Interference with Hydrological Processes

1.1 Introduction

The EU Marine Strategy Framework Directive lists 'Interference with hydrological processes' as one of the pressures to be assessed for the purposes of the MSFD Initial Assessment (Article 8). In accordance with Annex III of the Directive, interferences with hydrological processes are associated with changes in salinity and thermal regimes, however such interferences would also consist of changes in sediment transport and changes in current or wave action.

Interferences with hydrological processes are generally associated with anthropogenic interventions in the coastal or marine environment and may result in modifications of physical and chemical characteristics, with subsequent effects on marine biota as a result of changes to their immediate environment or through food chain effects[1].

While assessment of potential changes in hydrological processes is generally undertaken as part of environmental assessment procedures, the extent of changes which may have occurred to date as a result of anthropogenic activities and their impact on the marine environment is not known. Consequently, the scope of this report is limited to a description of the type and location of activities in Malta which could lead to interference with hydrological processes.

1.2 Existing legislation

Hydrological processes in the marine environment are mainly addressed through the EU Water Framework Directive (WFD) 2000/60/EC, which calls for the protection of all water resources, including coastal waters.

The main objective of the WFD for coastal water bodies is the achievement, by 2015, of 'good ecological status' up to one nautical mile from the coast; 'good chemical status' for territorial waters and 'good ecological potential'[2] for heavily modified water bodies. The latter are designated when the changes to the hydromorphological characteristics of the water body which would be necessary for achieving good ecological status would have significant adverse effects on: (i) the wider environment; (ii) navigation, including port facilities, or recreation; (iii) activities for the purposes of which water is stored, such as drinking-water supply,

[1] OSPAR Commission 2012. MSFD Advice document on Good environmental status - Descriptor 7: Hydrographical conditions. A living document - Version 17 January 2012

[2] 'Good Ecological Potential' is less stringent objective than good ecological status , making allowances for ecological impacts resulting from alterations to the physical environment that are necessary to either support a specific use, or must be maintained in order to avoid effects on the wider environment.

power generation or irrigation; (iv) water regulation, flood protection, land drainage, or (v) other equally important sustainable human development activities.

For the purposes of the WFD, the coastal waters around the Maltese Islands have been divided into 9 distinct water bodies, two of which are designated as heavily modified water bodies. Such bodies constitute the harbour areas (Il-Port il-Kbir and Il-Port ta' Marsamxett; Il-Port ta' Marsaxlokk) which are substantially changed in character as a result of physical alterations by human activity and cannot therefore, meet 'good ecological status'.

'Good ecological status' is defined by quality elements, including hydromorphological elements supporting the biological elements. These include:

- morphological conditions
- depth variation
- structure and substrate of the coastal bed
- structure of the intertidal zone[3]
- tidal regime[4]
- direction of dominant currents
- wave exposure

1.3 Anthropogenic Activities

The nature and extent of alterations to hydrographical conditions in the marine environment which have occurred to date is not known. However, information on the location and nature of anthropogenic activities which can potentially lead to interferences with hydrological processes can provide an indication of marine areas subject to this pressure.

This section provides a brief description of the type and location of activities known to occur in Malta which may result in interferences with hydrological processes.

1.3.1 Changes in thermal regimes

Thermal effluents in Malta are mainly associated with the operation of the power stations at Marsa and Delimara (Figure 1). Cooling waters from the Delimara power station are discharged into a bay known as il-Ħofra iż-Żgħira on the eastern side of the Delimara peninsula.

Axiaq (2004)[5] reported high temperature anomalies at the sites exposed to the discharge of cooling waters from the two power stations. In June 2003, waters at Marsa and il-Ħofra iż-Żgħira, were found to be at 5.4°C and 5.5°C above ambient

[3] The 'intertidal zone' would reflect the 'mediolittoral zone' in the Mediterranean region.
[4] This is not applicable in the local context due to the low tidal range in the Mediterranean
[5] Axiaq, V. (2004) Marine Coastal Monitoring Programme: June 2003, March 2004

temperature up to 25-50m away from the discharge points. This increase in ambient temperature spread throughout most of the Grand Harbour area, while in the case of il-Ħofra ż-Żgħira, it extended throughout most of the creek. Reduced oxygen levels, high levels of chlorophyll a and occasional water turbidity were also recorded in these areas.

Changes in surface and seabed temperatures as a result of cooling water discharges at il-Ħofra iż-Żgħira were modelled in 2011 with a view to assess the environmental impacts of additional cooling waters from an extension to the Delimara Power Station (which extension is now in place). On the basis of a predicted total discharge of cooling waters of 43,000m^3/hr with a temperature of 8°C above ambient temperature, the following changes were predicted[6]:

- Surface temperature inside the bay would increase up to 8°C at the outfall, while surface temperatures outside the bay would increase up to 2°C;
- Seabed temperatures inside the bay would also show an increase, extent of which was not specified through the study. Under normal weather conditions, seabed temperatures outside the bay would be unaffected;
- Under condition of strong wind and wave action, seabed temperature was predicted to increase by 1°C outside the bay and 1.5°C in a very small area at the mouth of the bay.

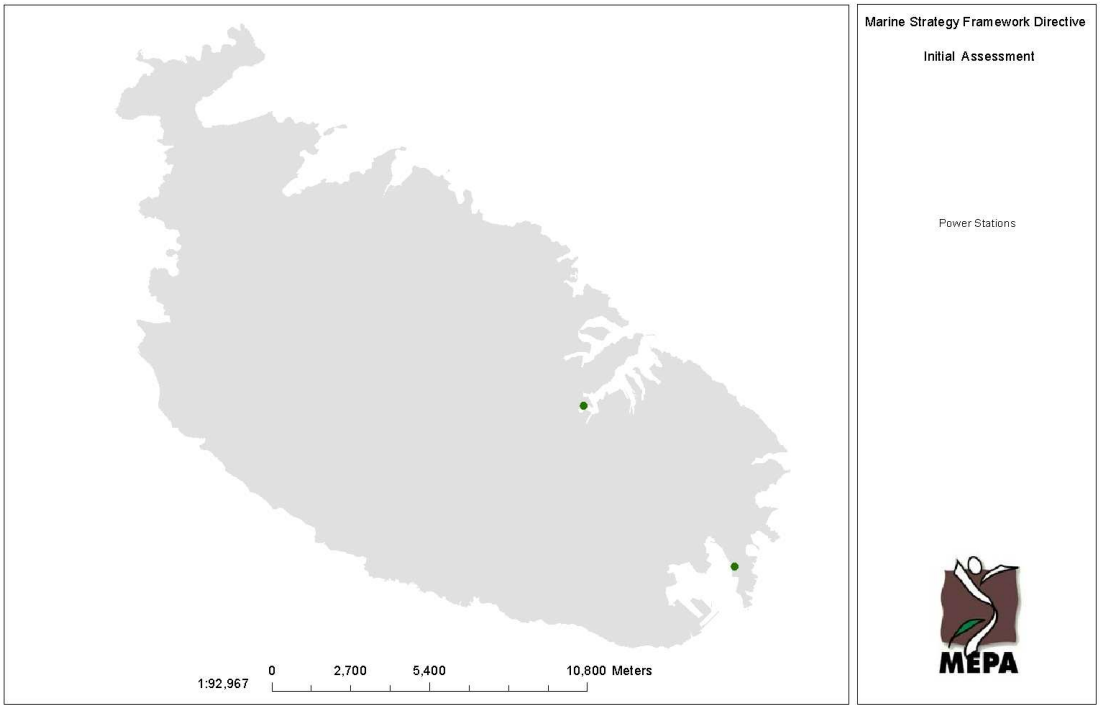
These effects were predicted prior to the installation of the extension to the power station. It is pertinent to note that the amount of cooling waters reported to be discharged in 2012 (a total of 155,246,760m^3) through the environmental permitting system appears to represent a lower flow rate than that used in predicting the temperature increases in 2011.

The impact of cooling water discharge from the Delimara power station was assessed in 2010. Impacts may include an increased epiphytic growth, a regression in the extent of *Posidonia* and the replacement of the seagrass with *Cymodocea nodosa* and photophilic algal assemblages[7]. The effects of the discharge of cooling waters on the marine ecosystems in the area will be assessed annually as part of the environmental permit of the power plant.

[6] AIS Environmental Ltd. 2011. Extension to the Delimara Power Station: IPPC permit. *Prediction of the spread and dilution of cooling water from Delimara Power Station.*

[7] AIS Environmental Ltd. 2010. Alternative Assessment Report for the Disposal of Cooling Water – Delimara Power Station

Figure 1: Location of the two power plants on mainland Malta.



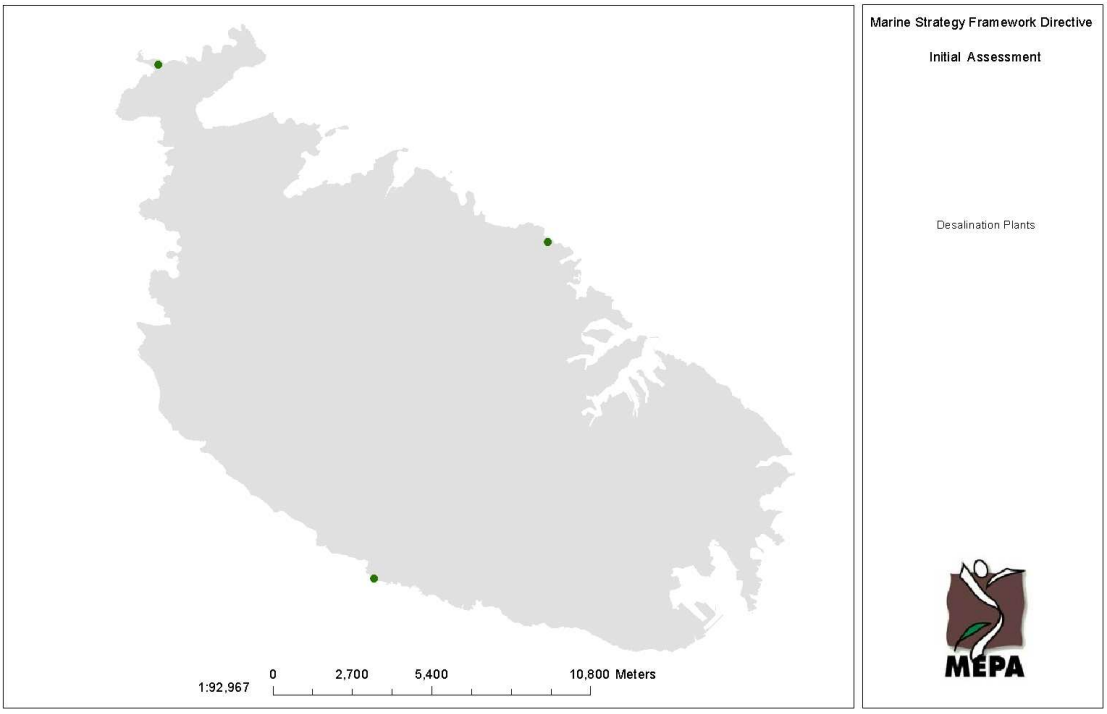
1.3.2 Changes in salinity regimes

Brine discharges in Malta are mainly associated with the operation of the three desalination plants (Figure 2). However brine is also known to be discharged by tourist resorts.

Brine discharges from desalination plants amounts to up to 24 million m^3 per year (Water Services Corporation, personal communication). Quantification of brine discharges from other sources cannot be quantified at this stage, since, while such information is generally collected as part of the environmental permitting system, this system has only recently started being implemented and does not cover all marine discharges as yet.

The effects of brine discharges on hydrological processes have not been assessed at a local scale. Nevertheless, the main brine discharges from desalination plants are localised and can be considered to be of low significance.

Figure 2: Location of desalination plants on mainland Malta.



1.3.3 Changes in currents or wave action

Changes in currents, wave action and sediment transport are generally a result of anthropogenic activities on the coast or at sea, including dredging activities, installation of offshore structures and construction works affecting the coastline.

1.3.3.1 Dredging

Dredging in Malta is generally undertaken for maintenance of fairways for navigation or development of port facilities. However, dredging may also be carried out in relation to coastal engineering projects, such as the building of platforms, quays and development of new marinas.

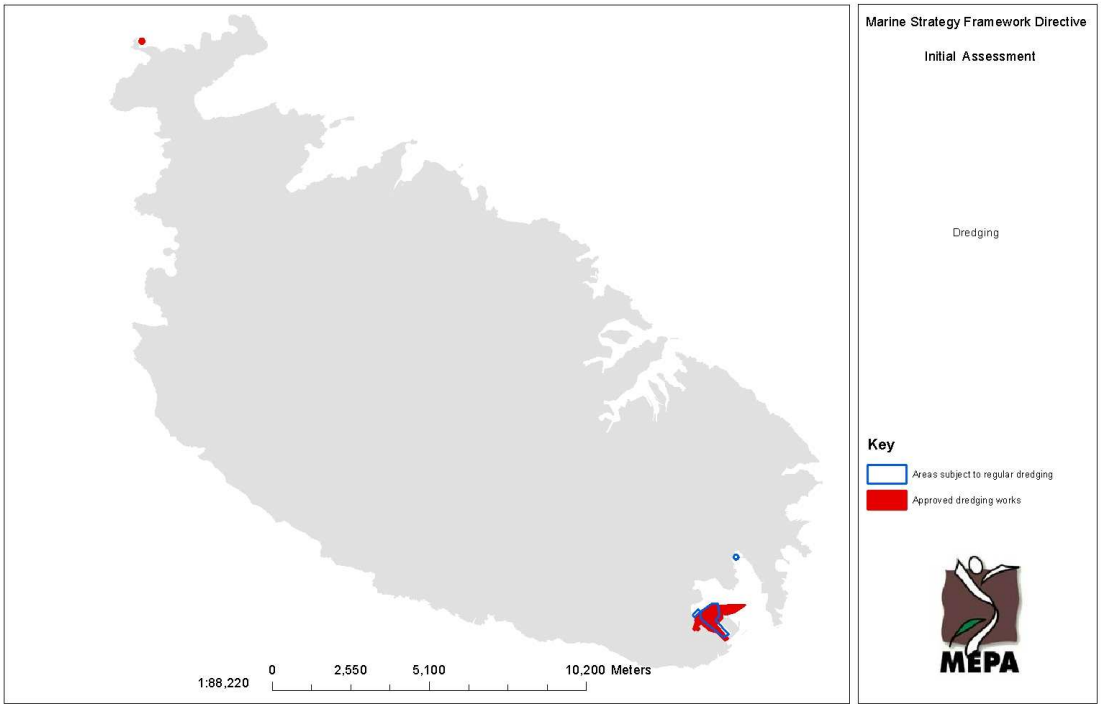
There are no areas designated for regular dredging, although some parts of Marsaxlokk harbour area are dredged every year (Transport Malta – Maritime – personal communication) (Figure 3). A review of 'Notices to Mariners' issued for the purposes of navigational safety between 2007-2012 implies that in addition to dredging at Marsaxlokk harbour, some dredging works also take place within the

Grand Harbour and Marsamxett harbour. Mariners were informed of dredging works within these harbour areas twice in 2009 and once in 2011[8].

A preliminary assessment of development proposals submitted in the period 2000-2010, confirm that dredging activities are mainly restricted to harbour areas (Marsaxlokk harbour and Ċirkewwa) (Figure 3).

The effects of dredging activities on hydromorphological elements has not been assessed to date, however these effects are expected to be highly localised within harbour areas and are thus expected to be of low significance.

Figure 3: Areas subject to regular dredging and approved dredging works



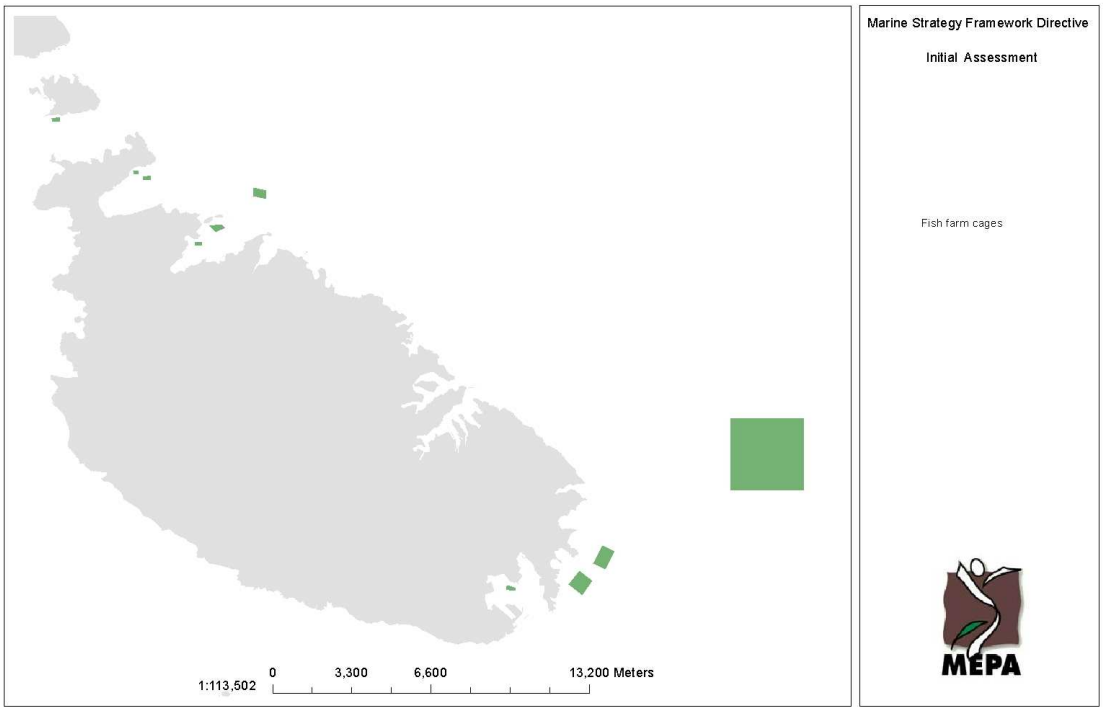
1.3.3.2 Offshore structures

Offshore structures in Malta are mainly related to aquaculture. In total there are 9 off-shore aquaculture sites, with the majority of the fish farm cages located in inshore waters (Figure 4). Two relatively large-scale aquaculture installations are located at 6km off Southeastern Malta, within the aquaculture zone. This zone is used by two operators with a licensed capacity of 1,500 tuna each. The effects of such cages in terms of interferences with hydrological processes have not been assessed.

[8] Notice to Mariners No. 14 of 2009; No. 21 of 2009 and No. 27 of 2011

To date there are no other large-scale offshore structures in Malta. However the installation of offshore renewable energy installations could be a possibility in the future. Currently a development proposal for the installation of an offshore windfarm is being assessed through the development control process.

Figure 4: Location of fish farm cages



1.3.3.3 Development on the coast or at sea

A preliminary assessment of development permit applications submitted during the period 2000-2010, implies that development on the Maltese coastline is mainly related to port operations or marinas.

Port-related development proposed during the period 2000-2010 mainly involved the construction or upgrading of terminals, or refurbishment and upgrading of existing quays within harbour areas (Figure 5). The majority of the existing marinas are also located within harbour areas and development proposals in relation to marinas which were granted permission during the period 2000-2010 were restricted to such areas[9], namely Marsamxett harbour, the Grand Harbour and Mġarr Harbour (Gozo).

Nevertheless it should be noted that Malta is seeking the growth of the yachting industry through the possible development of new permanent marinas and establishment of temporary marinas, to address the need of additional berths in Malta. The most recent report on this matter was compiled in 2009 by the Malta Maritime Authority (now Transport Malta – Maritime): *Development of Yachting Facilities in Malta: Identification of Potential Sites for All-Weather Marinas and Temporary Marinas*. This report identifies sites that can be considered for new permanent yacht marinas and sites for seasonal or temporary marinas. The latter would involve the installation of pontoons accommodating between 50-100 boats in the summer season, which pontoons would be stored away on land during the winter months.

Environmental considerations constituted the overriding principle for the selection of suitable sites for the development of permanent marinas. As a result of the occurrence of *Posidonia oceanica* meadows throughout most of the shallow waters, coupled to the significant costs associated with the construction of breakwaters in deeper waters, potential sites for permanent yacht marinas were once again restricted to the Marsamxett and Grand Harbour areas. Only a few other localities were explored by this report including St. Paul's Bay, Marsascala, St. Julians and Birżebbuġia.

Figure 6 shows the location of existing and planned marinas, potential sites for the development of permanent and temporary marinas and marina-related development proposals currently pending decisions through the development control process. Development related to marinas has the potential to interfere with hydrological processes due to the nature of the required infrastructure, mainly the development of breakwaters and quay walls. Nevertheless, taking into consideration the current and planned marinas, such effects would be mainly restricted to harbour areas.

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[9] Development proposals for development of marinas outside harbour areas were refused and are not being considered in this report.

Figure 5: Port-related development proposals in the period 2000-2010

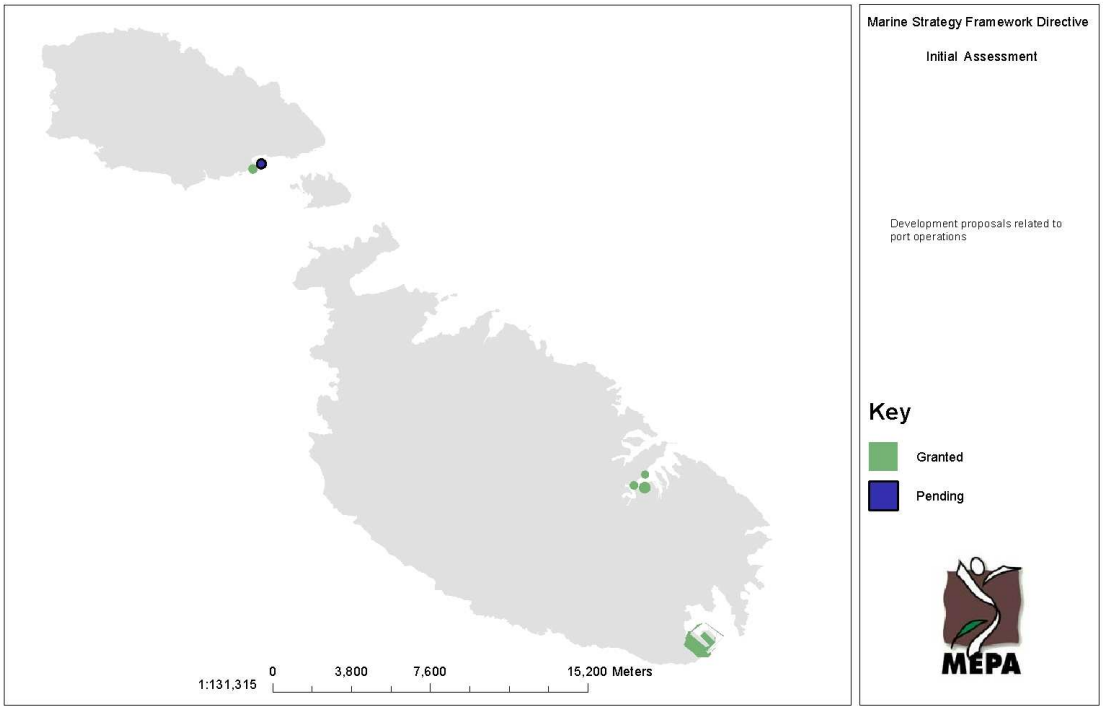
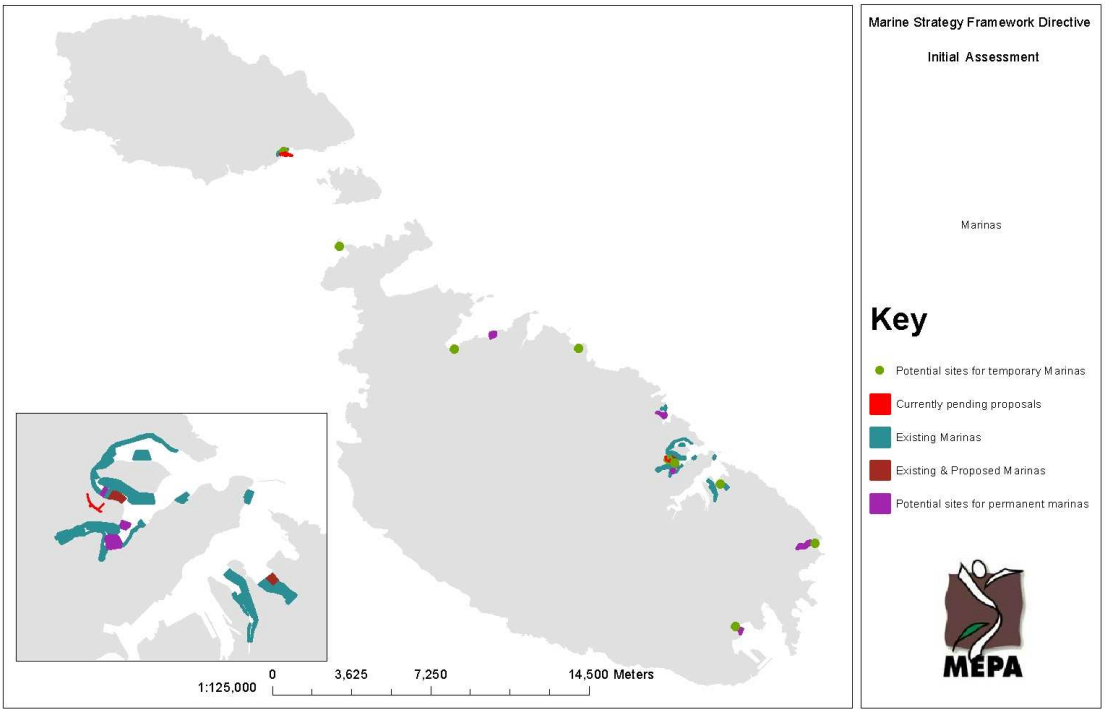


Figure 6: Existing and planned marinas, together with potential sites for temporary and permanent marinas as proposed by the Malta Maritime Authority in 2009



Development on the Maltese coastline, other than that related to port operations or marinas, as implied by an assessment of the development permit applications submitted in the period 2000-2010, mainly pertains to small construction works such as construction of new slipways, ramps and quays (Figure 7). Construction works related to coastal defence are very limited and were only requested at two locations: Marsalforn in Gozo and St. Paul's Bay in Malta in the period 2000-2010 (Figure 8). Two beach replenishment projects have been undertaken to date, however these interventions were not related to coastal defence, but were carried out for tourism or recreational purposes (Figure 9). The overall significance of such interventions in terms of interferences with hydrological processes is expected to be low.

In July 2013, the Government of Malta issued a call for an expression of interest for land reclamation proposals. The relevant and applicable environmental assessments will be carried out, once Government decides on the possible projects that could in principle be accepted.

Figure 7: Construction works related to piers, ramps and quays in the period 2000-2010 (based on a review of development permit applications)

Figure 8: Works related to 'coastal defence' on the basis of a review of development permit applications submitted in the period 2000-2010

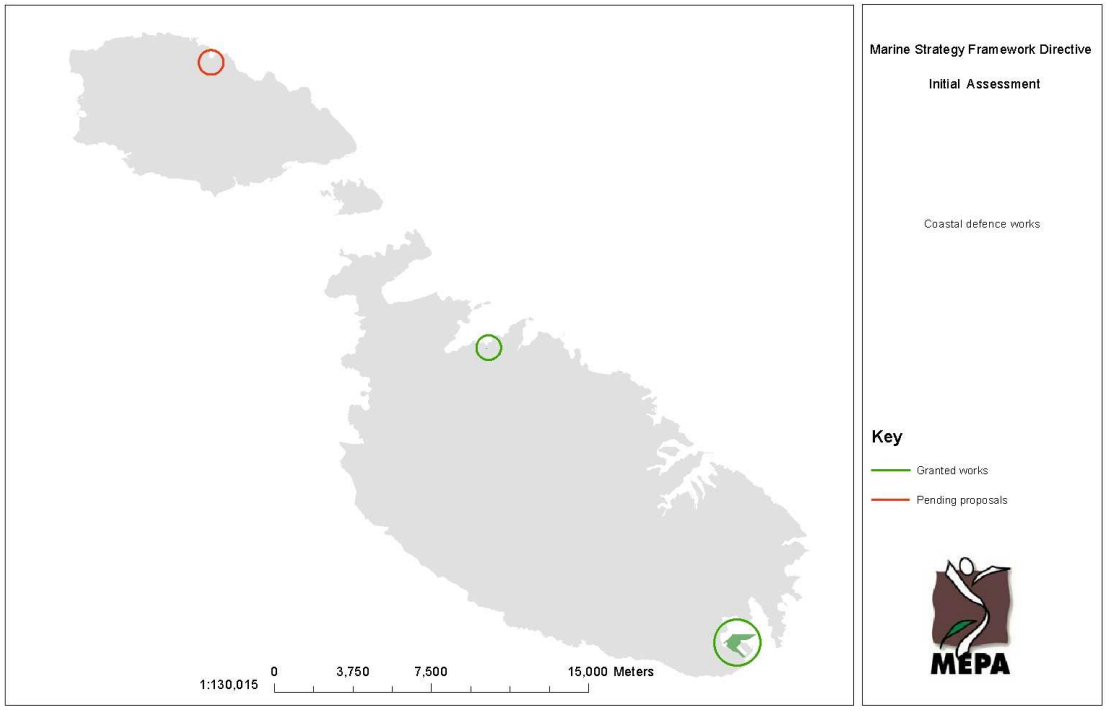
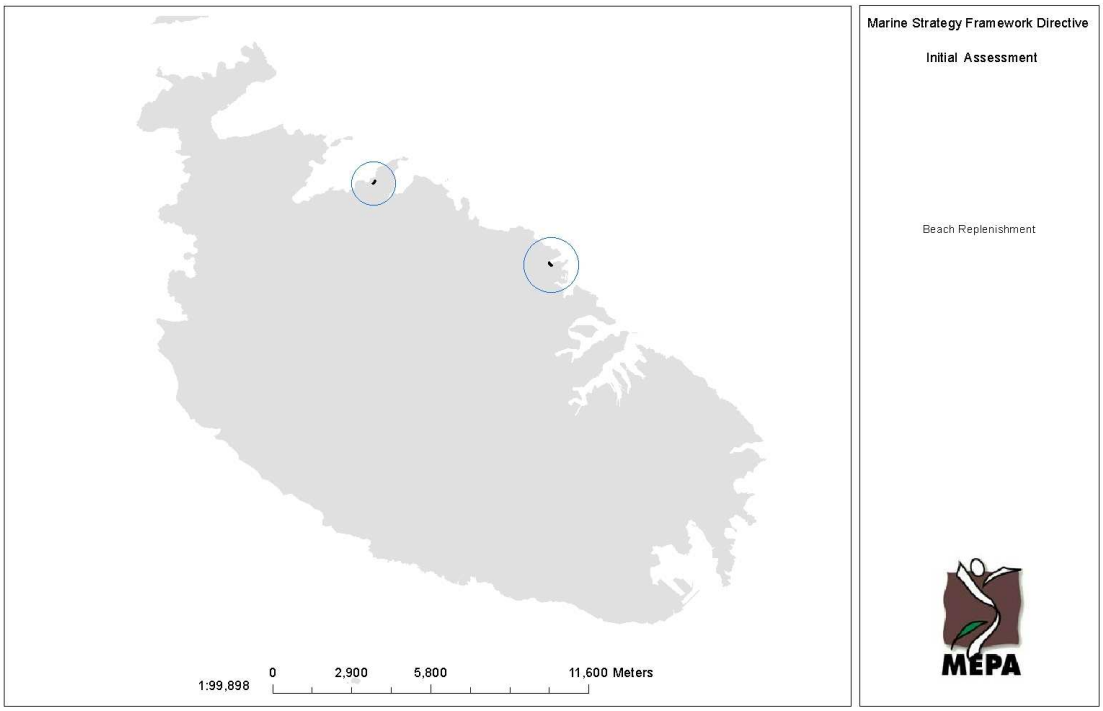


Figure 9: Beach Replenishment projects in the period 2000-2010



1.4 Assessment of Status

The MSFD requires the assessment of this pressure in terms of the criteria and indicators stipulated by the EU Commission Decision on criteria and methodological standards on good environmental status of marine waters (2010/477/EU) for GES Descriptor 7. These criteria and indicators are reproduced hereunder:

Criterion 7.1: Spatial Characterisation of permanent alterations

- Extent of area affected by permanent alterations

Criterion 7.2: Impact of permanent hydrographical changes

- Spatial extent of habitats affected by the permanent alteration
- Changes in habitats, in particular the functions provided (e.g. spawning, breeding and feeding areas and migration routes of fish, birds and mammals), due to altered hydrographical conditions

As indicated throughout the report, the currently available information does not allow an assessment of the status in terms of the MSFD criteria and indicators. Nevertheless, current activities or development which may lead to interferences with hydrological processes are mostly restricted to inshore waters, with the majority being further localised in harbour areas. The actual extent of affected areas and/or impacts of such activities on hydrological processes, habitats and species groups are to date unknown. However assessment of such effects might also fall within the scope of the EU Water Framework Directive, hence the need to ensure synergies between the two WFD and MSFD.

The possibility for such pressures to occur in offshore waters in the future exists and these would need to be assessed in line with the requirements of the MSFD.

1.5 Data gaps

Data gaps clearly exist with respect to the effects of past and current activities or development on hydrological processes and the associated impacts on habitats and biota. Baseline information with respect to the physical and biological elements which could be affected through interferences with hydrological processes, such as location of spawning areas, feeding areas, migratory routes, is also limited, hindering the adequate assessment of impacts related to this pressure.