Massawa Port Authority
State of Eritrea

Petroleum Jetty ESIA

Independent Category A Environmental and Social Impact Assessment and Management Plan Study: Construction of Petroleum Jetty at Hirgigo Bay - Massawa
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<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>AIDS</td>
<td>Acquired Immunodeficiency Syndrome</td>
</tr>
<tr>
<td>BA</td>
<td>Breathing Apparatus</td>
</tr>
<tr>
<td>CD</td>
<td>Chart Datum</td>
</tr>
<tr>
<td>DOE</td>
<td>Department of Environment</td>
</tr>
<tr>
<td>DWT</td>
<td>Deadweight tonnage</td>
</tr>
<tr>
<td>EMP</td>
<td>Environmental Management Plan</td>
</tr>
<tr>
<td>ESA</td>
<td>Environmentally Sensitive Areas</td>
</tr>
<tr>
<td>ESIA</td>
<td>Environmental and Social Impact Assessment</td>
</tr>
<tr>
<td>FEED</td>
<td>Front End Engineering Design</td>
</tr>
<tr>
<td>FRA</td>
<td>Fire Risk Assessment</td>
</tr>
<tr>
<td>HIV</td>
<td>Human Immunodeficiency Virus</td>
</tr>
<tr>
<td>LHI</td>
<td>Lanka Hydraulic Institute</td>
</tr>
<tr>
<td>LPG</td>
<td>Liquefied Petroleum Gas</td>
</tr>
<tr>
<td>m asl</td>
<td>meters above sea level</td>
</tr>
<tr>
<td>MOF</td>
<td>Ministry of Fisheries</td>
</tr>
<tr>
<td>MPA</td>
<td>Massawa Port Authority</td>
</tr>
<tr>
<td>MSDS</td>
<td>Material Safety Data Sheets</td>
</tr>
<tr>
<td>OSRA</td>
<td>Oil Spill Risk Assessment</td>
</tr>
<tr>
<td>PoE</td>
<td>Panel of Experts</td>
</tr>
<tr>
<td>RH</td>
<td>Royal Haskoning (the Design Consultant)</td>
</tr>
<tr>
<td>STD</td>
<td>Sexually Transmitted Diseases</td>
</tr>
<tr>
<td>TBC</td>
<td>Tuberculosis</td>
</tr>
<tr>
<td>TOR</td>
<td>Terms of References</td>
</tr>
<tr>
<td>WB</td>
<td>World Bank</td>
</tr>
</tbody>
</table>
EXECUTIVE SUMMARY

An Independent Category A Environmental and Social Impact Assessment and Management Plan Study was carried out for the Project of a new Petroleum Jetty at Hirgigo Bay - Massawa, Eritrea. The results of this study are described in the four volumes making up the entire report as follows:

- Vol. 1: Environmental and Social Impact Assessment (ESIA)
- Vol. 2: Oil Spill Risk Assessment and Contingency Plan (OSRA)
- Vol. 3: Fire Risk Assessment and Fire Training Plan (FRA)
- Vol. 4: Environmental Management Plan (EMP).

This Executive Summary recollects the summaries of the individual volumes in order to provide a fast overview of the main results of the study.

Environmental and Social Impact Assessment

The ESIA was done according to the TOR given to the Consultant, the Technical Proposal prepared by the Consultant and the Contract signed by the Client and the Consultant, dated October 17, 2007. The aim of the study was the preparation of an independent Environmental and Social Impact Assessment Study (ESIA) for the project of a new Petroleum Jetty in Hirgigo Bay, Massawa, Eritrea, which shall replace the existing jetty; the latter is not considered to be safe for use any longer. The Project is classified as a Category A Project according to World Bank OP 4.01 as well as according to Eritrean EIA Guidelines, meaning that a full impact assessment study needs to be carried out.

The Study (Volume 1 of the Study Reports) had to be made according to Eritrean as well as World Bank standards. Chapter 2 describes the institutional and legal framework for the present study. The most relevant legal document is the Eritrean document entitled National Environmental Assessment Procedures and Guidelines, enacted in 1999, which describes the procedures to be followed for such studies. No major inconsistencies have been found between this document and the relevant WB standard defining EIA procedures (WB OP 4.01).

The Project is described shortly in Chapter, 3 as well as the project area; project description is based on the technical documents, mainly the Feasibility Study and Preliminary Design Report (RH 2006). Project location is Hirgigo Bay, south of the town of Massawa, the most important harbour of the country. The project consists in a new jetty which will replace the existing one, built in the 1930ies by the Italians. This structure is now in a very bad state (see Photos in Annex 17 of the Report), and presents an increasing risk of a major accident to happen. The possibility of rehabilitating this existing structure in a way that would allow its continued use was ruled out in the feasibility study, and alternatives were developed and compared to replace it. The feasibility study identified first three locations for the new jetty (north and south of the existing jetty, and on Taulud Island). This last option was ruled out in an early stage and
is not investigated any further in the present Report. Initially, the feasibility study identified 6 alternatives at the two remaining locations. Later on, a seventh alternative was added, with an intermediate location (south of the existing Jetty, but closer to it). The main characteristics of the 7 alternatives are shown in Table 1.

Table 1: Alternatives for the new jetty

<table>
<thead>
<tr>
<th>No.</th>
<th>Loc.</th>
<th>Total length m</th>
<th>Rock bund length m</th>
<th>Trestle length m</th>
<th>On land pipeline m</th>
<th>Cost M USD</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>N</td>
<td>1500</td>
<td>875</td>
<td>625</td>
<td>300</td>
<td>25.2</td>
<td>Concrete trestle; marine loading arms; some dredging required; mooring: dolphins;</td>
</tr>
<tr>
<td>2</td>
<td>N</td>
<td>1500</td>
<td>875</td>
<td>625</td>
<td>300</td>
<td>26.5</td>
<td>Like Alt. 1, but steel trestle; marine loading arms; some dredging required; mooring: dolphins;</td>
</tr>
<tr>
<td>3</td>
<td>S</td>
<td>1125</td>
<td>625</td>
<td>500</td>
<td>850</td>
<td>23.1</td>
<td>Concrete trestle; marine loading arms; no dredging; mooring dolphins; <strong>technically and economically preferred option</strong></td>
</tr>
<tr>
<td>4</td>
<td>N</td>
<td>1500</td>
<td>875</td>
<td>625</td>
<td>300</td>
<td>23.5</td>
<td>Like Alt. 1, but with offloading hoses instead of loading arms; some dredging required</td>
</tr>
<tr>
<td>5</td>
<td>S</td>
<td>1900</td>
<td>1200</td>
<td>700</td>
<td></td>
<td>30.9</td>
<td>100 m submarine pipeline and hoses; no dredging (?); Conventional Buoy Mooring (CBM)</td>
</tr>
<tr>
<td>6</td>
<td>S</td>
<td>n.a.*</td>
<td>n.a.</td>
<td></td>
<td></td>
<td>21.5</td>
<td>Submarine pipeline and hoses; no dredging; CBM; most modern version; same location as Alternative 3.</td>
</tr>
<tr>
<td>7</td>
<td>S**</td>
<td>1220</td>
<td>1150</td>
<td>70</td>
<td></td>
<td>18.8</td>
<td>**south of the existing jetty, but north of the Alternatives 3 and 6. Loading hoses; dredging probably required; mooring dolphins</td>
</tr>
</tbody>
</table>


* n.a. = not applicable, since there is no jetty in this alternative

Alternative 7 was first selected as the most favourable one on economic grounds, but was later on abandoned due to a risk of interference with the cooling water intake structure of the existing Hirgigo Power Plant. Finally, Alternative 3 was selected as the most favourable alternative technically and economically. This alternative was developed further by the Design Consultant in parallel to the ESIA study.

As a first step of the ESIA, a comparative environmental analysis of the 7 alternatives had to be done; this is described in Chapter 4. For a number of environmental indicators, impact values were attributed to the various alternatives, on a range of -3 (very strong negative impact) over 0 (no or negligible effect) to +3 (very strong positive effect). From these evaluations, a first ranking of the alternatives was made. Alternative 3 (the preferred alternative technically and economically) resulted as the preferred option from this evaluation.

Since most differences of impacts between the alternatives are small, and since the impacts as such were mostly classified as small, it was somewhat questionable whether this result was very reliable. For this reason, for a number of indicators a ranking was made, of the type "although impacts are small, Alternative x is still somewhat better
than Alternative y, because…". This led again to an overall rank of the 7 alternatives. In addition, a sensitivity analysis was carried out by attributing different weights to different indicators.

In this analysis, Alternative 3 consistently ranked first, while the others, to some extent, changed position depending on the weights attributed to different indicators. The main arguments against the other alternatives were:

- Longer jetty, and especially longer rock bund, leading to more impact on sea bed habitats (Alternatives 1, 2, 4, 5 and 7).
- Dredging required, and through this again risk of a negative impact on sea bed habitats, mainly on coral reefs, through mobilisation of sediments (Alternatives 1, 2, 4, 5 and 7).
- Interference with cooling water intake of Hirgigo Power Plant (Alternative 7).
- Higher risk of pipeline leakages remaining undetected for prolonged periods, and potentially much larger amount of oil spilled in case of a pipeline rupture, due to entirely submarine pipelines (Alternative 6).

The conclusion of this analysis was that Alternative 3 is indeed the preferable one. This alternative, the only one which is analysed further, is described in some detail in Chapter 5, again based on the technical documents and information received from the Design Consultant. The main features of this option are summarised in Table 2.

### Table 2: Main characteristics of Alternative 3

<table>
<thead>
<tr>
<th>Item</th>
<th>Dimension</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock bund</td>
<td>625 m</td>
<td>from shore to -5 m below CD</td>
</tr>
<tr>
<td></td>
<td>10.75 m</td>
<td></td>
</tr>
<tr>
<td>Crown width</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trestle</td>
<td>500 m</td>
<td>concrete trestle</td>
</tr>
<tr>
<td></td>
<td>10.75 m</td>
<td></td>
</tr>
<tr>
<td>Width</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product pipelines</td>
<td>16&quot; for fuel oil</td>
<td>space for adding 2 additional pipelines for white products</td>
</tr>
<tr>
<td></td>
<td>16&quot; for white products (gasoil, gasoline, kerosene)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8&quot; for LPG</td>
<td></td>
</tr>
<tr>
<td>Fire fighting pipelines</td>
<td>12&quot; salt water for fire fighting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6&quot; spray and personnel protection</td>
<td></td>
</tr>
<tr>
<td>Access road</td>
<td>5 m wide</td>
<td>on jetty</td>
</tr>
<tr>
<td>Offloading</td>
<td>3 arms</td>
<td>marine offloading arms</td>
</tr>
<tr>
<td>Pipeline length on land</td>
<td>850 m</td>
<td></td>
</tr>
</tbody>
</table>

One of the Tasks for this study was stakeholder involvement. A number of stakeholders were listed as such in the TOR, additional ones have been identified by the Consultant during the study. All of these stakeholders were contacted at least once during the study period, some of them several times, in order to inform them about the Project and to obtain comments and input data. Towards the end of the study period, two stakeholder workshops were held, one in Asmara and one in Massawa, where the results of the study were presented and discussed (Chapter 6).
The following Chapters are devoted to the impact assessment of this preferred alternative. The results can be summarised as follows:

**Land use:** no impacts will be noted in this respect, since there is no alternative land use there now, nor is there any real possibility for using this land alternatively. It is a designated industrial area, of no tourist or cultural and historical interest whatsoever (Chapter 7).

**Air Quality and noise:** impacts will occur due to the construction activities, the most important of which will be due to transport of material through residential areas of Massawa town. However, given the volume and duration of these activities, effects will still be within accepted air quality and noise standards. Nevertheless, it is recommended to do the necessary for keeping the impact as low as possible. This can best be done by a good maintenance of the vehicles (mainly to prevent unnecessary air pollution) and a careful planning of transports (to prevent unnecessary driving of lorries and heavy equipment) (Chapter 7).

**Water quality:** as mentioned above, the main risk in this respect stems from the oil spill risk, which is considerably larger now as it is expected to be with the new jetty. The second most important source is the flushing of pipelines, which will remain the same as it is now unless dedicated pipelines are installed. In addition to this, there will be some, albeit limited, impacts on water quality due to construction activities. These should be minimised in the extent possible. The main mitigation measures here are to carry out maintenance and repair work on vehicles and machines in dedicated areas with sealed surfaces and water treatment facilities, and to store fuels, lubricants and chemicals in safe places away from water (Chapter 7).

**Waste:** the most noticeable amount of waste will be generated by the removal of the existing jetty. This material will have to be brought to a suitable dumping site. Most of the material will be suitable for being reused (the pipelines as piping for different purposes or as scrap steel, like the iron reinforcement of the jetty structure, and the concrete material and bricks form the jetty itself as filling material in road construction or similar). It is recommended to use this material in this way, if the jetty is demolished. The other relevant amount of waste is water contaminated with oil products, stemming from flushing the pipeline used for white products. This effect will persist with the new jetty, it could however be eliminated by having dedicated pipelines for the white products (Chapter 8).

**Coast and sea bed dynamics:** The situation at the project site is described. Due to its location in the bay, which is in addition shielded by a number of islands, wind and wave action are generally very weak. The currents are weak as well, sediment transport, erosion and accumulation processes are minimal. Given this situation, the project will not have any noticeable effect on wave action, currents and sediment transport. Changes in sedimentation and erosion will be very small and very localised, if any at all. Specific mitigation measures in this respect are not required (Chapter 9).

**Oil spill and fire risks:** an Oil Spill Risk Assessment and Contingency Plan and a Fire Risk Assessment and Fire Training Plan had to be prepared as part of the assignment. These aspects are dealt with in this Report only very briefly (Chapters 10 and 11); the plans are provided as separate documents (Vol. 2 and Vol. 3) of the ESIA Study.
Health: health risks will arise, in the amount to be expected at construction sites of this size, due to risks of accidents and the risk of transmitting of communicable diseases in the workforce. The contractor will have to take the usual precaution measures (safety equipment, training of workers, health checks, information and health services) in order to minimise risks and to deal with accidents and illnesses that might occur. The one overall public health risk presented by the project is the one which might be caused by a major oil spill. The risk of this happening will be greatly reduced by the new jetty (Chapter 12).

Biodiversity: the impacts on biodiversity (mangroves, sea grasses and sea weeds, coral reefs, marine fauna and birds) are caused mainly (i) by building the rock bund for the new jetty (permanent destruction of habitat, temporary impact on surrounding habitats through mobilised sediments), (ii) by general construction activities (presence of workforce; noise; risk for water contamination; fishing), and (iii) by all activities related to demolishing the old jetty (construction and removal of platform, removal of jetty as such). The latter impact is likely to be more important than the one caused by the new jetty. Although overall determined as rather small impacts, and some of them (like sediment mobilisation) of a temporary nature, mitigation measures are recommended for minimising the impacts to the strict minimum (Chapter 13).

Socio-economy: the project effects, overall, are positive. Given the site and its characteristics, the project does not cause any resettlement, there is no need for expropriation, and no limitation of access to resources. The effect on local fisheries will be negligible, if any (small indirect impact possible through impacting fish populations due to sediment mobilisation, but reduction in risk of much larger impact that would be caused by a major oil spill). On the other hand, there is some potential for jobs being created on the construction site (although on a temporary basis), and it is expected that the regional economy as a whole will benefit from the project (Chapter 14).

Given its potential impacts, the entire Chapter 15 is dedicated to the question of removal of the existing jetty. According to the feasibility report, demolishing the old jetty will require the construction of a "platform" (similar to the rock bund for the new jetty) along the old one over its entire length of about 760 m, and a crown width of about 10 m, to allow the use of cranes and other heavy machines for the work. After the removal of the old jetty, this platform will in turn also have to be removed again. This procedure will have a considerably larger negative effect on sea bed habitats than the construction of the new jetty, by directly destroying a seabed surface similar to the one needed for the new jetty, destroying the habitat which has formed, over the 70 years of its existence, on the submerged parts of the jetty and the rubble mound supporting it, and by damaging additional habitat through sediment mobilisation by building the platform, demolishing the jetty and then removing the platform again. Since there is no need, whether from environmental, aesthetic, land use or economic reason, for actually removing the existing jetty, it is recommended to remove the pipelines (including the submarine parts) and the dolphin, possibly remove the part of the jetty close to and accessible from land in order to make it less accessible for unauthorised persons, but to leave the remainder of it untouched. This would not only save costs, it would also reduce the impact on the marine environment.

Finally, Chapter 16 provides a synopsis of the main impacts and the recommended mitigation measures. The main conclusions are the following:
• The overall major environmental benefit of the project consists in the fact that
the environmental risk presented by the danger of a major oil spill caused by the
decaying structure of the existing jetty will be, not completely eliminated, but
reduced to acceptable standards.

• The construction of the selected alternative of the new jetty at the chosen site
will cause some impacts, all of which, however, are small and of no further
relevance. Furthermore, some of them can be reduced by applying suitable
mitigation measures. Overall, the advantage resulting from abandoning the
existing jetty prevails.

• The demolition of the existing jetty causes impacts which are at least of the same
magnitude, but probably considerably larger, than those caused by the new jetty.
Given this, and in the absence of a stringent reason for removing this structure, it
is recommended not to demolish it.

The recommended mitigation measures are described to some more detail in the EMP
(Vol. 4 of the ESIA Study).

Oil Spill Risk Assessment and Contingency Plan

An Oil Spill Risk Assessment and Contingency Plan has been prepared for the Front
End Engineering Design (FEED) Phase of the new jetty project for Massawa, Eritrea
(Volume 2 of the Study Report). This document will then have to be updated during the
system definition phase of the project.

Central to the Oil Spill Risk Assessment and Contingency Plan are the identification of
release locations along the new jetty and the release types that can occur due to the
products being offloaded at Massawa.

This oil spill risk assessment is based upon the release locations provided in the original
base data and the fact that LPG and a range of white products and black products are to
be offloaded.

Statistical release sizes during product offloading operations have been obtained from
international data based upon vessel sizes which will offload at Massawa. This data may
be seen in Appendix A.

The physical properties of the products to be offloaded (in particular the toxicity data
and recommended clean-up methods for small, large and huge releases) at Massawa
have been obtained from representative Material Safety Data Sheets (MSDS), which are
given in Appendix B.

The causes, consequences and a coarse risk assessment for these release types, sizes and
locations has been documented in the Hazard Register given in Appendix G. Also on
this register is documented the design and operational safeguards that have been
detailed in the FEED documents. The impact of the safeguards on the raw risk levels is
seen by the resulting level of residual risk. The recommended actions for the Massawa
Oil Spill Response Team to respond to the spills are then documented. This semi-
quantitative risk assessment has been the result of table top exercises at EPConsult’s
London offices, and it is recommended that operations personnel become familiar with the register and participate in keeping the document up to date so as to become familiar with the process of control of major accident hazards to the environment.

Huge spills are associated with product storage on the vessel entering the harbour and not jetty operations per se. A matrix is produced in the document, which give for spills at the locations identified for the harbour and jetty, the relevant oil spill response approach, equipment, skimmers and sorbent media.

Thus the resulting FEED level oil spill contingency plan is seen to be hazard based and proportionate. This document also details typical training needs, manning requirements, job descriptions for key positions in the emergency response structure, and emergency response plans. The regulatory framework is also discussed.

This FEED level oil spill risk assessment and contingency plan raises the following design issues, which may be in consideration:

- Windsocks are provided for the new jetty for LPG releases.
- Leak detection devices are considered for offloading product.
- Water sprays, including for personnel protection should be considered for confirmed gas release.
- Clearly flanges should be minimized along the jetty and bunding should be kept clear.
- Oil spill response equipment should be placed in fire proof cabinets on the Jetty, and the work boat should be tethered and provided with a purpose built landing with life saving equipment.
- A small laboratory should be provided for sample analysis and monitoring of harbour waters, sediments and groundwater.
- A freezer should be provided for preserving any wildlife or plants impacted by a spill for further analysis.

It is recognized that many of these measures cannot be considered without cost benefit analyses, and thus it is recommended that this document is revised in the next engineering phase so as to provide the basis for doing this.

This document should be read in conjunction with the companion Fire Risk Assessment and Fire Training Plan.

**Fire Risk Assessment and Fire Training Plan**

A Fire Risk Assessment and Training Plan has been prepared for the Front End Engineering Design (FEED) Phase of the new jetty project for Massawa, Eritrea (Volume 3 of the Study Report). This document will then have to be updated during the system definition phase of the project.
Central to the Fire Risk Assessment and Fire Training Plan are the identification of fire locations along the new jetty and the fire types that can occur due to the products being offloaded at Massawa.

This fire risk assessment is based upon the fire locations provided in the original base data and the fact that LPG and a range of white products and black products are to be offloaded.

Statistical release sizes during product offloading operations have been obtained from international data based upon vessel sizes which will offload at Massawa. This data may be seen in Appendix A.

The physical properties of the products to be offloaded (in particular the flammability data and recommended firefighting methods for small, large and huge fires) at Massawa have been obtained from representative Material Safety Data Sheets (MSDS), which are given in Appendix B.

The causes, consequences and a coarse risk assessment for these fire types, sizes and locations has been documented in the Hazard Register given in Appendix D. Also on this register is documented the design and operational safeguards that have been detailed in the FEED documents. The impact of the safeguards on the raw risk levels is seen by the resulting level of residual risk. The recommended actions for the Massawa Jetty Fire Team to tackle the fires are then documented. This semi-quantitative risk assessment has been the result of table top exercises at EPConsult’s London offices, and it is recommended that operations personnel become familiar with the register and participate in keeping the document up to date so as to become familiar with the process of control of major accident hazards.

Given that huge fires are associated with product storage and not jetty operations per se, two matrices are produced in the document, which give for small and large fires at the locations identified for the jetty, the relevant firefighting approach, equipment, media and personal protective equipment.

Thus the resulting FEED level firefighting training plan is seen to be hazard based and proportionate. It is then a short step to design the training segments and refreshers and the manning requirements of the fire team for the new jetty.

This FEED level fire risk assessment and fire training plan raises the following design issues, which may be in consideration:

- Windsocks are provided for the new jetty for LPG releases.
- Leak detection devices are considered for offloading product.
- The possibility of providing passive fire protection for the slops tank should be considered if this does not constitute corrosion under insulation risk.
- Passive fire protection should be considered for critical shutdown valves and ESD initiation stations.
- Strict no smoking and speed restrictions should be in force on the jetty.
• All work on the jetty should be subject to the appropriate permit to work, including electrical.

• Water sprays, including for personnel protection should be considered for confirmed gas release.

• A fixed inert gas / fresh water spray system should be considered for the electrical switchgear room and the firewater pump house due to gas oil fuel and electrical supply the fire pumps.

• Passive fire protection is considered for the roadside and piperack-side walls of the firewater pumphouse, with a fire rated wall between the switchgear room and the firewater pump house. Consideration should be given to providing passive fire protection to the roof of this building.

• Consideration should be given to locating each fire water pump in a separate pump house on the jetty.

• Clearly flanges should be minimized in this area.

• Consideration should be given to the option of providing foam induction at hydrants, with drums of foam stationed along the jetty.

• Hose reel cabinets to be provided with the necessary lengths of hose, couplings and nozzles.

• Spare firefighting BA to be provided on the jetty.

• Careful design, construction and siting of the operator huts.

It is recognized that many of these measures cannot be considered without cost benefit analyses, and thus it is recommended that this document is revised in the next engineering phase so as to provide the basis for doing this.

This document should be read in conjunction with the companion Oil Spill Risk and Contingency Plan.

Environmental Management Plan

The EMP, Volume 4 of the ESIA Study for the Project of a new petroleum jetty at Higrigio Bay - Massawa, describes in detail the important environmental mitigation measures identified during the impact assessment study (See Vol. 1).

In a first part, the Project as such is being described shortly. The description of the preferred Alternative (which was originally Alternative 3) is given in Table 2 above.

Chapter 2 provides a summary of impacts and mitigation measures as described in Volume 1 (ESIA Report).
Chapter 3 is the main part of the EMP and provides the information on the measures themselves and on institutional requirements. The following are the identified impacts requiring specific mitigation measures:

1. Air pollution  
2. Noise  
3. Pollution of coastal waters  
4. Waste (domestic, solid, liquid, and hazardous)  
5. Debris from existing jetty falling to sea bed  
6. Work accidents, occupational health  
7. Communicable diseases  
8. Loss of marine habitat  
9. Sediment mobilisation  

These measures are described shortly in a summarising Table; a second Table, similarly structured, describes the required monitoring activities. More details on each of the measures are provided in the Mitigation Measures Data Sheets in Annex 1. These sheets describe the impact and its importance, the required measures (including monitoring), the expected effect of the measure, and the responsibilities (for detailed planning, implementation of the measures, and monitoring).

As far as possible, costs of the measures are identified. However, most measures have either to be integrated in the design of the Project or in the overall work plan of the contractor, and therefore in many cases it is not possible to actually identify costs specific to one measure.

Most of the mitigation measures can be characterised as normal procedure and "good housekeeping practice" as required on any larger construction site. Some, however, especially those related to the protection of marine habitats, are project specific.

The most important institutional requirements for implementation of mitigation measures and for monitoring are the following:

- The Contractor will have to include all these measures in his proposal and in his cost estimate.

- The Contractor will need to hire one person whose main responsibility will be the supervision (implementation and internal monitoring) of the specific environmental measures.

- Two other specialised personnel of the Contractor, the responsible person for safety and security, and the responsible for health services and first aid, will
have to assume some responsibilities especially in relation to measures aiming at accident prevention and public health.

- These three specialists will, as part of their duty, carry out the internal monitoring and prepare the required reports (proposed are monthly progress and quarterly summarising reports).

- MPA as the project owner will need to have an environmental specialist for supervising the progress of the work and monitoring compliance with the conditions defined in this EMP.

- For some of the measures, periodic checking by the competent authority (DOE) will be required. This will be done based on the (quarterly) monitoring reports and on regular checks on site.

- It will be the decision of the burrower (the World Bank) whether an external independent monitoring (by means of hiring a recognised external expert, as routinely done in the form of a Panel of Experts in large WB projects) will be required. A short description of the duties of such a PoE is provided. Given the size of the Project, and especially the absence of socio-economic impacts, it is suggested that in this case one environmental expert should be sufficient for carrying out this work.

Since all of these measures will have to be taken during - and most of them are restricted to - the construction period, and will therefore have to be implemented by the Contractor, it is important that the measures formulated in this EMP will be included as conditions in the tender documents. This can be done by including the Mitigation Measures Data Sheets in the tender documents. In addition to that, it would also be possible to include general environmental conditions in the respective contracts. Such conditions are listed - although not necessarily as an exhaustive list - in Annex 2.

The implementation of the mitigation measures and the monitoring has to be integrated in the overall construction schedule as shown in Chapter 5.