocky area mainly detected North of the route, with rock outcrops rising 3-4m from the surrounding seabed at slopes of up to 20°. This rocky reef consists of a calcareous reef colonised mainly by different anthozoan and sponge species; - upon approaching the coast, an irregularly-shaped escarpment representing the offshore extension of the coastal cliff, consisting of Globigerina Limestone and featuring gradients of up to 70° has been recorded. The rocky outcrops characterising the more nearshore swathes of the Maltese landfall are colonised by dense meadows of seagrass (mainly *Posidonia oceanica* meadows), which become progressively sparser in the transition to the deeper sub-cropping areas.	

Location	Depth/m	Description	Voucher photos
		Four main benthic assemblages have been identified within this sector: (i) Fine to coarse sand (MEW001b_S20: shell fragments and corals with organic matter within a coarse SAND matrix; MEW001b_K59: very soft sand); approximately from KP149 to KP149.3 and from KP149.5 to KP150.12, sand is occasionally colonised by sparse growths of sciaphilic algae (namely, *Flabellia petiolata*). The Mediterranean cardinalfish *Apogon imberbis* was frequently encountered within this assemblage. (ii) Seagrass mainly settled on bedrock (biocoenosis of *Posidonia oceanica* meadows in association with other photophilic plants and algal species): dense meadows; (iii) Sparse vegetation (mainly on sand, settled on sub-cropping rock) consisting of reticulate *Posidonia oceanica* meadows and facies photophilic algae; (iv) Coralligenous / biogenic reef	 MEW001c_WI_IS_MT_001__I  MEW001a_OF_OS_MT_R0003_I  MEW001c_WI_IS_MT_003__I  MEW001c_WI_IS_MT_007__I  

Location	Depth/m	Description	Voucher photos
		The recorded *P. oceanica* meadows were settled mainly on rock, but also on patches of sandy seafloor covering the rocky outcrops. At the deepest end of the *P. oceanica*-based assemblage, the seagrass became sparser, becoming progressively replaced by the sciaphilic green alga *Flabellia petiolata.* The sandy seafloor intervals were etched by bedforms (ripples and megaripples), with the consequent accumulation of biogenic debris and vegetation residues. MEW001a_OF_OS_MT_R0004_I is the seaward extension of another inshore transect (MEW001c_WI_IS_MT_006__I), along which the lower limit for *Posidonia oceanica* was recorded at a depth of 30m. Closer to shore and in shallower waters, a biocoenosis of *P. oceanica* interspersed with the photophilic brown alga species *Dictyopteris polypodioides* was recorded. Sparse *Cymodocea nodosa* meadows settled on sand at water depths of about 28-30m were only at the start of the ROV line MEW001c_WI_IS_MT_003__I. Within this same assemblage, monospecific stands of *Cystoseira*, possibly of *C. brachycarpa*, were recorded at water depths less than 10m.	

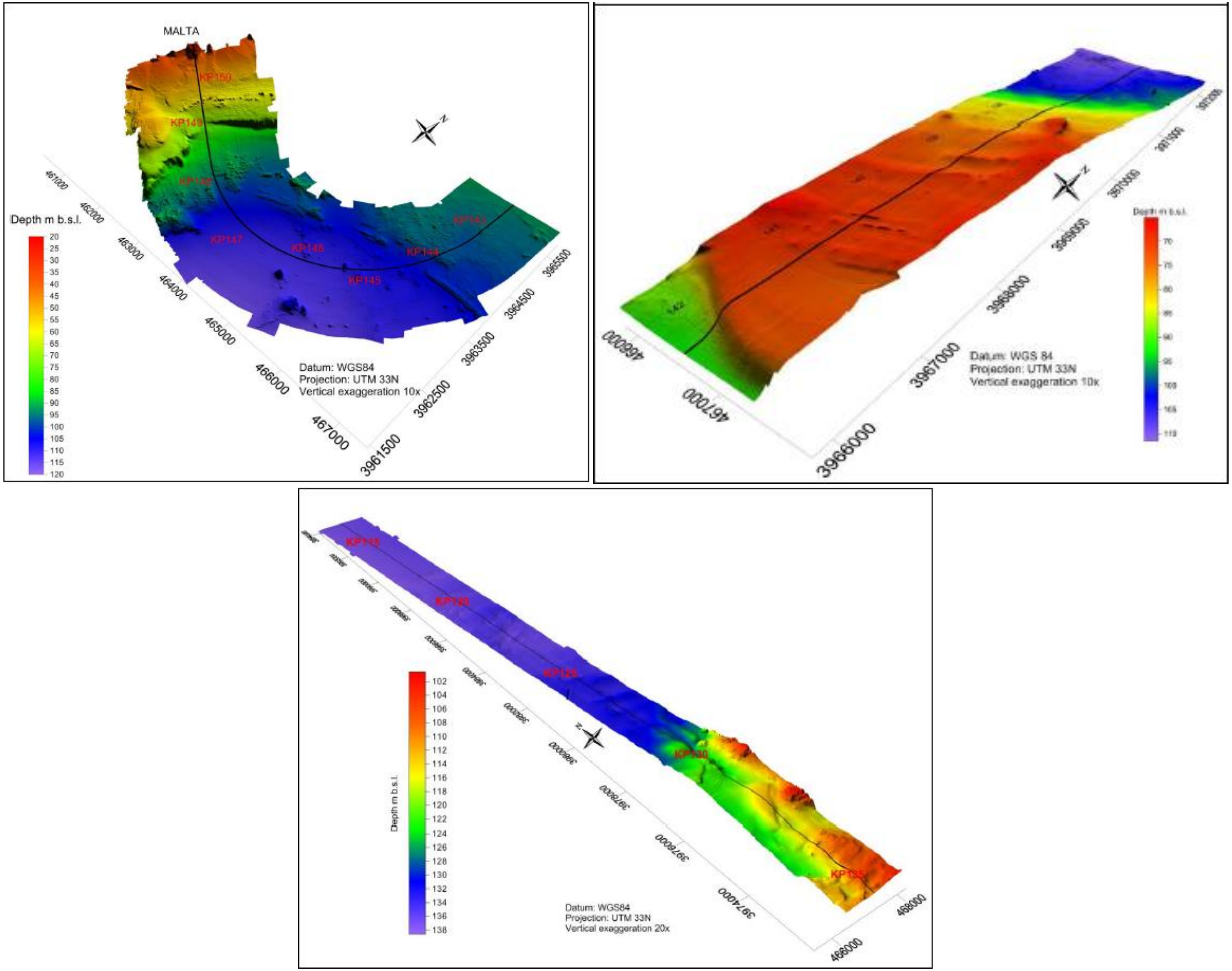


Figure 17: Bathymetric profile of the seabed (top left: KP142-Malta landfall; top right: KP135-KP142; bottom KP113-KP135)

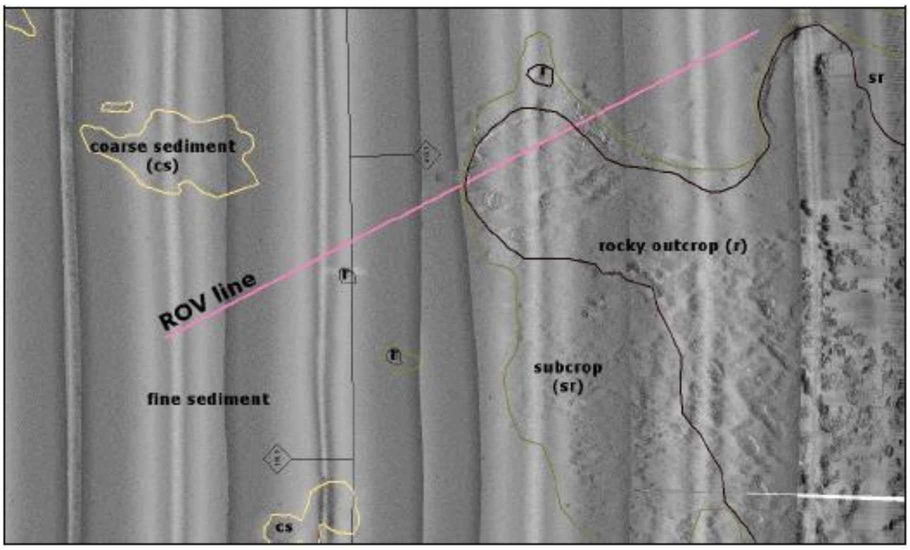


Figure 18: SSS mosaic at KP130-KP130.5

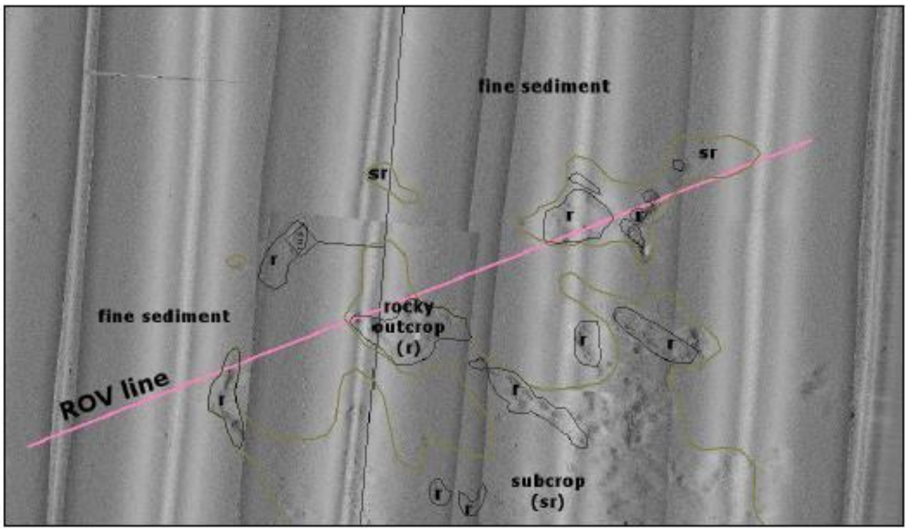


Figure 19: SSS mosaic at about KP134.3

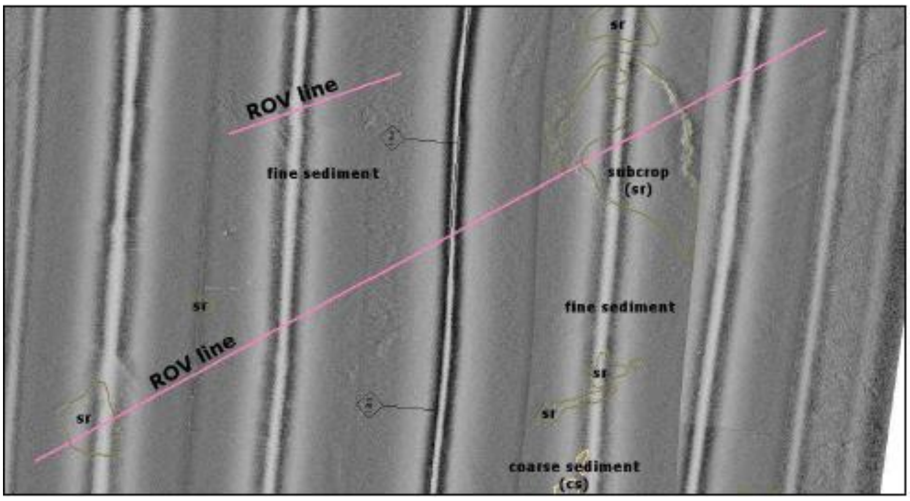


Figure 20: SSS mosaic at KP137.5-KP138.7

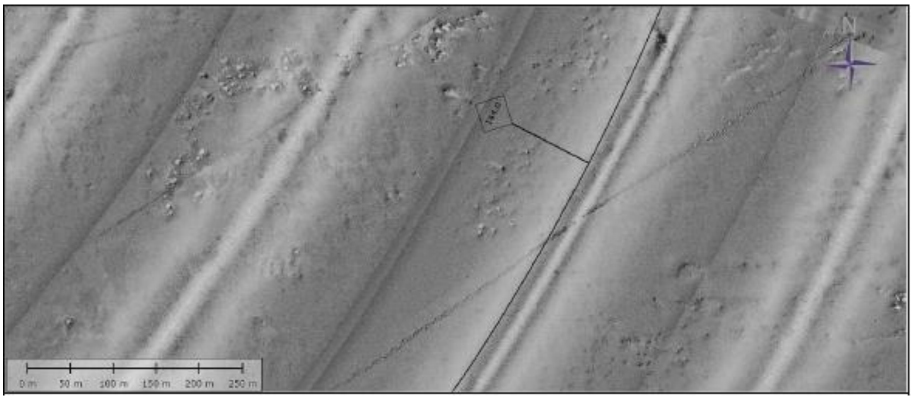


Figure 21: SSS mosaic at KP144 showing rocky pinnacles and scars

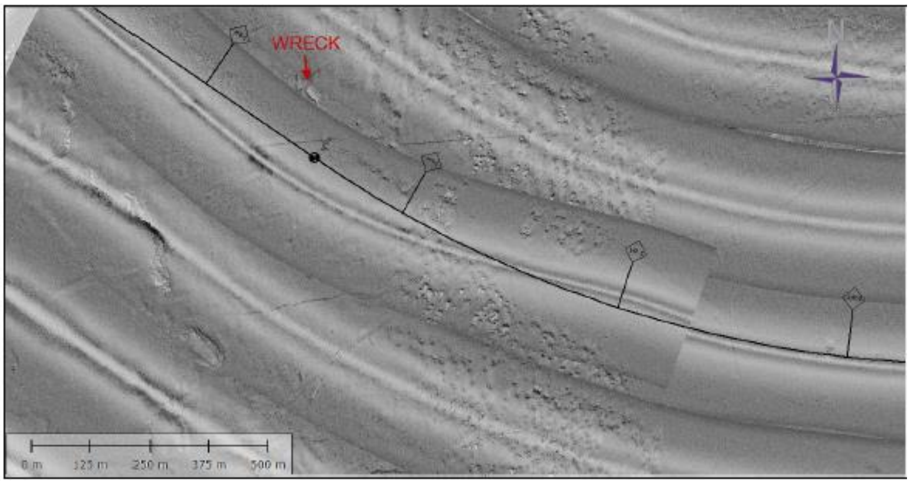


Figure 22: SSS mosaic at KP148 showing rocky pinnacles, scars and wreck

For the Maltese coastal areas (up to KP 142), a detailed *Posidonia oceanica* distribution habitat map as well as distribution maps for other sensitive benthic habitats were plotted by the PMRS contractor through the integration of both geophysical and ROV data, as reproduced in Figure 23. For the more offshore areas (up to KP 108), only maps for bathymetry, seabed topography, benthic topography and geodetic parameters have been produced, as shown in Figure 24.

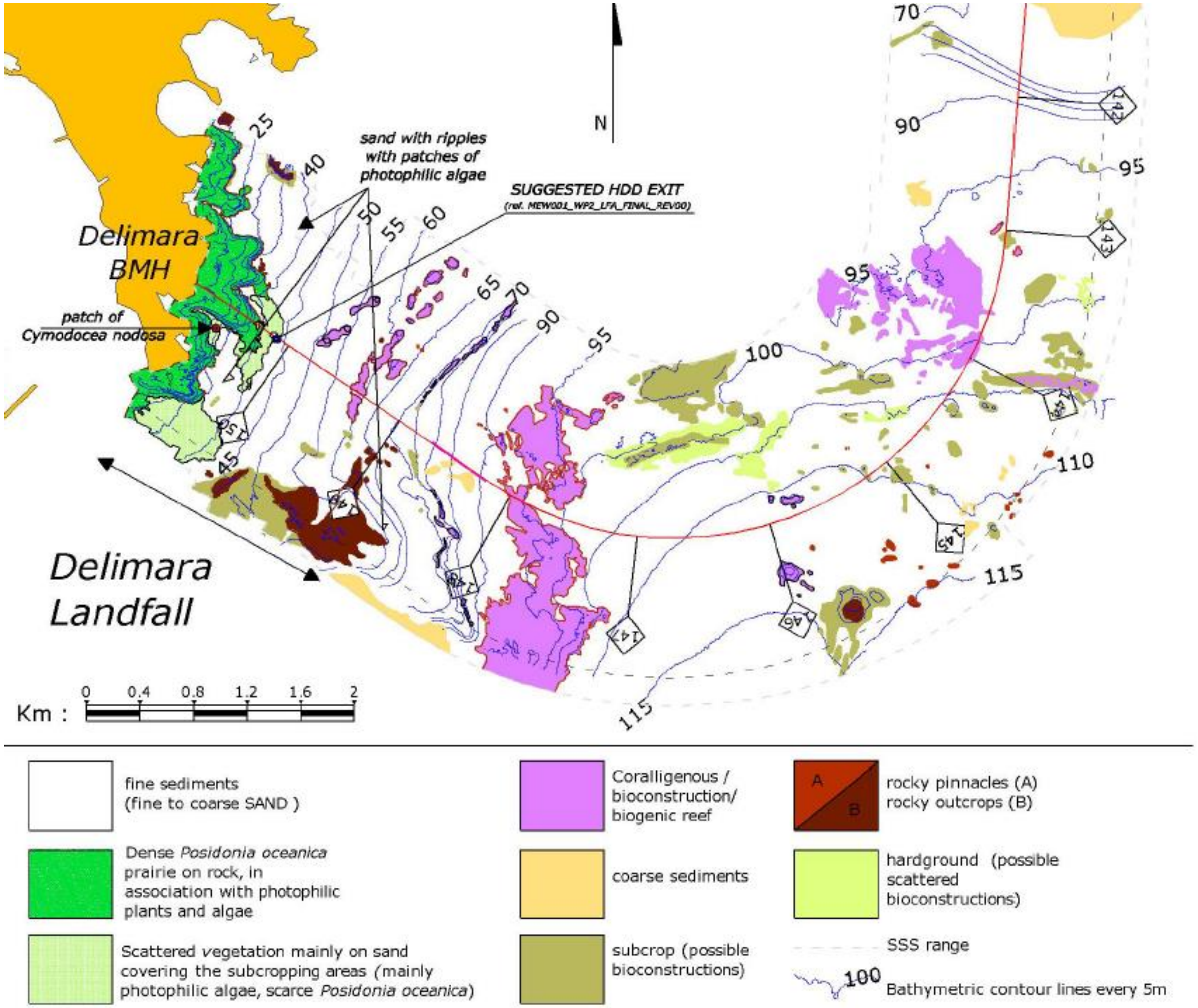


Figure 23: Benthic habitat map for the Maltese coastal areas

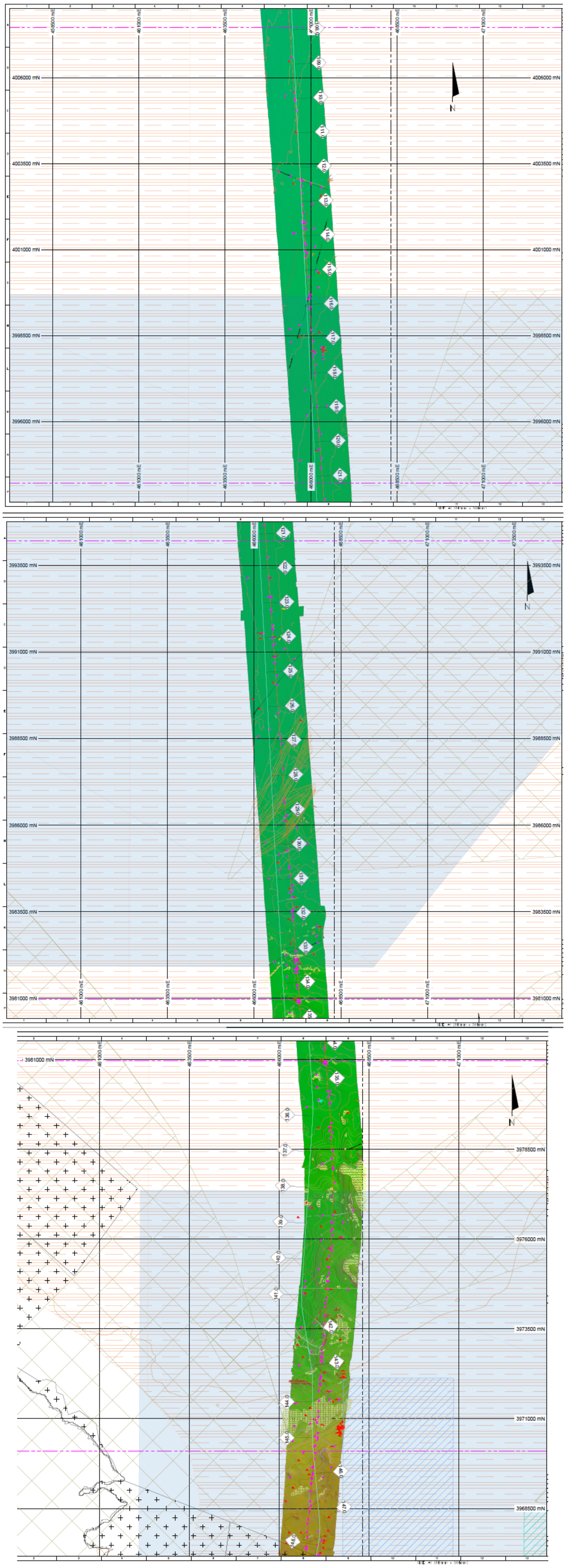


Figure 24: Bathymetric, benthic and seabed topography and geodetic map for offshore areas

5.3 Biotic characterisation considerations AoI

Evidence of existing anthropogenic disturbance were recorded within the surveyed swathes, such as those shown in Figure 25 and Figure 26.

Figure 25: Discarded fishing line at KP 150.077 (depth of 44.5m)

Figure 26: Long-standing discarded fishing net at KP 145.2 to KP 146.3

The full list of protected benthic species is given in Table 4. Where maerl or coralline algal aggregations were recorded within the AoI, these were ascribed to the following 2 species only: *Lithothamnion minervae* and *Lithothamnion corallioides,* given that these represent the main rhodolith-forming species in the Maltese Islands (Lanfranco et al., 1999).

Table 4: Full list of protected benthic species

Species	**S.L. 549.44**	**Habitats Directive**	**SAP-BIO Protocol**	**Bern Convention**
Cystoseira cfr. *brachycarpa*	Schedule III (but as *Cystoseira* spp.)	Not listed	Not listed	Not listed
Posidonia oceanica	Not listed	Not listed	Annex II	Appendix I
Cymodocea nodosa	Schedules III and VIII	Not listed	Not listed	Appendix I
Lithothamnion minervae and *Lithothamnion corallioides*	Schedule III	Annex V (*L. corallioides*)	Not listed	Not listed
Ophidiaster ophidianus	Schedule VI	Not listed	Annex II	Appendix II
Centrostephanus longispinus	Schedule V	Annex IV	Annex II	Appendix II
Palinurus elephas	Schedule VIII	Not listed	Annex III	Not listed
Eunicella cavolinii	Not listed	Not listed	Not listed	Not listed
Antipathes dichotoma	Schedule VI (as *Antipathes* spp.)	Not listed	Annex III (as *Antipathes* spp.)	Appendix III (as *Antipathes* spp.)
Axinella polypoides	Schedule VI	Not listed	Annex II	Not listed
*Pinna nobilis**	Schedule V	Annex IV	Annex II	Appendix II
P. oceanica meadows	Schedule I	Annex I – priority habitat	Not listed	Not listed
Reefs (recorded as biogenic reefs in the EBS conducted for the current proposal)	Schedule I	Annex I	Not listed	Not listed

**Pinna nobilis* was not directly recorded during the current study. However, the species is known to occur in nearshore waters within the surveyed area and is thus being included within this assessment as a precautionary measure.

Key:

S.L. 549.44:

» Schedule I = Natural habitat types whose conservation requires the designation of Special Areas of Conservation (SACs)
» Schedule III = Animal and plant species of national interest whose protection requires the designation of Special Areas of Conservation (SACs)
» Schedule VI = Animal and plant species of national interest in need of strict protection
» Schedule VIII = Animal and plant species of national interest whose taking in the wild and exploitation may be subject to management measures

Habitats Directive

- Annex I = Natural habitat types of community interest whose conservation requires the designation of Special Areas of Conservation (SACs)
- Annex IV = Animal and plant species of community importance in need of strict importance
- Annex V = Animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures

SAP-BIO Protocol

- Annex II = List of endangered or threatened species
- Annex III = List of species whose exploitation is regulated

Bern Convention

- Appendix II = Strictly protected fauna species
- Appendix III = Protected faunal species

The benthic communities of highest conservation importance located in closest propinquity to the proposed gas pipeline route which might potentially be impacted by the development are summarised in Figure 27 below. The short-listing of these assemblages is justified in Table 5.

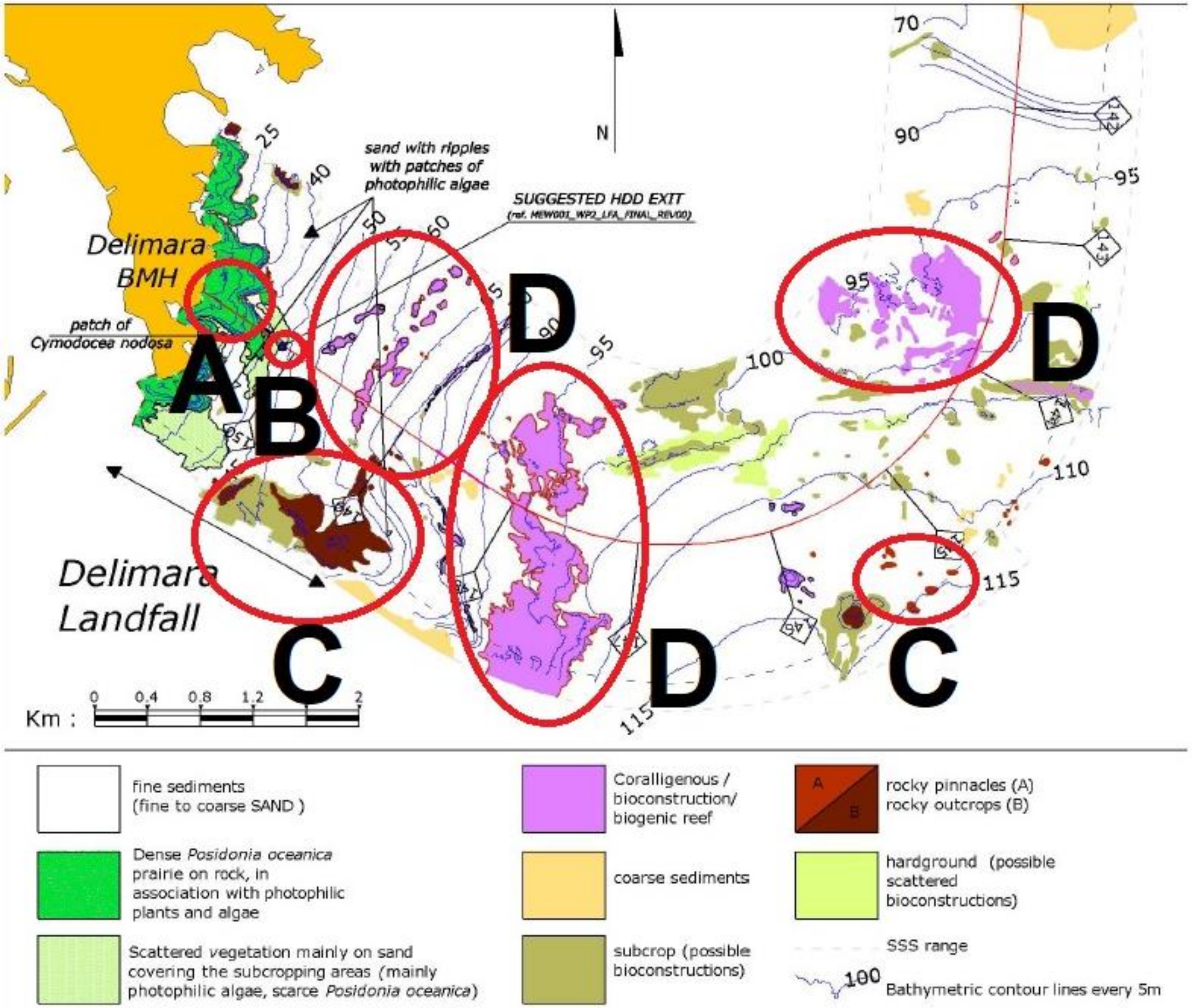


Figure 27: Benthic communities of highest conservation importance

Table 5: Justification for the selection of benthic assemblages in Figure 27

Benthic assemblage in Figure 27	Justification for the selection of the same benthic assemblages as ones of high conservation importance
A	Seagrass (*P. oceanica* and *C. nodosa*) meadows are listed as benthic habitats of high conservation importance which are notoriously sensitive to sediment budget changes
B	Escarpment area characterised by pronounced gradient figures as high as 70 degrees (Figure 28) and thus of high conservation value (through its potential to support gorgonian species and dense coralligenous assemblages) which will host the transition pit and landfall of pipeline within micro-tunnelling borehole
C	Dense aggregation of rocky pinnacles since this seabed typology has the potential to support benthic species of high conservation importance, including *Corallium rubrum* and *Eunicella cavolinii* (e.g. Cattaneo-Vietti et al., 2017).
D	Biogenic reef/bioconstruction area which could support living rhodolith-rich areas. Such areas are renowned, in turn, for the high biodiversity they support (e.g. Barbera et al., 2003).

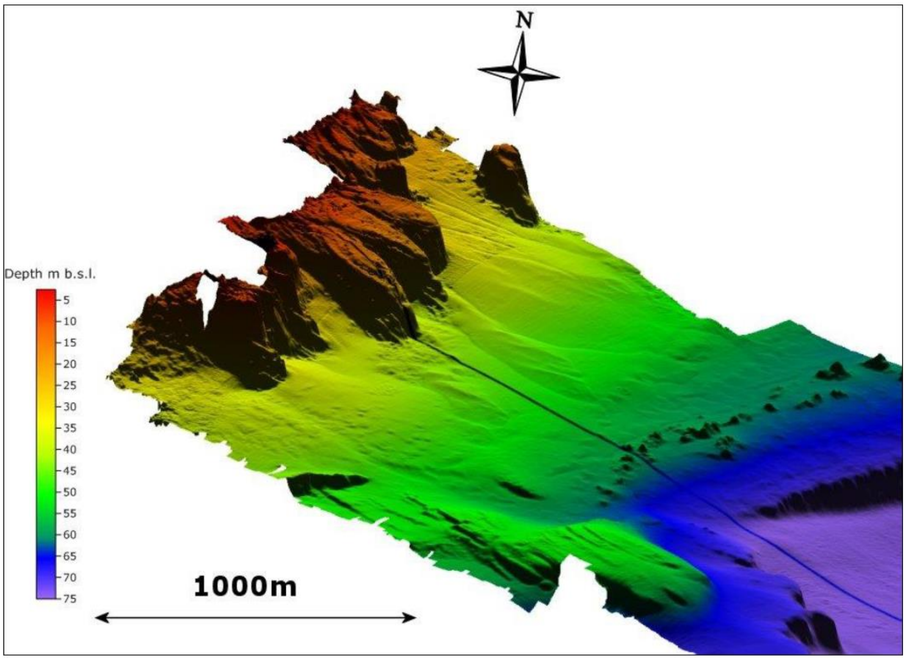


Figure 28: Region B, characterised by an escarpment and pronounced gradient values

Along the route (MEW001a_OF_OS_MT_CL000_I), *Posidonia oceanica* was detected down to a depth of about 40-45m. Such a deep lower limit for *P. oceanica* meadows is indicative of a high degree of water transparency and of generally a very good health status for the same meadows.

5.4 Water Framework Directive assessment

Article 4.7 of the Water Framework Directive delineates the circumstances in which deviation from WFD objectives for a specific water body is permitted, namely:

1. When failure to achieve good groundwater status, good ecological status or, where relevant, good ecological potential or to prevent deterioration in the status of a body of surface water or groundwater is the result of new modifications to the physical characteristics of a surface water body or alterations to the level of bodies of groundwater or
2. When failure to prevent deterioration from high status to good status of a body of surface water is the result of new sustainable human development activities.

The current assessment is being conducted within the ambit of circumstance (1), in the form of 8,000 m^2 of reclaimed seabed in close proximity of the existing Delimara power station. In fact, given that the proposed development envisages a potential modification to the physical/morphological characteristics of a surface water body which in turn might lead to a putative deterioration of the ecological status (in terms of the Biological Quality Elements) of the MTC 107 water body, an assessment is being conducted in order to evaluate whether the conditions exist to invoke Article 4.7 (WFD).

MTC 107, along with MTC 105, had been designated by Malta within the first WCMP as a 'heavily modified' coastal water body, due to the following two reasons:

1. the fact that they are substantially changed from their original, natural hydromorphological condition and that such change is extensive and therefore permanent and irreversible and
2. the fact that the objectives served by the modified characteristics of the water body cannot for reasons of technical feasibility and /or disproportionate costs be reasonably achieved by any other alternative means, which are significantly better environmental options.

In doing so, Malta acknowledged the fact that the scale of improvements to achieve good ecological potential could only be achieved over a longer timeframe since both water bodies have been subjected to historic contamination and therefore require considerable investment to alleviate the impacts. Both historical and recent developments within MTC 107 are responsible for such impacts, as follows:

- **Historic National heritage –**fortifications built both during the 16th Century and the British period
- **More recent development** – Marsaxlokk is a fishing port (fish landing facilities and hardstanding facilities); Malta Freeport built in 1988 which is continuously growing; Tank storage; Oil Tanking & San Lucian handling fuel oils; Delimara power station and Ħas-Saptan fuelling Dolphin; Birzebbuga key to handle light fuel oils

The measures relevant to hydromorphological changes in these port areas that were identified under the first WCMP (2010-2015) as those that would not have an adverse effect on the wider use of the port were as follows:

1. Strengthen the existing environmental and planning regulatory processes to cater for the objectives of the WFD
2. The development and implementation of planning and environmental guidance on major coastal engineering works
3. Develop and implement a protocol for the disposal or reuse of dredged material from harbours.

The 2nd WCMP for Malta also lists a number of mitigation measures which could potentially be adopted in order to address the four most insidious impacts identified for both MTC 105 and MTC 107, as well as summarising the status of implementation for each of these proposed mitigation measures. These mitigation measures were identified in line with the Prague Approach (WFD, 2009). This information is summarised in Table 6 below:

Table 6: Mitigation measures to address impacts identified for MTC 105 and MTC 107 (Malta's 2nd WCMP)

Water body	**Impact**	**Mitigation measure**	**Implementation status**
MTC 105/107	Significant and irreversible morphological alteration	No feasible mitigation measures can be taken for historic/past modifications. New modifications are subject to Environmental impact assessment or general environmental assessment procedures	Implemented but there is scope to improve existing processes
MTC 105/107	Extent of area of modified bottoms, related to dredging activities	Strengthen the existing environmental and planning regulatory processes to cater for the objectives of the WFD The development and implementation of planning and environmental guidance on major coastal engineering works Develop and implement a protocol for the disposal or reuse of dredged material from harbours	Implemented but there is scope to improve existing processes
MTC 105/107	Length of modified shore	Strengthen the existing environmental and planning regulatory processes to cater for the objectives of the WFD The development and implementation of planning and environmental guidance on major coastal engineering works	Implemented but there is scope to improve existing processes.
MTC 105/107	Alteration of key species and/or life stages composition and abundance of benthos.	Strengthen the existing environmental and planning regulatory processes to cater for the objectives of the WFD The development and implementation of planning and environmental guidance on major coastal engineering works	Implemented but there is scope to improve existing processes.

When interpreting WFD Article 4.7 provisions, the guidance document (WFD, 2007) was used, whilst the following literature was referred to in assessing the applicability of the same Article to the context in question:

- Malta's Second Water Catchment Management Plan (2nd WCMP);
- Dedicated hydrodynamic modelling study commissioned in support of the current study; and
- Laboratory analyses of the nutrient load and plankton-related metrics in the water column.

5.4.1 2nd WCMP

The overall and individual BQE (Biological Quality Element) status for MTC 107, as identified from the 2nd WCMP is summarised in Table 7.

Table 7: BQE (Biological Quality Element) status for MTC 107

Overall BQE Status	**WFD BQE**			
	Macroalgae	***Posidonia oceanica***	**Benthic invertebrates**	**Phytoplankton**
MTC 107	Good	High	Good	High

5.4.2 Hydrodynamic study

A dedicated coastal study was conducted for the Port of Marsaxlokk area due to the land reclamation proposed for the new terminal station in the Delimara Power Station necessary for the implementation of the submarine pipeline connecting Malta to Italy. The purpose of the coastal study was to provide nearshore metocean analysis defining the current baseline and the changes in the meteo-marine parameters in the Port of Marsaxlokk following the proposed land reclamation at the Terminal Area.

The study assesses the effects potentially induced by the Land Reclamation works foreseen for the Melita TransGas Pipeline Project on the current metocean conditions of the nearshore area surrounding the MTG Terminal Station. Analyses performed within the current study includes mathematical simulations of wave nearshore propagation, hydrodynamic modeling and an assessment of typical and extreme conditions in Present and Future Configuration, for the following foreseen structures:

- Land Reclamation at Delimara Terminal Station;
- Modification of the existing breakwater arm at Delimara and construction of a new breakwater arm at Ponta tal-Qrejten;
- Reclamation at Free Port Terminal 2 (North and West Quays).

The comparison of the results obtained with respect to the Present Configuration have allowed the quantification of the impact of the new structures on wave and current conditions (typical and extreme) of the entire port, with a special focus on three (3) sites of particular interest:

- Melita TransGas Terminal;

- Malta Freeport Terminal; and
- Il-Ballut ta' Marsaxlokk Protected Area.

In addition, detailed wave diffraction modelling was undertaken in order to deepen the analysis, and to verify the impact of the Land Reclamation on the inner harbour wave agitation and on the FSU mooring area.

Wave metrics component

All simulations have been performed with SWAN, a third - generation wave model to estimate wave parameters in coastal areas, lakes and estuaries, having wind, bottom and current conditions defined offshore. It describes waves using the bi – dimensional action density spectrum also in conditions characterized by non – linear processes, for instance within the surf – zone.

The model can consider the following physical processes:

- Refraction, due to spatial variation of currents and depth;
- Shoaling, due to spatial variation of currents and depth; and
- Transmission or dissipation connected to the presence of obstacle, for example breakwaters.

Moreover, SWAN takes into account as forcing and/or dissipation processes:

- Generation due to the wind;
- Dissipation due to "white – capping";
- Dissipation due to the breaking;
- Dissipation due to the bottom friction;
- Non – linear wave – wave interaction.

Hydrodynamic modelling component

To simulate the currents of the study area, the process-based hydrodynamic model Delft3D was used. The hydrodynamic module Delft3D-FLOW simulated two-dimensional (2DH, depth-averaged) or three-dimensional (3D) unsteady flow and transport phenomena resulting from tidal and/or meteorological forcing, including the effect of density differences due to a non-uniform temperature and salinity distribution (density-driven flow).

This model solves the unsteady waves, currents, sediment transport and sea bed level changes by a set of mathematical equations based on the conservation of mass, momentum, energy, etc.

The main module of Delft3D is the FLOW-module which computes the multi-dimensional hydrodynamic flows and transport phenomena, including sediments, mainly forced by the wave field provided by the WAVE module.

Delft3D-FLOW calculates non-steady flow and transport processes resulting from tidal and meteorological forcing on a rectilinear or curvilinear boundary fitted grid.

Some of the features of Delft3D-FLOW include:

- tidal forcing;
- Coriolis forces;
- density driven flows;
- advection-diffusion solver;
- space and time-varying wind and atmospheric pressure;
- advanced turbulence models based on eddy viscosity concepts;
- time varying sources and sinks;
- simulation of various types of discharge;
- domain decomposition and nesting;
- wave induced stresses and mass fluxes.

Wave diffraction component

All simulations of wave agitation have been performed with the in-house model PORTOS used in several previous studies. The numerical model evaluates the coefficient of amplification/reduction of the wave (Kd), which is the ratio between the effective wave height in consecutive points of the numerical grid and the incoming wave height.

The model requires as input the following parameters:

- a constant water depth in the whole computational grid (usually water depth at the entrance);
- the geometry of the port;
- reflection coefficients for all sections of the port;
- the wave height, period and incoming direction.

The mathematical model is based on the integration of the Navier-Stokes equations considering incompressible and inviscid fluid; irrotational velocity field; and on the solution of a boundary condition that satisfies the Laplace equation. The model equations take into account the absorption coefficient of the structures ($\alpha = 0$ for completely reflective dock, $\alpha = 1$ for totally absorbent dock, $0 < \alpha < 1$ for partially reflecting dock).

Figure 29 gives an example of an output from the hydrodynamic modelling study for future projected wave heights. Figure 30 gives the location of the various coastal sites within or contiguous to Marsaxlokk Bay and referred to within the assessment summary included below.

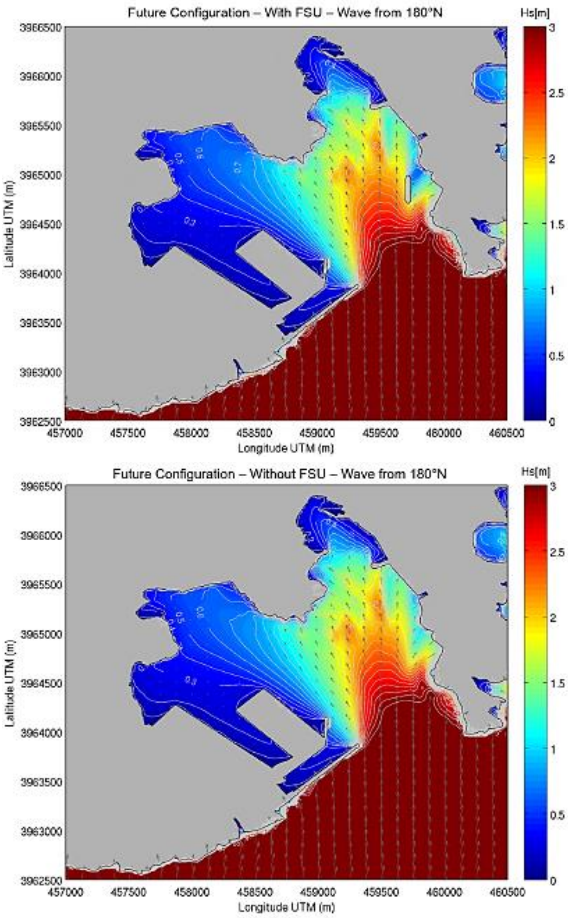


Figure 29: Hydrodynamic modelling output showing projected wave heights incl. and excl. the FSU

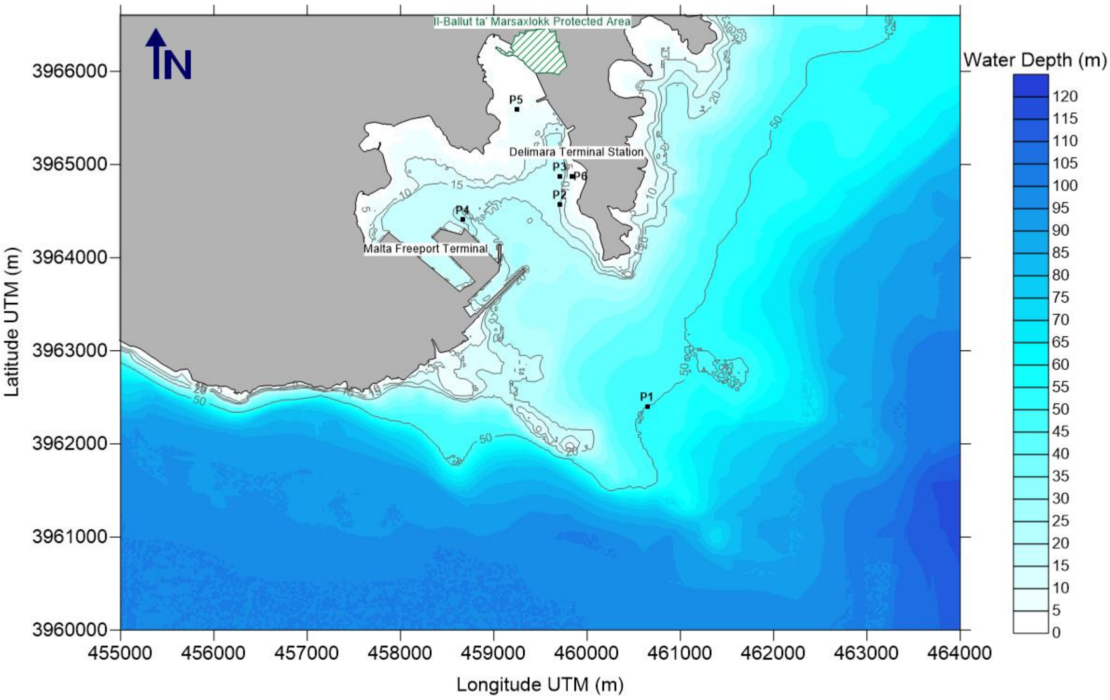


Figure 30: Various coastal sites within or contiguous to Marsaxlokk Bay

The salient conclusions from the hydrodynamic study are the following:

Marsaxlokk Harbour:

Nearshore waves: differences in wave heights occur only at Malta Free Port Terminal area and at Il-Ballut ta' Marsaxlokk area, but just in the very proximity of new or modified structures (quays in the first case and breakwater arms in the second zone). These results are mainly due to wave sheltering effects induced by the new foreseen structures. No discrepancies in wave heights in the other parts of the port are expected, where Hs differences field is very close to 0 m or below 0.1 m;

Nearshore currents: the counter-clockwise circulation induced by typical offshore winds from 150°N does not show significant modifications in Future Configuration. Only in the northernmost part of the Marsaxlokk basin, in correspondence of the new foreseen breakwater, the current flow seems to be slightly different with respect to the Present Configuration, with weaker velocities just south of the breakwater. The onshore winds from 300°N will induce weaker current velocities in the northernmost part of the Marsaxlokk basin in Future Configuration, close to the new breakwater. In addition, the tidal currents, although almost negligible, shows some differences only in the northernmost part of the Marsaxlokk basin, just between the two breakwaters in Project;

Residual Wave Agitation (Section 8): there are no significant differences between Present and Future scenarios, except in the northernmost part of the Marsaxlokk basin where the rubble mound breakwaters planned in the Future configuration will induce diffraction of the waves from 150 and 180°N directions, adequately protecting the Northern part of the port from the incoming waves.

Melita TransGas Terminal:

Nearshore waves: significant differences are not highlighted from results, neither in typical nor in extreme wave conditions between the Present and Future Configurations. Just few values of extreme Hs values are different in the two configurations, but differences are not higher than 10 cm;

Nearshore currents: typical current velocity is quite low, reaching maximum values of about 0.10 m/s induced by winds coming from 150°N. Discrepancies between the two configurations are not highlighted in terms of typical and extreme conditions;

Residual Wave Agitation: waves coming from 180°N are the most critical for the area as they are characterized by a small reduction of about 10% in both configurations, while 90°N is the least problematic incoming wave direction, in fact incoming waves strongly reduce because of the diffraction and wave agitation is characterized by a mean diffraction coefficient of about 10%. There are not significant differences between the two scenarios: from tabular results (Table 8.3) it is clear that the Land Reclamation will not induce significant modifications of the residual wave agitation in the Melita TransGas Terminal area.

Malta Freeport Terminal:

Nearshore waves: in this area the wave climate is characterized by the same energy in Present and Future Configuration. Differences in directional distribution of wave events are highlighted for 270 and 330°N sectors. The Freeport reclamation project seem to induce a sheltering effect of the wave coming from 270°N and more events in 330°N are expected to occur with respect to the Present Configuration. There are no discrepancies in extreme wave heights and periods for output Point P4 between Present and Future scenarios: just few values of Hs are different in the two configurations, but differences are not above 10 cm;

Nearshore currents: current fluxes mainly flowing toward North-West and toward South-East are induced by typical winds and by tide in the area interested by the Malta Freeport Terminal, in its Present and Future Configurations. The current velocity is quite low, reaching maximum values of about 0.05 m/s induced by winds coming from 150°N. Significant discrepancies between the two configurations are not highlighted although the tabular values show that weaker current velocities at point P4 could be expected in Future Configuration, in terms of both typical and extreme values (Figure 29 and Figure 30).

Il-Ballut ta' Marsaxlokk Protected Area:

Nearshore waves: in this area the wave climate is characterized by the same energy and directional distribution of wave events in Present and Future Configuration. No significant differences are highlighted from results in terms of typical and extreme conditions. At Point P5 just few values of extreme wave height Hs are different in the two configurations, but differences are not above 10 cm;

Nearshore currents: typical current velocity in this area is moderate, reaching maximum values of about 0.20 m/s in front of the Il-Ballut ta' Marsaxlokk beaches, induced by typical winds coming from 150°N, both in Present and Future Configurations. Regarding extreme values, the more intense current velocities within the port of Marsaxlokk occur in this area, both in Present and in Future Configurations. Extreme winds coming from 30, 60, 150, 180, 210, 240°N can induce maximum extreme current velocities of about 0.6 m/s in the shallow water facing the beach of the protected area. In this area the current mainly flows along the coast, toward North-Eat and South-East;

General consideration: the Protected Area is located in the northernmost part of the Marsaxlokk harbour, characterized by quite intense hydrodynamic conditions (i.e. the most intense inside the basin), as described above. However, the structures foreseen for the Future Configuration will not induce critical modifications to the Present condition (status quo), neither in the area facing the Il-Ballut ta' beaches nor along the opposite coast, area of mooring of small boats. On the contrary, the breakwaters in project ([4],[5]) seem to protect this area, providing more quiet conditions over the basin respect to the Present scenario.

FSU Mooring Site:

Nearshore waves: significant differences are not highlighted from results, neither in typical nor in extreme wave conditions between the Present and Future Configurations. Just few values of extreme Hs values are different in the two configurations, but differences are not higher than 10 cm;

Nearshore current: typical current velocity is quite low, reaching maximum values of about 0.10 m/s induced by winds coming from 150°N. Discrepancies between the two configurations are not highlighted in terms of typical and extreme conditions;

Residual Wave Agitation: the effect that the new revetment may have on the FSU mooring site has been investigated in terms of wave agitation due to non-linear interactions between incoming waves and diffracted/reflected waves. The residual wave agitation was assessed calculating the Kd (diffraction coefficient) statistics for Present and Future scenarios. Waves coming from 180°N are the most critical for the area as they are characterized by a small reduction of about 10% in both configurations, while 90°N is the least problematic incoming wave direction, in fact incoming waves strongly reduce because of the diffraction and wave agitation is characterized by a mean diffraction coefficient of about 10%, i.e. wave height reduction of about 90% in both configurations. Significant discrepancies between Present and Future configuration's outputs are not detected at the FSU mooring site. The breakwater/revetment protecting the reclamation area will not induce different wave conditions respect to the present situation, the layout seems to be properly designed in order to avoid critical conditions for berthing the FSU and modifications to its characteristics are not considered necessary.

In summary, this ad hoc hydrodynamic modelling study did not highlight any significant modification within the Marsaxlokk basin induced by the Land Reclamation project: the present metocean conditions (status quo) are not expected to significantly change in the future configuration.

5.4.3 Biogeochemical parameters

Within the current study, snapshot laboratory analyses of the nutrient (nitrogen and phosphorus chemical species, silicate) load of the water column within the Area of Study was conducted, with results being reported within Table 8.

The low values recorded within the current snapshot water quality study for all nitrogen and phosphorus chemical species as well as for silicate is coherent with similar findings reported for Marsaxlokk Bay within previous studies (e.g. Pisani, 2011), which resonate in their conclusion that Marsaxlokk carries a lower eutrophication risk than the Marsamxett and Grand Harbours, as testified by low dissolved nutrient concentrations and a high degree of water column oxygenation and visibility.

Table 8: Water column biogeochemical analyses results

Water parameter	Analytical protocol used	Units	Rep 1	Rep 2	Rep 3
Ammonium	APAT CNR IRSA 4030 A1 Man 29 2003	µmol/l	< 0.008	< 0.008	< 0.008
Nitrate	APAT CNR IRSA 4040 A2 Man 29 2003	µmol/l	1.48	1.51	1.48
Nitrite	APAT CNR IRSA 4050 Man 29 2003	µmol/l	0.05	0.05	0.05
Total phosphorous	APAT CNR IRSA 4110 A2 Man 29 2003	µmol/l	0.02	0.01	0.01
Orthophosphate	APAT CNR IRSA 4110 A1 Man 29 2003	µmol/l	< 0.005	< 0.005	< 0.005
Silicate	ICRAM/ANPA 2001-2003	µmol/l SiO4	< 3	< 3	< 3

5.4.4 Plankton-related metrics

In order to characterise phytoplankton assemblages for the Area of Study, three replicate one-litre water samples were collected within the nearshore area contiguous to the proposed land reclamation area, and these were filtered ex situ and screened for plankton species supported therein. Zooplankton assemblages were characterised through the collection of a single water sample of 30 litres, which was filtered ex situ. Zooplankton cell biomass for the collected water sample was calculated through the gravimetric method.

The diatom/dinoflagellate ratio has been mainly applied a water quality index in the Baltic Sea (e.g. Wasund et al., 2017), with high values for the index being considered as an indicator of Good Environmental Status (GES) and HELCOM adopting/approving such an index as a core indicator (HELCOM, 2016). High ratio values indicate high rates of diatom sedimentation and thus low food availability to zooplankton, whilst low ratio values indicate silicate limitation due to severe nitrogen and phosphorus-driven eutrophication. Although MSFD GES thresholds for the ratio exist only for Baltic (0.5-0.75), a notoriously eutrophied Sea, the ratio values recorded from Delimara in the current study (Table 9) are sufficiently higher (7.667-16.000) so as to suggest generally oligotrophic conditions and good water quality status within the surveyed area.

Four (*Ceratium furca, Lingulodinium polyedrum, Alexandrium* sp. and *Gymnonium* spp.) of the identified dinoflagellate genera or species recorded off Delimara during the current study are known to cause red tides as well as toxicity in fish and shellfish and in oxygen-depletion events when present in large enough concentrations (e.g. Morton et al., 2011). With respect to zooplankton, very low diversity values were recorded, which is consistent with the high values recorded for the diatom:dinoflagellate ratio, with only two taxa being represented: Copepoda and Scyphozoa. With respect to the latter, interestingly enough an immature (ephyra) stage of the non-indigenous (Lessepsian) scyphozoan *Cassiopea andromeda* was recorded. This non-indigenous species was previously recorded from Maltese waters only twice (Deidun et al., 2018).

In terms of recorded plankton cell densities, these can be considered to be low, especially when compared with corresponding values for more productive areas in the Mediterranean, such as the Alboran Sea, where the increment in such cell density values is three orders of magnitude when compared with current study values. In fact, Mercado et al. (2005) report phytoplankton cell densities of 60-338 per microlitre, as compared to the 175-870 cells per litre reported in the current study.

Table 9: Results for the phytoplankton-related metrics

Replicate	Diatom:Dinoflagellate ratio	Number of phytoplankton cells/L
1	16.000	175
2	15.000	590
3	7.667	870

Table 10 gives the phytoplankton species list and relative abundance for the three water column replicates sampled in the current study.

Table 10: Phytoplankton species list and relative abundance

Phytoplankton group/species	Number of cells	Relative abundance/%
Replicate 1		
Diatoms/ Bacillariophyceae	**16**	**94.12**
Amphora spp.	1	5.88
Leptocylindrus danicus	2	11.76
Leptocylindrus mediterraneus	13	76.47
Dinoflagellates/ Dinophyceae	**1**	**5.88**
Lingulodinium polyedrum (cyst)	1	5.88
Total abundance	**17**	**100.00**
Replicate 2		
Diatoms/ Bacillariophyceae	**60**	**93.75**
Dactyliosolen fragilissimus	8	12.50
Diploneis spp.	1	1.56
Leptocylindrus danicus	34	53.13
Leptocylindrus mediterraneus	16	25.00
Navicula spp.	1	1.56
Dinoflagellates/ Dinophyceae	**4**	**6.25**
Ceratium furca	1	1.56
Lingulodinium polyedrum (cyst)	3	4.69
Total abundance	**64**	**100.00**
Replicate 3		
Diatoms/ Bacillariophyceae	**69**	**88.46**
Amphora spp.	2	2.56
Leptocylindrus danicus	46	58.97
Leptocylindrus mediterraneus	21	26.92
Dinoflagellates/ Dinophyceae	**9**	**11.54**
Alexandrium sp.	1	1.28
Gymnodinium spp.	2	2.56
Lingulodinium polyedrum (cyst)	6	7.69
Total abundance	**78**	**100.00**

Table 11 gives the zooplankton species list and relative abundance for the three water column replicates sampled in the current study.

Table 11: Zooplankton species list and relative abundance

Zooplankton genus/group	Number of cells	Relative abundance/%
Cassiopea	1	25.00
Euterpina	1	25.00
Copepoda Larvae (*Nauplius)incertae sedis*	2	50.00
Total abundance	**4**	**100.00**

The zooplankton biomass for the water sample collected was quantified at 0.001 mg/L.

6.0 Baseline study – Terrestrial ecology

Terrestrial ecological features along the Delimara Peninsula and the Area of Influence (AoI) have been investigated. Desktop research has revealed that there are no documented terrestrial habitats within the Area of Influence. Nevertheless, the area is considered as mostly pristine because of its rural character and limited anthropogenic disturbance. The area encompasses various features that are important for the conservation of local ecological dynamics.

The mound of material intended for land reclamation encompasses various opportunistic and ruderal species that are synonymous of recently spoilt areas. Species colonising this area include: *Foeniculum vulgare* (Common fennel), *Galactites tomentosa* (Mediterranean thistle), and *Oxalis pes-caprae* (Bermuda buttercup) amongst others. These observations were also substantiated by the operators at the Power Station and owners of the overlying cultivated fields who revealed that this mound of material was generated from excavation activities that were carried out during the extension of the Delimara Power Station in recent years.

https://photos.google.com/photo/AF1QipMjWMrYpMlPEcE3CT0_ZT3Y9GM3Heri-HAQ49tS

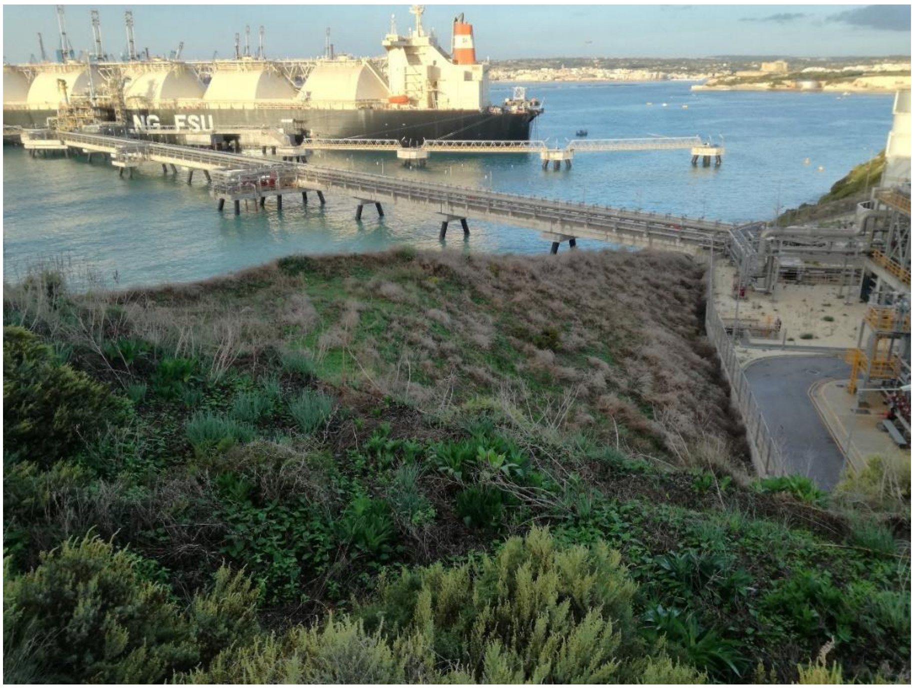


Figure 31: Top view of the mound containing ruderal and opportunistic species

Although the area occupied by the proposed access pathway leading to the terminal station is severely disturbed, the cliff face along the area of intervention contains important vegetation communities of conservation importance. The strictly protected endemic *Darniella melitensis* (Maltese salt tree) covers sections of the cliff face along with dense covers of *Inula crithmoides* (Golden samphire) and *Lygeum spartum* (Esparto Grass). The aforementioned species are resilient to a wide variety of abiotic conditions such as drought, heavy winds, sea spray and limited nutrients within the soil, and thus thrive in coastal cliff areas. The Esparto Grass provides stability to exposed clay/soil slopes, and is thus an important key stone species within the community (Figure 32 to Figure 34). The Maltese endemic salt tree is considered as a protected species through the provisions of Regulation 26 of S.L. 549.44. Any interventions on communities of this protected species should be covered by a nature permit as requested by the competent environmental authority.

Figure 32: Cliff communities surrounding the Delimara power station

Figure 33: Vegetation communities to be affected by the proposed widening of the access road

Figure 34: Close-up view of the ecological communities within the area of intervention

7.0 Baseline study – Avifauna

The site where the Terminal Plant for the pipeline will be built is located adjacent to the Regasification Plant at the DPS (Figure 35). A new internal access road will be built and land reclamation will also take place along the existing shoreline. The base of the plant will be about 6.50m above sea level. The gas pipeline will cross underground the Delimara peninsula between the Terminal Plant and the seaward side along the east coast. This will be done through a microtunnelling borehole which will surface at around -42m below sea level about 600-700m offshore. The pipeline will continue its pathway underwater until it reaches the shores of Gela. Along its pathway, the pipeline crosses three MPAs (Figure 36) which are:

- *Żona fil-Baħar tal-Grigal* (MT 0000107) designated as an SPA via GN No. 1311 of 2016, in accordance with the Flora, Fauna and Natural Habitats Protection Regulations, 2016 (S.L. 549.44);
- *Żona fil-Baħar fil-Lvant* (MT 0000108) designated as an SPA via GN No. 1311 of 2016, in accordance with the Flora, Fauna and Natural Habitats Protection Regulations, 2016 (S.L. 549.44);
- *Żona fil-Baħar fil-Lbiċ* (MT 0000111) designated as an SPA via GN No. 1311 of 2016, in accordance with the Flora, Fauna and Natural Habitats Protection Regulations, 2016 (S.L. 549.44).

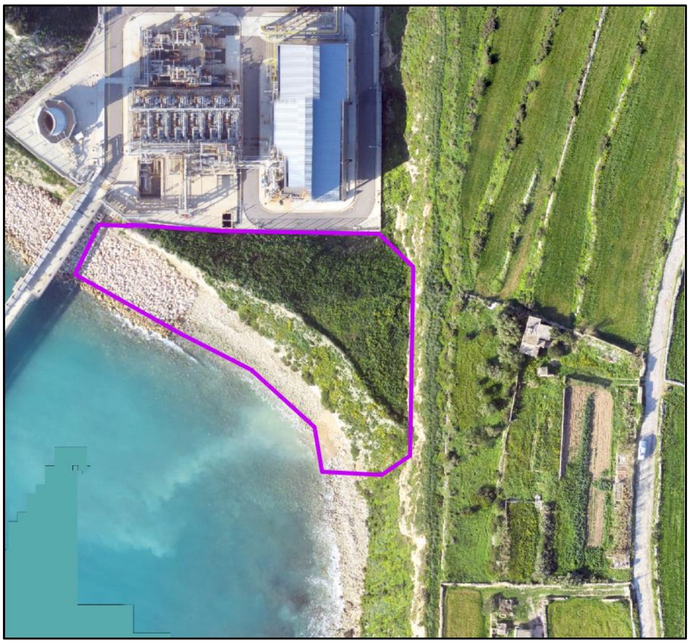


Figure 35: Location of Terminal Plant at DPS (taken from Leopardi G et al, 2019).

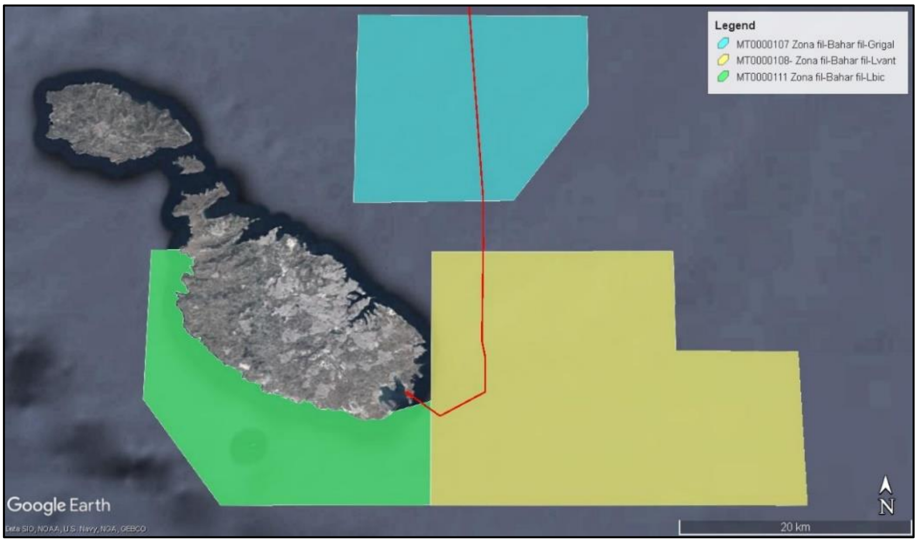


Figure 36: Aerial view showing gas pipeline route in relation to Marine Protected Areas (source: Google Earth, 2019)

7.1 Onshore literature data

Borg J.J (2013) gives a whole overview of the species of birds breeding along the Delimara peninsula. The following species were encountered at the time:

- Short-toed Lark (*Calandrella brachydactyla*)
- Blue Rock Thrush (*Monticola solitarus*)
- Zitting Cisticola (*Cisticola juncidis*)
- Sardinian Warbler (*Sylvia melanocephala*)
- Spectacled Warbler (*Sylvia conspicillata*)
- Spanish Sparrow (*Passer hispaniolensis*)
- Tree Sparrow (*Passer montanus*)

The only species found breeding in this area which is also an Annex I species is the Short-toed Lark which is also a SPEC 3 species.

7.2 Birdwatching data

The literature review and data collected by Borg J.J. (2013)[3] was supplimented with data collected from sea watching over a period between 2016 and 2019 from two areas, one at *Xrobb l-Għaġin* Park and the environs and the other from the area of *San Tumas* limits of *Marsaskala*. Morning records were normally collected from dawn for about three hours and afternoon records were normally collected for another three hours pre dusk. Details of the avian record data are found in Table 12. Most of the sampling effort was on birds flying out at sea or flying inland or migrating out. In fact, the highest numbers involved seabirds and resident birds with other migrants having much lower figures. The data covers different periods of the year and so can be considered as representative for the purposes of this report.

[3] *Borg J.J. (2013) Report on the vertebrate Fauna vis-à-vis Combined Cycle gas Turbine and Liquefied Natural Gas receiving, storage, and re-gasification facilities.*

Table 12: Details of avian surveys in the proximity of Scheme.

Date	Time of day	Location
03/06/2016	PM	Xrobb l-Għaġin
03/12/2016	PM	San Tumas
13/03/2016	PM	San Tumas
25/03/2016	PM	San Tumas
26/03/2016	PM	San Tumas
04/10/2016	AM / PM	Xrobb l-Għaġin
24/04/2016	AM / PM	Xrobb l-Għaġin / San Tumas
29/10/2016	PM	San Tumas
25/02/2017	PM	Xrobb l-Għaġin
26/02/2017	PM	Xrobb l-Għaġin
18/03/2017	PM	Xrobb l-Għaġin
04/02/2017	PM	San Tumas
16/04/2017	PM	Xrobb l-Għaġin
29/10/2017	AM	San Tumas
17/03/2018	PM	Xrobb l-Għaġin
25/03/2018	PM	San Tumas
31/03/2018	PM	Xrobb l-Għaġin
04/01/2018	PM	San Tumas
05/12/2018	PM	Xrobb l-Għaġin
25/11/2018	PM	Xrobb l-Għaġin
14/02/2019	PM	Xrobb l-Għaġin
24/02/2019	AM	San Tumas
16/03/2019	PM	San Tumas
24/03/2019	PM	San Tumas
30/03/2019	PM	Xrobb l-Għaġin / San Tumas
31/03/2019	PM	San Tumas
04/06/2019	PM	San Tumas
04/07/2019	AM	San Tumas
13/04/2019	PM	Xrobb l-Għaġin
14/04/2019	AM/PM	Xrobb l-Għaġin / San Tumas
28/04/2019	AM	San Tumas
05/01/2019	AM	San Tumas
05/05/2019	AM	San Tumas

7.3 Evaluation of the legal protection and conservation status of the ecological resources

The conservation status of birds has been assigned in accordance to the Species of European Conservation Concern (SPEC) system (Birdlife International, 2017), IUCN Red List (Category Europe) and the Birds Directive.

7.3.1 Protected sites and species

The peninsula across which the underground pipeline will be constructed is Scheduled as an Area of Ecological Importance (AEI) and forms part of the *Rdum mid-Daħla ta' San Tumas sa is-Sarc* AEI which was established via Government Notice 400 of 1996 with the specific aim of protecting the overall integrity of the rural surroundings against development pressures. The underwater part of the pipeline will also pass through three Marine Protected Areas namely *Żona fil-Baħar fil-Grigal* (MT 0000107), *Żona fil-Baħar fil-Lvant* (MT 0000108) and *Żona fil-Baħar fil-Lbiċ* (MT 0000111) all of which are designated as SPAs.

The closest bird sanctuary is *Il-Ballut ta' Marsaxlokk*, which is about 1.5 km away from the Terminal Plant.

7.3.1.1 Żona fil-Baħar fil-Lbiċ

The *Żona fil-Baħar fil-Lbiċ* is a large area of sea (Figure 37) beyond the cliffs stretching all the south west coast of the Maltese islands and beyond the islet of *Filfla* to the area known as *Għar Bella* close to the area where the gas pipeline reaches the Maltese shores. The site was identified in the Maltese Marine IBA inventory as a result of the EU LIFE+ Malta Seabird Project (LIFE10 NAT/MT090) due to its importance for *Calonectris diomedia, Hydrobates pelagicus* and *Puffinus yelkouan.*

The site is designated as a Special Protection Area via Government Notice 1311 of 2016, as declared through the provisions of the Flora, Fauna and Natural Habitats Regulations of 2016 [S.L. 549.44].

As outlined in the ERA N2K datasheets[4], the Storm Petrel (*Hydrobates pelagicus)* which has a strong colony on *Filfla,* is deemed to have a population of between 15-24,000 individuals within this area, whereas the estimate of the Scopoli's Shearwater (*Calonectris diomedia*) is 6,000 and that of the Yelkouan Shearwater (*Puffinus yelkouan)* between 840 and 1,350 individuals.

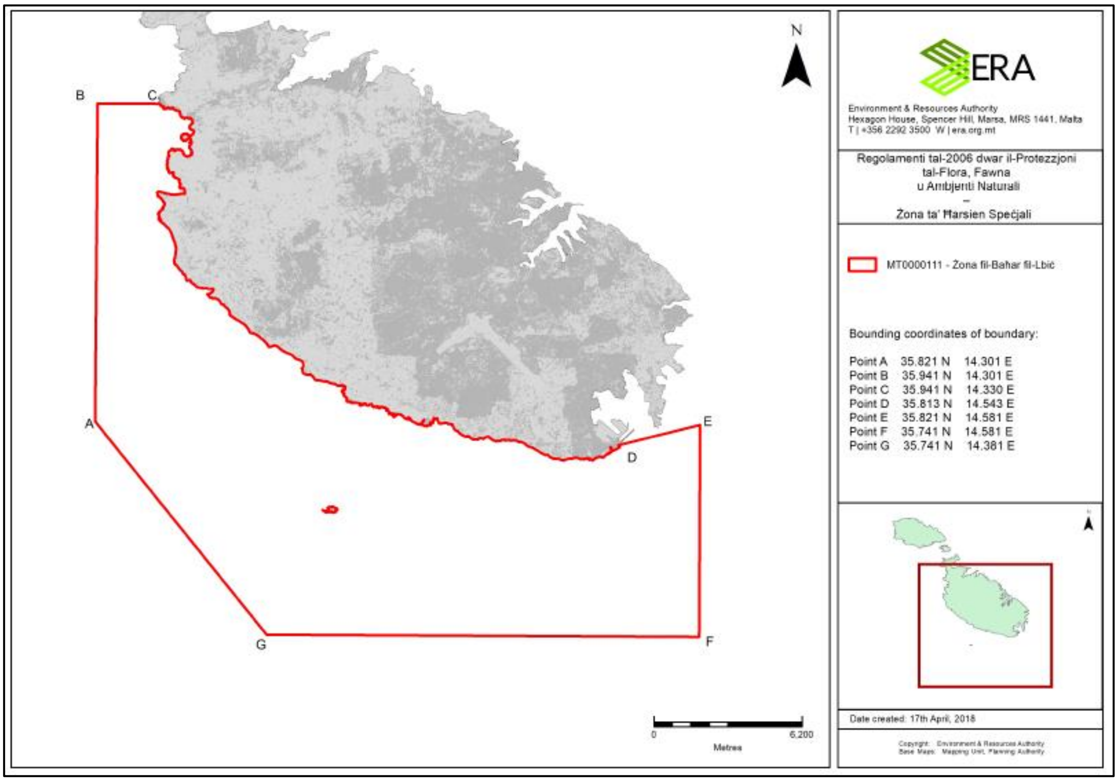


Figure 37: Żona fil-Baħar fil-Lbiċ N2K site

[4] *https://era.org.mt/en/Pages/Natura-2000-Datasheets-Maps.aspx.*

7.3.1.2 Żona fil-Baħar fil-Lvant

The *Żona fil-Baħar fil-Lvant* is another very large area of sea (Figure 38) along the east coast of the southern part of the island off the Delimara peninsula. The site was identified in the Maltese Marine IBA inventory as a result of the EU LIFE+ Malta Seabird Project (LIFE10 NAT/MT090) due to its importance for *Calonectris diomedia and Hydrobates pelagicus.*

The site is designated as a Special Protection Area via Government Notice 1311 of 2016, as declared through the provisions of the Flora, Fauna and Natural Habitats Regulations of 2016 [S.L. 549.44].

As outlined in the ERA N2K datasheets[4], the Storm Petrel (*Hydrobates pelagicus)* is deemed to have a population of 3800 individuals within this area most probably due to its proximity to its stronghold on *Filfla*, whereas the estimate of the Scopoli's Shearwater (*Calonectris diomedia*) is 3,800.

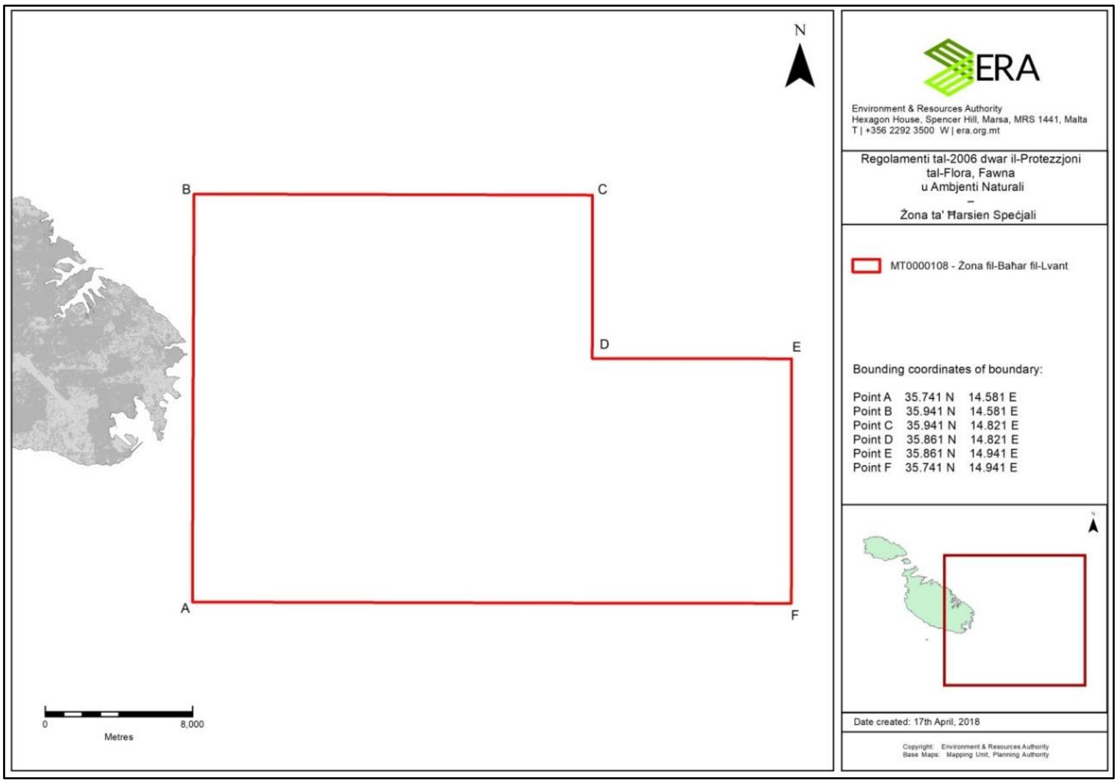


Figure 38: Żona fil-Baħar fil-Lvant N2K site

7.3.1.3 Żona fil-Baħar fil-Grigal

The *Żona fil-Baħar fil-Grigal* is a large area of sea (Figure 39) along the north east coast of the island north of the *Żona fil-Baħar fil-Lvant*. The site was identified in the Maltese Marine IBA inventory as a result of the EU LIFE+ Malta Seabird Project (LIFE10 NAT/MT090) due to its importance for *Hydrobates pelagicus and Puffinus yelkouan.*

The site is designated as a Special Protection Area via Government Notice 1311 of 2016, as declared through the provisions of the Flora, Fauna and Natural Habitats Regulations of 2016 [S.L. 549.44].

As outlined in the ERA N2K datasheets[4], the Storm Petrel (*Hydrobates pelagicus)* is deemed to have a population of 1,700 individuals whereas the estimate of the Yelkouan Shearwater (*Puffinus yelkouan*) is between 380 and 450 individuals.

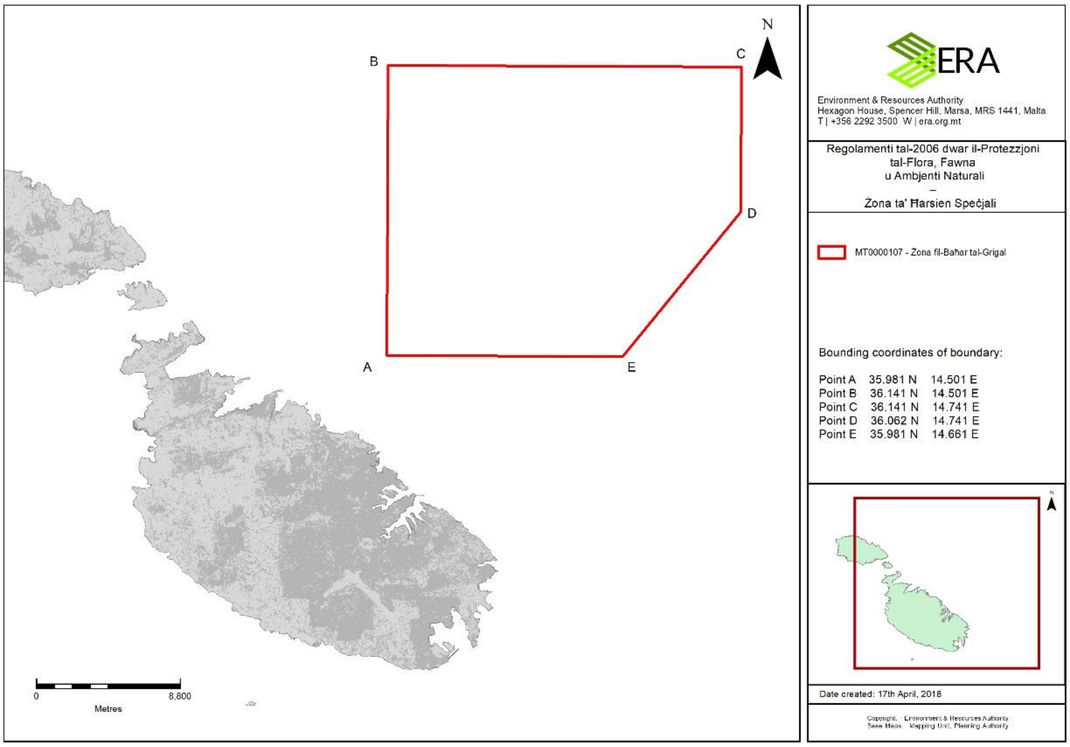


Figure 39: Żona fil-Baħar tal-Grigal N2K site

7.4 EU LIFE+ Malta Seabird Project (LIFE10 NAT/MT090)

The Life + Malta Seabird Project was led by Birdlife Malta in collaboration with the Ministry of Sustainable Development, The Environment and Climate Change, the RSPB and SPEA (Birdlife in Portugal). The project ran between September 2011 and June 2016.

The project utilised high-end technology to gather results about the lives of the three species of tubenose breeding in Malta. These results showed that these species utilise various parts of the areas around the Maltese islands for rafting prior to moving into their nests and also for feeding.

One of the major concerns for these species is disturbance from light sources which tend to keep adults at bay refraining from flying back into their nests and also disorients the offspring when they fly out of their nests hence light has a significant impact on the lives of these species.

The final outcome from this project was the declaration by the Maltese Government of a number of Marine Protected Areas around the islands, three of which are relevant to this project Figure 40).

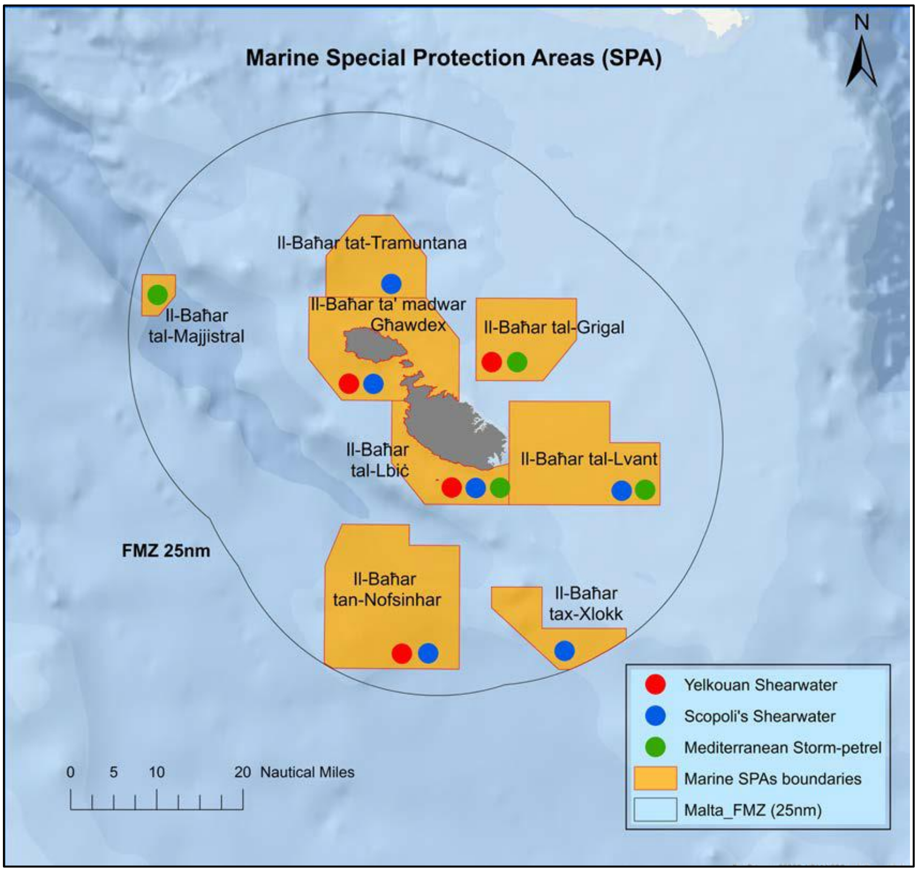


Figure 40: Marine SPAs around the Maltese Islands (source BLM, 2015)

7.5 International Conservation Status

The best source of data currently available to understand the status of wild birds is that provided by Birdlife International through its publication European Birds of Conservation Concern (EBCC), which is in its third review of the conservation status of all wild birds in Europe. The aim of the publication was to identify priority species (Species of European Conservation Concern, or SPECs) in order that conservation action can be undertaken to improve their status.

The geographical range for the data collection extends from Greenland to the Urals and from Macaronesia in the southwest to the Caucasus in the southeast. Data was collected through a network of national coordinators who sought input from experts, organizations and an army of field workers.

The methodology used in previous assessments was also used in the third version thus maintaining consistency. The categories listed in Table 13 were developed in order to classify each species.

Table 13: Categories developed by the EBCC to identify conservation status

Category	Description
SPEC 1	European species of global conservation concern i.e. Critically Endangered, Vulnerable or Near Threatened at global level (Birdlife International 2016 a)

Category	Description
SPEC 2	Species whose global population is concentrated in Europe, and which is classified as Regionally Extinct, Critically Endangered, Endangered, Vulnerable, Near Threatened, Declining, Depleted or rare at European level (Birdlife International 2015, Butterfield *et al*)
SPEC 3	Species whose global population is not concentrated in Europe and which, but which is classified as Regionally Extinct, Critically Endangered, Endangered, Vulnerable, Near threatened, Declining, Depleted or rare at European level (Birdlife International 2015, Butterfield *et al*)
Non-SPEC^E	Species whose global population is concentrated in Europe, but whose population status is currently considered to be Secure (Butterfield *et al*)
Non-SPEC	Species whose global population is not concentrated in Europe and whose European population Status is currently considered to be Secure (Butterfield *et al*)

A species is considered as concentrated in Europe if more than 50% of its global breeding or wintering population or range occurs in Europe.

Table 14: Percentage of European species in each category in BiE1 *(1994),* BiE2 *(2004) and BiE3 (2017)*

Status	Birds in Europe 1994 (*BiE1*)	Birds in Europe 2004 (*BiE2*)	European Birds of Conservation Concern 2017 (*EBCC*)
SPEC 1	5	8	13
SPEC 2	8	9	7
SPEC 3	25	27	19
Non-SPEC^E	16	18	60
Non-SPEC	46	39	

Table 14 shows that during the last fifteen years or so, birds in Europe continued to be threatened by widespread environmental change and many populations are in greater trouble than they were in the previous decade.

7.5.1 IUCN Threat Status

The assessment of the European Threat Status is based on the minimum European population size and the percentage of the total European population which is in countries where populations have declined. These criteria have therefore had to take into consideration the quality and availability of information on European bird populations, and calculations are thus based on categories of population trend rather than precise figures.

These assessments are made on the basis of breeding season data unless a species qualifies on winter data. Assessment of overall population trends based solely on the basis of the quantitative data which are available would introduce regional biases and therefore be invalid.

The criteria used in establishing the threat status was as follows:

Regionally Extinct [RE] Where no reasonable doubt that the last individual in Europe has died. (If it is possible that the species survives, then it is CR (PE), i.e. Possibly Extinct.

Critically Endangered [CR] if the European population meets any of the IUCN Red List Criteria for Critically Endangered species. Such species have an Unfavourable conservation status in Europe because they are considered to be facing an extremely high risk of extinction in the wild (IUCN, 2001).

Endangered [EN] if the European population meets any of the IUCN Red List Criteria for endangered species. Such species have an Unfavourable conservation status in Europe because they are considered to be facing an extremely high risk of extinction in the wild (IUCN, 2001).

Vulnerable [VU] if the European population meets any of the IUCN Red List Criteria for vulnerable species. Such species have an Unfavourable conservation status in Europe because they are considered to be facing an extremely high risk of extinction in the wild (IUCN, 2001).

Least Concern [LC] if its European population does not meet any of the criteria listed above.

Near Threatened [NT] if the European population is close to meeting the IUCN Red List criteria for VU.

7.5.2 European Birds Directive

The EU Birds Directive (transposed into LN 79 of 2006 [S.L.549.42] and amended by various legal notices) provides a framework for the conservation and management of, and human interactions with, wild birds in Europe. The main provisions of the Directive include, amongst others:

- The maintenance of the populations of all wild bird species across their natural range with the encouragement of various activities to that end.
- The identification and classification of Special Protected Areas (SPAs) for rare or vulnerable species listed in Annex I of the Directive, as well as for all regularly occurring migratory species, paying particular attention to the protection of wetlands of international importance. Together with Special Areas of Conservation (SAC) designated under the Habitats Directive, SPAs form a network of European protected areas known as Natura 2000 sites.
- The establishment of a general scheme of protection for all wild birds including specification of conditions under which hunting and falconry can be undertaken. Huntable species are listed on Annex II of the Directive.

The Birds Directive is a primary tool for delivery against EU obligations under global Conventions, including the Convention on Biological Diversity, the Ramsar and Bonn Conventions and the Plan of implementation of the World Summit on Sustainable Development. The EU had also committed itself to halting biodiversity decline by the year 2010. The full and proper implementation of both the Birds and Habitats Directives including the proper designation and adequate management of Natura 2000 sites should have been crucial to achieving this target.

EU member states are obliged under the above-mentioned Directives to:

- Take measures to conserve all naturally occurring bird species across the EU;
- Classify as Special Protected Areas (SPAs) the most suitable territories for species listed on Annex I of the Directive and migratory species;
- Maintain SPAs in Favourable conservation status;
- Prepare and implement management plans, setting clear conservation objectives for all SPAs in the EU 28;
- Provide co-financing of the management of these SPAs;
- Regulate hunting of certain species of birds listed in Annex II of the Birds Directive;

Follow the procedure outlined in Article 6 of the Habitats Directive for carrying out appropriate assessments of environmental impacts on SPAs.

7.6 Results and analyses

Borg J.J (2013) gives a whole overview of the species of birds breeding along the Delimara peninsula. The following species were encountered at the time:

- Short-toed Lark (*Calandrella brachydactyla*)
- Blue Rock Thrush (*Monticola solitarus*)
- Zitting Cisticola (*Cisticola juncidis*)
- Sardinian Warbler (*Sylvia melanocephala*)
- Spectacled Warbler (*Sylvia conspicillata*)
- Spanish Sparrow (*Passer hispaniolensis*)
- Tree Sparrow (*Passer montanus*)

The only species found breeding in this area which is also an Annex I species is the Short-toed Lark which is also a SPEC 3 species.

The list of birds recorded during the surveys that were carried out during the 2016-19 period in the area, together with the review of studies undertaken by Borg JJ (2013) and the local and conservation status (SPEC and IUCN Red List (Europe)) is shown in Table 15. Annex I species as designated in the Birds Directive are also indicated in the same list.

Table 15: List of all birds recorded from the area and reviewed together with their local and conservation status (SPEC, IUCN Red List (Europe) and Annex I species).

Common name	Latin name	Status in Malta				International Protection Status			Records of Species	
		Breeding	Migrant	Winter visitor	Rare & Irregular	SPEC Category	IUCN Threat Status	Birds directive	Borg JJ (2013)	Field data 2016-19
Mute Swan	*Cygnus olor*				x	Non-SPEC	LC		x	

Common name	Latin name	Status in Malta				International Protection Status			Records of Species	
		Breeding	Migrant	Winter visitor	Rare & Irregular	SPEC Category	IUCN Threat Status	Birds directive	Borg JJ (2013)	Field data 2016-19
Greylag Goose	*Anser anser*				x	Non-SPEC	LC		x	
Common Shelduck	*Tadorna tadorna*		x	x		Non-SPEC	LC		x	x
Eurasian Wigeon	*Anas penelope*		x	x		Non-SPEC	LC		x	
Eurasian Teal	*Anas crecca*		x	x		Non-SPEC	LC		x	
Garganey	*Anas querquedula*		x			SPEC 3	LC		x	
Common Quail	*Coturnix coturnix*	VR	x			SPEC 3	LC		x	x
Little Grebe	*Tachybaptus ruficollis*	VR		x		Non-SPEC	LC		x	
Great Crested Grebe	*Podiceps cristatus*		x	x		Non-SPEC	LC		x	
Black-necked Grebe	*Podiceps nigricollis*			x		Non-SPEC	LC		x	
Scopoli's Shearwater	*Calonectris diomedea*	x (SV)				Non-SPEC	LC	I	x	x
Yelkouan Shearwater	*Puffinus yelkouan*	x (PR)				SPEC 1	LC	I	x	x
European Storm-petrel	*Hydrobates pelagicus*	x (SV)				Non-SPEC	LC	I	x	
Northern Gannet	*Morus bassanus*			x		Non-SPEC	LC		x	x
Great Cormorant	*Phalacrocorax carbo*			x		Non-SPEC	LC		x	x
Eurasian Bittern	*Botaurus stellaris*		x			SPEC 3	LC	I	x	
Little Bittern	*Ixobrychus minutus*	VR	x			SPEC 3	LC	I	x	
Night Heron	*Nycticorax nycticorax*		x			SPEC 3	LC	I	x	x
Squacco Heron	*Ardeola ralloides*		x			SPEC 3	LC	I	x	x
Cattle Egret	*Bubulcus ibis*				x	Non-SPEC	LC		x	

Common name	Latin name	Status in Malta				International Protection Status			Records of Species	
		Breeding	Migrant	Winter visitor	Rare & Irregular	SPEC Category	IUCN Threat Status	Birds directive	Borg JJ (2013)	Field data 2016-19
Little Egret	*Egretta garzetta*		x	x		Non-SPEC	LC	I	x	x
Great White Egret	*Ardea alba*		x			Non-SPEC	LC	I	x	x
Grey Heron	*Ardea cinerea*		x	x		Non-SPEC	LC		x	x
Purple Heron	*Ardea purpurea*		x			SPEC 3	LC	I	x	x
Glossy Ibis	*Plegadis falcinellus*		x			Non-SPEC	RE	I	x	
Eurasian Spoonbill	*Platalea leucorodia*		x			Non-SPEC	LC	I	x	
Greater Flamingo	*Phoenicopterus roseus*		x			Non-SPEC	LC	I	x	
Egyptian Vulture	*Neophron percnopterus*					SPEC 1	EN	I		x
Honey-buzzard	*Pernis apivorus*		x			Non-SPEC	LC	I		x
Black Kite	*Milvus migrans*		x			SPEC 3	LC	I		x
Marsh Harrier	*Circus aeruginosus*		x			Non-SPEC	LC	I	x	x
Pallid Harrier	*Circus macrourus*		x			SPEC 1	NT	I		x
Montagu`s Harrier	*Circus pygargus*		x			Non-SPEC	LC	I	x	x
Osprey	*Pandion halieatus*		x			Non-SPEC	LC	I	x	x
Lesser Kestrel	*Falco naumanni*		x			SPEC 3	LC	I	x	x
Common Kestrel	*Falco tinnunculus*	VR	x	x		SPEC 3	LC		x	x
Red-footed Falcon	*Falco vespertinus*		x			SPEC 1	NT	I		x
Hobby	*Falco subbuteo*		x			Non-SPEC	LC		x	x
Eleonora`s Falcon	*Falco eleonorae*		x			Non-SPEC	LC	I	x	
Water Rail	*Rallus aquaticus*		x	x		Non-SPEC	LC		x	
Spotted Crake	*Porzana porzana*		x	x		Non-SPEC	LC	I	x	

Common name	Latin name	Status in Malta				International Protection Status			Records of Species	
		Breeding	Migrant	Winter visitor	Rare & Irregular	SPEC Category	IUCN Threat Status	Birds directive	Borg JJ (2013)	Field data 2016-19
Moorhen	*Gallinula chloropus*	x	x			Non-SPEC	LC		x	
Common Coot	*Fulica atra*		x	x		SPEC 3	NT		x	
Common Crane	*Grus grus*		x			Non-SPEC	LC	I	x	x
Oystercatcher	*Haematopus ostralegus*		x			SPEC 1	VU		x	
Little Bustard	*Tetrax tetrax*				x	SPEC 1	VU	I		x
Black-winged Stilt	*Himantopus himantopus*		x			Non-SPEC	LC	I		x
Avocet	*Recurvirostra avosetta*		x			Non-SPEC	LC	I	x	
Stone-curlew	*Burhinus oedicnemus*		x			SPEC 3	LC	I		x
Little Ringed Plover	*Charadrius dubius*	x	x			Non-SPEC	LC		x	
Ringed Plover	*Charadrius hiaticula*		x			Non-SPEC	LC		x	
Dotterel	*Charadrius morinellus*		x			Non-SPEC	LC	I		x
Little Stint	*Calidris minuta*		x	x		Non-SPEC	LC		x	
Eurasian Curlew	*Numenius arquata*		x			SPEC 1	VU		x	
Common Redshank	*Tringa totanus*		x	x		SPEC 2	LC		x	x
Green Sandpiper	*Tringa ochropus*		x			Non-SPEC	LC		x	x
Wood Sandpiper	*Tringa glareola*		x			SPEC 3	LC	I		x
Common Sandpiper	*Actitis hypoleucos*		x	x		SPEC 3	LC			x
Pomarine Skua	*Stercorarius pomarinus*		x			Non-SPEC	LC		x	x
Arctic Skua	*Stercorarius parasiticus*				x	Non-SPEC	LC			x
Great Skua	*Catharacta skua*		x			Non-SPEC	LC		x	x
Pallas Gull	*Ichthyaetus ichthyateus*				x	Non-SPEC				x

Common name	Latin name	Status in Malta				International Protection Status			Records of Species	
		Breeding	Migrant	Winter visitor	Rare & Irregular	SPEC Category	IUCN Threat Status	Birds directive	Borg JJ (2013)	Field data 2016-19
Mediterranean Gull	*Larus melanochephalus*		x	x		Non-SPEC	LC	I	x	x
Little Gull	*Larus minutus*			x		SPEC 3		I	x	
Black-headed Gull	*Larus ridibundus*		x	x		Non-SPEC	LC		x	x
Slender-billed Gull	*Larus genei*		x			Non-SPEC	LC	I	x	
Audouin`s Gull	*Larus audouinii*			x		Non-SPEC	LC	I	x	x
Lesser Black-backed Gull	*Larus fuscus*		x	x		Non-SPEC	LC		x	x
Yellow-legged Gull	*Larus michahellis (CACHINNANS)*	x	x	x		Non-SPEC	LC		x	x
Kittiwake	*Rissa tridactyla*				x	SPEC 3	VU			x
Gull-billed Tern	*Gelochelidon nilotica*		x			SPEC 3	LC	I	x	
Caspian Tern	*Hydroprogne caspia*		x			Non-SPEC	LC	I	x	x
Whiskered Tern	*Chlidonias hybrida*		x			Non-SPEC	LC	I		x
Black Tern	*Chlidonias niger*		x			SPEC 3	LC	I	x	
White-winged Black Tern	*Chlidonias leucopterus*		x			Non-SPEC	LC		x	
Sandwich Tern	*Sterna sandvicensis*		x	x		Non-SPEC	LC	I	x	x
Collared Dove	*Streptopelia decaocto*	x				Non-SPEC	LC		x	x
Turtle Dove	*Streptopelia turtur*	VR	x			SPEC 1	VU		x	x
Great Spotted Cuckoo	*Clamator glandarius*		x			Non-SPEC	LC		x	
Common Cuckoo	*Cuculus canorus*	VR	x			Non-SPEC	LC		x	
Barn Owl	*Tyto alba*		x		x	SPEC 3	LC		x	

Common name	Latin name	Status in Malta				International Protection Status			Records of Species	
		Breeding	Migrant	Winter visitor	Rare & Irregular	SPEC Category	IUCN Threat Status	Birds directive	Borg JJ (2013)	Field data 2016-19
Eurasian Scops Owl	*Otus scops*		x	x		SPEC 2	LC		x	
Long-eared Owl	*Asia otus*		x			Non-SPEC	LC			x
Short-eared Owl	*Asio flammeus*	VR	x	x		SPEC 3	LC	I	x	x
European Nightjar	*Caprimulgus europaeus*		x			SPEC 3	LC	I	x	
Alpine Swift	*Apus melba*		x			Non-SPEC	LC		x	x
Common Swift	*Apus apus*	VR	x			SPEC 3	LC		x	x
Pallid Swift	*Apus pallidus*		x			Non-SPEC	LC		x	x
Little Swift	*Aopus affinis*				x	SPEC 3	VU			x
Common Kingfisher	*Alcedo atthis*		x	x		SPEC 3	VU	I	x	
European Bee-eater	*Merops apiaster*		x			Non-SPEC	LC		x	x
European Roller	*Coracias garrulus*		x			SPEC 2	LC	I	x	
Hoopoe	*Upupa epops*		x			Non-SPEC	LC		x	x
Wryneck	*Jynx torquilla*		x	x		SPEC 3	LC		x	
Short-toed Lark	*Calandrella brachydactyla*	x (S V)	x			SPEC 3	LC	I	x	x
Sky Lark	*Alauda arvensis*		x	x		SPEC 3	LC		x	x
Wood Lark	*Lullula arborea*				x	SPEC 2	LC	I	x	
Sand Martin	*Riparia riparia*		x			SPEC 3	LC		x	x
Barn Swallow	*Hirundo rustica*	VR	x	x		SPEC 3	LC		x	x
House Martin	*Delichon urbicum*	VR	x			SPEC 2	LC		x	x
Red-rumped Swallow	*Cecropis daurica*		x			Non-SPEC	LC			x
Tawny Pipit	*Anthus campestris*	VR	x			SPEC 3	LC	I	x	x
Tree Pipit	*Anthus trivialis*		x			SPEC 3	LC		x	x

Common name	Latin name	Status in Malta				International Protection Status			Records of Species	
		Breeding	Migrant	Winter visitor	Rare & Irregular	SPEC Category	IUCN Threat Status	Birds directive	Borg JJ (2013)	Field data 2016-19
Meadow Pipit	*Anthus pratensis*		x	x		SPEC 1	NT		x	x
Red-throated Pipit	*Anthus cervinus*		x	x		Non-SPEC	LC		x	
Yellow Wagtail	*Motacilla flava*		x			SPEC 3	LC		x	x
Grey Wagtail	*Motacilla cinerea*		x	x		Non-SPEC	LC		x	
White Wagtail	*Motacilla alba*		x	x		Non-SPEC	LC		x	x
Dunnock	*Prunella modularis*		x	x		Non-SPEC	LC		x	
Robin	*Erithacus rubecula*	VR	x	x		Non-SPEC	LC		x	x
Common Nightingale	*Luscinia megarhynchos*	VR	x			Non-SPEC	LC		x	x
Black Redstart	*Phoenicurus ochruros*		x	x		Non-SPEC	LC			x
Common Redstart	*Phoenicurus phoenicurus*		x			Non-SPEC	LC			x
Whinchat	*Saxicola rubetra*		x			SPEC 2	LC			x
Common Stonechat	*Saxicola torquatus*		x	x		Non-SPEC	LC		x	x
Isabelline Wheatear	*Oenanthe isabellina*				x	Non-SPEC	LC			x
Northern Wheatear	*Oenanthe oenanthe*		x	x		SPEC 3	LC		x	x
Black-eared Wheatear	*Oenanthe hispanica*	VR	x			Non-SPEC	LC		x	x
Blue Rock Thrush	*Monticola solitarus*	x				Non-SPEC	LC		x	x
Blackbird	*Turdus merula*		x	x		Non-SPEC	LC			x
Song Thrush	*Turdus philomelos*		x	x		Non-SPEC	LC		x	x
Cetti's Warbler	*Cettia cetti*	x				Non-SPEC	LC		x	
Zitting Cisticola	*Cisticola juncidis*	x				Non-SPEC	LC		x	x
Reed Warbler	*Acrocephalus scirpaceus*	x	x			Non-SPEC	LC		x	

Common name	Latin name	Status in Malta				International Protection Status			Records of Species	
		Breeding	Migrant	Winter visitor	Rare & Irregular	SPEC Category	IUCN Threat Status	Birds directive	Borg JJ (2013)	Field data 2016-19
Icterine Warbler	*Hippolais icterina*		x			Non-SPEC	LC			x
Blackcap	*Sylvia atricapilla*		x	x		Non-SPEC	LC		x	x
Garden Warbler	*Sylvia borin*		x			Non-SPEC	LC			x
Common Whitethroat	*Sylvia communis*		x			Non-SPEC	LC			x
Spectacled Warbler	*Sylvia conspicillata*	x				Non-SPEC	LC		x	x
Subalpine Warbler	*Sylvia cantillans*		x			Non-SPEC	LC		x	x
Sardinian Warbler	*Sylvia melanocephala*	x	x			Non-SPEC	LC		x	x
Wood Warbler	*Phylloscopus sibilatrix*		x			Non-SPEC	LC		x	
Common Chiffchaff	*Phylloscopus collybita*		x	x		Non-SPEC	LC			x
Willow Warbler	*Phylloscopus trochilus*		x			SPEC 3	LC		x	x
Spotted Flycatcher	*Muscicapa striata*	x	x			SPEC 2	LC		x	x
Collared Flycatcher	*Ficedula albicollis*		x			Non-SPEC	LC	I	x	
Pied Flycatcher	*Ficedula hypoleuca*		x			Non-SPEC	LC		x	x
Golden Oriole	*Oriolus oriolus*		x			Non-SPEC	LC		x	x
Red-backed Shrike	*Lanius collurio*		x			SPEC 2	LC	I	x	
Woodchat Shrike	*Lanius senator*	x	x			SPEC 2	LC		x	x
Common Starling	*Sturnus vulgaris*	x	x	x		SPEC 3	LC		x	x
Spanish Sparrow	*Passer hispaniolensis*	x				Non-SPEC	LC		x	x
Tree Sparrow	*Passer montanus*	x	x			SPEC 3	LC		x	x
European Serin	*Serinus serinus*	VR	x	x		SPEC 2	LC		x	
Greenfinch	*Carduelis chloris*	VR	x	x		Non-SPEC	LC		x	

Common name	Latin name	Status in Malta				International Protection Status			Records of Species	
		Breeding	Migrant	Winter visitor	Rare & Irregular	SPEC Category	IUCN Threat Status	Birds directive	Borg JJ (2013)	Field data 2016-19
Linnet	*Carduelis cannabina*	VR	x	x		SPEC 2	LC		x	x
Corn Bunting	*Emberiza calandra*	x	x			SPEC 2	LC		x	
Ortolan Bunting	*Emberiza hortulana*				x	SPEC 2	LC	I	x	

Various species listed in Table 15 which were recorded or reviewed for the area are either SPEC 1 or Annex I species. However, the species of greatest conservation concern for the proposed Scheme are the seabird species, namely the Scopoli's Shearwaters (Annex I and Non-SPEC), Yelkouan Shearwaters (Annex I and SPEC 1) and the Storm Petrels (Annex I and Non-SPEC).

The nearest colonies of Shearwaters are found along the cliffs starting off from *Bengħisa* and beyond heading in northern direction. Conversely, the Storm Petrels are clustered in a large colony at *Filfla* albeit some records indicated potential breeding along the cliffs. According to the data presented in Table 15, both Shearwater species were observed but Storm Petrels were not recorded. Since, the latter is a relatively small bird and tends to move inshore at night, it may be harder to spot from a distance. On the other hand, Shearwaters were recorded in double (Yelkouan) and triple digits (Scopoli's) figures within the area of study. Both species are usually seen flying a few centimetres above the water level, several hundreds of metres away from the shore. Occasionally one can also witness some shearwaters in closer proximity to the land, but this is normally less common. Sporadically, one can witness bird rafting even from land. The presence of fish farms offshore has also changed the rafting dynamics of these birds which are occasionally seen flying close by these structures. In fact, Borg (2013) reports the presence of double and triple figures of Storm Petrels around fish farms.

8.0 Impact Assessment

This section provides a description of the potential impacts of the Scheme on the ecological resources associated with the construction and operational phases of the Scheme. Mitigation measures have been suggested and residual impacts were identified.

8.1 Impact Significance Criteria

The potential impacts will be assessed based on the following criteria:

Duration of Impact	
Permanent	Impact would still be detectable following decommissioning of project
Temporary	Impact would persist throughout the phase of project under consideration only

Extent of Impact	
Widespread	Impact is expected to affect in the entire area of study and/or may extend beyond the boundaries of direct intervention into adjacent areas
Localised	Impact is expected to affect receptors in the immediate vicinity of its source

Consequences of Impact	
Direct	Changes that result from the cause-effect consequences of interactions between the environment and project activities
Indirect	Changes that result from cause-effect consequences of interactions between the environment and direct impacts

Effect of Impact	
Adverse	A negative effect on the sustainability of the resource under consideration, which are distinguishable from background fluctuations
Beneficial	A positive effect on the sustainability of the resource under consideration, which are distinguishable from background fluctuations

Reversibility of Impact	
Reversible	The state of the resource is expected to return to baseline state following cessation of the source of impact
Irreversible	The state of the resource is not expected to return to baseline state following cessation of the source of impact

Sensitivity of resources to impact	
Major	The resource under consideration is highly susceptible to a detectable deviation from the background state and its general dynamics
Moderate	The resource under consideration is vulnerable but able to tolerate a degree of detectable deviation from the background state and its general dynamics
Low	The resource under consideration is highly tolerant to a detectable deviation from the background state and its general dynamics

Probability of Impact Occurring	
Definite	Impact will occur irrespective of any mitigation measures taken
Likely	Impact may occur despite the implementation of mitigation measures
Unlikely	Impact would only occur in cases of major mitigation failure

Impact Significance	
Major	The effect on the existing state of the feature under consideration will lead to a high or large-scale change in its resilience
Moderate	The effect of the existing state of the feature under consideration will lead to an observable but contextually restricted change, which is sufficiently important for its long-term resilience
Minor	The effect on the existing state of the feature under consideration will lead to no, low or small-scale change that will not alter its resilience

Residual Impact	
Major	The effect on the existing state of the feature under consideration will lead to a high or large-scale change in its resilience after application of mitigation measures (if any) and impact cessation
Moderate	The effect of the existing state of the feature under consideration will lead to an observable but contextually restricted change, which is sufficiently important for its long-term resilience after application of mitigation measures (if any) and impact cessation
Minor	The effect on the existing state of the feature under consideration will lead to no, low or small-scale change that will not alter its resilience after application of mitigation measures (if any) and impact cessation

8.2 Impacts on Marine Ecology

8.2.1 Construction works

The main activities relevant to the project which are envisaged to lead to substantial marine ecology impacts during the Construction Phase are the following:

(i) Excavation of an underwater pre-trenched transition zone
(ii) Pipeline laying activities
(iii) Release of drilling fluids into the marine environment
(iv) Land reclamation at the envisaged gas terminal site in Delimara
(v) Installation of pipeline supporting structures
(vi) Installation of pipeline cable crossing features
(vii) Benthic impacts from servicing vessels (for trenching and drilling activities)
(viii) Abandonment and recovery of abandoned pipeline components during rough weather
(ix) Anthropogenic generation of submarine noise

Each of these related activities are hereby described in detail, along with the most glaring marine ecological impacts they will precipitate. The Impact Summary Table is reproduced in Section 9.0.

Nearshore impacts – land reclamation, excavation of the transition pit, submarine noise generation, anchoring and discharge of drilling fluids

The development of the proposed land-based gas terminal entails the reclamation of 8,000 m^2 of seabed in close proximity of the existing Delimara powerstation. Land reclamation will be realised through the construction of a breakwater/revetment, needed also to protect the new plant from wave action, and the backfilling with suitable material of the area up to the project elevation of the plant (6.5 m above sea level). The breakwater of about 230 m perimeter is located in the inner Marsaxlokk Bay in front of Delimara Regasification Plant. Rubble mound breakwater is foreseen for the project. It consists of piles of stones more or less sorted according to their unit weight: smaller stones for the core and larger stones as an armour layer protecting the core from wave attack. Rock or concrete armour units on the outside of the structure absorb most of the energy, while gravels or sands prevent the wave energy from continuing through the breakwater core. Aspects of the nearshore area to be reclaimed are given in Figure 41.

Figure 41: Aspects of the nearshore area to be reclaimed

The footprint that the proposed breakwater will constitute on the seabed is higher than what their above-water extent suggests. In fact, from drawings of the proposed breakwaters (one of which is reproduced below as Figure 42), it transpires that in addition to the actual footprint of the breakwater itself, armouring resting on the underlying 'toe mound' will be positioned on the seabed at the outermost extremity of the same breakwaters, further extending the footprint of the entire construction.

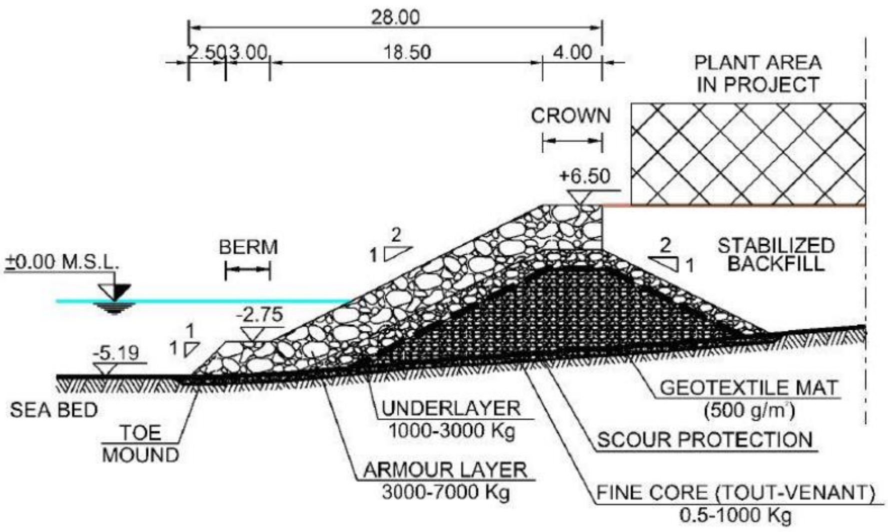


Figure 42: Schematic outline of the rock protection layer

According to Gupta et al. (2005), dredging and reclamation result in the formation of plumes of suspended sediments around dredgers, reclamation outfalls and dumping grounds. Dredging and dredge spoil disposal activities can induce short- and long-term impacts on marine systems, namely resuspension and settlement of sediments, portioning of toxic contaminants and reintroduction to the water column; contaminant uptake by and accumulation in fish and shellfish, increased turbidity causing decrease in light penetration and associated photosynthetic activity, short-term depletions of dissolved oxygen levels; modified bathymetry causing changes in circulation; possible saltwater intrusion to ground-water; inland surface water; altered species diversity and structure of benthic communities; fluctuations in water chemistry, changes in shoreline structure; loss of habitat and fisheries resources. Re-settlement of the re-mobilised particulates can also lead to changes in sediment budgets and to the possible siltation of benthic species.

The re-suspension of fine sediments as a result of the disturbance of the seabed during the construction phase will augment turbidity and murkiness. This in turn will result in reduced levels of illumination reaching the photic zone and could possibly result in the regression of seagrasses and macroalgal species inherently dependent on good levels of light penetration in the water column, as well as impact on filter-feeding species whose filtering apparatus (e.g. siphon) might be clogged through such a re-suspension.

The marine ecology impacts arising with the heightened re-suspension and re-deposition of fine benthic sediment fractions as a land reclamation-associated dredging works within Marsaxlokk Bay are anticipated to be moderate given the relatively coarse nature of the benthic sediment enclosed within the seabed area to be reclaimed, which would thus restrict the extent of sediment mobilisation through disturbance of the same seabed, and the relatively large intervals between the area to be reclaimed and the current distribution of seagrass meadows. Conversely, the anticipated obliteration of benthic communities through the same land reclamation activities falling within the footprint of the proposed coastal constructions are unavoidable and irreversible.

The potential for marine ecology impacts to arise through the atmospheric deposition of fine particulates is high given:

(i) the typology of heavy machinery to be deployed and hoarded in the coastal zone immediately contiguous to the intervention areas, consisting of an excavator crane, bulldozers, trucks, pilers and cranes, which will inevitably disturb terrestrial surface sediment, the fine portions of which will become air-borne;
(ii) the coastal nature of the heavy machinery hoarding area, in close proximity to the marine waters under study; and
(iii) the semi-arid climate of the Maltese Islands, with at least some of the works being conducted during the dry season, heightening the probability of loose, unconsolidated terrestrial sediment entering the marine environment.

Upon settling in the sea, considerable volumes of these fine particulates can lead to an increase in water turbidity and decrease in water transparency, analogous to the disturbance of benthic sediment during dredging, but on a lower scale in view of the smaller volumes of fine particulates which will be involved.

The re-suspended benthic sediment might contain sequestered (i.e. not available for uptake by biota) pollutants (e.g. mercury) and nutrients (e.g. organic nitrogen) which might be released into the water column upon disturbance of the seabed (e.g. Kaiser et al., 2003) as a result of proposed works. The subsequent decomposition of such released pollutants and sediments by micro-organisms will result in a depletion of oxygen levels. Depletion of dissolved oxygen may also be compounded by the resuspension of anoxic sediments as a result of excavation works, although the MARINE AND COASTAL ENVIRONMENT report compiled by the PMRS contractor has underscored the low productivity levels of waters sampled within the study area.

In terms of putative hydrodynamic changes that the proposed land reclamation might induce, the specialised, ad hoc hydrodynamic study commissioned to assess such a possibility concluded that no significant modifications to the prevailing hydrodynamic regime within Marsaxlokk Bay would be induced by the same proposals. This essentially means that the present metocean conditions (in terms of nearshore waves, nearshore currents and residual wave agitation) are not expected to significantly change in the future configuration.

The excavation of an underwater pre-trenched transition zone will be necessary to ensure proper alignment of the offshore pipeline with the MT offshore exit point. After the preliminary excavation, the trench will be backfilled with the excavated material to create an artificial receiving pit in which the TBM will stop drilling; from here, the TBM will be easily recovered from the backfilled material, as shown in Figure 43.

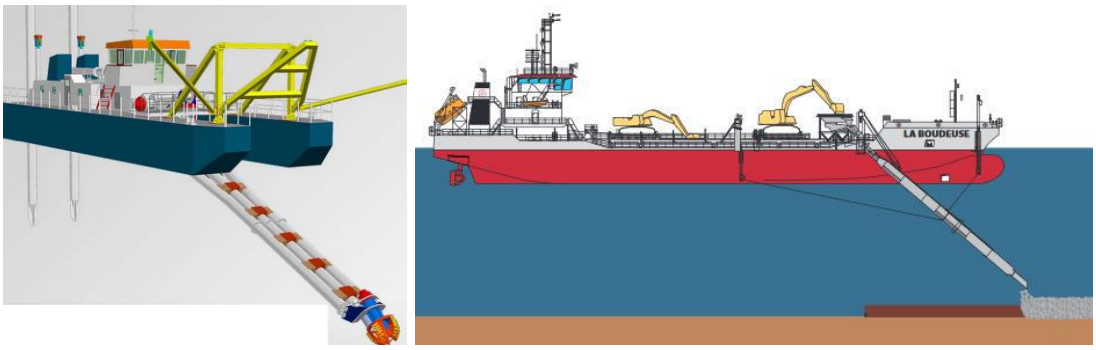


Figure 43: Schematic views of a typical multipurpose vessel for a backfilling with fall pipe

The excavation of such a 150m-long, 5m-deep pit is envisaged to generate an estimated 9,500m^3 of spoils, which should be largely reused through a mud cleaning and recycling facility, as shown in the schematic outline of the excavation pit represented by Figure 44, although the contractor might trench a deeper pit in order to enable access by the dredger and to allow recovery of pre-backfilling before TBM recovery. The benthic assemblages falling directly within the footprint of the benthic area to be excavated will be irreversibly obliterated, with the same footprint presenting limited opportunities for recovery given the laying of a bedding layer over the trench bottom so as to reduce the 'interference' of the seabed with the same trench contents. The applicants are confident that design of proposed excavation pit has been optimised so as to minimise its footprint and environmental impact.

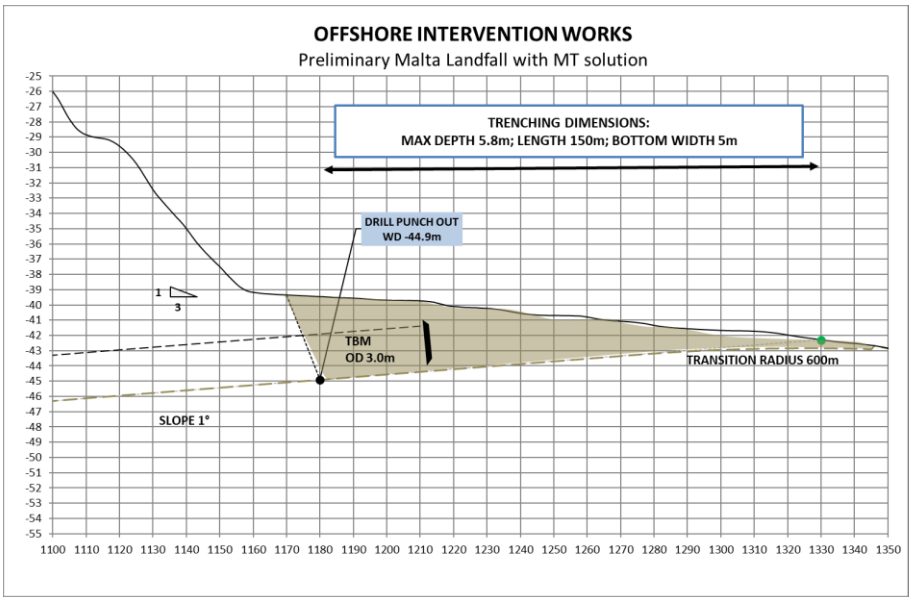


Figure 44: Schematic outline of the proposed transition pit

The dredging associated with this aspect of the project is expected be carried out from jackup platforms, or even fixed structures, as shown in Figure 45, and this will exacerbate benthic impacts on sensitive assemblages, especially through the extensive associated anchoring impacts.

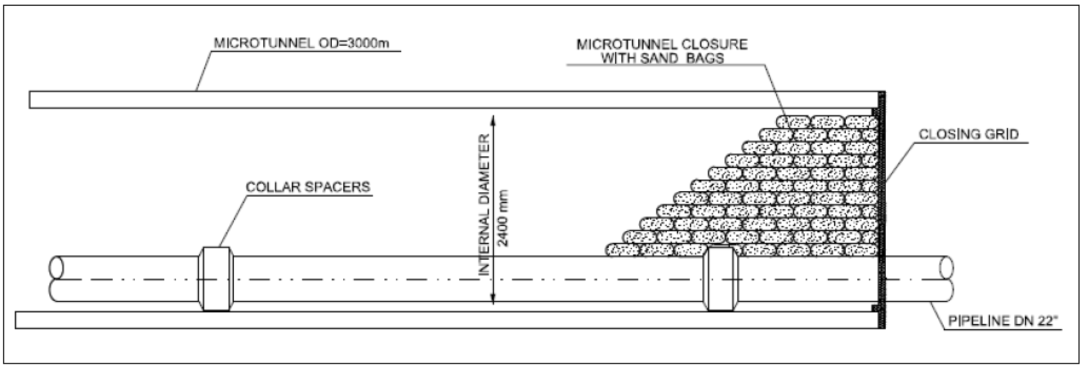


Figure 45: Schematic diagram of closure at subsea end of the proposed MTT section

The landward side of the trenched swath ('the drill punch-out') is located at a depth of 44.9m, which does not support *Posidonia oceanica* or *Cymodocea nodosa* meadows and is mainly characterised by rocky seabed colonised by the sciaphilic alga *Flabellia petiolata* and stretches of unvegetated fine sediment. Despite this, the distance between the landward/shallow extremity of the excavated pit and the current distribution of seagrass meadows in the area is in the order of hundreds of meters, rendering the same meadows subject to typical impacts arising from such excavations, including regression due to siltation (due to changes in sediment budgets), smothering and reduction in photosynthetic efficiency. The fact that the sediment within this unvegetated stretches is characterised by fine grain sizes (mainly silt, as evident from Table 16) makes the probability of such an impact materialising even higher. The benthic assemblages, including macrofaunal anthozoan, echinoid and poriferan species of high conservation importance, characterising the seabed swath to be excavated will be irreversibly obliterated.

Table 16: Grain-size properties of the various pipeline route swathes

KP (m)		Thickness	Surficial Soil		γ'	w	Su	Dr	ϕ	Samples	CPT
from	to										
(m)	(m)	(m)	Soil Type	Consistency/Density	(kN/m3]	(%)	kPa	(%)	(°)		
12600	17000	0-1.5	SILT	extremely soft	5.8-7.0	55-70	2.3+1z	-	-	MEW001B_K01-K02	C01
17000	44000	0-8	CLAY	extremely soft	5-6.5	65-85	2+1.8z	-	-	MEW001B_K03-K13	C02-C07
44000	50000	0-3.5	CLAY	extremely soft	5-6.5	65-85	2+1.8z	-	-	MEW001B_K14	C08
50000	52000	0-0.35	SAND	loose	8.5	25	-	15-35	28-30^{+}	MEW001B_K16	C09
52000	55000	0-1.75	SILT	extremely soft	6.0-9.0	35-65	8+2.7z	-	-	MEW001B_K17	
55000	63500	0-4	CLAY	extremely soft	5-6.5	60-80	4+2.5z	-	-	MEW001B_K18-K21	C10, C11
63500	71500	0-4.5	CLAY	extremely soft	5-6.5	60-80	4+2.5z	-	-	MEW001B_K22-K24	C12
71500	76000	0-3	CLAY	extremely soft	5-6.5	60-80	4+2.5z	-	-	MEW001B_K25-K26	C13
76000	87000	0-10	SILT	extremely soft	6.0-9.0	35-65	8+2.7z	-	-	MEW001B_K27-K30	C14, C15
87000	103000	0-0.5	SILT/SAND	Medium dense	7.7-9	25-35	-	30-60	30-36+	MEW001B_K31-K36	C16-C18
103000	113000	0-0.5	SILT/SAND	Medium dense	7.7-9	25-35	-	30-60	30-36+	MEW001B_K37-41	C19-C21
113000	119000	0-0.8	SILT	Loose to medium dense	6.5-10	28-60	-	20-60	29-36+	MEW001B_K42-K43	C22
119000	126000	0-0.5	SAND	Loose to medium dense	6.5-10	28-60	-	20-60	29-36+	MEW001B_K44-K46	C23
126000	137000	0-0.5	CLAY	extremely soft	5.8-8	43-72	5+10z	-	-	MEW001B_K47-K51	C24, C25
137000	138500	0-0.8	SAND	Loose to medium dense	9.6	23	-	20-40	29-31+	MEW001B_K52	C26
138500	156500	0-0.8	SILT	Medium dense	7.5-8.3	33-45	-	30-60	30-36+	MEW001B_K53-K59	C27-C30
156500	158.911	0-0.5	SAND	Medium dense	7.0-8.0	15-38	-	40-60*	31-36+	MEW001B_K60	

Anchoring impacts on sensitive benthic assemblages are expected to arise from the following typologies of vessels which have been identified for deployment during the construction phase:

- Jackup platform for offshore assistance to drilling
- Backhoe or cutter section trailing dredger, split hopper barges, multipurpose vessel, crew vessel for offshore trenching works
- Maxi drilling rig, crew vessel, support vessel, crawler crane, multi-cat equipped with crane, and submersible mud pump for drilling operations

A crane barge, coupled with intervening SCUBA divers, is expected to be deployed once the MT trenchless phase has been completed in order to enable recovery of the TBM, with a such a barge expected to exert a considerable impact on nearshore benthic communities.

The benthic footprint to be impinged upon by such anchoring activities is expected to be higher than for conventional anchors, given that:

(i) Most probably, the deployment of anchor stabilisers will also be requested/needed (Worzky, 2009); and
(ii) The mooring corridor is larger than the laying corridor and significantly depends on encountered water depth; it can be typically estimated in a width of 1,000-1,500m approx. beside the route corridor axis.

The direct (hits, scour) and indirect (crabbing, for example) impacts of anchoring on seagrass meadows (e.g. Milazzo et al., 2004) and on other sensitive benthic assemblages is well-known. For instance, as in the case of seagrass beds, besides obliteration of flora and fauna through direct physical damage, anchoring on infralittoral and circalittoral habitats affects the associated fauna, particularly sessile species, through alteration of habitat structure, reduced primary production and changes to trophic relationships (García Charton et al., 2000).

Anthropogenic noise can be produced during route clearance, trenching and backfilling, pipeline laying and pipeline protection installation by the vessels and tools used during these operations. Intensity and propagation of underwater noise will vary according to bathymetry, sea-floor characteristics (e.g., sediment type and topography), vessels and machines used, and water column properties. Nedwell & Howell (2004) examined the noise produced by plough trenching in a sandy gravel area for the installation of an electric cable within a Welsh offshore wind farm. Results showed a maximal noise emission of 178 dB re 1µPa (on a frequency range from 0.7 to 50 kHz) at 1 m from the trenching area. A similar study by Bald et al. (2010) focused on noises from trenching and cable installation of a wind-farm platform in a sandy area in the Bay of Biscay. During the installation phase, average sound level was 188.5 dB re 1µPa (at 11 kHz) at 1 m from the source. Modelling using these in situ data estimated that the underwater noise would remain above 120 dB re 1µPa in an area of 400 km^2 around the source.

According to Taormina et al. (2018), there is no clear evidence that underwater noise emitted during pipeline installation will affect marine mammals or any other marine animal, although it is accepted that many marine animals (notably mammals and fishes) detect and emit sounds for different purposes such as communication, orientation or feeding. Marine mammals have high frequency functional hearing ranges from 10 Hz to 200 kHz, while fish typically hear at much lower frequencies, often from 15 Hz to 1 kHz. Other organisms including sea turtles, and many invertebrates such as decapods, cephalopods, or cnidarians, have also been shown to be sound-sensitive. Many studies highlight the reaction of cetaceans to anthropogenic sounds of different intensities. Sounds generated by ship activity can impact the behaviour of different fish species. Anthropogenic underwater noise can affect marine life in different ways, by inducing species to avoid areas, disrupting feeding, breeding or migratory behaviour, masking communication and even causing animal death. So far, characterisation of acoustic thresholds causing temporary or permanent physical damage are much better described for marine mammals than for fish, and remain unknown for marine invertebrates and sea turtles. Compared with other anthropogenic sources of noise, such as sonar, piling or explosions, underwater noise linked to undersea pipelines remains low. Pipeline laying is a spatially localised temporary event, so that the impact of noise on marine communities is expected to be minor and brief.

The drilling mud has physical characteristics designed to preserve the integrity of the drilled hole, remove cuttings, and lubricate the bit and the down-hole tools, besides ensuring an exclusively hydraulic seal. Generally, the mud is an inert substance containing water, bentonite and an added organic colloid which provides the necessary viscosity and filtration properties to the slurry (additive like "*Tunnel-GEL SW*" or "*Bore-GEL*" by Baroid or similar product may be used for this scope).

The total volume of mud necessary and the dispersion of drilling fluids mainly depend on the selected procedure. The contractor has preferred the MT technique over the HDD one, and this constitutes a much-lower anticipated volume of discharged drilling muds given that, during the progress of the microtunnel, the sludge is recovered through an internal piping system and, with an adequate layer of soil above the tunnel, the dispersion of the same muds into the sea is reduced.

The water consumption, mainly used for the transport of the excavated soil in the water-based slurry, is estimated in the order of 3600 to 8000m^3, with such a high level of uncertainty arising from the state of the particular soil conditions and potential losses of slurry due to known fracture conditions. This estimate includes the slurry volume and the relatively minor volumes associated with lubrication mud.

The preferred sealing of the subsea section of the excavated microtunnel will involve the placing by SCUBA divers of numerous bags of dry cement at the mouth of the laid structure (Figure 26). It is assumed that the same bags are watertight, such that no cement leakage into the surrounding water will occur, and that the placing of the same bags will not result in spill-over of benthic impacts through shifting of some of the same bags onto a contiguous seabed footprint.

Relatively little research has been conducted to date on the marine ecological impacts of the discard of drilling muds on the marine environment. The few studies which do exist suggest a reduction in the macrofaunal biodiversity asset within discharge points, also due to a proliferation in opportunistic, low-conservation species (e.g. Denoyelle et al., 2010).

Offshore impacts – pipeline laying, deployment of pipeline support and cable crossing measures

In offshore areas, further works might be necessary along additional stretches of the pipeline route in association with:

- Protection of existing pipelines or cables in connection with crossings;
- Reduction of free span heights to reduce the forces due to over-trawling. On uneven seafloors, the pipeline may form "free spans" along its route where it will hang without touching the seafloor. This may promote vibration, chafing, fatigue and, ultimately, pipeline failure (Worzyk, 2009). Spans that are unacceptable in the unstressed, air-filled condition must be rectified before installation of the pipeline (pre-lay intervention). Other free span rectification may be postponed until after the pipe string has been laid (post-lay intervention) and thus marine ecological impacts might extend beyond the pipeline-laying phase; and
- Smoothing of the pipeline profile to reduce the length of free spans or prevent contact pressures that could damage the coating or dent the pipe steel.

Whilst trenching of the transition pit is the preferred option in nearshore waters, dredging or the deployment of gravel installations or grout bags are the preferred option to remove extensive freespans constituted by outcrops in offshore areas.

The CONSTRUCTION, OPERATION AND MAINTENANCE METHODOLOGY report indicates that the pipeline support at freespan and cable crossing offshore areas will be exclusively conducted through the deployment of extraneous material resting on the seabed, rather than through seabed modification techniques such as dredging and excavation. The current impact assessment exercise took stock of this guidance.

Bulk gravel lowering may be performed by split barges, or through a gravel installation vessel equipped with a fall pipe, as shown in Figure 46 and Figure 47.

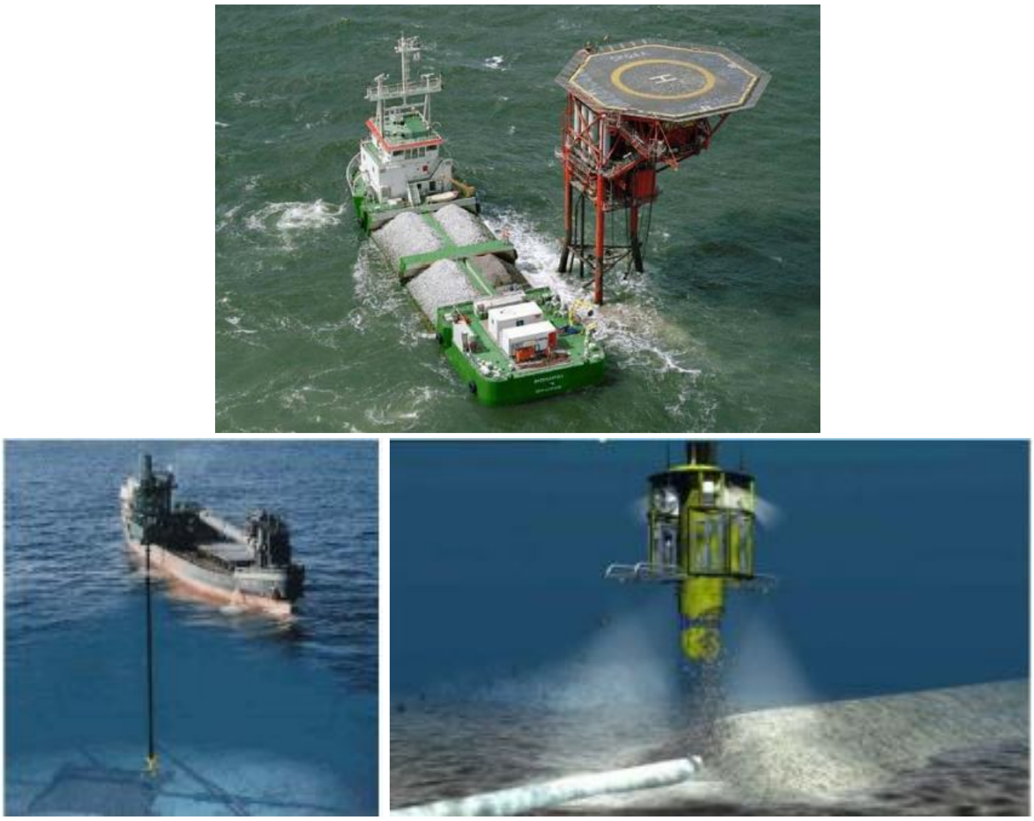


Figure 46: Different gravel-based pipeline support systems through the fall-pipe technology

Figure 47: Fabric formworks – Example of local gravel installation pipe support

Isolated gravel berms may be built with few rock bags through a single installation or through multiple installations via a dedicated frame, as shown in Figure 48 below, and this technique is preferred since it allows the placement of material over the seabed with great accuracy, thus reducing the probability of impact spill-over over contiguous benthic areas.

Despite marine ecological considerations, the final selection/choice of the applicable technology (bulk or gravel berm) as well as the selected sediment size of the individual stone or gravel particles is very dependent on water depth and amount of materials to be installed, so as to ensure that these will not be removed by wave and current action.

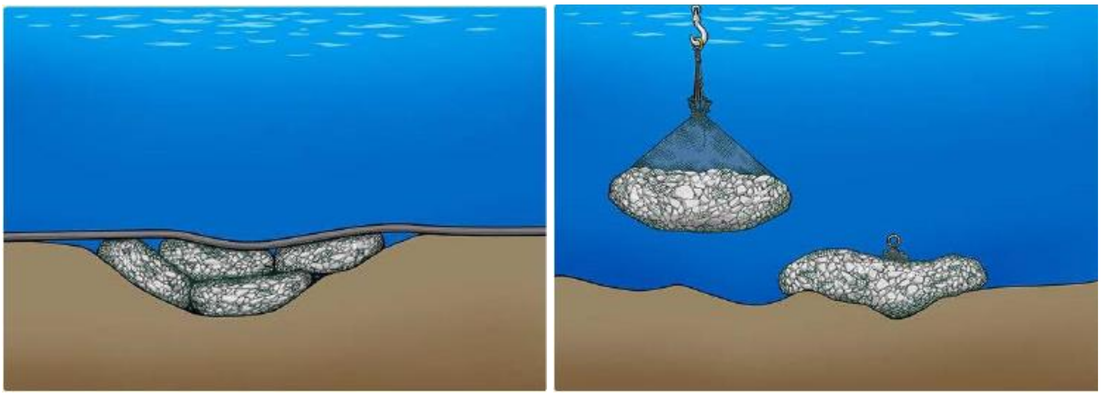


Figure 48: Different pipeline support rock filler units

Pre-lay free span supports will have to be made sufficiently wide to cater for the pipelay tolerance as well as the horizontal tolerance on gravel installation, which is greater when the gravel berm cannot be related to a fixed object (e.g. the pipeline) on the seabed. Hence, pre-lay installations are expected to impinge on a larger benthic footprint than post-lay interventions.

The benthic impact of the various pipeline support technologies to counteract freespan areas will entail the detachment and obliteration of sessile, erect, rigid macrofaunal individuals and colonies falling directly within the footprint of the free-span being addressed. Localised enhanced scouring around the margins of the seabed intervention area might also result in a small-scale sediment budget change, with the accumulation and erosion of benthic sediment in alternate mobile sediment areas. Within project description documents, there is an indication of where such free-spans might be addressed through the deployment of five mattresses – approximately KP 137 to KP 151, where the seabed is characterised by a complex heterogeneity. It has emerged through the ENVIRONMENTAL BASELINE SURVEY (EBS) report that the same stretch supports benthic communities of conservation importance, mainly settled on rocky outcrops, as indicated in Figure 27.

It may also be necessary to establish lateral supports (counteracts) to guide the pipeline in the horizontal plane to achieve the desired curved lay radius if the lateral soil friction is evaluated insufficient in combination with on-bottom residual lay tension. Rather than gravel berms, such counteracts may take the form of structural elements that can be retrieved and reused. This kind of occurrence should be evaluated in the Malta nearshore from KP 141 and KP 148 approximately.

To avoid damage to any of the existing cables lying on the seabed, crossing infrastructures should be separated by a suitable material. In addition, the pipe lay corridor in the concerned area should be reduced to ±2.5m in order to reduce as much as possible the dimension of the intervention work to be carried out. At cable crossings, two different scenarios exist:

(i) Existing cable is trenched into the seabed – pipeline can simply be placed on top of it, but would itself need surface protection; or
(ii) Existing cable lies on the seabed and cannot be tampered with; it is necessary then to engineer a crossing using rock berms, mattresses, grout bags or similar, so the new pipeline can be laid across without damage to the existing cable, and the entire crossing covered, if required.

To meet the above requirements, some pre-lay works would be necessary and in particular the installation of some mattresses very close to the crossing to achieve the proper gap between the pipeline with existing facility. Flexible bitumen mattresses are typically used for such task, installed as shown in Figure 49.

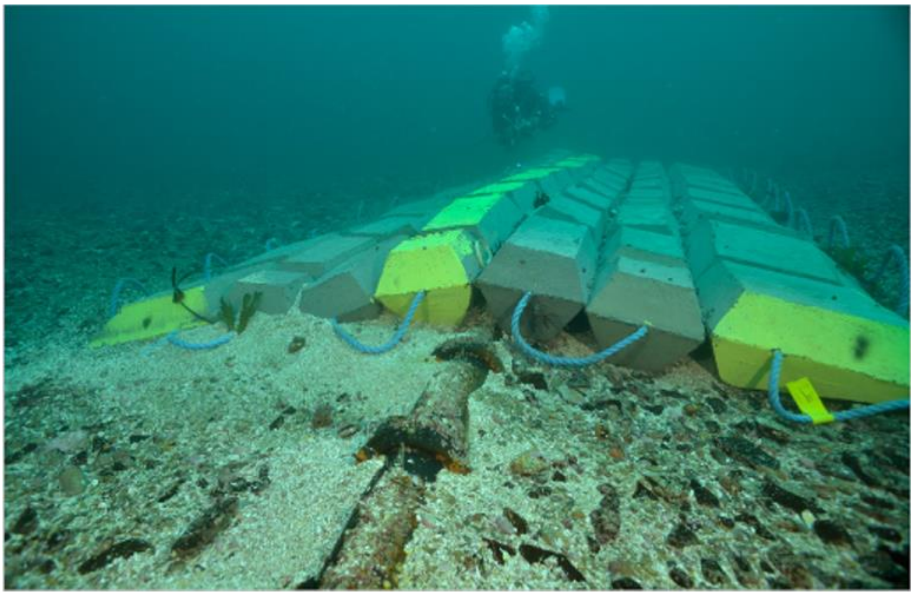


Figure 49: Iron shells and a concrete 'mattress' used to protect an unburied cable at a French tidal turbine test site

Marine ecological impacts through such works will arise mainly through the seabed footprint impinged upon through the laying of the cable crossing features, which will obliterate and smother benthic assemblages falling directly within their footprint. Most of the recorded cable crossings are in offshore waters characterised by fine sediment stretches. As a result, besides the direct impact on sensitive benthic assemblages, one can also expect an indirect impact through the re-suspension of fine particulates in the water column through the proposed seabed interventions.

Localised covering of the pipeline may be required, for example, to protect against dropped objects at platforms, or to prevent scour in the vicinity of platform legs or other structures on the seabed. In such cases, a structural cover is an alternative to the deposition of rocks on the seabed for structure protection purposes. The engineered covering may be constituted by structural concrete elements placed over the pipeline, built up by flexible mattresses manufactured from geotextile, bitumen and aggregate or from interlocked concrete blocks. Also sand bags or grout bags placed by divers may be used (Braestrup et al., 2009).

Like all other offshore operations, pipelaying is weather dependent, and the tolerance depends upon the type and size of the pipelaying vessel and its tensioning capacity in respect of the pipeline sizing. At a certain sea state, it becomes impossible to add more pipe to the string, which is then kept under constant tension by the tensioners. Pipelaying will also have to be suspended if the weather prevents either the tugboats from relocating the anchors, or the supply vessels from docking at the laybarge to transfer pipe or essential supplies. If the movements of the laybarge become so large that they may endanger the integrity of the pipeline, the pipe string will have to be temporarily abandoned. A laydown head with an attached cable is welded on to the pipe string, which is lowered to the seabed under tension.

At the return of calm weather, the pipe string is winched aboard the laybarge, secured by the tensioners, the laydown head removed, and pipelaying resumed. The marine ecological impacts of such a procedure would be restricted to the benthic area impinged upon by the temporarily abandoned pipeline laydown head as well as of anchors and associated anchor stability structures of the servicing vessels.

8.2.2 Operational phase

The main activities relevant to the project which are envisaged to lead to substantial marine ecology impacts during the operational phase are the following:

(i) Benthic impacts from servicing vessels (e.g. for exercises involving pipeline repairs or regular monitoring of the pipeline's integrity/structure);
(ii) Benthic impacts arising directly from pipeline maintenance and repair works; and
(iii) Anthropogenic generation of submarine noise during pipeline maintenance and repair works

Given that the anti-corrosion strategy will revolve around the deployment of sacrificial anodes rather than on the use of an impressed current, no significant EMF generation is expected to accompany the pipeline's operations.

Anticipated anchoring impacts are described in detail in the CONSTRUCTION, OPERATION AND MAINTENANCE report. Pipeline maintenance and repair works could entail the following activities:

- Replacing a pipe rupture
- Repairing a pipe leak
- Repairing corrosion pitting
- Repairing anticorrosion coating
- Replacing a pipe pup or a pipeline section damaged by third party

The maintenance/repair works would impinge on the seabed through associated welding, excavation, field coating and other activities which extend beyond impacts related to anchoring. Anthropogenic generation of submarine noise impacts are expected to be of the same nature as those arising during the construction phase but are expected to be of a lower significance given the pulse/episodic nature of noise generation during the operational phase associated with stochastic pipeline maintenance and repair works.

As with any other artificial structure placed in the sea, the pipeline's non-submerged surface area will eventually be colonised by fouling organisms. Whilst some of these fouling species are of an opportunistic, cosmopolitan nature, thus holding a low conservation value (even representing a novel introduction pathway for non-indigenous species in some cases), a number of high conservation importance fouling species can also colonise the pipeline. This phenomenon has been recorded for numerous submerged cables and pipelines resting on the seabed (Taormina et al., 2018).

8.2.3 Decommissioning phase

The proposed pipeline has an anticipated lifetime of 35 years, after which the pipeline infrastructure might be partly (onshore sections only, given that the recovery of offshore sections of the pipeline is not deemed feasible) recovered (with an array of marine ecological impacts which are similar to the construction phase ones arising) or completely discarded. In the second scenario, marine ecological impacts are basically neutralised.

8.2.4 Water Framework Directive Assessment

The current Article 4.7 assessment exercise had to contend with two caveats:

1. The snapshot nature of the BQE characterisation exercise, consisting solely of the single-point sampling of the water column in order to characterise water column nutrient and plankton attributes, as well as the lack of *in situ* hydrodynamic measures taken during the current study for validation purposes. This shortcoming is not expected to impinge significantly on environmental management decision-making in connection with this planning proposal given the extensive previous datasets on such aspects (and on additional BQEs, such as seagrass meadows) which already exist and which have been cited within this report and in view of the fact that water sampling was conducted in autumn 2019, which coincides with one of the two annual phytoplankton blooms characterising Mediterranean waters (Deidun et al., 2011); and
2. The lack of a cumulative assessment which incorporates impacts arising from other projects/proposals within the same study. This typology was not possible in the current study given that no information concerning such additional projects within MTC 107 was available at the time of writing. Despite this caveat, this shortcoming is expected to have limited bearing on the final assessment outcome given that the ad hoc commissioned hydrodynamic study did in fact take into consideration the novel coastal defences being developed within Marsaxlokk Bay as part of a separate approved planning application and given that additional (i.e. not related to the Melita Gas Terminal development) land reclamation within Marsaxlokk Bay is expected to be of a minor nature (and restricted to the Freeport side).

Malta's 2nd WCMP ascribes the ecological status of MTC 107 to the good potential category. Given that the good potential category for this heavily-modified coastal water body has already been achieved, there is a requirement to maintain such a status, through the implementation of measures to mitigate the putative impacts arising from past and ongoing human activities (summarised in Table 6).

In conclusion, despite the good potential ecological status for MTC 107, the status of the four component BQEs within the same water body as a result of the proposed land reclamation work is not expected to deteriorate, given:

1. The relatively limited extent of the seabed to be reclaimed, when compared with significantly larger seabed swathes which were reclaimed during previous works within the same water body (e.g. development of the Freeport);
2. The non-proximity to existing *P. oceanica* meadows of the benthic area identified for land reclamation purposes;
3. The non-proximity of coastal stretches supporting macroalgae of high conservation importance (and thus responsible for the HIGH ecological status of this BQE for MTC 107) to the benthic area identified for land reclamation purposes;
4. The insignificant contribution that the proposed land reclamation works are expected to exert to existing organic pollution loads within MTC 107, such that the BENTIX index for the benthic invertebrates BQE (currently characterised as being of HIGH ecological status) will probably not be directly impacted; and
5. The negligible impact that the proposed land reclamation will have on hydrodynamic dynamics within the different assessed locations within Marsaxlokk Bay.

These extenuating factors lead us to conclude that the proposed development qualifies as an eligible circumstance under which Article 4.7 of the WFD can be applied.

8.3 Impacts on Terrestrial Ecology

No significant ecological impacts are expected from the removal of vegetation communities overlying the mound of material to be used for land reclamation. Similarly, no ecological effects are expected from the trenchless drilling of the pipeline on the overlying surface features.

The widening of the proposed access road leading to the terminal station will cause the most significant ecological impacts because rock clearing, trimming and shotcreting works will give rise to the complete destruction of the endemic communities of the Maltese salt tree which cover the existing cliff face. These endemic communities are rather scarce on a national context, but are common in certain areas, especially at the Delimara peninsula.

The approximate area of intervention (Figure 50) covers 330m in length and a maximum height of 18m, and is thus considered a major adverse impact. An approval from the ERA is required to carry out this irreversible intervention. The planting of shrubs following such interventions is being proposed as a mitigation measure.

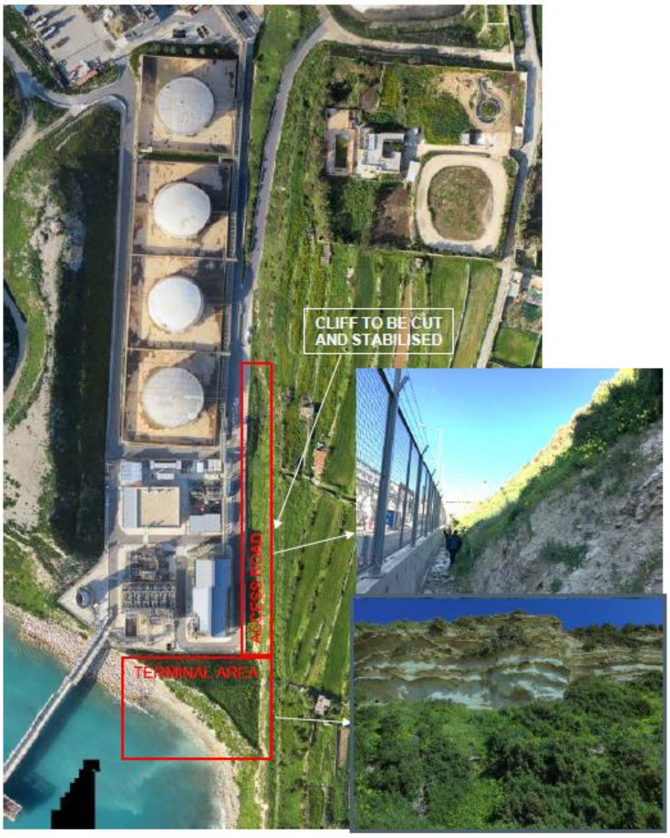


Figure 50: Area of proposed interventions

8.4 Impacts on Avifauna

The proposed Scheme will have a permanent structure added to the existing DPS complex which in terms of size can be considered as minimal when compared to the rest of the DPS. At the time of writing one needs to consider two scenarios for the presence of the FSU tanker as it is yet unclear when such structure will be decommissioned. The first scenario considers the FSU remaining present on site irrespective of the gas pipeline for a number of years, whilst the second scenario sees its removal in the immediate term. In the former case, impacts resulting from the proposed Terminal station at DPS will be added to those caused by the FSU, whereas in the second scenario any light impacts arising from the proposed structure will be reduced but not completely eliminated since the pier to which it is anchored will remain in place. Therefore, in the second scenario the only remaining effect on avifauna species will be that arising from light pollution caused by the pier and the area occupied by the Terminal Station.

The impacts which could have an effect on avifauna species are those occurring during the construction of the land reclamation area, the terminal station and the laying of the pipeline. This impact will be spread throughout the whole length of the development but would be mostly pronounced closer to land. This is mainly due to the fact that the seabird species tend to use areas in the proximity for rafting prior to reaching their breeding grounds and for feeding purposes. Light impacts could also affect fledglings and nocturnal migratory species which are easily attracted by light.

The construction period at sea will take about five to six months, however, other activities could be taking place prior and after the laying of the pipeline. There could also be setbacks resulting from adverse weather conditions and other problems encountered along the route which would prolong the process. These activities could have a temporary effect on these species during this period.

The following ecological impacts have been identified for both the construction and operational phases:

- Silting of water column from drilling / construction works;
- Noise from working vessels;
- Illumination of working vessels and immediate surroundings; and
- Illumination of Terminal area.

8.4.1 Silting of water column from drilling / construction works

Project component: Construction

The connection of the pipeline to land will be via a connection hole at a depth of around 42m below sea level and about 600m offshore. This location would be within the Marine Protected Area *Żona fill-Baħar fil-Lbiċ* and close to the adjacent one known as *Żona fil-Baħar fil-Lvant* so any siltation of the water column resulting from sediments arising from rock excavation, dredging, cement and rehabilitation works could affect these two protected sites. Sea water currents in the area will quickly diffuse these sediments in directions depending on the prevailing currents at the time. Hence it is difficult to identify the consequential effects resulting from such works. Sedimentation of the water column with the potential of some contamination resulting from same works could have an effect on the organisms in the water column, including plankton and fish which are food for seabirds in the area.

Contamination of the food sources could have a significant effect on the recipient species be they adults or fledglings albeit in the latter case the consequences could be highly significant.

Precautionary measures should be undertaken in order to prevent the use of any toxic materials used in cements or other products which could prove toxic to aquatic life. Special care should be undertaken in order to reduce the possibility to avoid the spread of sediments away from the working areas. This would reduce the impacts and avoid affecting the respective protected avifauna in the surroundings.

Disturbance of existing sediments from the bottom of the sea should not have any particular effect albeit the visual effect might look alarming as the area of proposed intervention is significant. Usually, it is the fine material which would take long to settle rather than the large pieces which would settle in the immediate vicinity. Disturbance of sediments could also result in the attraction of fish and consequently various species of birds, usually gulls. Other protected bird species could also be attracted; hence it is crucial to avoid direct or accidental release of toxic chemicals during the construction works within such areas. The intoxication of any species, irrespective of its protection status, is always a negative impact on the species. The higher the protection status, the higher the significance of impact.

8.4.2 Noise from working vessels

Project component: Construction

Work on the vessels will take place during day and night. The working area will change depending on the part where the pipe laying would be taking place. The procedure will follow through a pathway which crosses three main Marine Protected Areas, namely *Żona fil-Baħar fil-Lvant*, *Żona fil-Baħar fil-Lbiċ* and *Żona fil-Baħar fil-Grigal*. The three sites are known to be used to a different extent by the Yelkouan Shearwater, Scopoli's Shearwater and the Storm Petrel as rafting site and also as feeding areas.

The noise emanating from vessels working within the aforementioned zones will definitely have a negative impact on all these species. Such disturbance would most likely cause such species to be displaced from these areas, albeit in a temporary manner. However, this displacement is dependent on the timing of the works and whether the species would be present at the same time.

- The adults of the Yelkouan Shearwater are mainly seen offshore from December to July albeit small numbers being noted during the shoulder months. Birds fledge between mid-June and July.
- The adults of the Scopoli's Shearwater start visiting their nests in February, whereas, in this case the offspring fledge by the end of October.

Both species utilize practically similar resources and in order to partition such resources they have adapted slightly different breeding timetables, hence allowing both to live practically together with reduced competition between them (Figure 51).

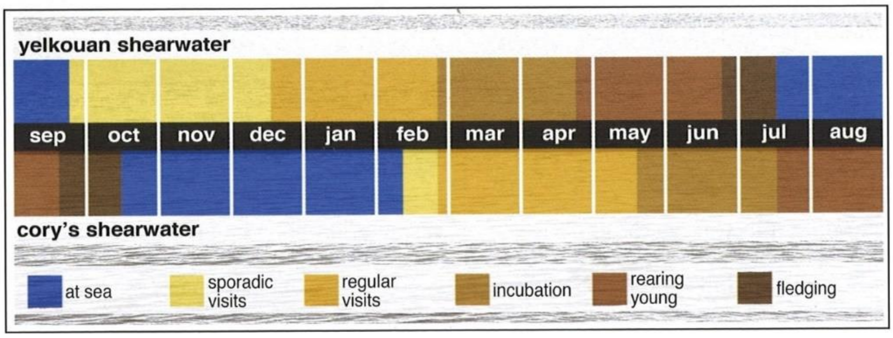


Figure 51: Annual cycles of the Yelkouan and the Scopoli's (Cory's) Shearwater (Sultana et al, 2011)

The Storm Petrel returns to its breeding grounds around mid-February and would have left by end of October. During this period there are two breeding cycles, one between mid-April and mid-July and a second one between mid-July and late October.

The impact significance resulting from construction related noise on the above species would much depend on the period when the work would be carried out and also on the level of disturbance on the species. The noise levels resulting from the works on the vessels are unknown to the author and therefore predictions cannot be made with certainty except to adopt the precautionary principle.

The worst-case scenario implies that the level of noise would be high enough to cause displacement of the species from the rafting / food gathering areas especially if this is taking place during the breeding period where the adults are actively seeking food resources for their offspring. The displacement would imply longer flight distances and greater energy expenditure by adult seabirds to gather the same quantity of resources. This shift could negatively influence the likelihood of successful rearing of their offspring. Despite the significance of this impact, it is also transitionary and should only last for a period ranging from a few weeks to a few months depending on the progress of works being registered at the time.

According to a preliminary programme of works provided by the front-end engineering design team, pipe laying is scheduled to take place between March 2023 and September 2023 starting off from the Malta end. This implies that it would coincide with the breeding period of all three seabird species. This could have a significant impact on the species.

8.4.3 Vibrations resulting from tunnelling works

Project component: Construction

Vibrations transmitted from tunnelling works could potentially impact the breeding population of the Short Toed Lark (*Calandrella brachydactyla*) especially if these coincide with their breeding season. If these works are planned outside the breeding season such impacts should be easily avoided

8.4.4 Illumination of working vessels and immediate surroundings

Project component: Construction

Illumination is one of the most contentious issues with regards to nocturnal species especially, both species of Shearwaters and the Storm Petrel. Seabirds' offspring are disoriented by light during their first flights as they tend to head towards sources of light. This implies that fledglings often end up getting lost or injured during their first flights. Simultaneously, adults are often hindered from visiting their nests if there is light in the proximity to their nesting sites. Borg JJ (2013) reports that young birds of both Yelkouan and Scopoli's Shearwater have been collected from *Marsaxlokk* bay (*Birżebbuġa*, Freeport area, DPS) after being disoriented and dazzled by bright lights. He also reported that three recently fledged Storm Petrels were also collected from near the Delimara Lighthouse after being disoriented by bright lights.

Consequently, the installation of floodlights on working vessels close to shore could have a negative impact on the species, especially the Yelkouan and the Scopoli's Shearwaters since their breeding grounds are located in close proximity to the Scheme. The impact would be of a lesser extent on Storm Petrel populations since their major breeding ground in located on the island of *Filfla* which is relatively far away from the Scheme, albeit the presence of six individuals recovered from coastal areas in the proximity of the Scheme (Sultana et al, 2011). The proposed schedule of works for offshore pipe laying (between March 2023 and September 2023) coincides with the breeding period of the three species. It is unlikely that works would still be taking place when the offspring fledge so there shouldn't be any major impact on any offspring since the works vessels should be located a significant distance offshore when the young birds fledge. Nonetheless, floodlights on vessels could deter adults prior to reaching their nests.

Project component: Operational

Once the construction phase is over, there shouldn't be any illumination impacts from the offshore section of the scheme as it is located below sea level and although there might be occasional buoys to mark cable crossings, the pipeline route lacks permanent light features to indicate its position.

The only permanently lit area which remains during the operational phase is the Terminal Plant which will be located in *Marsaxlokk* Bay next to the pier currently used by the FSU.

One scenario of the operational phase of the project would be the removal of the FSU tanker from the bay. The effect from lights resulting from the FSU would be removed and the current illumination impacts resulting from this structure would be nullified. The proposed terminal is located further inland and is much smaller in size than the FSU tanker. Nonetheless, it is likely that the new facility will be furnished with exterior lighting fixtures, details of which are not yet available. It is being assumed that the quality of light dispersion from this area would be reduced as a result of the new facility. Therefore, upon the removal of the FSU vessel, there will be an overall positive impact on the avian species when compared to current illumination and dispersion levels. Nevertheless, the illumination caused by the terminal station would still have a negative impact of lower significance when compared to the current levels.

The second scenario to consider is the co-existence of the FSU vessel and the new terminal station for a number of years. Lights from the new Terminal facility would have an additional adverse contribution towards the overall glare and light pollution albeit to a minor extent when compared to that being generated from the FSU vessel. The net result would be a slight negative increase over and above the current impacts.

8.4.5 Presence of working vessels at sea

The impact arising from vessels at sea could on most occasions prove to be beneficial for migrant bird species as they would be able to utilise any possible structure on the vessel as a resting post, particularly when they are tired. It's is not unheard of that birds perch on moving vessels and remain there, hitchhiking a free ride. Sometimes they are so exhausted that they die on these vessels.

During the night, lights on vessels could have a negative effect on nocturnal migrants since they could be disoriented by lights on vessels. Part of the proposed works period coincides with the migratory periods of some of these migrants, including herons and waders. Therefore, some of these species could also be negatively impacted but unless there is a large influx of birds at one time, the significance shouldn't be high.

A Summary of Impacts Table is found in Section 9.0.

8.5 Mitigation Measures

The Scheme cannot avoid any impacts on the protected areas and species found along its way, however, diligent working practices and mitigation measures could reduce some of the identified impacts.

8.5.1 Marine ecology

A possible further re-routing of the pipeline is not being considered as a feasible mitigation measure given (i) the extensive effort invested in selecting the least impactful of pipeline routes and (ii) the technical constraints in prescribing a further change in the pipeline's route at this stage.

Selection of preferred pipeline support technology

Wherever the need to counter possible pipeline free spans arises, dredging-free pipeline support protocols (i.e. based on gravel and grout bags) should be preferred over those protocols entailing a degree of dredging, so as to minimise impact spill-over over contiguous areas.

Selection of preferred pre-lay cable crossing technology

The pre-lay cable crossing technology which presents the smallest footprint and thus, presumably, the least direct impact on benthic assemblages, should be selected.

Selection of the MT technique over HDD

This tunneling technique choice implies that the potential dispersal of drilling fluids into the marine environment is of much lower concern given the higher recovery rates involved in the MT.

Anthropogenic generation of submarine noise

The temporary deployment of air bubble screens should be considered for selected aspects of the project representing the highest generation levels of submarine noise, such as the excavation pit for instance.

Dispersion of resuspended fine sediment particles

The MT entry point which is farthest away from known seagrass meadows and other sensitive benthic assemblages should be selected for excavation purposes, so as to minimise the probability of regression of the same assemblages through benthic sediment re-suspension and re-settlement which will inevitably arise as a result of the envisaged associated dredging. Such enhanced sediment dynamics are also expected to take place in the nearshore area as a result of the proposed land reclamation activities, and the shallow nature of this area makes the deployment of silt curtain technology feasible as a mitigation measure.

Targeted anchoring activities

In order to mitigate anchor damage to sensitive benthic assemblages, the use of anchor stabilisation devices should be minimised, in order to reduce the impacted seabed footprint, whilst prior benthic habitat distribution knowledge should be applied in order to avoid, wherever technically feasible, seabed areas supporting such sensitive assemblages. Crabbing (anchor dragging) should be precluded.

Selection of anti-corrosion inhibitors

In order to improve the performance of the aluminium-based anodic corrosion inhibition system, a small amount of mercury or indium is generally added. The use of indium should be prioritised in this case so as to avoid any discharges of mercury in the marine environment, although there is a very high probability that the hydrotesting stage will not constitute a water quality hazard as this stage will be conducted with inhibitor-free seawater followed by freshwater, such that both types of water can be safely disposed of at sea.

Trenching protocol

The dimensions of the excavation pit should be kept to a minimum, and the benthic sediment recovered from such an activity should be screened for the occurrence of translocable specimens of species of conservation importance prior to disposal or re-use on site for back-filling.

8.5.2 Terrestrial ecology

The Maltese endemic salt tree is considered as a protected species through the provisions of Regulation 26 of S.L. 549.44. Any interventions on communities of this protected species should be covered by a nature permit as requested by the competent environmental authority.

In order to minimise ecological and visual impacts, the proposal incorporates the planting of shrubs and grasses on the exposed shotcrete surface. According to the FEED contractor, grassing in the lower part of the escarpment shall be done with hydroseeding to assure good adhesion, whilst the climbing shrubs will be planted inside holes drilled on the surface. It is fundamental that the shrubs planted along the exposed cliff are taken from local stocks (preferably from the same shrubs on site), prioritising the planting of *Darniella melitensis* seedlings and planting from local nurseries. Such planting should be monitored by an appropriately qualified expert.

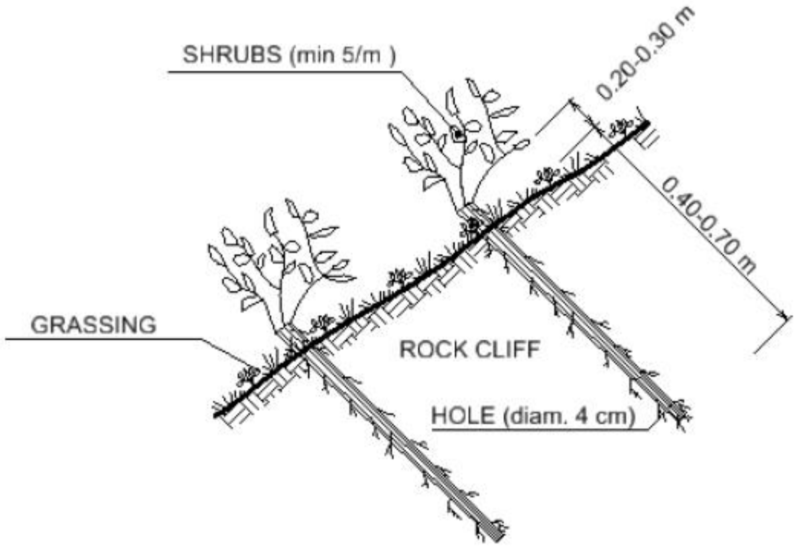


Figure 52: Proposed planting on cliff face (Source: Specification for cliff face stabilising at Marsaxlokk, 2019)

8.5.3 Avifauna

The Scheme cannot really avoid any impacts on the protected areas and avian species found along its way, however, diligent working practices and mitigation measures could reduce some of the identified impacts.

Siltation of the water column can be reduced by suction technologies during excavation works. Waters should be filtered from fine sediment prior to return back to the sea. Furthermore, excavation works should be restricted to periods of good weather. This would reduce the risks of accidents where greatest damage could take place and mitigation measures fail. The utilisation of a sediment curtain around the working area especially during the excavation process should be implemented and studied in further detail. This would reduce the dispersal of sediment over large areas.

Through an environmental monitoring programme (EMP) or works method statement (WMS), an environmental monitor should draft an environmental monitoring strategy that incorporates water sampling to ensure that no toxic materials are used in cements or materials which could end up dispersed in the waters. Works should be concentrated as much as possible to one area rather than having different vessels spread over large areas. This would reduce significantly disturbance to aquatic fauna such as seabirds.

The works contractor should ensure that no toxic materials are used in cements or materials which could end up dispersed in the waters.

All machinery and equipment used on vessels should employ noise abating technology thus reducing noise pollution and disturbance.

Ideally works at sea close to land along the Malta side should commence late October, albeit one must understand that in terms of climatic conditions this could be the worst time. The greatest impacts on avian species are during the pre-laying period, incubation, rearing of young and fledging. So ideally any operating vessel should be out of the protected zones during those periods otherwise the impacts could be highly significant.

The problem with commencing works close to shore in October are that this period coincides with the commencement of bad weather conditions which could result in nasty accidents or delay works, thus entering a more sensitive period when the vessels are working within the protected areas.

The latest proposal for offshore works states that these would be between 1st March 2023 and 1st September 2023, starting from the Malta side. The number of vessels in the proximity of each other at one go is not yet clear so one would recommend that the number of vessels working within the protected areas from late evening to early morning should be the least number possible. This should reduce ecological disturbances when passing through the protected areas. The impacts of such works on the protected avian species are unknown albeit one would expect that it would be minimal especially in view of the distances between the breeding sites and the pipe laying areas. However, one must also note that these areas are known for rafting and feeding purposes. Disturbances during this critical stage of the life cycle could result in loss of offspring and drop in population, albeit, temporary. Transhipments and supply transfers should take place during day light hours.

Lighting at the Terminal area should be limited to down lighters and avoiding floodlights where possible. Unless necessary for security reasons, lights should be wall mounted or if placed on poles these shouldn't extend beyond the height of buildings. Lights facing seaward should be avoided as much as possible. One should also avoid light bouncing off surfaces increasing the halo effect from the area, as well as the potential for installing intelligent lighting solutions.

One should consider revising the level of lighting on the pier if the FSU tanker is removed, since the only lighting required at the time would be limited to navigational lights and possibly limited security lighting which could take the form of intelligent lighting. Such measures would further reduce the impacts resulting from light pollution.

If the FSU is to remain there, one should consider revising the necessary lights on deck and their orientation. This also applies for the pier. One should also consider intelligent lighting solutions.

Diligent planning for tunnelling works to avoid that these would not coincide with the avian breeding season should avoid any impacts of ground breeding Annex I species in the area.

8.6 Residual Impacts

Residual impacts are those impacts which are bound to remain after taking into consideration the proposed mitigation measures.

8.6.1 Marine ecology

Despite the comprehensive adoption of the recommended mitigation measures, a number of unavoidable residual impacts are still expected to arise, namely:

(i) Obliteration of sensitive benthic assemblages (coralligenous ones settled on rocky outcrops or on unvegetated sand mainly, given that seagrass meadows will be largely spared such impacts) falling directly within the footprint of seabed interventions (i.e. pipeline, pipeline support structures, cable crossings, excavated transition pit prior to the MT section),

(ii) Smothering of sensitive benthic assemblages through re-suspension/re-mobilisation of fine particulates through seabed disturbance activities (e.g. dredging in connection with the trenching of the transition pit),

(iii) Anthropogenic generation of submarine noise,

(iv) Discharge and subsequent dispersion of waste drilling muds into the marine environment and the

(v) Fouling of the laid pipeline by epibiotic species.

8.6.2 Terrestrial ecology

It is fundamental that the shrubs planted along the exposed cliff are taken from local stocks, prioritising the planting of *Darniella melitensis* seedlings and planting from local nurseries. Residual impacts will nevertheless remain since the removal of the existing plants is inevitable and irreversible.

8.6.3 Avifauna

A limited amount of siltation is bound to remain within the immediate proximity of the working vessels at sea. The climatic conditions during the recommended working period are not expected to help in achieving the desired results and it is understood that the currents along that part of the coast are rather strong so the dispersion of sediments could be difficult to contain within the desired limits. If works take place during the March to September period, the chances are that silt dispersion could be better managed due to the calmer seas in this period.

The machinery utilised for such a project involves heavy machinery and high-powered engines, so the amount of noise generated should also be limited as a certain level of residual noise is bound to remain. The remaining impacts and disturbance generated from such impacts will depend on the level of residual noise following the implementation of several noise mitigation measures (as stipulated in the noise technical study). Setting a threshold limit on the noise levels which should not be exceeded during the construction phase could be a very crucial safeguard to protect the species from excessive noise impacts.

Works during the pre-laying period could result in bird species abandoning their nesting grounds, thus affecting the population of the species. It could also affect their energy levels since they might need to travel longer distances to obtain food and other resources.

Works during the incubation period could have even impacts of a higher significance. In the case of both Shearwater species, incubation takes place alternatively by both sexes which change place every few days, so delays in the construction works could have an effect on the wellbeing of the individual parent and the fate of their offspring. In the case of the Storm Petrel incubation takes 38 days and is carried out by both parents and takes longer if the egg is not incubated regularly.

Works during the rearing period would have an even higher impact significance since during this period parents need enough resources for themselves and also their offspring. The success of rearing their offspring depends much on the regular availability of food. If the parents fail to reach their nests due to disturbance activities their offspring are at stake and this can have an effect on their population.

When the offspring are bound to leave their nests, this usually takes place in the absence of their parents and in most cases, they leave their nests out of instinct and because they have gained enough strength to fly. During this period, it is lights which are their worst enemy since they tend to move towards sources of light and get grounded or disoriented. The residual impacts during this period could be significant if the birds get injured and cannot fly. Otherwise, if caught and are allowed a second chance to fly, they will leave safely without much harm.

The residual impacts resulting from the removal of the FSU are still negative since there would still be other sources of light in the vicinity. Better management of these light systems should reduce the significance level. Any artificial sources of light in the proximity of the breeding colonies always results in adverse impacts on the breeding species. This is not only limited to lights from the DPS but also lights from the Freeport area and surroundings.

Leaving the FSU in place with all the existing lights and adding more lights at the new Gas Terminal facility would result in a slight increase in impacts. Revising the lighting on the FSU and pier could reduce the level of impacts resulting from sources of illumination.

8.7 Monitoring Programme

8.7.1 Marine ecology

A BACI (Before-After) marine ecological monitoring approach is proposed, consisting of the following design:

(i) Adoption of the mapping datasets collected during the pre-permitting phase to characterise the 'Before' component
(ii) Collection of a second tranche of monitoring data, collected in replicate fashion to the 'Before' dataset (concomitant and collocated survey sites, as well as matching seasons and data collection techniques), so as to represent the 'After' component
(iii) A semi-quantitative comparative approach is conducted, in order to identify any significant changes between the two tranches. One possible way of doing this is through the application of machine learning protocols (in the form of image analysis) to the processing of ROV footage, as has been applied previously within Maltese waters as a part of a separate environmental monitoring project (the Malta-Sicily Interconnector – Gauci et al., 2016).

A minimum interval of 12 months should be allowed prior to the conduction of the second survey, in order to enable ecological responses to the disturbance wrought to the impacted marine ecosystems to emerge. The adoption of control sites within the monitoring protocol is a possibility, although the sheer extent of the surveyed marine area makes this option a challenging one.

8.7.2 Terrestrial ecology

Monitoring of the plantation of the shrubs planted along the exposed cliff should be carried out in order to ensure appropriate practices are implemented.

8.7.3 Avifauna

Should the Scheme be permitted to be developed, a monitoring programme should be set up and implemented during both the construction and operational phases of development. A construction management plan should be developed and complied by the applicant/contractor in order to ascertain that the best practicable environmental options available are followed through.

During the construction phase, periodic monitoring is being recommended to ensure that mitigation measures are in place and working as they should. This should ensure that no unwarranted impacts arise due to deviations from proposed working practices. Such deviations could have additional impacts over and above those originally predicted. It is being recommended that when work is being carried out in the protected areas, monitoring should be undertaken on a daily basis. Once outside these areas, this could take place on a weekly basis. There should be regular contact between the site manager in charge of all the works and the monitor responsible for works and ERA in order to address any problems which could arise in due course.

In view that offshore works are planned during the breeding season, it is highly recommended that the populations of the three species are monitored regularly prior to commencement of works, during works and also on the following year/s to ensure that the populations have not been affected by the works. This could take various forms, such as radio tracking or satellite tracking devices installed on birds to understand their behaviour during works, population counts at the breeding sites, boat-based observations or other means to better understand whether there were any significant impacts.

All monitoring data should be presented to the relevant authorities at pre-agreed frequencies.

9.0 Summary of Impacts Table

Impact type and source			Impact receptor		Effect & Scale							Probability of impact occurring (Inevitable/ Likely/ Unlikely/ Remote/ Uncertain	Overall impact significance	Proposed mitigation measures	Residual impact significance	Other requirements
Impact type	Specific intervention leading to impact	Project phase (construction/ operation/ decommissioning)	Receptor type	Sensitivity & resilience toward impact	Direct/ Indirect/ Cumulative	Beneficial/ Adverse	Severity	Physical/ geographic extent of impact	Short-/ Medium-/ Long-term	Temporary (indicate duration)/ Permanent	Reversible (indicate ease of reversibility)/ Irreversible					
Obliteration of benthic assemblages	Seabed reclamation	Construction	Benthic assemblages	Moderate	Direct	Adverse	Moderate	Local/Restricted	Long-term	Permanent	Irreversible	Inevitable	Major	N/A	Major (slight reduction)	N/A
Obliteration of benthic assemblages	Transition pit (including associated dredging)	Construction	Benthic assemblages	High	Direct	Adverse	High	Local/Restricted	Medium-term	Permanent	Irreversible	Inevitable	Major	Size of the excavation pit should be minimised	Major (slight reduction)	N/A
Obliteration of benthic assemblages	Pipe-laying within the identified corridor	Construction	Benthic assemblages	High	Direct	Adverse	High	Widespread	Long-term	Permanent	Irreversible	Inevitable	Major	Pipeline route has already minimised this as much as possible	Moderate	N/A
Obliteration of benthic assemblages	Heightened anchoring activity	Construction	Benthic assemblages	High	Direct	Adverse	High	Local/Restricted	Long-term	Permanent	Irreversible	Inevitable	Moderate	Use of anchor stabilisation devices should be minimised	Minor	N/A
Atmospheric fall-out/ deposition of fine particulates	Various works	Construction	Marine organisms and habitats	Low	Indirect	Adverse	Low	Moderate extent	Short-term	Temporary	Reversible	Likely	Minor	Use of dust mitigation techniques	Minor (slight reduction)	Monitoring
Heightened marine contamination risk	Accidental release of fuels, lubricant oils, additives, etc	Construction	Marine organisms and habitats	Low	Indirect	Adverse	Low	Moderate extent	Short-term	Temporary	Reversible	Likely	Minor	Use of appropriate bunding, spill kits and booms	Minor (slight reduction)	Monitoring
Re-mobilisation of nutrients and pollutants sequestered within the	Various works	Construction	Marine organisms and habitats	Moderate	Indirect	Adverse	Moderate	Widespread	Short-term	Temporary	Reversible	Likely	Minor	N/A	Minor (slight reduction)	N/A

Impact type and source			Impact receptor		Effect & Scale							Probability of impact occurring (Inevitable/ Likely/ Unlikely/ Remote/ Uncertain	Overall impact significance	Proposed mitigation measures	Residual impact significance	Other requirements
Impact type	**Specific intervention leading to impact**	**Project phase (construction/ operation/ decommissioning)**	**Receptor type**	**Sensitivity & resilience toward impact**	**Direct/ Indirect/ Cumulative**	**Beneficial/ Adverse**	**Severity**	**Physical/ geographic extent of impact**	**Short-/ Medium-/ Long-term**	**Temporary (indicate duration)/ Permanent**	**Reversible (indicate ease of reversibility)/ Irreversible**					
benthic sediment																
Re-suspension of fine benthic sediment fractions	Dredging works	Construction	Marine organisms and habitats	Moderate	Direct	Adverse	Moderate	Widespread	Short-term	Temporary	Reversible	Inevitable	Moderate	Deployment of geotextile silt curtain	Minor	Monitoring
Installation of pipeline support structures	Pipe-laying within the identified corridor	Construction	Benthic assemblages	High	Direct	Adverse	High	Widespread	Short-term	Permanent	Irreversible	Inevitable	Major	Size of structures should be minimised	Major (slight reduction)	N/A
Installation of cable crossing structures	Pipe-laying within the identified corridor	Construction	Benthic assemblages	High	Direct	Adverse	High	Moderate	Short-term	Permanent	Irreversible	Inevitable	Major	Size of structures should be minimised	Major (slight reduction)	N/A
Release of drilling fluids into the marine environment	Post-lay works	Construction	Marine organisms and habitats	Moderate	Direct	Adverse	Moderate	Local/Restricted	Short-term	Temporary	Reversible	Inevitable	Minor	Drilling muds should be recovered as much as possible	Minor (slight reduction)	N/A
Anthropogenic generation of submarine noise	Various works	Construction	Marine organisms and habitats	Moderate	Indirect	Adverse	Moderate	Widespread	Short-term	Temporary	Reversible	Inevitable	Moderate	Deployment of air bubble screens for stretches of high noise generation (such as trenching)	Minor	N/A
Heightened marine contamination risk	Increase in marine traffic in the area	Operation	Marine organisms and habitats	Low	Indirect	Adverse	Low	Moderate extent	Short-term	Temporary	Reversible	Likely	Minor	N/A	Minor (slight reduction)	N/A
Benthic impacts	Pipeline maintenance and repair works	Operation	Benthic assemblages	High	Direct	Adverse	High	Widespread	Long-term	Permanent	Irreversible	Inevitable	Moderate	Use of anchor stabilisation devices should be minimised	Moderate (slight reduction)	N/A

Impact type and source			Impact receptor		Effect & Scale							Probability of impact occurring (Inevitable/ Likely/ Unlikely/ Remote/ Uncertain	Overall impact significance	Proposed mitigation measures	Residual impact significance	Other requirements
Impact type	Specific intervention leading to impact	Project phase (construction/ operation/ decommissioning)	Receptor type	Sensitivity & resilience toward impact	Direct/ Indirect/ Cumulative	Beneficial/ Adverse	Severity	Physical/ geographic extent of impact	Short-/ Medium-/ Long-term	Temporary (indicate duration)/ Permanent	Reversible (indicate ease of reversibility)/ Irreversible					
Anthropogenic generation of submarine noise	Maintenance/ repair	Operation	Marine organisms and habitats	Moderate	Indirect	Adverse	Moderate	Moderate extent	Short-term	Temporary	Reversible	Inevitable	Moderate	Deployment of air bubble screens for stretches of high noise generation	Minor	N/A
Colonisation of laid pipeline by epibiota	Laid gas pipeline	Operation	Marine habitats	High	Direct	Beneficial and adverse	High	Widespread	Long-term	Permanent	Reversible	Inevitable	Moderate	N/A	Minor	N/A
Removal of existing plants from cliff face	Cliff works	Construction	Protected shrub species	High	Direct	Adverse	High	Local	Long-term	Permanent	Irreversible	Inevitable	Major	Planting of *Darniella melitensis*	Moderate	Application for a nature permit before removing protected species; monitoring of plantation
Silting of water column	Drilling and construction works	Construction	Avian	Moderate	Indirect	Adverse	Could be high	Could be widespread	Short term	Temporary	Reversible	Likely	Minor to Moderate	Good working management practices; use of silt curtains; Avoid use of toxic chemicals in cements, binders etc.	Minor	Monitoring
Noise	Machines/ engines etc.	Construction	Avian	Moderate	Direct	Adverse	Could be high	Could be widespread	Short term	Temporary	Reversible	Likely	Minor to moderate	Good working management practices; use mufflers to	Minor	Set threshold levels

Impact type and source			Impact receptor		Effect & Scale							Probability of impact occurring (Inevitable/ Likely/ Unlikely/ Remote/ Uncertain	Overall impact significance	Proposed mitigation measures	Residual impact significance	Other requirements
Impact type	Specific intervention leading to impact	Project phase (construction/ operation/ decommissioning)	Receptor type	Sensitivity & resilience toward impact	Direct/ Indirect/ Cumulative	Beneficial/ Adverse	Severity	Physical/ geographic extent of impact	Short-/ Medium-/ Long-term	Temporary (indicate duration)/ Permanent	Reversible (indicate ease of reversibility)/ Irreversible					
														attenuate noise levels to a minimum; Set maximum operational noise threshold levels;		
Illumination	Working vessels and terminal	Construction	Avian	High protected species	Direct	Adverse	High	Could be widespread	Short term	Temporary	Reversible	Likely	Moderate to Major	Limit number of working vessels at night and illumination levels on vessels	Moderate	Population monitoring of protected species
Illumination	Terminal facility	Operation	Avian	High protected species	Direct	Adverse	High	Could be widespread	Long term	Permanent	Irreversible	Likely	Moderate to Major	Limit the amount of lighting fixtures; position fixtures strategically to reduce glow and dispersion of light and light points at sea; Consider intelligent lighting solutions	Moderate	Population monitoring of protected species
Disturbance on Annex I species	Tunnelling works	Construction	Avian (*Calandrella brachydactyla*)	High protected species	Indirect	Adverse	Could be high	Limited	Short-term	Temporary	Reversible	Uncertain	Minor to Moderate	Good management practices; avoid	Minor	None

Impact type and source			Impact receptor		Effect & Scale							Probability of impact occurring (Inevitable/ Likely/ Unlikely/ Remote/ Uncertain	Overall impact significance	Proposed mitigation measures	Residual impact significance	Other requirements
Impact type	**Specific intervention leading to impact**	**Project phase (construction/ operation/ decommissioning)**	**Receptor type**	**Sensitivity & resilience toward impact**	**Direct/ Indirect/ Cumulative**	**Beneficial/ Adverse**	**Severity**	**Physical/ geographic extent of impact**	**Short-/ Medium-/ Long-term**	**Temporary (indicate duration)/ Permanent**	**Reversible (indicate ease of reversibility)/ Irreversible**					
														tunnelling works during breeding season as much as possible		
Illumination	Terminal facility plus FSU	Operation	Avian	High protected species	Direct	Adverse	High	Could be widespread	Long term	Permanent	Irreversible	Likely	Moderate to Major	Revise lighting on FSU and pier and limit levels of light to basic necessity; consider intelligent lighting solutions	Moderate	Population monitoring of protected species
Staging post	Presence of vessels at sea	Construction	Avian	Migratory species	Direct	Beneficial	Low-high	Limited	Short term	Temporary	Reversible	Likely	Minor to Moderate	Keep a lookout for any injured species on board	Minor to Moderate	Monitoring
Illumination	Working vessels	Construction	Avian	Migratory species	Direct	Adverse	Low to high	Limited	Short term	Temporary	Reversible	Likely	Minor to Moderate	Limit illumination during the night and avoid over illumination of vessels	Minor	Monitoring

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