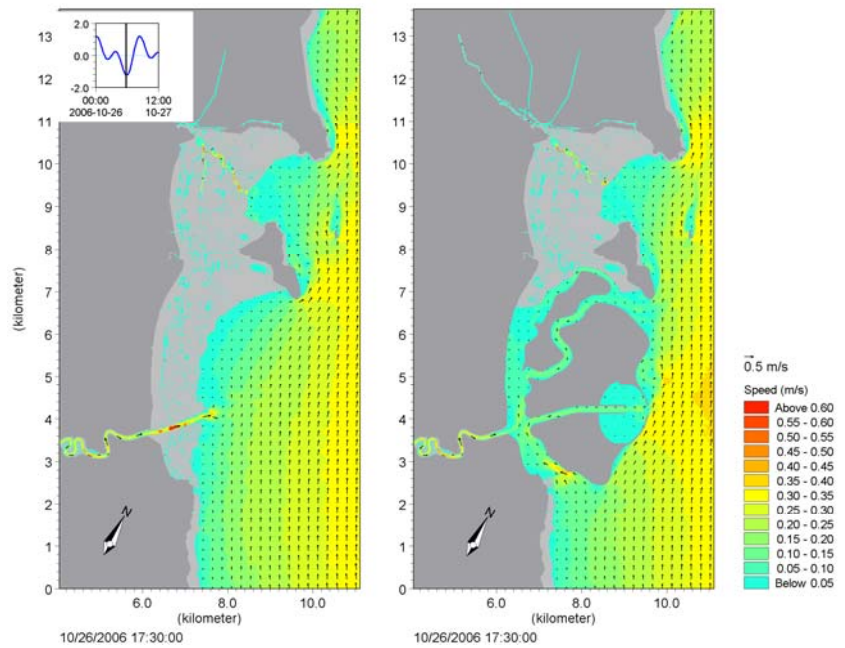
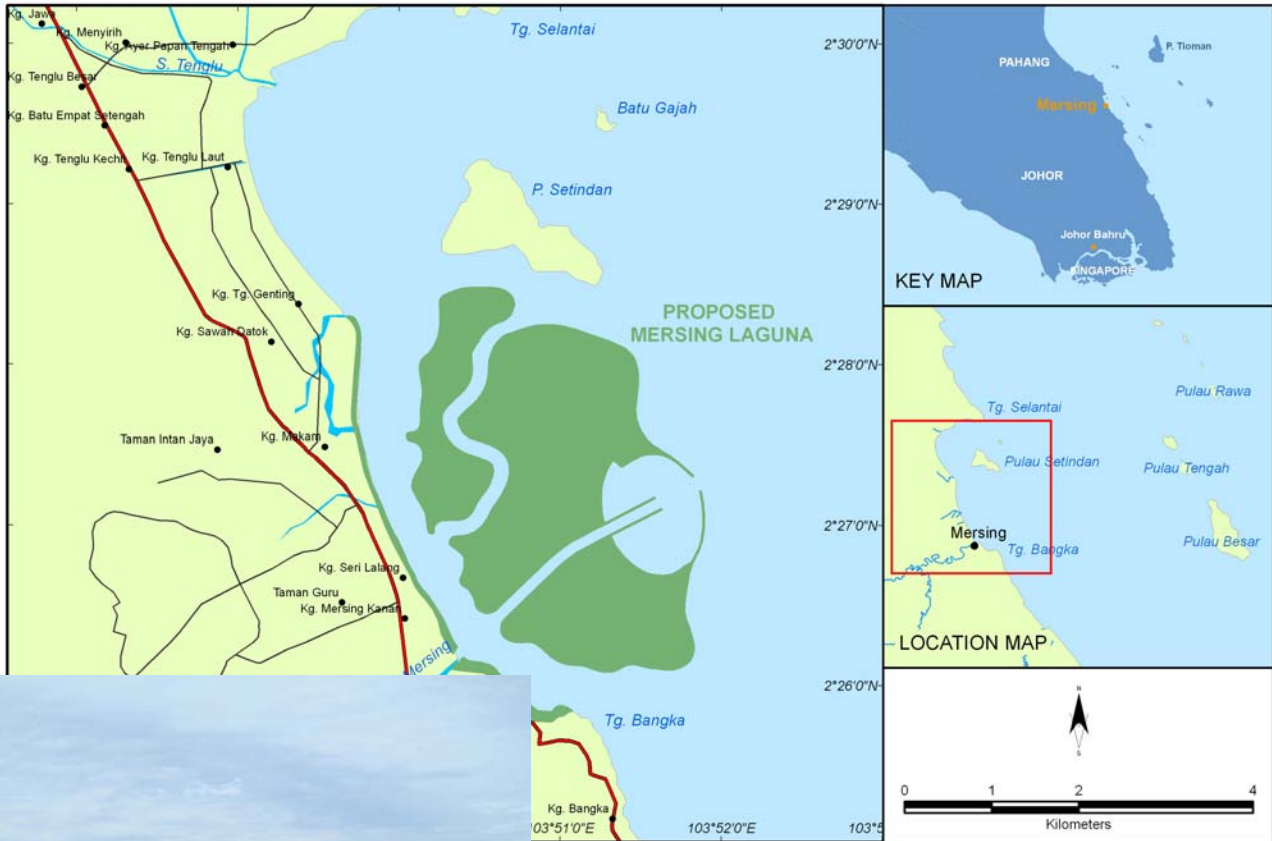


Proposed Mersing Laguna Reclamation

Revised Detailed Environmental Impact Assessment

Volume I: Summary



Proposed Mersing Laguna Reclamation

Revised Detailed Environmental Impact Assessment


January 2009

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Project Title DEIA and Hydraulic Studies for the Proposed Mersing Laguna Reclamation	Project / Report No MY5380 / 03
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	Approved by  Mark Oliver

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“DEIA for The Proposed Mersing Laguna EIA Reclamation”

Radiant Starfish Development Sdn Bhd

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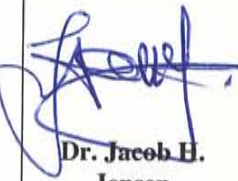







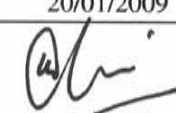


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I declare the following:

- (a) I have conducted the study professionally using acceptable methodologies;
- (b) The study findings are correct to the best of my knowledge; and have not been altered in any manner;
- (c) The mitigating measures proposed (whenever relevant) to the best of my knowledge are reliable, practical and adequate to comply with the relevant legal requirements; and
- (d) I shall be accountable for any misleading information in any part of this report

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Radiant Starfish Development Sdn Bhd

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- (n) The study findings are correct to the best of my knowledge; and have not been altered in any manner;
- (o) The mitigating measures proposed (whenever relevant) to the best of my knowledge are reliable, practical and adequate to comply with the relevant legal requirements; and
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I declare the following:

- (a) I have read and checked the content of this EIA report;
- (b) My study team members have conducted the study professionally using acceptable methodologies;
- (c) The study findings are correct to the best of my knowledge; and have not been altered in any manner;
- (d) The mitigating measures proposed (whenever relevant) to the best of my knowledge are reliable, practical and adequate to comply with the relevant legal requirements; and
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DEIA FOR THE PROPOSED MERSING LAGUNA DEVELOPMENT

RADIANT STARFISH DEVELOPMENT SDN BHD

I declare the following:

- (a) I have provided correct and relevant information to the EIA Study Team;
- (b) I have allowed the EIA Study Team to conduct the EIA study professionally and independently;
- (c) I have read and understood the content of the EIA Report;
- (d) I agree to implement all mitigating measures proposed in this EIA report; and
- (e) I understand that additional mitigating measures may also be imposed by Department of Environment Malaysia; should the original mitigating measures proposed in this EIA report found not to be adequate to comply with the relevant legal requirements.

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EXECUTIVE SUMMARY



1 INTRODUCTION

Radiant Starfish Development Sdn. Bhd. proposes to develop an integrated tourism resort on 2,000 acres of reclaimed land in Mersing. The reclamation project and subsequent development is titled the “Proposed Mersing Laguna Development”.

1.1 Project Location

The proposed project is located on shallow tidal flats in Mersing Bay at Mersing, Johor. Mersing is the name of a town and district in the northeast corner in the state of Johor; the town being located approximately 136 km from Johor Bahru, the capital of Johor.

The proposed reclamation stretches just over seven kilometres along the coast of Mersing Bay, lying between Tg. Selantai and Tg. Bangka. Geographically, the Project site spans across from Latitude 2°30'19"N, Longitude 103°50'52"E at Tg. Selantai and Latitude 2°25'53"N, Longitude 103°51'32"E off Tg. Bangka.

1.2 DEIA Scope

The present EIA study covers the impacts arising from all activities involved in the reclamation of land for the proposed Mersing Laguna development, both during construction (reclamation phase) and post-reclamation.

The infrastructure and activities that are beyond the scope of this assessment and will be assessed under separate approval processes are:

- Offshore borrow dredging (requiring EIA)
- Geotechnical surveys and detailed design.
- Construction and operations of individual components (hotels, resorts, etc.) on the reclaimed land (requiring EIA).

2 STATEMENT OF NEED

The proposed project dovetails with current Federal and State government policies and strategic plans, in particular, this project is an essential component in the Eastern Corridor Economic Region (ECER) covering the state of Kelantan, Terengganu, Pahang and the district of Mersing for Johor. Specifically, the need for the proposed project is based on the following:

(i) Localising Tourism Benefits

Tourists visit Mersing Town primarily as a stopover in transit to P. Tioman in Pahang. In 2004 it was reported that the number of tourists from Mersing visiting Tioman exceeded those heading for the Mersing islands by more than 70 per cent.

The aim of the Mersing Laguna development is therefore to create a new tourism destination and facilities of international standards in line with the national tourism masterplan. This will attract additional tourist arrivals into Johor and increase tourism revenue, especially for Mersing town and its surroundings.



(ii) Balanced Development

Presently, development within the State is concentrated in the state capital of Johor Bahru. The agricultural sector is the main economic activity for the population within the Mersing district, which in general generates low income levels. Thus, Mersing was reported to have high unemployment rate and out migration rate. Employment growth rate including level of industry is still low compared to other districts in Eastern Johor.

These and other factors indicate an imbalance in population and urbanisation between the districts in Johor. The development of this project, with its projected economic and employment opportunities, in one of the rural areas of the state, will contribute to achieving the third key thrust of the Ninth Malaysia Plan to address socio-economic inequalities.

(iii) Land Development Area

Based on the land suitability analysis of the Mersing Town Local Plan (1999-2010), only around 25% of the land in Mersing District is suitable for development. This area also includes agricultural lands which are not gazetted as agriculture reserves.

Much of the coastal lands around Mersing town are agricultural land, with Class 1 and Class 2 soil suitability classifications. These areas are hence designated Prime Agriculture Areas (PAA), for which under the National Physical Plan the policy is to conserve such PAAs from conversion to urban land. As such, less than one third of the land available in Mersing is not suitable for development, hence the need to reclaim the beach front to avoid future conversion of productive agricultural land for Mersing Town expansion and to prevent land usage conflicts.

In addition, the land availability analysis does not take into account land fragmentation. A large proportion of coastal land in Mersing Bay and Air Papan is Malay Reserve. It is highly unlikely that a sufficiently large contiguous land area is available for a development of the scope of the Proposed Mersing Laguna and if reclamation was not carried out, socio economic impacts of land acquisition, and conversion of land status from Malay Reserve land would be very high.

iv) Breakwater Development

The Mersing river mouth currently faces sedimentation problems, such that navigation for fishing vessels and ferries to the offshore islands is tidally-restricted. Maintenance dredging in Sg. Mersing has been carried out regularly (every two or three years) by the Marine Department in the past.

Among the key infrastructural components of the present Development are the river training walls and breakwaters. These have been designed to allow safe 24-hr navigation into Sg. Mersing. After construction of these river training walls and breakwaters the requirements for maintenance dredging will be significantly reduced.



3 PROJECT OPTIONS

3.1 Site Options

Mersing town was selected as a reclamation area for the following reasons:

- (i) The Johor State government considers that Mersing has been left out of the mainstream economic development.
- (ii) Mersing has all the attributes to be developed as a successful international eco tourism development as it is situated between the Mersing marine park and the Endau Rompin forest national park.
- (iii) The State of Johor has included the designated reclamation area in the District of Mersing Structural Plan (1991-2010) and the District of Mersing Local Plan (1999-2010).
- (iv) Jabatan Perancang Bandar dan Desa is also incorporating the designated reclamation area in the State Draft Structure Plan 2020 and have submitted the working paper to their head office for the said project to be table and adopted by the Majlis Perancangan Fizikal Negara.

Hence no site options were considered given that the Project concept was developed based on the site at Mersing itself with the aim specifically to bring economic development to Mersing Town.

As for site selection within Mersing Town, for the reasons set out in the statement of need above, reclamation is the only viable option to obtain the land area required for a project development of this scale.

3.2 Project Concept

The Project Concept entails the development of a fully integrated resort planned and managed by a single entity as detailed in Section 4 below.

An alternative to turn Mersing into a tourist destination is to encourage and provide incentives for individual developers to construct the tourism facilities separately.

However, such development outside of the Mersing Laguna masterplan context would be unlikely to be able to attract foreign investors or bring the scale of economic development and investment to Mersing such as that estimated for the present Mersing Laguna development. Integrated management of environmental and planning issues would also be hampered by development by individual project proponents which would likely be on a piece-meal basis. Hence, the proposed Mersing Laguna development is considered the best option to create more tourism attractions, foreign investments and economic development to the town of Mersing.

3.3 Layout Options

Numerous layout options were assessed in an interactive process between the project design team and the hydraulic engineers. The initial conceptual plan developed by the project architect was studied and subjected to hydraulic modelling to determine environmental impacts. Key considerations to optimise the layout were:

- (i) To preserve the existing shoreline



- (ii) Navigation safety at breakwater entrance
- (iii) Providing 24 hour navigation access to Sungai Mersing
- (iv) Sedimentation in the existing Sg. Mersing channel leading to increased upstream flooding risks
- (v) Flushing and water quality considerations within the internal channels between reclamation areas, and also between the reclamation and the existing shoreline. A key issue is to avoid areas of stagnant water within the channels owing to inadequate flow of water through these areas
- (vi) Minimising the impact on the sea grass in the vicinity of Pulau Setindan.

The DEIA is based on the Final Layout, which has shown the least impacts in terms of the factors listed above. This layout was developed following the DOE/JPS review of the DEIA submitted in August 2008. This review included JPS carrying out independent modelling work using model data supplied by the project proponent. The final layout is based on the layout recommended by DOE and JPS following this independent modelling work.

4 PROJECT DESCRIPTION

4.1 Reclamation and Marine Construction Works

The reclamation covers a total area of approximately 2,000 acres of coastal land requiring approximately 50 million cubic metres of fill material for this purpose. The project components are summarised in Table E4.1.

Table E4.1 Key components of the Mersing Laguna reclamation.

Component	Description
Reclamation areas	<ul style="list-style-type: none"> • Three islands. • Shore linked reclamation south of Mersing River • 50 million m³ of fill material.
Breakwater	Symmetrical breakwaters with entrance at -4m CD
Navigation Channel	New navigation channel through the reclaimed area between the existing river mouth and the breakwater entrance. The channel is 150m wide and dredged to -4m CD.
Marina	Two marinas within breakwater.
River channel dredging	<ul style="list-style-type: none"> • Dredging of Mersing river channel to -4mCD. • Dredged material used as reclamation fill
Internal channel dredging	<ul style="list-style-type: none"> • Dredging of internal channels. • Around 20 million m³, including river channel and basin dredging • Dredged material used as reclamation fill
Artificial beaches	Stretches of artificial beach at one location
Coastal Protection	Revetment protection to perimeter of reclamation islands



4.2 Built Development

Mersing Laguna development is a Master Plan guiding the project proponent and co-developers for the various specific components. A portion of the reclaimed land will be parcelled out to various independent developers for subsequent development based on the Masterplan layout with the remainder being develop by the project proponent.

The carefully planned layout will optimise and synergise the various tourism developments and its support facilities which will include among others:

- 4-star thematic boutique hotels
- 5 to 6-star hotels
- Individual chalets
- convention centre
- yacht clubs
- marinas / jetty / water parks
- specialty restaurants
- shops / retail arcades
- mosque
- Waterfront villas
- Resort Specialist Medical Centre – Health Tourism
- Hospitality Colleges - Education Tourism
- A1 Grand Prix Street Circuit with high-end estate development around the track
- State of the art Cultural Centre

5 EXISTING ENVIRONMENT

5.1 Physical Components

The baseline physical environment as relevant to the environmental impact assessment of the proposed reclamation project are summarised in Table E5.1.

Table E5.1 Existing physical environment within and in the vicinity of the proposed project site.

Components	Description
Meteorology	<p>Meteorological conditions are governed by the monsoon and inter-monsoon seasons. The Northeast monsoon season dominates from November through March and can bring heavy rains and strong northerly winds to the East Coast of Peninsula Malaysia.</p> <p>The Southwest monsoon season usually lasts from June through early October and is much generally much weaker than the Northeast monsoon. The land-sea breeze is significant (with respect to the strength of the offshore wind field) only during the SW monsoon, whereas offshore winds dominate during the NE monsoon.</p> <p>April to May and October to early November are transition periods also known as inter-monsoon periods.</p> <p>Generally winds at Mersing can be considered light with a monthly average maximum speed of less than 7 m/s. Average wind speed is approximately 4.2m/s.</p> <p>The average rainfall in the area is 2378 mm/year.</p>



Components	Description
Hydrography	<p>The proposed reclamation site is located in shallow waters between Tg. Genting and Tg. Bangka. The site is relatively protected by the string of small offshore islands. The beach generally has a shallow slope, with a large intertidal area. In the immediate vicinity of the river mouth the 0.0m CD contour is approximately 1km offshore, with the -4m CD contour being approximately 4km offshore. At low spring tides the beach dries out landward of Pulau Setindan which is in excess of 1km offshore.</p> <p>The wave climate is composed of locally generated wind waves and swell waves approaching from the South China Sea. The highest wave heights and predominant wave direction is from the Northeast. There is a sheltering effect of the offshore islands (Tioman and the Seribuat – P. Besar islands).</p> <p>The tides along the Mersing coast are a mixture of semi-diurnal and diurnal tides. Tidal characteristics vary little along the Mersing and Pahang coastlines with an average tidal range of approximately 1.9 m.</p> <p>Regionally, coastal currents are influenced by the prevailing monsoon seasons, running strongly north along the coast during SW monsoon, and south during NE monsoon. Currents at the project site are influenced by the wide shadow basin between the mainland and P. Setindan.</p>
Coastal Processes	<p>The coastline around Mersing Bay is strongly influenced by the shelter afforded by the offshore islands. It is characterised by headlands with bays contained between the headlands. Tg. Selantai provides additional shelter to nearshore areas, resulting in an extensive tidal flat that extends to the island.</p> <p>There is limited exchange with the northern coastal cells past Tg. Selantai, and to the south the coast becomes rocky with protruding outcrops and small stretches of beaches between, which would limit sediment transport. Littoral processes are mostly contained within Mersing Bay, and coastal morphology is close to equilibrium.</p>
Hydrology and Drainage	<p>There are a number of drains, tributaries and rivers that drain runoff from the hinterland behind the proposed reclamation site to the sea. Of these, Sg. Mersing is the main river system with a catchment area of 270 km². Sg. Tenglu is to the north of the proposed reclamation, which drains a catchment area of around 70 km². Elsewhere, there are a number of smaller coastal catchments that drain into the sea rather than into the major river networks, many of which are outlets for urban drainage networks.</p>
Water Quality	
River Water Quality	<p>Water quality surveys in Sg. Mersing and Sg. Tenglu showed that river water quality is poor, with several parameters falling outside the Interim National Water Quality Class IIB standards:</p> <ul style="list-style-type: none"> • Several DO samples fell below the minimum concentration level for Class III. • Several BOD samples exceeded Class IV standards. • Several COD samples exceeded Class III • E.coli concentrations exceeded US Environmental Protection Agency (USEPA) Water Quality Standards • Ammoniacal Nitrogen concentrations exceeded the Class IIA/B limit • Iron levels exceed Class IIA/B
Marine Water Quality	<p>Nearshore marine water quality is poor, with several parameters falling outside the Interim National Water Quality Class IIB standards:</p> <ul style="list-style-type: none"> • DO concentrations were found to be borderline compared to the ASEAN marine water quality standards. • BOD samples exceeded Class IV standards • COD samples exceeded Class III standards • E.coli concentrations exceeded Water Quality Standards • Ammoniacal Nitrogen concentrations exceeded the Class IIA/B limit • Iron levels exceed Class IIA/B
Air Quality and Noise Levels	
Air Quality	<p>Surveys of total suspended particulate (TSP) levels around the project site showed low existing air pollution, with 24 hour average of 10 - 30 µg/m³, which is well within the DOE TSP guideline of 260 µg/m³ averaged over 24 hours.</p>



Components	Description
Noise Levels	Noise levels ranged from 44.9 to 60.1 dB(A) during the day; and from 46.0 to 51.8 dB(A) during the night, some exceeding the permissible noise levels for medium and high density areas as specified by the DOE guidelines. The highest average noise levels were recorded at Mersing Town for day and Hotel Seri Malaysia for night.

5.2 Biological Components

The baseline physical environment as relevant to the environmental impact assessment of the proposed reclamation project are summarised in Table E5.2.

Table E5.2 Existing biological-ecological habitats and communities within and in the vicinity of the proposed project site.

Components	Description
Habitats	<p>Among the key habitats in the project site are mangroves fringing the western side of P. Setindan, along Teluk Papan and Sg. Tenglu. In addition, the vast intertidal sand/mud flats in Mersing Bay provide habitat to abundant benthos and seagrass habitats.</p> <p>Along the shoreline, a narrow strip of coastal vegetation comprising primarily <i>Casuarina</i> trees and <i>Terminalia</i> buffer the beach and the rural village areas inland of the coastal road.</p>
Terrestrial flora	<p>Surveys of the coastal areas fronting the proposed project site have shown that the vegetation is generally sparse. There is a narrow vegetation belt consisting of mainly sparse dwarfland shrub and open woodland running along the coast, backed by the coastal road. The dominant species were <i>Casuarina equisetifolia</i> (Aru) tree and the Sea Almond, <i>Terminalia catappa</i>, which were found growing along all coastal areas surveyed.</p> <p>Terrestrial vegetation at Pulau Setindan comprises coastal and rocky shore forest.</p>
Marine and intertidal flora	<p>Mangrove growth in Mersing Bay is concentrated around Sg. Tenglu and along Teluk Papan to the north of the Bay, and on the western side of P. Setindan. The lower reaches of Sg. Mersing also support some mangrove trees, however, the area is disturbed owing to the human activity concentrated along the river banks in the Mersing Town area (in particular docking for fishing vessels). Further upstream, the wetland areas are dominated by Nipah.</p> <p>Seagrass beds are present in Mersing Bay, covering an area of approximately 140.6 ha. Seagrass growth within the area is concentrated on the shallow flats connecting Tg. Genting on the mainland to P. Setindan. Patchy growth was observed and inferred in other areas. A total of seven species were observed during the surveys.</p>
Shorebirds and waders	<p>The extensive sand flats of Mersing Bay provide habitat to more than 35 species of waterbirds. Among the bird species identified at the site include a globally-threatened species, the Chinese Egret, <i>Egretta eulophotes</i>, and two Near-Threatened species, the Malaysian Plover <i>Charadrius peronii</i> and the Black-tailed Godwit <i>Limosa limosa</i>.</p> <p>Mersing Bay is not currently listed as an Important Bird Area in Malaysia, however, the numbers of birds recorded in more recent surveys have increased compared to historical data. Numbers recorded for three species could potentially meet the Ramsar Convention Criteria for designating wetland areas of importance.</p>



Components	Description
Marine communities	<p>The phyto- and zoo-plankton in Mersing Bay comprises common species found in Malaysian coastal waters. In general densities of both phyto- and zoo-plankton were relatively low compared to other studies carried out in Malaysia.</p> <p>The intertidal flats in Mersing Bay support abundant macrobenthic fauna. Nearshore samples collected on the intertidal flats were found to contain a greater number of individuals compared to those samples collected below the inter-tidal area. The species diversity however, is low. In general, there were no unique or rare species of benthic invertebrates found in the Mersing Bay area.</p> <p>Surveys have shown no coral reef areas around Mersing Bay. Scattered coral growth was found around P. Setindan, P. Batu Gajah and around the Tg. Selantai headland. These were mainly isolated sub-massive and massive hard coral heads, encrusting coral and some soft corals and gorgonians, including sea fans and whip corals. The corals are generally attached to rock outcrops that fringe these islands and headlands. Overall the live coral cover as a percent of the substrate is estimated to be less than ten percent.</p> <p>Crab and shellfish collection are two activities that are conducted in the study area. Some fishing is also carried out around the seaward side of P. Setindan and around P. Batu Gajah. Collection of grouper fish fry is also carried out around the Batu Chawang area after the NE monsoon period. The seagrass and mangrove areas in Mersing Bay would likely support an important nursery ground for juvenile fish and fish fry.</p>
Marine Megafauna	<p>Owing to the wide shallow flats in Mersing Bay, the beaches in the bay are highly unlikely to be used as nesting beaches for marine turtles, which prefer deeper approaches to the nesting beaches. The nearest nesting beach is Air Papan 1.5 km to the north of Mersing Bay, where a Fisheries Department Turtle Hatchery is operating. Hawksbill turtles (<i>Eretmochelys imbricata</i>) are reported to nest along this beach, while the Olive Ridley (<i>Lepidochelys olivacea</i>) is reported to be an occasional visitor to the beach.</p> <p>Despite the relatively large areas of seagrass in Mersing Bay, no dugong sightings in recent years have been reported by locals. The area in Mersing Bay is likely too shallow most of the time for dugongs to graze, as it has been reported that dugongs can gain access to their inshore feeding areas only when water depth is 1m or more. It is further thought that the dugongs would likely prefer the less populated and more undisturbed areas around the islands of the marine park offshore Mersing.</p>

5.3 Socio-cultural Components

The socio-cultural environment in Mersing as relevant to the environmental impact assessment of the proposed reclamation project is summarised in Table E5.3.

Table E5.3 Existing socio-cultural environment in Mersing.

Components	Description
General	<p>Mersing District is a small township with suburban communities, divided into 10 mukims comprising of 77 villages and 36 islands. Mersing town was once known as a fishing village, but now economically relies mainly on crop agriculture, tourism and fishing activity.</p> <p>The population of Mersing District is 69,947. Malays form the biggest racial group in Mersing Town, followed by Chinese, Indian and others.</p> <p>Agriculture is the main economic activity for Mersing. Regarding tourism, Mersing Town is a 'staging point' for tourists heading to the more popular tourist sites nearby, such as P. Tioman, Taman Negeri Endau-Rompin etc.</p>



Components	Description
Fisheries	<p>Fisheries play an important role in the subsistence economy of the local people at Mersing. The proposed project site is a fishing ground for locals looking for <i>gonggong</i>, a local shellfish and for <i>bubu</i> (portable traps). Fish purse seiners also work offshore of the proposed reclamation area, employing FADs or unjam. The fishing ground off Mersing is shared with fishermen from Endau, Pahang. There are aquaculture farms in the surrounding area, and the mangrove areas in Sg. Tenglu have been identified as nursery areas for sustaining fish stocks. For Johor State, annual income from the fisheries sector has been around 20 Million MYR.</p>
Tourism	<p>Mersing is a departure point for visitors to the Mersing Marine Park and P. Tioman in Pahang. There are several small chalets and lodging houses in Mersing, including along the coast in Mersing Bay, and at Teluk Buih in Tg. Selantai. More chalets and generally low-medium budget accommodation can be found at Pantai Air Papan to the north of Tg. Selantai.</p>
Land use	<p>The majority of land use in Mersing District is agricultural land (61%). Immediately surrounding the project site, land usage is commercial, residential and institutional. There are several gazetted coastal villages, however settlements are essentially scattered all along the coastal stretch. Along most of the coastline, houses and built development are set-back from the shoreline, behind a stretch of open / vegetated space following a small one-lane village road.</p> <p>Present settlement developments suggest a ribbon development pattern, where settlements grow along roads radiating from Mersing Town and along the coastline. In order to control this existing trend and to conserve Mersing Town as an old historical town for tourism purposes, an integrated planning approach and redevelopment of the existing town with the focus towards the east corridor is encouraged, which refers to the proposed reclamation development.</p> <p>The proposed sea reclamation is one of the largest proposed landuses outlined in Mersing Town Local Plan 1999-2010, known as the Coastal Integrated Zone for Mersing. The expansion via the reclamation is expected to reduce the need to convert existing agriculture lands in the hinterland area. Committed development trends show a tendency of development growing outside the town itself towards the coastal area through the redevelopment of the existing town and the proposed sea reclamation project. .</p>
Navigation	<p>Inside Sg. Mersing there are numerous jetties, ranging from small wooden walkways catering to the numerous fishing boats that dock along the riverbank, to LKIM fish landing jetty and the ferry terminal to Tioman.</p> <p>Six ferries, 150 licensed boats and 74 registered boats are on the Marine Department records.</p> <p>In terms of fishing vessels, there are 168 vessels utilising the Mersing landing area, ranging from Class A to Class C2 vessels. The most common vessel is the Class A, with 137 vessels.</p>
Interview survey	



Components	Description
Survey	<p>The socio-economic study was conducted in two phases. In the first phase a Focus Group Discussion was held in February 2007 of which there were 42 participants attended comprising of representatives from various sectors of the community, the public and private sectors. Among them were the fisheries department, the indigenous groups, the hotel and accommodation, food and beverage sectors, tourism and local businesses, manufacturing, transportation, agriculture and NGOs.</p> <p>In the second phase, a sample survey and on-site observations were conducted in November 2007 for the purpose of assessing the potential socio-economic impact on the community living within the zone of influence, during and post-reclamation phases. In the sample survey the face-to-face interview technique was used with the help of specially constructed questionnaire to capture the data. The selection of the respondents was made based on the quota sampling method. The necessary criteria of the respondents to be interviewed were decided prior to the actual fieldwork which was then made known to the field workers for identification and interviewing.</p> <p>The zone of influence is defined as an area circumscribed by a region 3km radius from the project site. Hence the households within the zone of influence from a broad spectrum of income groups formed the sample of stakeholders selected for the study.</p> <p>A total of 692 respondents were interviewed and data pertaining to their socio-economic profile were collected which include, among others, data on their socio-economic attainment, project awareness and their perceptions towards the proposed project. In addition, targeted surveys of the fishermen community and owner/operators of the chalets along the shoreline were carried out in June 2008. The sample size was 67 respondents from the fishermen group, representing more than 10% of the total fishermen in the area; and operators of nine chalets located in the shoreline area of Mersing Bay and surrounds.</p>
Gender	The respondents comprised of 55.2% males and 44.8% females.
Age	The ages of the respondents ranged from 20 years to 65 years.
Education	Respondents' education levels vary from primary school, secondary school, colleges and universities with percentages of 15.8%, 64.0%, 11.3% and 8.8%, respectively.
Occupation	The respondents worked in various sectors of the economy. The most significant were in the business sector (13.4%), the tourism industry (13.1%) and the agricultural sector (10.7%). However, some 32.6 % were recorded as ' <i>unemployed</i> ' which comprised of those who did have specific job which can generate regular income such as housewives, retirees, college/university students, those not fully employed and those waiting to be employed.
Family Size	The respondents were categorised according to family sizes as follow: 1, 2 to 5 people, 6 to 10 people and more than 10 people which accounted for 7.4%, 45.1%, 16.3% and 0.1%, respectively.
Household income	The households' income of the respondents ranged widely, from less than RM6,000 per year to more than RM40,000 per year. However, the largest groups were those earning less than RM6000 per year (23.1%) and between RM6000 to RM10,000 per year (22.3%)
Awareness and perception of project	<p>The results of the survey show that the majority of the respondents (67%) were aware of the proposed development in the area. Another 29% were unaware and the remaining 4% gave no comment.</p> <p>The findings also show that about 50% of the respondents '<i>strongly agreed</i>' that the project should proceed. Around 41% "<i>agreed</i>" and only about 9% have no opinion towards the project. In conclusion, more than 90% of the respondents were in favour of the project development.</p>



Components	Description
Fishermen community	<p>Of the 67 respondents from the fishermen target occupation group, 49 were locals and the remainder non-locals from Terengganu and southern Thailand.</p> <p>A total of 30 or 44.8 percent were coastal fishermen and the remaining 37 or 55.2 percent are deep-sea fishermen.</p> <p>The age distribution of the respondents was concentrated between 45 and 50 years of the age, with an average age of 47 years. The age of the coastal fishermen was higher than the deep sea fishermen, reflecting the absence of interest among the youth in the nearshore, generally subsistence fishing.</p> <p>Overall, the average income is at RM733 per month (for fulltime and part-time coastal and offshore fishermen). The coastal fishermen earn much lower income compared to the deep sea fishermen. Monthly mean income for the coastal fishermen is RM552, while, monthly mean income for deep sea fishermen is RM887.</p>
Chalet Operators	<p>Nine chalets are located within 100 meters from the shoreline in Mersing Bay and surrounds. Most of these chalets cater for local clients, although two reported that most of their regular clients are foreigners, and two have a mixture of foreign and local clients.</p> <p>The occupancy rates for most chalets are around 20 days in a month. The cheapest room rate per night was RM70 and the highest was RM200. Peak periods are generally between the months of March and October whilst the off-peak periods are the months of January, February, November and December, which coincide with the monsoon season.</p>

6 POTENTIAL SIGNIFICANT ENVIRONMENTAL IMPACTS

The potential significant impacts are discussed in Sections 6 to 8 of the DEIA, whereby the various impacts are considered for each environmental component affected and assessed in an integrated manner in terms of the magnitude of the effect, the consequences and the temporal and spatial scale of the effect.

The most significant impact during the reclamation phase is water pollution. Dredging and reclamation are predicted to create sediment plumes which will cause impacts to the marine ecosystems. The primary post-reclamation impact is related to the loss of habitat due to reclamation and the dredged internal channels within the development. These and other key affected environmental components are briefly summarised here.

6.1 Physical System

6.1.1 Suspended sediment plumes

The suspended sediment dispersion generated from the dredging and reclamation areas have been predicted through numerical modelling for the Southwest (SW) monsoon and inter monsoon (pure tide) conditions. Northeast monsoon conditions were not assessed, as no dredging and reclamation activity is possible at the site during the high wind and waves associated with this season.

Simulation results show that the maximum suspended sediment concentrations of 25mg/l and above is for the most part confined to Mersing Bay for Phases A, and B where the reclamation activities are concentrated in the southern part of Mersing Bay.



During SW monsoon conditions, the beach along Air Papan will be affected by maximum suspended sediment concentrations of up to 25mg/l during all phases of the dredging and reclamation works. During the reclamation of Island 3 and dredging of the channels around this island (Phase C), the maximum suspended sediment concentrations during the SW monsoon are between 10 mg/l and 25 mg/l extending up to Tg. Gemok, which lies approximately 30km north of the site.

The coastline south of Tg. Bangka is generally not affected by the sediment plumes, which are carried to the north of the project site by the currents. During Phase A and B reclamation and dredging works nearest to Tg. Bangka, the maximum suspended sediment plume concentration of 25mg/l extends around 1 km along the shoreline south of Tg. Bangka.

6.1.2 Long-term Water Quality

Long-term water quality impacts may arise due to changes in the hydrodynamics within Mersing Bay from the reclamation footprint. For the existing situation, flushing is affected by the large expanses of intertidal flats and shallow waters. The extent of the tidal flats is reduced with the dredging works associated with the reclamation; however the reclamation itself limits tidal exchange.

Flushing from Sg. Tenglu Besar is presently generally quite poor because of the extensive tidal flats at the entrance. There are no major works in the immediate vicinity of this river mouth, and the modelling results suggest that flushing in this river and adjacent tidal flats is similar post-reclamation compared to the existing condition.

For Sg. Mersing, the reclamation effectively extends the river entrance further offshore where deeper waters and stronger currents result in better flushing, so pollutant concentrations reduce faster compared to the existing situation, where polluted water from the river flows more or less directly into Mersing Bay.

Post-reclamation, flushing in the newly-created channel between the reclamation area and the existing coastline is good with tidal flows flushing this channel. Dispersal of pollutants from the small drains discharging into this channel is improved when compared with the existing condition where they discharge across the mud flats.

The hydraulic modelling has also shown that there is good flushing of the channels between the reclamation areas with no risk of stagnant water areas within these channels.

6.1.3 Flooding

There are a number of drains, tributaries and rivers that drain runoff from the hinterland behind the proposed reclamation site to the sea. The proposed reclamation has the potential to influence water levels at the outlet to these drains and waterways, which could adversely affect conveyance and result in a worsening of flooding upstream. Hydrologic modelling according to standard hydrological procedures and MASMA guidelines has been carried out to investigate this potential impact.

At the existing river entrance of Sg. Mersing, there is a small reduction (0.05m to 0.1m) in peak water levels post-reclamation extreme river flows, with no change to peak water levels during normal river flows. This is largely because of the proposed dredging of the navigation channel and channel along the coast, which improves the conveyance out of the river mouth. This is a key conclusion which means that major flooding of Sg. Mersing, and



its associated floodplains (which include Mersing Town), *will not be increased by the reclamation works.*

There are five large drains that discharge across the shoreline between Sungai Mersing and Sungai Tenglu Besar. Flooding has been reported in the vicinity of these. This flooding is due to the entrances of these channels being blocked by coastal sedimentation. There will be no increase in offshore peak water levels as a result of the reclamation, and the risk of blockage of some of these drain outlets will be reduced as they will now discharge into the new dredged channel rather than across the intertidal flats. The risk of flooding in these areas will not be increased as a result of the reclamation works, and is expected to reduce in the vicinity of the drains that discharge into the new dredged channel as the risk of blockage of these drains is reduced.

6.1.4 Impacts on Coastal Processes

River mouth sedimentation

At present there is littoral transport across the navigation channel into Sg Mersing that leads to high accretion rates in this channel. Regular maintenance dredging is therefore required to maintain this channel. Sediment transport modelling has shown that the construction of the symmetrical breakwaters in combination with dredging the new navigation channel will reduce the need for maintenance dredging currently borne by the Marine Department. This will be a long term, regional *beneficial impact.*

Sedimentation in the dredged channels between reclamation areas

Sedimentation in the dredged channels between the reclamation areas will be minimal. No maintenance dredging will be required in these channels except at the seaward entrances where some sedimentation due to littoral transport is expected.

Shoreline erosion

Sediment transport rates along the coast in the vicinity of Mersing are very low, and the net transport is to the south.

With the net transport being southerly no impact is expected on the coastline to the north of the reclamation works. The coastline immediately south of the reclamation area is rocky, and therefore no impact on the coast in this area is expected as a result of the reclamation works.

6.1.5 Air and Noise Quality

Air

The main sources of air pollutants are expected to be derived from smoke and dust generated from construction vehicles and the movement of these vehicles over unpaved roads, material stockpiling and handling, and dust generated from the reclaimed land before completion of landscaping and on-site development especially under windy conditions.

Prevailing wind directions during the NE monsoons would result in potential impacts to Tg. Genting and Kg. Mersing Kanan area and also Mersing Town area during high winds,



while the residential areas to the north and northwest are at lower risk of dust from the site as they are not in the path of prevailing winds.

During the southwest monsoon, the south-westerly winds would direct dust into the direction of the sea, with lower risk of dust from the site reaching the residential areas.

Overall, with standard mitigation measures in place, dust pollution is not expected to be a significant impact.

Noise levels

Maximum reclamation and construction noise levels are predicted to exceed permissible limits (based on existing ambient noise levels) by between 8 – 9 dB(A) at Mersing Town and Kg. Tenglu Laut. This maximum predicted noise is assuming all construction activities are concentrated at the nearest boundary of the site, hence such moderate noise impacts will be expected to occur only for a small percentage of the total construction time.

Mitigation measures such as physical noise barriers may ameliorate some of the impacts on receivers and hence the impact is considered to be a minor to moderate disturbance to the residents of Kg. Tenglu Laut and activities at Mersing Town.

6.2 Biological System

6.2.1 Seagrass areas

The footprint of the reclamation in the final layout has been designed so that there is no dredging or reclamation work carried out in the sea grass area, and therefore no direct loss of sea grass due to the works.

During the dredging and reclamation period 0.3% of the sea grass area is predicted to suffer major damage by the suspended sediment plumes and sedimentation. Around 50% will be exposed to moderate impacts while the remainder can be expected to experience only slight/minor impacts. This assessment is based on carrying out the dredging and reclamation works without any specific mitigation measures in this area. The risk of this damage occurring will however be significantly reduced as it is proposed to use a silt curtain to minimise the ingress of suspended sediments into this area.

The damage to the seagrass areas is not expected to result in long-term impacts to seagrass biodiversity or ecosystem functions, given the habitat availability and recruitment capacity from seagrass beds in the islands offshore. The spatial scale of the impact is thus considered local to Mersing Bay. Overall impact evaluation is a moderate adverse impact.

6.2.2 Benthos

The area of benthic intertidal and shallow subtidal area lost directly due to the reclamation footprint is around 38% of the total benthic habitat in Mersing Bay. This impact is permanent and irreversible.

The area of benthic habitat lost due to dredging of the channels is approximately 839 ha, or 21% of the intertidal and shallow sub-tidal benthic habitat in Mersing Bay. This is a reversible as recovery of benthic communities in the dredged areas is generally relatively rapid.



The area of benthic habitat impacted by sedimentation during the reclamation and dredging period is predicted to be localised to the project area itself. This impact is considered minor and short-term due to the high likelihood of rapid recovery. Deeper sub-tidal benthic habitats outside the immediate project area will be unaffected by sedimentation and may potentially experience an increase in abundance owing to the higher amount of food availability during the dredging periods.

6.2.3 Fish Fauna

Seagrass areas are known nursery areas for juvenile fish, while fish fry collection has been reported at the Batu Chawan area. The damage to the seagrass beds as summarised above also represents an impact to its function as a nursery ground for juvenile fish. This is a temporary impact and the extent of the impact will be further minimised by the use of silt curtains.

During the reclamation phase, there will be a decrease in water clarity caused by suspended solids around the project site which can affect the ability of fish to see and catch food. Suspended sediment can also clog fish gills, reduce growth rates, decrease resistance to disease and prevent egg and larval development. The predicted increase suspended sediment concentrations in the nearshore area around the reclamation and inside Sg. Mersing and P Setindan estuary as a result of the reclamation activity are much lower than the concentrations shown in experimental studies to cause lethal effects. It is likely that impacts to fish fauna, including juvenile fish and fry, will be primarily behavioural and that the fish will avoid the areas of turbid plumes for this short period.

6.2.4 Shorebirds

Thirty-six percent of the intertidal area generally used by the waders will be directly and permanently affected by reclamation and dredging. Associated habitats such as the nearby mangroves, rocky outcrops, etc. and beach areas used for roosting will not be directly impacted by the project. Overall this will constitute a Moderate Adverse Impact on shorebird habitat.

In terms of population effects, the area is not a breeding or nesting ground for any of the migratory species observed at the site and hence effects are expected to be behavioural (i.e. stress and behavioural change in selecting alternative sites) rather than affecting the population viability of any of the vulnerable or near-threatened species. The magnitude of impact on these threatened / near-threatened species is therefore Minor Adverse given that there are other areas and embayments along the south east coast of Johor with extensive intertidal areas that could provide feeding grounds to the shorebirds.

6.2.5 Mangroves

No direct loss or removal of mangroves will occur during the reclamation or operational phases of the project. Sedimentation during the construction phase is not predicted to cause appreciable impacts to any mangrove areas.

Post reclamation changes in current speeds, water quality or water levels are also not predicted to affect the existing mangroves areas.



6.2.6 Plankton

Plankton community will be affected mainly due to reduced light penetration and reduced oxygen concentration. The turbidity associated with the reclamation activity may also cause temporary increases in the level of organic matter and nutrients available, which may increase productivity outside the plume areas to some extent.

However, as predicted from the modelling, the area affected by high concentrations of suspended sediments (above 50, 75mg/l) for extended periods of time is relatively low. Given the limited extent of high suspended sediment plumes, the impact on plankton communities are predicted to be negligible.

6.3 Socio-economic System

6.3.1 Fisheries and Aquaculture

The location of the proposed reclamation is primarily in the shallow intertidal flats in Mersing Bay, which does not support significant fishing activity because of its shallow depth. Artisanal fishermen use small vessels with outboard engines to fish primarily within the zone between 3 to 5 nautical miles from the shore. No direct impacts to these fishing grounds are predicted, either during the reclamation or operational phase.

Fish fry collection at the Batu Chawan area during reclamation of the southern islands and dredging of the channels between the southern island and the mainland (Construction Phase A) will be affected due to high suspended sediment plume concentration. However the impact will be reduced with the proposed mitigation measures using silt curtains and prohibition of reclamation and dredging work in the vicinity of the Batu Chawang during the fish fry collection period immediately following the NE monsoon.

The loss of the intertidal habitat in Mersing Bay will also directly reduce income or food supplementation from collection of shellfish along the intertidal area currently carried out by some of the fisherman families. However, this is a minor adverse impact given the low number of people involved in this activity and the large remaining area available for use.

No permanent impacts to water quality are predicted to affect the prawn aquaculture area. Suspended sediment plumes will be elevated in particular during the reclamation of the northern island and dredging (Construction Phase C). The concentrations are not anticipated to cause mortalities or significant reduction in growth rates of the prawns.

6.3.2 Other Reclamation-Phase Impacts

Impacts to public health, safety and general well-being of local population will occur during the reclamation and construction phases of the project. The predicted increase in noise levels will be minor to moderate, resulting in annoyances to the affected communities. Dust impacts will probably be limited to visual impacts, as with the implementation of the recommended mitigation and management measures the dust impacts are unlikely to be of sufficient magnitude to cause health impacts (e.g. respiratory problems). Traffic impacts to public safety may arise from the projected increase in marine navigation and road traffics.

In general, the consequence of accidents would be major but the risk is low provided standard safety procedures and emergency response procedures are put into place.



It is likely that access to at least some sections of the beach along Tg. Genting to Tg. Bangka will be limited during the reclamation period for public safety reasons. This will reduce the amenity and aesthetic value of the beach area for the public users of the beach. The beach area currently frequented by members of the public is concentrated mainly at Taman Selalang (along Jalan Makam), Taman Genting (along Jalan Makam), Teluk Buih and Air Papan Beach.

6.3.3 Public Awareness and Perception of the Project

Findings of the survey showed that about 91% of the respondents have a positive perception of the Project and agreed that it should proceed. A further 9% had no opinion towards the Project, with none of the subjects responding negatively to the Project.

The findings clearly indicated that majority of the respondents, regardless of their job category, feel that the Project will improve the socio-economic level in Mersing, in particular those respondents who are currently unemployed.

The majority of the stakeholders (97%) believe that the project development can contribute to protection and enhancement of tradition, customs and heritage in the area.

7 MITIGATION MEASURES

7.1 Physical System

7.1.1 Suspended sediment plumes

The suspended sediment generation and excursion due to reclamation and dredging activity is one of the fundamental causes of impacts to the marine biological environment and fishing activity in the Mersing Bay area. Several mitigation measures have thus been proposed as described below:

(i) Reclamation methodology

The key proposed mitigation measure has been incorporated into the project concept, whereby a dry fill method or pump-ashore in conjunction with perimeter bunds have been shown to decrease the magnitude of plume generated dramatically compared to pump ashore methods without bunding.

(ii) Silt curtains

The installation of silt screens or curtains is recommended in the shallower areas along the shoreline where the seagrass beds are located. This should be implemented during dredging and reclamation works.

(iii) Best management practices

Good construction practices should be implemented, including but not limited to:

- Regular maintenance of barges, dredging plant, pipelines, etc. so as to prevent accidental leaks and spillage.
- Implementation of soil erosion control measures on the reclaimed land as soon as practicable (to follow standard practices and guidelines).



7.1.2 Long-term Water Quality

In addition to the reclamation layout optimisation, which also considered potential long-term water quality issues, other design-stage and operational stage measures are proposed as described below.

Existing water quality within Mersing Bay is found to be generally poor and, while post-reclamation flushing characteristics have been shown to be adequate, the following is recommended:

- The discharge of polluted water from developments on the reclamation is not allowed. This can be realised by considering
 - Appropriate sewerage collection and treatment systems that include treatment of sullage and other grey water urban and domestic discharges being adopted, and treated water will be used for irrigation on the reclaimed areas
 - Strict controls on food outlets, etc. to eliminate waste and contamination of waterways
 - Water quality control devices such as detention ponds, wetlands, gross pollutant traps, litter traps, etc within drains and waterways in the urban stormwater system
 - At source controls and water sensitive urban drainage design
- Water quality monitoring throughout operational phase

7.1.3 Flooding

The key mitigation for flooding impact is preventative and thus has been addressed at the project design phase, where it has been a major component of the detailed layout optimisation studies. The hydraulic study has demonstrated that the final optimised layout does not have any adverse impact (increase on water level), inside Sg. Mersing or in adjacent areas.

To guard against temporary impacts during the reclamation and dredging phase due to siltation and blockage of existing drain and stream outlets which may cause flash flood, the following measures shall be implemented:

- Screens and debris interceptors will be installed at all drain outlets in order to trap floatable items from being washed into the sea.
- Drains will be maintained (cleaned) periodically to ensure they are clear of mud, silt or any other obstruction caused by the works.

7.1.4 Impacts on Coastal Processes

No adverse impacts on the morphology of the shorelines north and south of the proposed reclamation which may generate coastal erosion or river mouth sedimentation have been predicted. The Project Proponent will undertake monitoring of the coastline south of the Project site for five years following the completion of the reclamation to detect any unanticipated impacts resulting from the Project implementation, which is the timeframe for which any impacts would become evident if they were to result from the reclamation.

River mouth sedimentation in Sg Mersing and the subsequent need for maintenance dredging will be reduced compared to the present situation. The Project Proponent will undertake monitoring of the river mouth to detect any unanticipated sedimentation impacts resulting from the Project implementation.



7.1.5 Other mitigation measures during the reclamation and construction phase

Air

Standard mitigation measures to be implemented to reduce sources of fugitive dust:

- Watering and washing – of bare dust surfaces, mud tracked onto public roads, tyres of construction vehicles.
- Covering dust sources (lorry loads and stockpiles)
- Imposing speed limit on access and internal roads.
- Stabilisation of access points and haul roads.
- Public complaints register to identify and resolve nuisances and annoyances to the public.

Noise levels

Various mitigation measures will be employed, including:

- Prevention: maintenance of equipment and vehicles, noise suppressors and adherence with guidelines on vehicle noise emissions, control of traffic speed.
- Barrier: Hoarding is recommended to be erected at the boundary of the Project site at the Mersing River mouth, around the existing Pasar Tani site and public walkways.
- Public complaints register to identify and resolve nuisances and annoyances to the public.

Water Quality

Various mitigation measures will be employed to prevent and reduce water pollution arising from the activities during construction phase, including:

- Identification of potential contaminants in borrow fill material to avoid contaminated material being introduced to the Project site.
- Handling and disposal of scheduled wastes such as spent oil and grease according to DOE guidelines both on marine vessels and on land.
- Dredge vessels shall adhere to ballast water management guidelines from the International Maritime Organisation (IMO).
- Appropriate sanitary and solid waste management and disposal on both marine vessels and on land.

7.2 Biological System

7.2.1 Loss of habitat through dredging and reclamation

Preventative measures

The channels created by the Project (internal channels in the reclamation and between the reclamation and the main land) require dredging. The final project layout has been developed to ensure that this dredging does not directly impact the seagrass areas. As a result, impacts on the intertidal and shallow subtidal zone with high benthic invertebrate abundance have also been reduced.



Remedial measures

Areas of the seagrass will be affected by suspended sediment plumes and sedimentation during the reclamation and dredging phases. With the proposed mitigation measures to be implemented, these impacts are expected to be further reduced; however, monitoring will be carried out to determine the realised impacts and rehabilitation of these areas by replanting will be carried out following completion of the reclamation and dredging phase as required.

Adoption of monitoring and adaptive management of natural habitats, including seagrass, mangroves and intertidal flats, throughout the life of the development shall be carried out as part of a biodiversity management programme. This is to protect these areas from further damage or loss. The programme includes development of a shorebird habitat management plan monitoring bird numbers around the intertidal areas and mangroves and developing measures to minimise disturbance to the birds during the migration season. The biodiversity management programme should also include visitor programmes to transform these natural habitats into an attraction for nature tourism and education.

7.3 Socio-economic System

7.3.1 Fisheries and Aquaculture

In general, monitoring of fishing and shellfish collection activities within Mersing Bay should be carried out at the onset, during and after reclamation. Continuous consultation with the local fishermen on any deleterious effect or losses is to be carried out. This is to establish causes and enable remedial action to be taken at the earliest possible stage. Apart from general monitoring and open dialogue with the affected group, the following mitigation measures will reduce impacts to the local fisheries.

(i) Water Quality Control

Mitigation measures to abate poor water quality are key in protecting against losses of juvenile fish, fish fry and shellfish in Mersing Bay. These have been described in Section 7.1.5 above.

(ii) Fish Fry Collection Activity

The potential loss of income to the local people who catch grouper fry in the area around Batu Chawan can be reduced by avoiding reclamation and dredging works for Island 1 in the months immediately following the northeast monsoon, when the fish fry collection activity is normally carried out. The fish fry catch normally peters out gradually toward the end of the season, thus monitoring of the catch should be carried out to determine re-commencement period of the works; this should be determined in conjunction with consultation and dialogue with the affected group.

7.3.2 Public Health, Safety and Well-being

Measures to mitigate or minimise air and noise pollution described in Section 7.1.5 will act to reduce potential effects on the health, safety and well-being of the public in the vicinity of the proposed project. Other measures include standard procedures to control road safety and marine navigation safety.



7.3.3 Social Impacts

During the construction phase, mitigation measures will be implemented to control the influx of construction workers with will include foreign labour including but not limited to:

- a) Compliance with all existing immigration and employment laws and regulations.
- b) Provision of self-contained workers camp away from the site and Mersing town complete with all the support facilities.
- c) Controlling and monitoring the movement of the workers to and from the site and the camp.

The local populace will be given first consideration for employment at all levels and phases, from the construction to the operational phase of the Mersing Laguna development.

7.3.4 Public Awareness and Engagement

A Stakeholder Engagement Plan will be implemented by the Project Proponent to inform the relevant stakeholders (villagers, fishing groups, etc.) of the proposed Project, the implementation schedule and planned mitigation and management measures.

The Stakeholder Engagement Plan shall also include setup of an employment register for locals seeking employment. The Project Proponent will ensure that locals with the relevant skills and experience are offered first right of refusal of employment opportunities arising from the Project.

A system to process and respond to complaints from the public for any source of nuisance or risk to the public (for example, noise nuisance, perceived hazards, near-miss marine or land traffic incidents) will also be included under the Environmental Management Plan and Stakeholder Engagement Plan.

8 RESIDUAL IMPACTS

8.1 Loss of Shorebird Intertidal Habitat

Roosting areas along the beaches, mangroves and rocky outcrops will not be directly affected. Active management of these habitats (e.g. temporary fencing to provide visual buffer zone and mangrove replanting) during the constructions and operations of the Project will also serve to protect and enhance awareness of these communities.

Nonetheless, the loss of 36% of the existing intertidal area in Mersing Bay which provide feeding grounds for shorebirds is a direct impact due to reclamation and habitat modification due to channel deepening, which cannot be fully compensated for. This has been evaluated as a *Moderate Adverse Impact*

8.2 Loss of Intertidal and Shallow Subtidal Benthic Habitat

No macrobenthic species of conservation significance were found at the project site. Nevertheless, the permanent loss of 1514 ha (38%) of intertidal and shallow sub-tidal benthic habitat in Mersing Bay due to the reclamation footprint cannot be feasibly mitigated or avoided if the Project is implemented.



9 ENVIRONMENTAL MANAGEMENT PLAN

The EMP as outlined in detail in Section 10 of this report is prepared as a preliminary EMP specification. The final EMP will be prepared at the conclusion of the DEIA process and upon contract award, so that:

- (i) comments on the DEIA as part of the public notification and DOE panel review stages can be taken into account; and
- (ii) monitoring and management plans can be updated with respect to:
 - Reclamation detailed design
 - Final construction sequence and time schedule
 - Final construction methodology (equipment).

The EMP is structured to address the major activities associated with each phase of the project development, comprising (i) the dredging and reclamation phase; and (ii) the post-reclamation phase. The main components of the EMPs for each phase are summarised below:

9.1 Management of Dredging and Reclamation

9.1.1 Overall Monitoring and Management Strategy

A feedback monitoring strategy will be utilised for the Environmental Management Plan (EMP) of the dredging and reclamation works. The main elements of Feedback Monitoring are:

- Control measurements (suspended sediments and turbidity) targeted at the spill from the dredger/reclamation.
- Sediment plume models (numerical models) are used to keep a running balance of cumulative impact levels based on actual production and measured spill. Action can then be taken in advance of any negative impacts occurring in the field.
- The sediment plume model also includes a current forecast model, such that any intermediate construction stage impacts can be assessed.

The models give a spatial picture at all receptor sites not just the locations where instrumentation is deployed, as is the case for traditional monitoring methods. Coverage is thus more rigorous. The use of spill measurements and modelling allows the monitoring and management system to be responsive to changes in conditions (e.g. seasonal effects) and work schedules.

9.1.2 Environmental Management Plans

The key environmental management planning issues that will be addressed by the EMP (Dredging and Reclamation) are summarised in Table E9.1.

Table E9.1 EMP topics during Dredging and Reclamation.

Management Issue	Scope
Suspended Sediment Control	Generation and excursion of sediment plumes at dredging and reclamation sites.
Ecology	Monitoring of marine megafauna



Management Issue	Scope
	Monitoring of migratory shorebirds
	Monitoring of seagrass beds.
Noise	Monitoring and management of dredging and reclamation noise.
	Monitoring and management of noise from earthworks at reclamation site.
Air Emissions	Monitoring and management of air emissions at reclamation site.
Maritime Safety	Operation of the dredging vessel and the waterway users, i.e. fishing port and ferry operations, fishing activity.
Water Quality	Waste management
	Storage and handling of hazardous substances on board the dredger and at reclamation site.
	Ballast and De-ballast procedures.
Contingency Planning and Emergency Response	Emergency preparedness to manage any of the following: <ul style="list-style-type: none"> • Marine collision • Hydrocarbon and chemical spills from the dredge vessel • Fire on the vessel • Pipeline failure (release of slurry into ambient environment) • Wildlife incident (marine megafauna) • Cultural heritage discovery • Weather and climatic events.

A summary of the monitoring requirements during the dredging and reclamation phase is given in Table E9.2

Table E9.2 Summary of monitoring programmes during dredging and reclamation.

Monitoring components	Stations	Parameter to be Tested/Observed/Measured	Frequency of Sampling/Observation
Water Quality			
Maintenance of control structures	Along bunds, silt curtains, sedimentation pond outlets	Inspection and maintenance	Weekly and after storm events
Total suspended solids	13 permanent and several mobile water quality stations	<ul style="list-style-type: none"> • Turbidity (NTU) • TSS 	Daily Weekly
General Water Quality	13 water quality stations	<ul style="list-style-type: none"> • Faecal coliforms • Oil & grease • Arsenic • Cadmium • Chromium • Copper • Lead • Mercury • Nickel • Manganese 	Monthly
Ecology			



Monitoring components	Stations	Parameter to be Tested/Observed/ Measured	Frequency of Sampling/ Observation
Marine megafauna	Around project site and dredger routes	Marine megafauna observation information/data to be collected on each dredge trip by dredging contractor	Continuous monitoring.
Seagrass	Dredging channels	Document GPS tracklog of dredger to ensure dredging is limited to channel widths.	Continuous monitoring
	Six (6) monitoring stations	<ul style="list-style-type: none"> Seagrass Bed mapping Shoot density Species diversity Percent cover of substrate 	Monthly
Mangrove	Six (6) stations	<ul style="list-style-type: none"> ambient water quality sedimentation Mangrove tree health observations 	Monthly
Grouper fry monitoring	Three (3) stations around Batu Chawang	<ul style="list-style-type: none"> Fish fry counts using catch and release methods 	Fortnightly
Air and Noise			
Ambient sound levels	Four stations at sensitive noise receptors along Mersing Bay.	<ul style="list-style-type: none"> L_{eq} L₁₀, L₅₀, L₉₀ L_{min}, L_{max} 	Monthly
Total Suspended Particulates	At least four stations	24-hour average TSP	Monthly
Compliance Monitoring			
Waste disposal		Site inspections	Monthly
Sanitary facilities			
Construction site (site offices and base camps) housekeeping			

9.2 Post-reclamation / Operational Environmental Management

Following the completion of dredging and reclamation works, environmental management programmes will include the following:

- Rehabilitation of seagrass and monitoring
- Monitoring of benthic recovery in dredged channels
- Water quality monitoring within the channels around the reclamation area
- Water level monitoring
- River profile monitoring at Sg. Mersing
- Coastal profile monitoring along coastline south of reclamation area.

A summary of the environmental monitoring requirements during the post-reclamation or operational phase of the development is given in Table E9.3.

Table E9.3 Summary of monitoring programmes post- reclamation.



Monitoring components	Stations	Parameter to be Tested/Observed/ Measured	Frequency of Sampling/ Observation
Water Quality			
Channel Water Quality	Eight (8) stations	<ul style="list-style-type: none"> • DO • BOD • Oil & grease • Total Nitrogen • Total Phosphorus • Faecal coliform 	Quarterly
Ecology			
Seagrass	Six (6) stations in remnant seagrass areas; Four (4) stations in replanted areas	<ul style="list-style-type: none"> • Seagrass bed mapping • Shoot density • Species diversity • % cover of substrate 	Monthly. Frequency may be reduced based on monitoring results.
Benthic macroinvertebrates	Eight (8) stations in dredged channels	<ul style="list-style-type: none"> • Species diversity • Species abundance (Density) 	Monthly. Frequency may be reduced based on monitoring results.
Water levels			
Water level	Two locations at tidal gate and in Sg. Mersing	<ul style="list-style-type: none"> • Water levels 	Continuous
Coastal Processes			
River mouth sedimentation	Sg. Mersing river channel.	<ul style="list-style-type: none"> • Cross sectional profiles 	6-monthly
Coastal morphology	Six (6) coastal profile monitoring stations	<ul style="list-style-type: none"> • Coastal profile 	6-monthly for 5 years



**SUMMARY TABLE OF ACTIVITIES,
POTENTIAL IMPACTS AND
MITIGATION MEASURES**



1 DURING RECLAMATION AND MARINE CONSTRUCTION WORKS

Activity	Potential Impacts during Reclamation and Dredging	Proposed Mitigation Measures	Impact Evaluation
Site preparation, construction of access routes and site office	<p>1. Land based and Sanitary wastes</p> <p>Uncontrolled disposal will lead to:</p> <ul style="list-style-type: none"> • Unsightly appearance • Disease vector • Putrid odour 	<ul style="list-style-type: none"> • Developer provides sufficient number of mobile toilets and treating the effluent from the toilets and the sludge in self-contained septic tank system to minimise further contribution of wastewater pollution in the waters. • Developer to provide sewage treatment plant to treat domestic wastewater generation from workers' quarters. 	Slight negative impacts – temporary and can be controlled to acceptable levels.
	<p>2. Traffic and transportation</p> <p>Increase in number of vehicles and heavy machinery at the site, with impacts on:</p> <ul style="list-style-type: none"> • associated noise and air pollution • deterioration of road condition • Risks to safety public road users. 	<ul style="list-style-type: none"> • The mobilisation of construction vehicles and trucks must be properly controlled in order not to create unnecessary traffic hold-ups and inconvenience to other road uses especially at junctions leading to the project site. • The contractor must ensure not to overload trucks with construction materials that might damage the road surface. • Heavy vehicles are advised to keep the legal speed limit and construction materials loaded are properly covered with canvas. Any spillage on the road must be cleaned up or cleared by the contractor. • Appropriate warning signs for the public to slow down near the construction site access point. • Road safety incidents monitored by the RS project manager and appropriate measures taken to address the causes of such incidents. 	Slight negative impacts – temporary and can be controlled.



Activity	Potential Impacts during Reclamation and Dredging	Proposed Mitigation Measures	Impact Evaluation
Reclamation and Dredging of Channels	<p>1. Suspended Sediment Plumes & Sedimentation</p> <p><i>Turbidity Impact</i></p> <ul style="list-style-type: none"> • During Phase C, the resorts along the Mersing Bay shoreline will be affected by visible turbid plumes for more than 50% of the time during the SW monsoon and 20 to 30% of the time during the inter monsoon period over an estimated nine months. For other phases the impact will be negligible. • During the SW monsoon periods, the resorts and hotels north of the reclamation at Ayer Papan will be affected by visible turbidity for up to 50% or more of the time. <p><i>Seagrass</i></p> <ul style="list-style-type: none"> • Seagrass habitat will be impacted by plumes greater than 10mg/l for over 50% of the time during the SW periods, and for between 0 and 50% during the inter monsoon period depending on the reclamation phase. • Concentrations above 25 mg/l are experienced over the central seagrass beds near P. Setindan for up to 50% of the time when dredging near to the seagrass beds during both climatic scenarios. <p><i>Fish fry grounds</i></p> <ul style="list-style-type: none"> • The fish fry grounds near Batu Chawang will be exposed to concentrations exceeding 25mg/l for between 20% and 50% of the time when dredging the channel to the south of Island 1. 	<ul style="list-style-type: none"> • Reclamation methodology - dry fill method or pump-ashore in conjunction with perimeter bunds have been shown to decrease the magnitude of plume generated dramatically compared to pump ashore methods without bunding. • The construction of silt screens or curtains is recommended along the northern boundary of the dredging area to minimise suspended sediment impacts on the sea grass areas and the resorts in the north of Mersing Bay.. • Avoid dredging the channel immediately south of Island 1 during the key fish fry period immediately after the NE monsoon period • Regular maintenance of barges, dredging plant, pipelines, etc. so as to prevent accidental leaks and spillage. • The contractor is required to prepare a soil erosion control plan for all stages of reclamation progress, the earthworks and construction as per the Department of Irrigation and Drainage guidelines. • Best management practices include construction of silt traps, replanting of vegetation and covering all stockpiles. • Drains and erosion control measures such as silt traps should be inspected weekly, as well as after any heavy rainfall event 	<p>Temporary <i>moderate negative impact.</i></p>



Activity	Potential Impacts during Reclamation and Dredging	Proposed Mitigation Measures	Impact Evaluation
Reclamation and Dredging of Channels -Cont.	<p>2. Water Quality impacts</p> <p>Other water quality impacts due to spills/ discharge of oil and grease and solid and liquid wastes.</p>	<ul style="list-style-type: none"> • Oil and grease storage and disposal to adhere to DOE guidelines. • Contractor to provide sufficient number of mobile toilets and treating the effluent from the toilets and the sludge in self-contained septic tank system to minimise further contribution of wastewater pollution in the waters. • Contractor to provide sewage treatment plant to treat domestic wastewater generation from the workers quarters. • Contractor to provide covered solid waste collection areas; weekly disposal according to local authority requirements. 	<p><i>Minor adverse impact, mitigation required</i></p>
	<p>3. Air Pollution</p> <ul style="list-style-type: none"> • Some smoke and dust may be generated from construction vehicles (i.e. trucks, bulldozers, excavators, generators and compressors) and when moving over internal haul roads. • Dust will also be generated from the reclaimed land during reclamation as well as before completion of on-site development especially under windy conditions 	<ul style="list-style-type: none"> • Watering on bare surfaces and roads twice a day. • Vehicles speeds should be limited to 30km/hr on unpaved roads. • Lorry loads and stockpiles of earth/ gravel should be covered with tarpaulin. • Washing bay at the exit point of the development site to wash off mud adhering to the tyres. • Regular maintenance of construction machinery can reduce unnecessary emissions and to ensure that emissions are within the DOE guidelines for vehicles • Key access points and haul roads within the site should be stabilised as soon as possible by gravel surfacing. 	<p><i>Minor Adverse Impact, Mitigation Required</i></p>



Activity	Potential Impacts during Reclamation and Dredging	Proposed Mitigation Measures	Impact Evaluation
Reclamation and Dredging of Channels -Cont.	<p>4. Noise impacts</p> <ul style="list-style-type: none"> • The main sources of noise would be from the reclamation works, increased traffic, loading and unloading of engineering equipment and materials and earthworks. • Residential area, mosque and businesses along the beach area located along the shoreline of the proposed site are in the range of 200 m to 300 m away from the proposed site will be subject to increased noise levels. 	<ul style="list-style-type: none"> • Selection of quieter running equipment. • Fitting of supplemental noise suppressors recommended by the manufacturer. • Regular maintenance of dredger and other construction equipment and vehicles so as not to produce noise higher than the manufacturer's specifications. • Construction vehicles must comply with the noise control requirements of the Environmental Quality (Motor Vehicle Noise) Regulations 1987. • Hoarding is recommended to be erected at the boundary of the Project site at the Mersing River mouth, which will be connected to the reclamation area. • Monitoring and setup of community noise complaints register to record any complaints from the public owing to noise pollution. <p>In the event that frequent noise complaints are received from the affected community, the following additional mitigation measures should be implemented:</p> <ul style="list-style-type: none"> • Installation of acoustical shielding panels around high emission sources, such as generators. 	<p><i>Moderate Adverse Impact.</i></p>
	<p>5. Flooding</p> <p>Siltation of existing drain and stream outlets during the reclamation and dredging phase could result in backwater effects and localised flooding.</p>	<ul style="list-style-type: none"> • Maintenance on all drains, streams and waterways on or adjacent to the site free from mud, silt and any other obstruction or pollution caused by the works and make good where necessary. • Stringent control should be adhered to as not to obstruct the flows in the existing monsoon drains/streams that flow into the project area • Screens and debris interceptors will be installed at all drain outlets in order to trap floatable items from escaping into the sea. 	<p><i>Minor adverse impact, mitigation required.</i></p>



Activity	Potential Impacts during Reclamation and Dredging	Proposed Mitigation Measures	Impact Evaluation
Reclamation and Dredging of Channels -Cont.	<p>6. Marine Ecology</p> <p>Seagrass</p> <p>0.5 ha of seagrass is predicted to suffer major damage by the suspended sediment plumes and sedimentation during the reclamation and dredging period and 70 ha can be expected to suffer moderate impacts.</p>	<ul style="list-style-type: none"> Mitigation measures proposed in suspended sediment plumes and sedimentations are primarily aimed at minimising potential impacts on the seagrass areas. This includes construction of a silt curtain at the boundary of the sea grass area Rehabilitation of seagrass areas damaged by suspended sediments and sedimentation where mortalities are determined through monitoring 	<p>Overall impact evaluation for damage to seagrass habitats is Moderate Adverse Impact, Mitigation Required.</p>
	<p>Benthos</p> <p>The area of benthic intertidal and shallow subtidal area lost due to dredging of the channels is 1514 ha (38% of the intertidal and shallow sub-tidal benthic habitat in Mersing Bay). This impact is reversible.</p>	<p>No mitigation available.</p> <ul style="list-style-type: none"> Refer to residual impacts for Loss of Habitat due to reclamation footprint. 	<p>Overall impact evaluation for damage to benthic habitats is Moderate Impact, Mitigation Required.</p>
	<p>Fish Fauna and Plankton</p> <p>The turbidity may reduce the hunting success of fish fauna and zooplankton. It is likely that impacts to fish fauna, including juvenile fish and fry, will be primarily behavioural and that the fish will avoid the areas of turbid plumes.</p>	<ul style="list-style-type: none"> Mitigation measures to abate poor water quality in protecting against losses of juvenile fish, fish fry and shellfish in Mersing Bay. 	<p>Minor Adverse Impact.</p>
	<p>Mangrove</p> <p>The impact of sedimentation on the mangroves at P. Setindan will be negligible as the predicted maximum sedimentation of less than five millimetres over 2 weeks is well within the tolerance limits of the mangroves found in the area.</p>	<p>No mitigation required.</p>	<p>Negligible adverse impact.</p>
	<p>7. Marine Navigation</p> <p>Increased marine traffic may result in a corresponding increase in accident risk, such as vessel collisions.</p>	<ul style="list-style-type: none"> Implementing standard navigation safety procedures, proper lighting, etc. Standard operating procedures and emergency operating procedures to be drafted by dredging contractor in consultation with Marine Department. 	<p>Minor impact - short-term and risks are manageable.</p>



2 POST RECLAMATION (RESIDUAL) IMPACTS

Environmental Component	Potential Post Reclamation Impacts	Proposed Mitigation Measures	Impact Evaluation
Physical Components	<p>1. Flooding</p>	<ul style="list-style-type: none"> Installation of water level recorder to monitor for any changes to water levels and tidal variations as a result of the reclamation. 	<ul style="list-style-type: none"> Existing flooding of Sg. Mersing Sg Tenglu and drainage channels discharging into Mersing Bay will not be exacerbated by the reclamation (Negligible / No change).
Biological Components	<p>1. Loss of Habitat due to reclamation footprint</p> <ul style="list-style-type: none"> The proposed reclamation would result in a loss of 1514 ha of mudflats that provide habitat to macrobenthic communities and foraging grounds to shore birds. 	<ul style="list-style-type: none"> The permanent loss of 1514ha of benthic habitat cannot be feasibly mitigated or avoided if the project is implemented. 	<ul style="list-style-type: none"> Loss of Intertidal and Shallow Subtidal Benthic Habitat: Moderate Adverse Impact.
	<p>Shorebirds</p> <p>There will be the loss of the intertidal habitat as well as potential disturbance to the birds once the area is fully built-up and occupied.</p>	<p>No mitigation available.</p> <p>Refer to residual impacts for Loss of Habitat due to reclamation footprint.</p>	<p>Loss of habitat: Moderate to High Adverse impact</p> <p>Effect on important bird species: Minor Adverse impact</p> <p>Effect of disturbance during operational phase: Negligible</p>



Environmental Component	Potential Post Reclamation Impacts	Proposed Mitigation Measures	Impact Evaluation
Human Environment	<p>1. Adjoining Land uses</p> <p>Adjoining land uses directly affected by the proposed development will be the coastal villages and beaches stretched from Sg. Tenglu Besar to Tg. Bangka. The key affect on these land uses would be the permanent loss of coastal frontage.</p>	<ul style="list-style-type: none"> • The loss of the coastal view is a permanent impact to the affected population which cannot be mitigated. • The loss of the beach front is partly mitigated by the provision of public beach frontage on the reclaimed land, which will have better beach quality (water depth and water quality). • The final development plan on the proposed reclamation should take into account the immediately adjacent existing landuses. • Scenic modification will accompany the development of the project, which can be partially minimised by ensuring the built development has takes into account attractive architectural and landscape design considerations. • Sufficient green areas should be allowed for in the final development plan. 	<p>Moderate negative impacts.</p>
Human Environment (cont.)	<p>2. Changes in Demand for Different Land uses in Mersing area.</p> <p>Commercial space for businesses which may be encouraged by increased trade to establish in the area; potential increased demand for residential areas (low to medium cost) for increased related employment.</p>	<ul style="list-style-type: none"> • No specific mitigation measures are available, other than strict control by the local authorities. 	<p>Potential negative impact if induced development is not planned/ controlled by the local authority; otherwise a positive impact to the economy and growth of the town.</p>
Human Environment (cont.)	<p>3.Socio-Economics Impacts</p>	<p>Landscape and visual aesthetics - The project development will be made accessible to the public once it is completed and the loss of sea view is compensated by having other recreational activities added in the area while still having access to beach from the artificial beaches and canals fronting the development area.</p>	<p>Moderate negative impacts.</p>
Human Environment (cont.)	<p>3. Land and Tenure Rights</p>	<p>No acquisition of land is required as part of the proposed development thus no impacts on existing land ownership is anticipated.</p>	<p>No impact.</p>



Environmental Component	Potential Post Reclamation Impacts	Proposed Mitigation Measures	Impact Evaluation
	<p>4. Fishing Industry</p> <p>The navigational channel and breakwaters is expected to provide a significant positive benefit to the fishing community.</p>	-	<i>Significant positive benefit.</i>