

11. CONCLUSIONS AND RECOMMENDATIONS

11.1. Introduction

The purpose of this DEIA Study is to assess the key environmental issues arising from the construction and operation of the DGA at Tang Lung Chau, as identified in the Key Issues Report, and to propose mitigation measure requirements for all identified adverse environmental impacts. The identified key issues comprise water quality, fuel spillage, air quality, noise, waste management and mud contamination, hazard assessment and ecology.

The main objectives of the assessment are as follows :

- To identify and quantify emission sources and determine the significance of impacts on sensitive receivers and potential affected uses.
- To quantify the potential losses or damage to flora, fauna and natural habitats during construction and operation of the DGA.
- To propose the provision of mitigation measures so as to minimize pollution, environmental disturbance and nuisance during construction and operation of the DGA.
- To identify, predict and evaluate the residual (i.e. after practicable mitigation) environmental impacts and cumulative effects expected to arise during the construction and operation phases of the DGA in relation to the sensitive receivers and potential affected uses.
- To identify, assess and specify methods, measures and standards, to be included in the detailed design, construction and operation of the DGA which are necessary to mitigate these impacts and reduce them to acceptable levels.
- To design and specify the environmental monitoring and audit requirements necessary to ensure the implementation and the effectiveness of the environmental protection and pollution control measures adopted.
- To identify constraints associated with the mitigation measures recommended in the study.
- To identify any additional studies necessary to fulfill the objectives to the requirements of this Environmental Impact Assessment Study.

This section summarizes the findings and recommendations of the DEIA Study, and draws the conclusions of the study.

11.2. Findings of the Evaluation of Key Environmental Issues

The findings of the prediction and evaluation of potential environmental impacts which may arise during the construction and operation phases of the TLCDGA are summarized below for each identified key issue.

11.2.1. Water Quality

The key issues during the construction phase would be potential impacts from dredging and sandfilling works for the breakwater foundations, the release of contaminants during dredging of marine sediment, and potential cumulative impacts on water quality should there be other marine-based projects in progress near the study area. During the operational phase, key water quality issues include effects on tidal flow due to the presence of the breakwaters for the DGA, local impacts related to the discharge of sewage from vessels inside the DGA, and potential impacts from maintenance dredging.

of the proposed DGA, which is the maximum odour impact distance predicted. Similarly, baseline and impact monitoring of noise levels are not considered necessary as the IEIA predicted no unacceptable noise impact during construction activities. The IEIA also predicted no noise impact from unmitigated operational activities.

During the operational phase, annual surveys would be conducted by Marine Department (MD) to ensure that the vessels using the TLCDGA meet the safety requirements of the MD. The "Declaration of Fitness for Vessel to Carry Petroleum" which specifies the type of DG cargo that the vessel is licensed to carry would be renewed following the satisfactory outcome of this survey. Furthermore, spillages or discharges of petroleum products from vessels moored within the DGA would not be permitted under the Merchant Shipping (Prevention of Oil Pollution) Regulation and would be controlled by MD. With the implementation of these operational controls at the TLCDGA, it is considered that an EM&A programme of the operational activities of the DGA would not be required.

Water Quality Baseline and Impact Monitoring

It is recommended that a baseline water quality monitoring programme be undertaken prior to the commencement of the construction works. The determined baseline levels would be used as a basis for environmental impact and compliance auditing during the implementation stage.

The location and number of water quality monitoring stations will be identified in the EM&A Manual, together with details of the monitoring parameters and frequencies and equipment to be used. It is recommended that monitoring stations be located in the vicinity of the nearest identified sensitive receivers and that control stations will be necessary to compare the water quality from potentially impacted stations with the ambient water quality. These control stations should be located within the same body of water as the impact monitoring stations but outside the area of influence of the works and, as far as practicable, not affected by any other works.

Waste Disposal Impact Monitoring

Waste management will be the contractor's responsibility to ensure that all wastes produced during the construction of the proposed TLCDGA are handled, stored and disposed of in accordance with good waste management practices and EPD's regulations and requirements. The contractor will be required to ensure that loss of dredged material does not take place during transportation of the material in barges to the designated marine disposal ground. Transport barges or vessels should be equipped with automatic self monitoring devices as specified by DEP. The Contractor will be required to monitor all vessels transporting dredged material to ensure that no dumping outside the approved location takes place.

Other waste materials generated during construction activities, such as waste construction materials, chemical wastes and general refuse from the workforce, are recommended to be monitored or audited at regular intervals to ensure that proper storage, transportation and disposal practices are being implemented. This monitoring of waste management practices will ensure that these solid and liquid wastes generated during construction are not disposed into the surrounding marine waters.

Although monitoring of marine water quality is not considered necessary during maintenance dredging within the DGA (as the degree of impact is far less than the construction phase dredging, Section 3.8.3), monitoring of barge loading should be undertaken during the transport of dredged material to the allocated marine disposal ground, as for the construction phase dredging works.

The above recommended monitoring and control requirements will be developed in detail in the EM&A Manual.

reduction in flow of 3.11% through Victoria Harbour on the wet season spring tide, it is not anticipated that the water quality in Victoria Harbour would deteriorate significantly. This is because the predicted flow reduction through Victoria Harbour on the wet season ebb tides would be compensated by the reduction of pollution loading into Victoria Harbour from the implementation of the SSDS Stage 1.

Based on the findings of the preliminary siltation study carried out to give an initial estimate of the likely sediment deposition rate within the DGA, the volume of maintenance dredging required within the DGA is minor in scale on comparison to the construction phase dredging. Sediment plumes generated during dredging will largely be contained by the breakwaters, due to the weak tidal currents within the DGA, and therefore no unacceptable impacts on water quality are anticipated to result at the sensitive receivers. Nevertheless, it is recommended that good operational practices be observed during maintenance dredging to minimize potential impacts on water quality.

11.2.2. Fuel Spillage

Simulations of the movement and shoreline stranding of fuel spilt at a site near the centre of the DGA and at sites near the northern and southern entrances were conducted for spring and neap tides in the dry and wet seasons for the defined worst-case scenario. The model results correspond to the prevailing environmental conditions (tide type, wind, etc), and have been used to assist in contingency planning.

The frequency of the worst-case spill from a 1,200 tonne vessel (loss of 90% of spill cargo) happening outside the DGA was found to be 3.81×10^{-4} per year (i.e. once in 2,600 years). For a smaller typical vessel of 400 tonnes capacity, the frequency of a spill event is estimated to be once in 190 years. These frequencies are considered to be low. The surface fuel thicknesses predicted at the sensitive receivers are for the event that no containment actions are implemented at the source of the spill nor mitigation measures implemented at the sensitive receivers, and thus represent likely maximum values.

The results of the fuel spill modelling indicate that the shortest time in which the fuel slick is shown to impact bathing beaches is within 1 hour for the two beaches on Ma Wan for a spill location near the northern entrance of the DGA (dry season tides). For the gazetted beaches along the southern coastline of the north-west New Territories, there is a time lag of at least 7 hours until the fuel slick affects the beaches. At the Ma Wan fish culture zone, the fuel slick is shown to first affect the fish culture zone at Kung Tsai Wan between 1 to 2 hours following a spill at the southern entrance of the DGA (dry season tides). Marine Department (MD) have advised that their response time to activate the Oil Pollution Contingency Plan (OPCP) is within 2 hours in the harbour limit and that the same time frame shall apply to the DGA. For a fuel slick reaching the fish culture zone within 2 hours, it would require flood tide conditions in the dry season with an east-south wind direction. Coupled with the low frequency of a fuel spill event near the DGA southern entrance, the frequency of the spill reaching the fish culture zone within 2 hours is even lower. Anti-oil pollution equipment is available at gazetted bathing beaches and appropriate action will be taken in accordance with the OPCP in the event of a fuel spill. Therefore, oil pollution mitigation measures in addition to the OPCP are not considered to be required.

Prompt response action will be required in the event of a major fuel spill near the northern and southern entrances of the TLCDGA so as to limit the spread of fuel at the source and thereby minimize the potential for adverse environmental impacts on the two beaches at eastern Ma Wan and the Ma Wan fish culture zone. Provided that the protocols and operational procedures defined in the MD's OPCP are implemented immediately, it is considered that the risk posed to the marine environment would be minimized as far as possible.

underlying the environmental monitoring and audit programme;

- Full details of the methodologies to be adopted, including all field laboratory and analytical procedures, and details on quality assurance and quality control programme;
- Rationale on which the environmental monitoring data will be evaluated and interpreted and the details of the statistical procedures that will be used to interpret the data;
- Definition of Action and Limit Levels for each of recommended monitoring parameters;
- Establishment of Event and Action Plans for impact and compliance monitoring;
- Requirements of reviewing pollution sources and working procedures required in the event of non-compliance of the environmental criteria and complaints;
- Requirements of presentation of environmental monitoring and audit data and appropriate reporting procedures and frequency; and
- Requirements for review of EIA predictions and effectiveness of the environmental monitoring and audit programme.

surrounding marine waters. Similarly, provided that the recommended mitigation measures are also followed during maintenance dredging, no unacceptable impacts on water quality and marine biota are anticipated. As discussed under water quality, the results of the bacteria dispersion modelling of sewage discharges from vessels moored within the DGA indicated minimal *E. coli* concentrations at the nearest sensitive receivers on Ma Wan.

11.2.6. Hazard

The proposed relocation of the DGA from Tsuen Wan Bay to Tang Lung Chau may result in potential hazards from the transport and storage of the dangerous goods to nearby populations and the railway, road and ferry users. The off-site risk associated with the DGA has been the subject of a few recent assessments. The most relevant study is the *Tsuen Wan Dangerous Goods Anchorage: Alternative Site Search Study - Site Search Study* (the Site Search Study) conducted by Marine Department in March 1995. The results suggested that the individual risk level is within the acceptable risk level and the societal risk level is within the as low as reasonably practicable (ALARP) region.

The purpose of the hazard assessment is to review and confirm that the potential hazard associated with the TLCDGA, as presented in the Site Search Study, is still valid in light of changes incurred since the assessment was carried out in 1995. To assess the potential effect of these changes to the off-site risk levels, past assessments have been reviewed and updated information and data has been collected from Government Departments. The findings of the review confirm that the assumptions and assessment results of the Site Search Study are still applicable for the majority of the issues considered. For those assumptions that have changed since the Site Search Study, the findings of the review indicate that these modifications do not alter the individual risk and societal risk results as presented in the Site Search Study. Therefore, the individual risk and societal risk associated with the TLCDGA are acceptable according to the risk levels prescribed in Annex 4 of the *TM on EIA Process*.

The proposed "Film-City" development at south Ma Wan is an uncommitted private sector project and thus is considered to be outside the scope of the DEIA study. According to the decision of the Town Planning Board, the proponent of the "Film-City" development would need to provide sufficient information including those on risk issues in relation to the DGA for the Town Planning Board's consideration of approving the proposed "Film City" development.

11.2.7. Ecology

The sensitive ecological receivers identified are:

- the Ma Wan fish culture zone;
- the fishery resources in the vicinity;
- beaches along the coastline of Ma Wan, southern North-West New Territories and Lantau;
- intertidal organisms on Tang Lung Chau; and
- Chinese White Dolphins (*Sousa chinensis*) which may be present in the area.

Dredging activities during the construction phase of the DGA are likely to locally increase the turbidity of water, smother or disturb sensitive species and modify the bottom substratum, and hence potentially affect the above sensitive receivers. The sediment plume modelling simulations, undertaken to simulate the fate of sediment lost to suspension during dredging, predicted elevations in SS levels in compliance with the WQO at the Ma Wan fish culture zone. It is considered that the loss of suspended solids to the marine environment and the resulting impacts on ecological sensitive receivers can be minimized, provided that the recommended mitigation measures for dredging works are fully implemented. In the long term, after construction is complete, areas no longer subject to

Sediment plume modelling of the effects on water quality of fine sediment lost to suspension during dredging was conducted. A worst-case scenario was assumed for the sediment plume modelling, with loss rates for fine particles based on three open grab dredgers working concurrently without the employment of silt curtains. The predicted increases in suspended sediment (SS) concentrations above ambient levels are less than 1 mg/L for all of the beaches except Tung Wan Tsai. The maximum predicted increases in SS concentrations at Tung Wan Tsai during the dry season spring tide and wet season neap tide are above the acceptable level stipulated by the Water Quality Objectives (WQO) for SS. The full implementation of the recommended mitigation measures will be necessary to reduce impacts resulting from the dredging works to within acceptable levels and to maintain the water quality in accordance with the WQO. The recommended measures include the use of closed grab dredgers or trailing suction hopper dredgers (with no overflow nor ALMOB), the specification of an upper limit on the dredging rate to be employed and no concurrent dredging and sandfilling works. At the Ma Wan fish culture zone, the predicted maximum increases in SS concentrations are in compliance with the WQO. The release of heavy metals from sediment pore water during dredging of contaminated sediment is not predicted to result in any adverse impacts on water quality.

The predicted increases in SS concentrations at Tung Wan Tsai and the Ma Wan fish culture zone during filling activities by bottom dumping are well in exceedance of the allowable increase under the WQO. Therefore sandfilling by bottom dumping is not considered to be an environmentally acceptable method. In view of the predicted high concentrations at the sensitive receivers, the recommended method for sandfilling is the use of a trailer suction hopper dredger, or other suitable vessel, with sandfill placement by pipeline discharge relatively close to the breakwater trench. With this proposed mitigated method, the maximum elevations in SS concentrations at Tung Wan Tsai and the Ma Wan fish culture zone are shown to be in compliance with the WQO for SS. The mitigated sandfilling works are therefore not anticipated to result in any unacceptable impacts on water quality at the water sensitive receivers.

To further reduce the potential impact to the water sensitive receivers during the dredging and sandfilling works, particularly at the Ma Wan fish culture zone, the adoption of additional mitigation measures is recommended. These additional measures comprise restricting the number of closed grab dredgers to not more than two working at one time; and conducting one of the weekly water quality monitoring events for impact monitoring during night-time hours should there be dredging or sandfilling works at this time. The proposed mitigatory measures would provide further protection at the water sensitive receivers.

Based on the available information, the potential has been identified for construction activities for the DGA to be concurrent with dredging and filling works for the Penny's Bay Reclamation and CT9. An assessment of potential cumulative impacts on water quality resulting from these concurrent works indicates that the predicted maximum increases in SS concentrations during the mitigated dredging and sandfilling works for the DGA construction are within the allowable increases stipulated by the WQO. Therefore, it is anticipated that the construction activities for the TLCDGA are unlikely to result in unacceptable impacts on water quality should there be marine-based works in progress near the study area for the Penny's Bay Reclamation and CT9.

Bacterial plume modelling was carried out to simulate the dispersion of bacteria generated from sewage discharged by vessels moored within the DGA. The results show that only minimal *E. coli* concentrations occur at Tung Wan Tsai and Tung Wan beach under the two spring tides. Bacterial concentrations at the Ma Wan fish culture zone are almost undetectable.

As the overall water quality related to the TLCDGA has been found to be acceptable in the Cumulative Impact Study on Harbour Reclamation, detailed tidal flow modelling was conducted to determine the impact of the completed TLCDGA on tidal current patterns. Despite the predicted net

placement for the breakwater foundations shall not be carried out concurrently. This restriction on there being no concurrent dredging and sandfilling works includes such works for different stages of the breakwater construction at one time.

11.4. Overall Conclusion

It is considered that with the full and strict implementation of the recommended environmental protection and pollution control measures, that there will not be any insurmountable environmental impacts associated with the construction and operation of TLCDGA. In addition, no unacceptable residual impacts are anticipated to result from the implementation of the recommended mitigation measures.

If the fuel spill occurs within the DGA, it is shown that the majority of the slick is contained by the breakwaters and that only very small quantities of fuel can pass through the northern entrance of the DGA. On examining possible spill plumes from chronic vessel seepage, it is found that the majority of the fuel seepage plume formed is likely to remain within the DGA due to the weak tidal currents inside the DGA. Furthermore, it is considered unlikely that any significant impacts on water quality would arise at the sensitive receivers due to the very low surface fuel thickness predicted.

11.2.3. Air Quality

The IEIA described that the casting of concrete armours is likely to be the only source of dust during the construction of the breakwaters. This was not expected to result in unacceptable air quality impacts. The IEIA also stated that no unacceptable air quality impact was anticipated from the operations of the DGA.

In a meeting with a group of fishermen from Ma Wan, however, concern with potential odour emissions from the vessels within the DGA was raised. To assess future conditions during operation, computer dispersion modelling was undertaken to determine the odour impacts in the vicinity of the proposed DGA based on the odour levels measured at the existing TWDGA.

The dispersion modelling predicted that the maximum distance of the 5 odour units (OU) odour level contour would be around 500 m from the boundary of the proposed DGA. Since the nearest air sensitive receivers on Ma Wan are located more than 550m from the boundary of the DGA, it is not anticipated that there would be any exceedance of the odour limit of 5 OU (5-second average) at these air sensitive receivers. No odour mitigation measures are therefore necessary during the operation of the DGA.

11.2.4. Noise

The IEIA concluded that there would be no exceedance of the Acceptable Noise Levels stipulated under the NCO during construction activities. In addition, the IEIA predicted that there would be no noise impact at the identified noise sensitive receivers from unmitigated operational activities. No significant difference in noise levels from the IEIA is anticipated for the proposed construction activities. Therefore no unacceptable noise impacts have been predicted during the construction and operational stages. Noise mitigation measures are thus not necessary during the construction and operation of the DGA.

11.2.5. Waste Management and Mud Contamination

The assessment has concluded that the potential impacts of the dredging works and associated dredged sediment disposal will be minimized, provided that the recommended mitigation measures, including the procedures detailed in *Works Branch Technical Circular No. 22/92*, are strictly implemented. Dredged sediment identified as seriously contaminated material will require disposal at the East Sha Chau Contaminated Mud Pits. Dredged sediment classified as uncontaminated or moderately contaminated material will be suitable for disposal at a gazetted marine disposal ground. The quantities of contaminated and uncontaminated sediment and the required disposal ground allocation will be confirmed at the detailed design stage following detailed sediment quality analysis. It is therefore anticipated that no unacceptable impacts will result from the dredging, transport and disposal of the marine sediments.

It is anticipated that no adverse environmental impacts will arise during the construction period, provided that the non-sediment construction waste arisings are handled, transported and disposed of using approved methods and that no solid or liquid wastes (other than sewage discharges) enter the