Impact Evaluation

Based on the RIAM, the impact is considered to be a **slight negative** impact.

Criteria	Score	Rationale
Importance	1	Deposition occurs within 1km of the Project
Magnitude	-1	Minimal change to macrobenthic community located within the Project footprint. Similar habitats are found near the impacted area.
Permanence	2	Temporary impact until the completion of reclamation and dredging
Reversibility	2	Reversible
Cumulative	3	Cumulative
Environmental Score	-7	
Description	-A	Slight negative impact

Loss of Habitat due to Capital Dredging

Approximately 178 ha of subtidal benthic habitat will be affected by capital dredging along the navigation channel and basin. The macrobenthic fauna can be affected by the dredging operations through direct removal of the habitat and associated benthos, as well as potential changes in the bottom conditions after the cessation of dredging. However, in general, effects of the dredging are not expected to be permanent as benthic communities will be able to recolonise the area on a time scale of months to a few years post dredging /94,95/.

As mentioned, the site is presently dominated by polychaetes. The relative immobility of polychaetes /96/ makes them susceptible to physical disturbances around them, however they are also an opportunistic species that have been found to account for a large part of the increase in macrobenthic abundance following dredging. Polychaetes show great diversity in reproductive traits /97/ which is beneficial in terms of recovery and colonization of new areas. Thus, the impact is considered to be minimal.

Impact Evaluation

Based on the RIAM, the impact is considered to be a **slight negative** impact.

Criteria	Score	Rationale
Importance	1	The loss of habitat is confined to the dredging area
Magnitude	-1	Affects 178 ha of benthic habitat in the dredging area
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulative	2	Non-cumulative
Environmental Score	-6	

Criteria	Score	Rationale
Description	-A	Slight negative impact

7.2.7.3 Post-construction Phase

Loss of Habitat

Benthic communities within the area being reclaimed will be completely lost due to the Project footprint. The area that will be lost due to reclamation (768 ha) is dominated by the polychaete *Ditrupa* sp. The loss of macrobenthos will reduce food sources for fish in the Project area. However, as there are similar habitats near the Project area and along the east coast of Terengganu, the impacts due to loss of macrobenthic habitat is considered minimal.

Impact Evaluation

Based on the RIAM, the impact is **minor negative**.

Criteria	Score	Rationale
Importance	1	The loss of habitat is confined to the reclamation footprint.
Magnitude	-2	Complete loss of habitat and macrobenthic communities within 768 ha reclamation area; nevertheless, the habitat is common along the east coast of Peninsular Malaysia.
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulative	2	Non-cumulative
Environmental Score	-16	
Description	-B	Minor negative impact

7.2.8 Plankton

7.2.8.1 Evaluation Framework

In general, reclaiming a large area of the coast will change the existing condition of the area permanently. These changes may affect the existing water quality in the area, for example through reduced flushing with possible consequent changes in nutrients, turbidity, and dissolved oxygen. Section 7.2.1.3 has assessed the changes in flushing using numerical modelling, and these findings are used in the present assessment. It is noted that potential impacts due to discharge of treated wastewater from developments on the reclaimed area, if any, are not considered in this EIA and will be evaluated in separate EIAs for the topside developments.

During the construction phase, the potential issues addressed in this section include water quality and sediment plumes and ship ballast water. The evaluation of impacts towards planktonic organisms was carried out based on the results of the suspended sediment plume modelling compared with the available literature on the tolerance level of the planktonic organisms towards elevated suspended sediments.

7.2.8.2 Construction Phase

Water Quality

During the construction stage, no significant pollutant discharges to the marine environment are expected apart from the release of suspended sediments which are addressed separately below. The dredged sediments are clean and hence enrichment of nitrogen and phosphorus, or metals due to releases from the sediments are not expected. Accidental spills of e.g. waste water may occur on occasion, as opposed to routine discharges. Given the good water exchange in the area, impacts to water quality are not expected to result in any impacts to phytoplankton.

Another potential impact to plankton related to water quality is the release of pollutants from dredge sediments, for example release of nutrients and organic carbon / organic matter and heavy metals.

The surveys in the area have however shown that the sediments within the dredging areas are predominantly sand, with very little organic matter and no heavy metal pollution.

Impact Evaluation

Based on the impact matrix, the impact is categorised as **minor negative** impact.

Criteria	Score	Rationale
Importance	2	Spills and leaks from marine vessels and releases from disturbed sediments are likely to remain localised, but may disperse up to 5 km from the Project area.
Magnitude	-1	Phytoplankton blooms caused by accidental spills and discharge of pollutants, including waste water from vessels, etc. are very unlikely. This is due to the good water exchange at the surrounding area. The sediment within dredging areas contain low heavy metal concentration and is predominantly sandy.
Permanence	2	Temporary. Accidental release may occur sporadically over the lifetime of the Project.
Reversibility	2	Reversible
Cumulative	2	Non-cumulative
Environmental Score	-12	
Description	-B	Minor negative impact

Ship Ballast Water

Ballast water discharged by the dredging vessels may contain trace metals, foreign planktonic organisms and viable dinoflagellate cysts that are brought in from the loading origin. Any release of such contaminants could result in impacts of high significance, particularly if they affect the fisheries in the area through the introduction of toxic blooming species or diseases. Consumption of shellfish contaminated with harmful algal blooms by human cause shellfish poisoning and can be fatal.

The vessel operators will be required to demonstrate adherence to a Ballast Water and Sediments Management Plan International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) adopted by the International Maritime Organisation (IMO) Guidelines, which among others requires the following:

- Ships to maintain a record on when ballast water is taken on board; circulated or treated and discharged into the sea.
- Ships using ballast water exchange to conduct ballast water exchange at least 200 nautical miles from the nearest land and in water of at least 200 m depth.
- In cases where the ship is unable to conduct ballast water exchange, this should be as far from the nearest land as possible, and in all cases at least 50 nautical miles from the nearest land and in water of at least 200 m in depth.

The recommended measures will ensure that ballast water releases do not contaminate the water or introduce any exotic plankton.

Impact Evaluation

Based on the impact matrix, the impact is categorised as **moderate negative** impact.

Criteria	Score	Rationale
Importance	3	Pollution or exotic species released from ballast water has the potential to affect a wide area beyond the point of release.
Magnitude	-1	Only three dredgers will be involved; and the risk occurs only in the initial mobilisation phase. For the remaining six years of construction phase, the dredger only moves between reclamation and borrow dredging site.
Permanence	2	Temporary, construction phase impact only.
Reversibility	2	Reversible
Cumulative	3	Cumulative; introduced algal species can reproduce and establish or change existing populations and produce follow-on effects in the ecosystem.
Environmental Score	-21	
Description	-C	Moderate negative impact

Sediment Plume

Turbidity is a major factor mediating bacterial and primary productivity in marine waters. The increased load of suspended solids would reduce light penetration and thus reduce the depth of photosynthetic activity by phytoplankton. In addition, high sediment loads can cause water temperatures to increase due to greater heat absorption, in turn, reducing dissolved oxygen concentrations. This would affect negatively on zooplankton.

Similar to fish, the turbidity may also reduce the hunting success of zooplankton. On the other hand, the turbidity associated with the reclamation activity may cause temporary increases in the level of organic matter and nutrients, which may increase productivity outside the plume areas to some extent.

Based on the hydraulic study, the predicted sediment plume excursion is quite localised with excess concentrations within the recommended safe limit for aquatic organisms which is <50 mg/L as per MMWQS Class 2 and <80 mg/L according to Boyd (1998) /98/. During the peak of Phase 2 which involves both dredging and reclamation, the zone of impact for exceedance of 50 mg/L is localised within the vicinity of the Project area and limited to 5 – 10% of the time (details in Section 7.2.1.2).

Hence, the impact to phyto- and zooplankton communities due to the suspended sediment plumes is expected to be low.

Impact Evaluation

Based on the impact matrix, the impact is categorised as **slight negative** impact.

Criteria	Score	Rationale
Importance	1	The zone of impact for exceedance of 50 mg/L is small and localised within the vicinity of the Project area.
Magnitude	-1	The effect is localised in relation to the wide distribution of plankton in the open coastal marine waters.
Permanence	2	Temporary.
Reversibility	2	Reversible
Cumulative	2	Non-cumulative
Environmental Score	-6	
Description	-A	Slight negative impact

7.2.8.3 Post-construction Phase

Eutrophication

As mentioned earlier, changes in flushing in the Project area owing to the reclamation footprint, which includes newly created canals, may affect water quality through

reduced flushing. If combined with increases in nutrient loads (eutrophication), this in turn may affect the density and distribution of planktonic communities, hence affecting their predators e.g. fishes, shellfishes and crabs.

As detailed in Section 7.2.1.3, flushing within the Project's inner channel and dredged basin are poor. Introduction of any contaminants within these areas during operation would lead to poor water quality such as higher concentrations of nutrients, etc and this would potentially cause phytoplankton blooms. Nevertheless, no routine discharges are anticipated from the reclaimed area therefore no water quality deterioration is anticipated. No changes to the flushing capacity of Sg. Terengganu is anticipated during the operation stage. No eutrophication with consequent potential for algal blooms is therefore anticipated.

Impact Evaluation

Based on the impact matrix, the impact is categorised as **slight negative** impact. This assumes no routine discharges from the future topside development into the canal and basin.

Criteria	Score	Rationale
Importance	1	The zone of impact is limited within the boundary of Project area.
Magnitude	-1	No significant impact on plankton communities anticipated due to the low risk of discharges into the canals and consequent eutrophication.
Permanence	2	Although the changes in flushing capacity induced by presence of reclaimed land is permanent, pollution loading can be controlled, and water pollution events due to discharges are temporary.
Reversibility	2	Reversible
Cumulative	2	Non-cumulative
Environmental Score	-6	
Description	-A	Slight negative impact

7.2.9 Fish Fauna

7.2.9.1 Evaluation Framework

The Project comprises of land reclamation and dredging activities which would entail the release of suspended sediments and sedimentation during the construction stage and permanent loss of habitat during the post-construction stage. Sensitive receptors susceptible to impacts are three FADs within 1 km and 15 FADs within 5 km from the Project area, soft-bottom subtidal habitat within the Project footprint, and a mangrove area in a tributary of Sg. Terengganu that runs parallel to the shoreline. It is noted that the density of fish fauna in the area was low with only 55 individuals caught during

neap tide and 13 individuals caught during spring tide. Species richness was also relatively low with only 14 species of fish fauna recorded across spring and neap tides.

In addition to the observed low density and species richness of fish fauna in the area, soft-bottom habitats (a type of unstructured coastal habitat) generally have lower densities of juveniles compared to structured coastal habitats (e.g. mangroves and coral reefs) which indicates the area to be a fish fauna habitat of relatively low importance /61/.

The evaluation of impacts towards fish fauna during the construction stage was carried out based on the results of the sediment plume modelling results as discussed in Section 7.2.1 and the Project footprint. The suspended sediment threshold for fish habitat is based on the MMWQS Class 2 (Fisheries) with a limit of 50 mg/L.

7.2.9.2 Construction Phase

Suspended Sediment and Sedimentation

In general, fish are more likely to experience sub-lethal stress from suspended sediments rather than mortality because of their ability to move away from or out of an area of higher concentration to a lower concentration compared to sessile or less mobile species /99/.

The results of the sediment plume modelling show relatively limited dispersion and short periods for exceedance of 50 mg/L excess TSS concentration (see Section 7.2.1). The greatest plume dispersion is expected during Phase 1b and 1c where maximum TSS could exceed 120 mg/L but is dispersed quickly by the current flows. Plume excursion is expected to extend less than 4 km from the spill source with the duration in exceedance of 50 mg/L below 20% for a large part of this area. Furthermore, the zone of impact where the Class 2 standard are exceeded is limited to approximately 2 km from the Project area.

During Phase 2, Phase 3, Phase 4 and Phase 5 of construction, TSS concentrations above 50 mg/L occur only within the Project area. As discussed in Section 7.2.6 (Primary Producer Benthic Habitats), these will not affect the FADs nearest to the Project (see Figure 7.23).

As unstructured coastal habitats (sand and mud) have significantly lower densities of juveniles compared to structured coastal habitats (e.g. mangroves and coral reefs), and the exceedance time is low, minimal impact is expected due to the sediment plume /61/.

During the entire construction period, the sediment plume is not expected to reach into Sg. Terengganu, with no sedimentation expected at the mangrove area.

Impact Evaluation

Based on the impact matrix, the impact is categorised as **minor negative** impact.

Criteria	Score	Description
Importance	2	Furthest extent of plume with concentrations exceeding 50 mg/L is 2 km from the Project area. Maximum extent of sediment plume is less than 4 km from the Project area.
Magnitude	-1	Results of the sediment plume modelling indicates minimal impact to receptors as plume exceeding 50 mg/L occurs less than 20% of the time and is mostly confined around the Project area.
Permanence	2	Plume extending beyond the Project area occurs only during dredging works, for Phases 1 and 2.
Reversibility	2	Plume only during reclamation and dredging works.
Cumulative	2	No interaction with other conditions.
Environmental Score	-12	
Range Value	-B	Minor negative impact

7.2.9.3 Post-construction Phase

Loss of Habitat

A total area of 768 ha of subtidal habitat equating to the total reclamation area is expected to be completely lost. While coastal areas are considered as breeding and nursery areas for certain species of fishes, unstructured habitats (sand and mud) generally have lower juvenile density, growth and survival compared to structured coastal habitats (seagrasses, corals, mangroves, and marshes) /61/. Based on the surveys of the area, no noteworthy species of fish fauna or macrobenthos was found. Additionally, low density of fish fauna and macrobenthos density and diversity were similarly found at other sandy areas near P. Karah. Hence, there is no indication of a unique or highly diverse habitat in the area.

As unstructured coastal habitats are found to have significantly fewer juvenile densities with some showing lower juvenile and growth compared to structured habitats, and no evidence of the reclamation area being a significant fish breeding and nursing area, the loss of the soft-bottom habitat is deemed to be not crucial /61/.

Impact Evaluation

Based on the impact matrix, the impact is categorised as **minor negative** impact.

Criteria	Score	Description
Importance	1	Direct effect within reclamation area.

Criteria	Score	Description
Magnitude	-2	Permanent loss of habitat. Nevertheless, soft-bottom habitats generally have lower fish juvenile density compared to structured habitats.
Permanence	3	Permanent reclamation because of Project footprint.
Reversibility	3	Irreversible because of Project footprint.
Cumulative	2	No interaction with other conditions.
Environmental Score	-16	
Range Value	-B	Minor negative impact

7.2.10 Marine Megafauna

7.2.10.1 Evaluation Framework

The focus of the impact evaluation is on the species of marine megafauna that may potentially occur in the vicinity of the Project and along the vessel route between the Project area and sand and rock borrow sites. A study has recorded sightings of several species of marine mammals between Redang Island and the Project area. Additionally, the NPP-CZ indicated a number of marine turtle nesting sites along the Terengganu coastline between the Project area and sand and rock sources (Figure 7.28).

Two TSHDs will be carrying out sand mining at the borrow area and transporting it to the Project area while flat top barge and tug will transport rocks from the Hexatrend Quarry to the Project area. The evaluation assessment was carried out based on the potential impacts of boat strikes and considers the extent to which these marine megafauna will be affected, by considering their vulnerability.

Post-construction, no impacts to marine megafauna are anticipated as the beach is not a turtle nesting area as discussed in Section 6.3.5.1.

7.2.10.2 Construction Phase

Boat Strike

Marine megafauna such as sea turtles are susceptible to vessel strikes. Boat speed affects the severity of collision impacts with marine megafauna. Fast travelling vessels give a small amount of time for the megafauna to flee as an avoidance response. In some cases, small vessels travelling at fast speed are only detected by the animals when the vessels are in close range thereby causing a startle reaction /100/. Vessels travelling at 13 to 15 knots or faster are more prone to cause severe injury or mortality to the animals /101/.

As outlined in Section 6.3.5, only two species of marine megafauna (*Kogia breviceps* and *Dugong dugon*) have been previously sighted in the waters nearest to the Project area. Sea turtle nesting sites are also located on Pulau Kapas and several more located along the Terengganu coastline (Figure 7.28). It is expected that boat strikes near the Project area are not likely to occur. As the sailing speed of an unloaded TSHD does not generally reach speeds greater than 14 – 15 knots with a loaded dredger moving at less than 13 knots, the likelihood of boat strikes along the sand and rock source routes is considered low due to the slow speed of the dredger. This is also the case with tugboats where tugboats towing loaded barges move at generally less than 10 knots.

Impact Evaluation

Based on the RIAM, the impact is minor negative impact. Mitigation measures to reduce the predicted impacts are recommended.

Criteria	Score	Description
Importance	3	Sand and rock source areas are located 124 km and 83 km south of the Project area respectively.
Magnitude	-1	Low likelihood of boat strikes due to generally low speed of vessels moving to and from the Project area and rock/sand source areas.
Permanence	2	Temporary as the vessels will be travelling along the route only during the construction phase.
Reversibility	2	The impact is reversible upon completion of the construction works.
Cumulative	2	Non-cumulative
Environmental Score	-18	
Range Value	-B	Minor negative impact

Figure 7.28 Marine megafauna sightings and sea turtle nesting sites between the Project area and rock and sand source areas.

7.2.10.3 Post-construction Phase

Not applicable.

7.2.11 Mangrove

7.2.11.1 Evaluation Framework

The evaluation of impacts to the mangrove during construction phase was carried out using the results of the sedimentation or suspended sediment and morphological impacts modelling as outlined in Section 7.2.1.2 and Section 7.2.2.2 respectively.

The key impacts to mangroves anticipated and their evaluation of impacts are:

- Sedimentation during construction – based on modelling of sedimentation as per Section 7.2.2.2;
- Impacts of the Project footprint post-construction on flushing and water quality – based on modelling as described in Section 7.2.1.

Sensitive Receptors

The nearest mangroves are located in the following areas:

- Along a tributary of Sg. Terengganu
- Along the riverbanks of Kuala Terengganu, Pulau Wan Man, Pulau Duyong and Pulau Sekati.

In general, the mangroves are in good condition with a mixture of nipah (*Nypa fruticans*) and gedabu (*Sonneratia* spp.).

7.2.11.2 Construction Phase

Sedimentation

Mangroves are very tolerant towards a range of suspended sediment loads that may be generated from dredging and reclamation activities /102/. However, sedimentation, i.e. deposition of these suspended sediments may lead to burial of the mangrove aerial roots, which inhibit the root aeration and thus lead to mortality /103, 104, 105/.

As shown in Section 7.2.1.2, no suspended sediment plumes or sedimentation will extend into Sg. Terengganu. No impacts to the mangroves are therefore predicted.

Impact Evaluation

Based on the RIAM, the impact is categorised as **no change** to the existing mangrove areas.

Criteria	Score	Description
Importance	1	Mangroves within 1 km of from the Project area.

Criteria	Score	Description
Magnitude	0	No change to the mangroves.
Permanence	1	No impact
Reversibility	1	No impact
Cumulative	1	No impact
Environmental Score	0	
Range Value	N	No change

7.2.11.3 Post-construction Phase

Flushing

Changes in flushing as described in Section 7.2.1.3 will not affect any mangrove areas within Sg. Terengganu. No impacts are therefore predicted during the post-construction phase.

Impact Evaluation

Based on the RIAM, the impact is categorised as **no change** to the existing mangrove areas.

Criteria	Score	Description
Importance	1	Mangroves within 1 km of from the Project area.
Magnitude	0	No change in flushing / salinity or other water quality parameters predicted.
Permanence	1	No impact
Reversibility	1	No impact
Cumulative	1	No impact
Environmental Score	0	
Range Value	N	No change

7.2.12 Terrestrial Ecology

7.2.12.1 Evaluation Framework

The Project involves clearing of a limited amount of coastal vegetation during the construction phase, including the temporary site office area. Nevertheless, these are permanent impacts related to the presence of the reclamation footprint. The

evaluation of impact magnitude for the loss of vegetation is based on the area of habitat removed and ecosystem functioning.

7.2.12.2 Construction Phase

Not applicable.

7.2.12.3 Post-construction Phase

Loss of Habitat

The vegetation along the shoreline of the Project area consists mainly of shrubland while some part comprised of woodland with one area showing planted *Casuarina equisetifolia.* Other than *Casuarina equisetifolia* as the dominant species, the woodland community in this area includes common coastal trees such as *Terminalia catappa, Acacia auriculiformis* and *Pandanus affinis.* None of the vegetation is of conservational significance and associated fauna are mainly birds.

The total loss of wooded vegetation area (i.e. trees) within the reclamation footprint is approximately 11.5 ha, including the planted *Casuarina equisetifolia* as shown in Figure 7.29.

Figure 7.29 Vegetation loss photo location for photos shown in Photo 7.1.

Photo 7.1 Trees that will be cleared.

Impact Evaluation

Based on the impact matrix, the impact is considered to be **slight negative** impact.

Criteria	Score	Description
Importance	1	Loss of habitat within reclamation area
Magnitude	-1	No flora species of conservational importance will be affected
Permanence	3	Total loss will be permanent
Reversibility	3	Total loss will be irreversible

Criteria	Score	Description
Cumulative	2	No interaction with other conditions
Environmental Score	-8	
Range Value	-A	Slight negative impact

7.2.13 Socioeconomics

7.2.13.1 Evaluation Framework

The evaluation framework applied for socioeconomics is based on the below framework (Table 7.27).

Table 7.27 Impact magnitude criteria for social impact assessment.

Significance	Criteria: Social Impact
Major negative impact (3)	• Considerable adverse change to current amenity, lifestyle and everyday community activities and functioning. • Displacement or relocation of houses or businesses • Severance of many communities in the area from facilities and services. • Permanent and total loss of formal and informal recreational facilities of regional importance, without opportunity for replacement / re-provisioning within the region. • An 'unhealthy' demographic structure is created in a community. • Permanent closure of one or more businesses. • Significant impact to many tourist attractions / facilities. • These impacts would be considered by society as constituting an important and usually long term- permanent change to the social environment.
Significant negative impact (2)	• Noticeable adverse change to current amenity, lifestyle and everyday community activities, but with scope for some mitigation. • Relocation of a community and or recreational facility to a less socially appropriate location. • Separation of a small number of residences from facilities and services. • Impact to a number of tourist attractions / facilities. • Adverse impact upon a large number of businesses, however their operations remain viable. • The disruption of livelihood for a community. • These impacts are real but not substantial, and would be viewed by society as constituting a fairly important and usually medium term change to the social environment
Negative impact (1)	• Localised or limited noticeable change to current amenity, lifestyle and everyday community activities, which can be largely mitigated. • The functional usability of community and recreational (formal or informal) facilities affected.

Significance	Criteria: Social Impact
	• Localised or limited change to the operation of businesses or tourism facilities. • Temporary access alterations to residential properties, businesses, community facilities and recreational areas during construction. • The disruption of livelihood for a group of households. • These impacts have little real effect, and would be viewed by society as constituting a fairly unimportant and usually short term change to the social environment

The aspects considered in this section for both construction and operation phases are:

- health and social wellbeing;
- aesthetic value;
- public safety due increase vehicular movement;
- in-migration, influx of foreign workers, etc;
- potential job opportunities due to the presence of the Project;
- economic impacts, primarily on local small-scale businesses.

It is noted that other aspects of impact to the human environment, such as tourism and recreation, fisheries, cultural heritage and archaeology, are addressed in separate sections below.

7.2.13.2 Construction Phase

Health and Social Wellbeing

During the construction period, the airborne dust and noise pollution may affect the nearby residents' health. As highlighted in Section 7.2.4 Air Quality and Section 7.2.5 Ambient Noise, the impacts are expected to affect areas within 3 km of the Project. The air and noise impacts are expected to be minimal and temporary during construction phase. Mitigation measures are required to reduce the impacts to health and social wellbeing.

Criteria	Score	Description
Importance	2	Confined to areas within 3 km radius of Project area
Magnitude	-1	Minor impact due to air quality and noise levels; affects areas within 3 km of the Project.
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulative	2	Non-cumulative
Environmental Score	-12	

Criteria	Score	Description
Range Value	-B	Minor negative impact

Aesthetic Value

The Project is located at Pantai Teluk Ketapang, one of Terengganu's tourism attraction spots. Local people and tourists tend to carry out recreational activities and walk along the coastline to admire the scenery of the seafront of Pantai Teluk Ketapang. The construction of the Project will affect the seafront scenic drive due to the hoarding installed along the Project boundary, which will block seafront views, resulting in the loss of seafront or beach aesthetic value.

Note that permanent changes in the aesthetic value / visual amenity due to the presence of the reclamation / built development is assessed in Section 7.2.13.3. Mitigation measures are required to reduce the aesthetic value impact.

Criteria	Score	Description
Importance	1	Affects within 1 km from Project area
Magnitude	-2	Loss of visual amenity to the local visitors and drivers driving through for the seafront view.
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulative	2	Non-cumulative
Environmental Score	-12	
Range Value	-B	Minor negative impact

Public Safety

Given that the Project is located nearby to villages along the road which is directly opposite the Project, the increased traffic movement from transporting of workers and construction equipment and materials during construction period may affect the safety of the locals in the area. It is expected that the majority of the construction materials will be transported by sea and only during mobilisation that earthmoving equipment will be transported through land. The impact can be reduced with the implementation of mitigation measures.

Criteria	Score	Description
Importance	1	Areas within 1 km from Project area
Magnitude	-1	Localised impact in the disruption of daily community activities and increase risk of public safety due to traffic movements.

Criteria	Score	Description
Permanence	2	Temporary during construction
Reversibility	2	Reversible
Cumulative	2	Not cumulative
Environmental Score	-6	
Range Value	-A	Slight negative impact

In-migration

In-migration of foreign / non-local workers during the construction period is relatively high due to the requirement of an estimated 500 workers during peak construction. The increased number of foreign / non-local workers may bring impacts such as the unsafe feeling, cultural/ethnic differences and social inequality among the local residents. These can lead to social tension between the two community groups. Due to the different value and culture, the influx of the workers could be possibly cause apprehension and uneasiness between local communities and foreign workers. Mitigation measures are required to address the influx of foreign workers during construction phase.

Criteria	Score	Description
Importance	2	Areas within 5 km from Project area
Magnitude	-2	Fairly important change to the social environment with estimated 500 workers potentially staying within the community around the Project area. The increase in non-locals / foreign workers may increase security risk and friction due to cultural differences, if any.
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulative	2	Non-cumulative
Environmental Score	-24	
Range Value	-C	Moderate negative impact

Job Opportunities

Given that the Project construction will need a lot of manpower, this can create job opportunities to the local residents during the construction period. Labour needs may be skilled or unskilled, but it is anticipated that most of the local personnel will be hired as unskilled labour. It is expected that many locals would be in favour of seeking the employment opportunities. This will indirectly help improve the community socioeconomic status. During construction phase, the increased workers to the areas also increases the demands for supply and daily necessities, which creates indirect

jobs at existing businesses and business opportunities for the locals to cater for the demands.

However, due to foreign workers lower wage rate, the locals might find themselves less preferred by employers. This will may lead to community disappointment towards development. It may also elevate the tension and conflict between local residents and the foreign workers during construction phase as discussed. Mitigation measures are required to mitigate the impact.

Criteria	Score	Description
Importance	1	Areas within 1 km from and within Project footprint
Magnitude	+1	Limited noticeable change to job opportunities for local community.
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulative	2	Non-cumulative
Environmental Score	+6	
Range Value	A	Slight positive impact

Economic Activity

During construction period, Pantai Teluk Ketapang will cease to be a recreational / tourist attraction as the entire stretch will be hoarded for Phase 1 construction. The loss of attraction will affect the number of daily visitors visiting the beach, which will in turn affect the businesses that depend on the beach location such as chalets, homestays and food hawkers. A total of three chalets, one hotel and 22 homestays are within 1 km radius from the Project area and will likely see a decrease in turnover due to their dependence on Pantai Teluk Ketapang as a key attraction.

Approximately ten hawker stalls operate in the northern area of Kg. Telaga Daing, opposite Pantai Teluk Ketapang whose business may also be affected by the effective closure of the beach. Nevertheless, the loss of visitors is alleviated by the increase in workers for the Project, which are likely to patronise food and drinks stalls.

Overall it is likely that the business activities in the area are likely to see minimal impact as they will be supported by the demands from the increased construction workers such as food and accommodation. The impact significance is evaluated as **Slight negative impact**. Mitigation measures are required to ensure existing business activities can adapt and transfer to support demand during the Project construction phase.

Criteria	Score	Description
Importance	1	Areas within 1 km from Project

Criteria	Score	Description
Magnitude	-1	Overall, localised or limited changes to the operations of businesses or tourism facilities (10 hawker stalls, 3 chalets, 1 hotel and 22 homestays) located within 1 km radius from Project are anticipated.
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulative	2	Non-cumulative
Environmental Score	-6	
Range Value	-A	Slight negative impact

7.2.13.3 Post-construction Phase

Aesthetic Value

The landscape and scenic drive view from the Pantai Teluk Ketapang will be replaced by the new township landscape. The beach attraction will be lost as the recreational area is shifted to the new beach on the reclaimed land. Mitigation measures are required to ensure public access to the new beach and recreational areas on the proposed Sunrise City development.

Criteria	Score	Description
Importance	1	Affects viewshed – limited to 1 km from Project
Magnitude	-3	Permanent and total loss of formal recreational area of importance.
Permanence	3	Permanent with a new township
Reversibility	3	Irreversible
Cumulative	2	Non-cumulative
Environmental Score	-24	
Range Value	-C	Moderate negative impact

Property Value

The demand for housing will increase accordingly to cater to the expanding population. This may lead to an increase in property and housing values. The value of surrounding property in Seberang Takir and other nearby areas are expected to increase due to the variety of economic activities offered by the Project. However, the rise is still considered manageable due to the availability of newly developed

residential properties in the new township. Overall this is assessed as a **moderate negative** impact. No mitigation measures are required.

Criteria	Score	Description
Importance	2	Areas within 5 km from Project
Magnitude	-2	Noticeable change to the current lifestyle due to the increase in property and housing values.
Permanence	2	Temporary during the first few years but may gradually stabilise
Reversibility	2	Reversible
Cumulative	3	Cumulative, impact has spillover effect to other sectors i.e. lifestyles
Environmental Score	-28	
Range Value	-C	Moderate negative impact

Socio-cultural Differences and Social Network

The Project will attract higher income groups to settle down in Seberang Takir, which currently has an average monthly household income of RM1,501 – RM2,000. The income group disparity will create two social income groups in Seberang Takir. Apart from economic differences, cultural differences may also become apparent when newcomers with different social background in-migrate to the Seberang Takir area. The in-migration may affect the culture, tradition, dialect language and traditional expertise. Terengganu has its own local dialect that is recognisable outside the state. As the original population in Seberang Takir may mix with the other newcomers from different states, tradition and culture will be affected as the Project is planned to be a modern township development. Furthermore, these cultural differences also can be seen through the urban design and local identity of Seberang Takir. The new township is seen as something new and modern as opposed to Seberang Takir which has been known as small fishermen's village throughout the years.

Overall, this impact can cause social differences and social inequality for both groups. Social tensions arising from competition and lack of integration between the newcomers and the existing local communities may also occur. Furthermore, the loss of Pantai Teluk Ketapang beach also lessen the opportunity of social engagement and recreational activities. This issue also can lead to social tension in the community.

The impact has been evaluated as a potential **moderate negative** impact; with mitigation measures implemented, the impact can be minimised.

Criteria	Score	Description
Importance	2	Areas within 5 km from Project area
Magnitude	-2	Noticeable change to current lifestyles

Criteria	Score	Description
Permanence	2	Temporary in the first few years as opportunities for social interaction and networking increase as time goes by. The benefit of increased opportunities for social networks and interaction will have spillover effects to other sectors i.e. increased job opportunities and economics activities which will help balance the income disparity.
Reversibility	2	Reversible with mitigation measures
Cumulative	2	Expected to be non-cumulative, as the increased opportunities for social networks and economic opportunities should narrow rather than increase the socioeconomic gap.
Environmental Score	-24	
Range Value	-C	Moderate negative impact

Job Opportunities

The Sunrise City project is expected to create a lot of job opportunities through the economic activities planned on the mixed development, such as light industries, transportation hub, hotels and resorts, mixed development, public facilities and town centre. The impact is anticipated to be **significant positive**.

Criteria	Score	Description
Importance	3	Kuala Nerus / Kuala Terengganu areas
Magnitude	+2	Noticeable increase businesses and job opportunities.
Permanence	3	Permanent / long term.
Reversibility	2	Reversible, as job opportunities still depend on wider economic climate.
Cumulative	2	Non-cumulative, the spillover effects are considered separately.
Environmental Score	+42	
Range Value	D	Significant positive impact

Economic Activity

As outlined above, the Sunrise City project is expected to create a lot of job opportunities. Therefore, there will likely be an influx of skilled, managerial and technical foreign workers and migration of locals from other states due to the job opportunities generated by the Project. This will bring a substantial shift in the size of the working population, and in tandem, the age composition of the population in Seberang Takir area may also change. There will likely be an increase in the working

age group which may have beneficial impact on the local economy. In addition, the increase in economic activities due to the Project will also contribute to the urbanisation of the Seberang Takir. This urbanisation will change the status of Seberang Takir as a small town to an urban area with the increased population density. The urbanisation of Seberang Takir can indirectly contribute to the socioeconomic upgrade of the local community and enhance the local economic activities.

The increased job and business opportunities will result in spillover (cumulative) effects to the general economy; this is seen as a **major positive** impact.

Criteria	Score	Description
Importance	3	Kuala Terengganu / Kuala Nerus area
Magnitude	+3	Considerable change to current amenity, lifestyle and social environment.
Permanence	3	Permanent.
Reversibility	2	Reversible
Cumulative	3	Cumulative, the benefit spillover to other sectors i.e. increase economic activities
Environmental Score	+72	
Range Value	+E	Major positive impact

Transportation and Rural Accessibility

The incoming population may affect the physical environment in various ways, including increased demand for housing, public amenities and services. With the Project, it is expected public facilities such as accessibility and mode of transportation will be enhanced corresponding to the population growth, resulting in a **Significant positive impact**. No mitigation measures are required.

Criteria	Score	Description
Importance	2	Areas within 5 km from Project area
Magnitude	+2	Noticeable change in social environment and amenities.
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulative	3	Cumulative, the benefit spillover to other sectors i.e. increase economic activities
Environmental Score	+36	
Range Value	D	Significant positive impact

7.2.14 Fisheries

7.2.14.1 Evaluation Framework

The assessment of fisheries impacts from dredging, and reclamation activities are based on data collected during the social survey, public engagement and focus group discussions, assessment of fish fauna as indicated in Section 7.2.9 and supplemented by secondary information from consultation with the fisheries authorities.

The criteria developed for evaluating the magnitude of fisheries impact is shown in Table 7.28.

Table 7.28 Fisheries impact magnitude scoring criteria.

Impact / Magnitude scoring	Criteria
Major Adverse (-3)	• Loss of common fishing ground above 70% of the area within district boundary. • Significant loss of important fish fauna habitat (breeding and nursery area) with high diversity / abundance. • Significant loss of income from fishing activity. • Relocation of fish landing jetty / site to less accessible location.
Moderate Adverse (-2)	• Loss of common fishing ground up to 50% of the area within district boundary • Noticeable loss of fish fauna habitat (breeding and nursery area) with moderate diversity / abundance. • Noticeable loss of income from fishing activity. • Relocation of fish landing jetty / site to nearby location.
Minor Adverse (-1)	• Localised or limited noticeable loss of fishing ground of less than 30% of the area within district boundary. • Loss of fish fauna habitat (breeding and nursery area) of low significance (low diversity / abundance). • Income from fishing activity is affected. • Temporary access alterations to fish landing jetty / site.

Fishing Grounds

There is a total of 1,796 registered fishermen with the Fishermen's Association at Kuala Terengganu, and an estimated 200 fishermen that are not registered with the Association. During the socioeconomic survey in the study area, 64 respondents were fishermen from the study area. The fishing grounds and frequency as reported by these fishermen are shown in Figure 7.30. These show the local fishermen primarily frequent the area within 5 km from the shore, which falls within fishing Zone A. None however report fishing within the Project area. Nevertheless, consultation with the Fishermen's Association and LKIM reveal that during certain seasons, in particular prawn season after the Northeast monsoon, the shallower areas nearshore may also be utilised by fishermen.

From the survey, the highest reported income per month from fishing activities was RM2,000 and the average income per month was RM1,000.

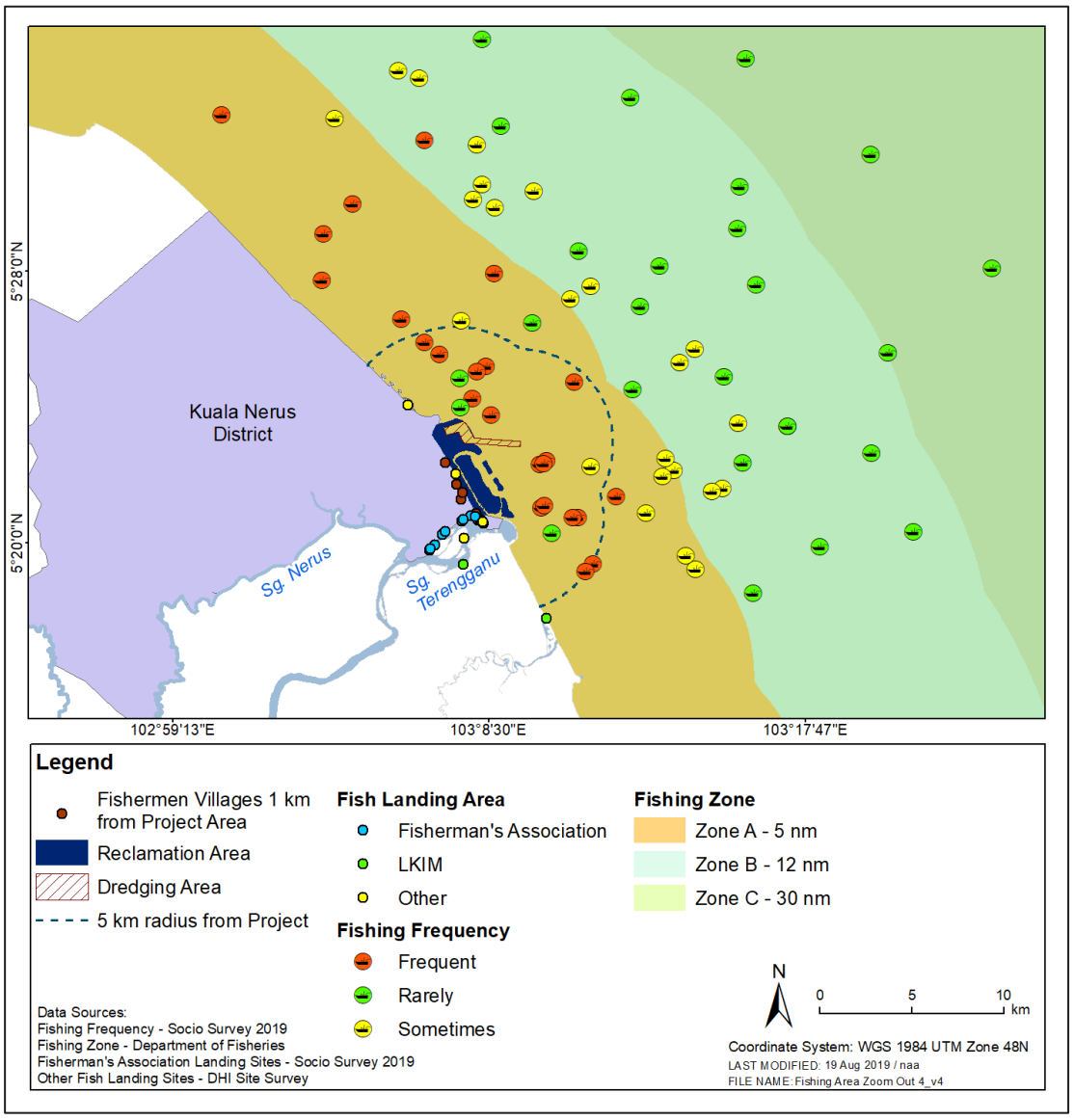

Figure 7.30 Fishing grounds identified by the fishermen in the social survey.

7.2.14.2 Construction

Decrease in Fish Catch

During the construction phase, the suspended sediment plumes from the dredging and reclamation could potentially result in avoidance of the affected areas by fish, resulting in lower catch for the fishermen utilising the area. As presented in Section 7.2.1.2, the relevant threshold of 50 mg/L total suspended sediment for fisheries (MMWQS Class 2) will be exceeded less than 10 % of the time during the construction phase, within an area covering up to around 2 km north-west and 2 km south-east from the Project (see Figure 7.31). The impact on fish fauna is predicted to be minor negative as mentioned in Section 7.2.9.2, and these are restricted primarily to the dredging works which will occur over nearly 10 months in total for Phase 1 and Phase 2, as opposed to the reclamation works.

Based on this, there is expected to be minimal reduction in fish catch due to the plumes from dredging and reclamation works.

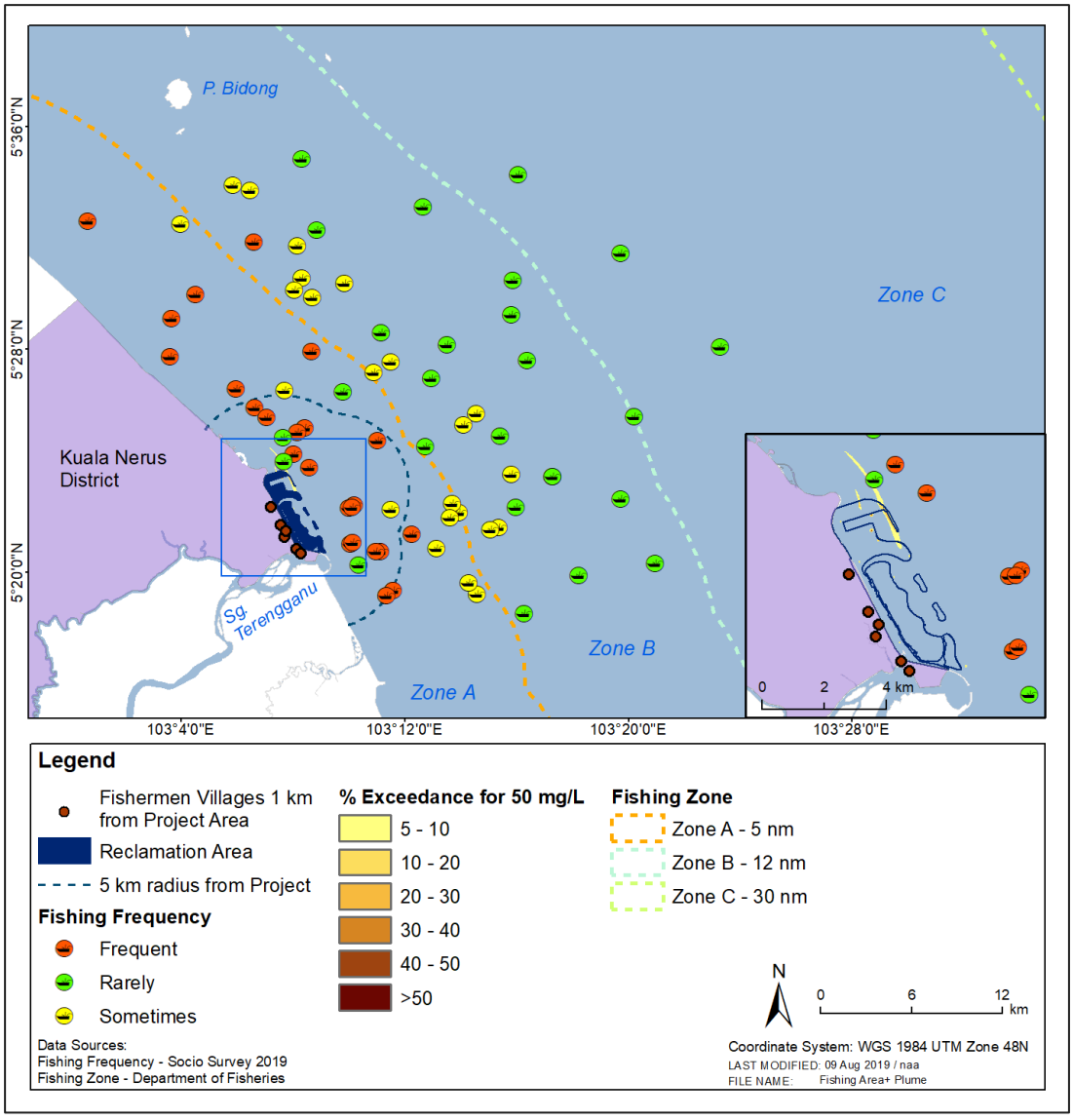

Figure 7.31 Fishing grounds identified by the fishermen in the social survey overlaid against sediment plume impact area (duration in exceedance of 50 mg/L TSS).

Impact Evaluation

No reduction in fish catch is anticipated due to water pollution during Project construction. Based on the RIAM, the impact is considered to be **minor negative** impact. Mitigation measures are required for fishermen affected by the Project during construction phase.

Criteria	Score	Rationale
Importance	2	Extent of impact is within 5 km of the Project area.
Magnitude	-1	The impact on fish fauna based on the predicted sediment plume dispersion is minor and the zone of impact is not within the main fishing grounds.

Criteria	Score	Rationale
Permanence	2	The impact is temporary during construction
Reversibility	2	Reversible, after construction stage ends
Cumulative	2	Non-cumulative
Environmental Score	-12	
Description	-B	Minor negative impact

Navigation and Access to Sea

One of the concerns raised during the Fisheries FGD (see Section 6.4.4) and agencies consultation was the effect of the Project on movements of fishermen. The fishermen will need to avoid the marine working area during the six-year construction period. Restricted areas will be marked with buoys. Fishermen from the villages along Pantai Teluk Ketapang who currently access the sea from the beach (six affected villages within 1 km radius from the Project area) will need to use alternative fish landing areas – either Tok Jembal to the north, or jetties inside Sg. Terengganu. However, no impacts to the key fish landing areas at Tok Jembal or inside Sg. Terengganu are anticipated.

As a result of the Project, the increase in marine traffic also increases the risk of exposure to accidents for the fishermen. Fishing gear (e.g. FADs) could be damaged and small boats may be damaged or sunk by a collision with larger vessel. In terms of navigating around the area, the dredging vessels will be moving at a low speed of 8 knots, thus minor impacts in terms of ship wake or risk of collision is anticipated. However, tug boats may go at a higher speed and may cause higher waves to form increasing the risk to the fishermen. Mitigation measures related to navigation safety are discussed further in Section 8.2.17.

Impact Evaluation

Overall, the income of the fishermen from the six fishing villages along Pantai Teluk Ketapang who currently use Pantai Teluk Ketapang to access the fishing grounds will likely decrease slightly due the need to find an alternative access / landing site which may discourage fishermen from going out to the sea.

Based on the RIAM, the impact is considered to be **moderate negative** impact. Mitigation measures are required for fishermen affected by the Project during construction phase.

Criteria	Score	Rationale
Importance	2	Primarily affects access to fishermen from six fishing villages along Pantai Teluk Ketapang.
Magnitude	-2	Alternative landing sites will need to be used for the fishermen from the six villages along the Project area. This may result in slight decreases in income from fishing (i.e. higher fuel costs)

Criteria	Score	Rationale
Permanence	2	The impact is temporary during construction
Reversibility	2	Reversible, after construction stage ends
Cumulative	2	Non-cumulative
Environmental Score	-24	
Description	-C	Moderate negative impact

7.2.14.3 Post-construction Phase

Loss of Fishing Ground / Access to Sea

Based on the social survey, fishing is the key source of income for 19% of respondents within the study area. The reclamation footprint of 768 ha represents a direct loss of fish fauna habitat, however this is unlikely to result in significant impacts to the fisheries resource as discussed in Section 7.2.9, due to the relatively low density and species richness of fish fauna in the area. This is also reflected by the reported fishing grounds as described in Section 6.4.4.3, whereby none of the 64 respondents report fishing in the nearshore area within the Project footprint. Furthermore, no FADs will be removed as part of the Project development.

Therefore, the long-term impacts of the Project on the fishermen and their livelihood is expected to be minimal. However, the Project footprint will result in loss of direct access for some fishermen from the six fishing villages along Pantai Teluk Ketapang to the sea via the beach (e.g. Kg. Telaga Daing and Kg. Baru Seberang Takir). Fishermen will be redirected to use landing sites or jetties located within Sg. Terengganu in the south or Tok Jembal in the north, and once the Sunrise City project is constructed, the proposed fishing jetty within the development.

Impact Evaluation

Based on the RIAM, the impact is considered to be **moderate negative**; mitigation measures are required.

Criteria	Score	Rationale
Importance	2	Within 5 km radius from Project
Magnitude	-2	Slight or localised loss of fishing grounds and fish fauna habitat; no impact on existing FADs; relocation of fish landing sites to nearby location.
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulative	2	Non-cumulative
Environmental Score	-32	
Description	-C	Moderate negative impact

7.2.15 Tourism and Recreation

The key tourism attractions and recreational activities affected by the Project are mainly the Teluk Ketapang beach and the beach-associated recreational activities such as horse riding, picnics and scenic drives along Jalan Pantai Teluk Ketapang.

7.2.15.1 Evaluation Framework

An evaluation framework for the assessment of impact to existing tourism and recreational activities has been developed as outlined in Table 7.29. The assessment considers the impact of the Project construction to the tourism attraction spots and recreational areas. As per the overall assessment framework, permanent impacts deriving from the presence of the reclaimed land (Project footprint) and the Sunrise City mixed development are considered under the post-construction phase impacts.

Table 7.29 Impact significance criteria for tourism and recreational activities impact assessment.

Significance	Criteria: Social Impact
Major negative impact (3)	• Considerable adverse change to current amenity, lifestyle and everyday community activities and functioning. • Permanent and total loss of formal and informal recreational facilities of regional importance, without opportunity for replacement / re-provisioning within the region. • Significant impact to many tourist attractions / facilities.
Significant negative impact (2)	• Noticeable adverse change to current amenity, lifestyle and everyday community activities, but with scope for some mitigation. • Relocation of a community and or recreational facility to a less socially appropriate location. • Permanent and total loss of recreational areas of local importance with opportunity for replacement / re-provisioning within the area • Impact to a number of tourist attractions / facilities.
Negative impact (1)	• Localised or limited noticeable change to current amenity, lifestyle and everyday community activities, which can be largely mitigated. • The functional usability of community and recreational (formal or informal) facilities affected.

Sensitive Receptors

The key sensitive receptors are Pantai Teluk Ketapang which is located within the Project area, in particular, the 1 km northern stretch of beach where most activities and facilities are concentrated. Beyond the Project area, Tok Jembal is a key recreational site north of the airport runway, and Pantai Batu Burok south of the Kuala Terengganu breakwaters. Recreational fishing activity was also observed along the airport extension revetment and the Kuala Terengganu breakwaters.

7.2.15.2 Construction Phase

Loss of Recreational Areas

Recreational activities along the entire 5 km stretch of Pantai Teluk Ketapang will be affected by the Project construction whereby hoarding will be installed along the Project area at the start of Phase 1 construction, in effect closing the beach for the entire construction period of six years. Given this will be later replaced by the Sunrise City development, this is considered a permanent impact. The newly-constructed walk / cycle way and rest huts along the full stretch of beach will be affected, while most of the impact will be felt around the 1 km northern section where the majority of activities and facilities, including roadside stalls, are located.

Other tourism and recreational spots beyond Pantai Teluk Ketapang are not affected (i.e. Tok Jembal, Pantai Batu Burok) by construction-related activities or sediment plumes.

Recreational fishing along the airport extension revetment in the Project area will be affected by the construction works, whereas fishing on northern section of Kuala Terengganu breakwater, which is between 2 – 3 km from the Project area will be slightly affected due to aesthetic impacts. Mitigation measures are required to reduce the impact of the loss of tourism attraction spot and recreational area.

Impact Evaluation

Based on the RIAM, the impact on tourism and recreation is limited to Pantai Teluk Ketapang and is **minor negative**.

Criteria	Score	Description
Importance	1	Affects Pantai Teluk Ketapang
Magnitude	-2	Permanent loss of recreational areas with opportunity for replacement / re-provisioning within the area
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulative	2	Non-cumulative
Environmental Score	-16	
Range Value	-B	Minor negative impact

7.2.15.3 Post-construction Phase

Loss of Pantai Teluk Ketapang

Pantai Teluk Ketapang will be permanently replaced by the Project, and upon completion of the Sunrise City topside development, new beaches will be created in the new development approximately 2 km seaward of the existing beach. The Sunrise

City project also includes a channel with public promenades and other spaces for additional public amenity. These waterfront areas will provide locals and visitors alike with beach recreational amenities, and in particular for tourists, will provide an alternative attraction to offshore island tourism during the monsoon season months.

Recreational fishing along the airport extension revetment and Kuala Terengganu breakwaters will not be affected post-construction.

Impact Evaluation

The long-term impact to tourism and recreational areas is anticipated to be **minor negative.** Mitigation measures are required to ensure the public are assured continued access to the beaches in the Sunrise City development.

Criteria	Score	Description
Importance	1	Affects within 1 km from Project area
Magnitude	-2	Permanent loss of beach as attraction and recreational areas with opportunity for replacement / re-provisioning within the area.
Permanence	3	Permanent with a new township
Reversibility	3	Irreversible
Cumulative	2	Non-cumulative
Environmental Score	-16	
Range Value	-B	Minor negative impact

7.2.16 Cultural Heritage / Archaeology

7.2.16.1 Evaluation Framework

The cultural heritage in Terengganu includes traditional arts, culture and rich Malay heritage in the area. For this assessment, consideration is given on impact of the Project to the historical and cultural facilities and values found within the study area.

The evaluation framework for cultural heritage is as shown in Table 7.30.

Table 7.30 Impact magnitude criteria for cultural heritage.

Magnitude	Criteria: Social Impact
Major negative impact (3)	• Considerable adverse change to current facilities and functions. • Permanent and total loss of formal and informal cultural facilities of regional importance, without opportunity for replacement / re-provisioning within the region.
Significant negative impact (2)	• Noticeable adverse change to current facilities and functions, but with scope for some mitigation. • Relocation of a cultural heritage facility to a less appropriate location.

Magnitude	Criteria: Social Impact
Negative impact (1)	• Localised or limited noticeable change to current facilities and functions, which can be largely mitigated. • The functional usability of cultural heritage facilities (formal or informal) facilities affected.

7.2.16.2 Construction Phase

No impacts are anticipated to cultural heritage facilities or functions during construction phase. The closest facilities or building with cultural heritage value are located on the other side of Sg. Terengganu. No mitigation measures are required.

Criteria	Score	Description
Importance	1	Affects areas 5 km from Project area
Magnitude	0	No change to current facilities and functions
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulative	2	Non-cumulative
Environmental Score	0	
Range Value	N	No change

7.2.16.3 Post-construction Phase

As discussed in Section 7.2.13.3, impacts on cultural heritage may occur through the urban design of the Sunrise City topside development and via in-migration changing the local identity of Seberang Takir. The new township is seen as something new and modern design as opposed to Seberang Takir which has been known as small fishermen village throughout the years. However, the impact of the modern design of the township is not expected to affect the value of existing facilities with cultural heritage status or value. Instead, these facilities may have their importance highlighted or promoted due to the scarcity of buildings identified as cultural heritage. Mitigation measures are required to address the differences.

Criteria	Score	Description
Importance	1	Affects areas within 1 km from Project area
Magnitude	-1	Localised change to current facilities and functions
Permanence	3	Permanent with a new township
Reversibility	3	Irreversible
Cumulative	2	Non-cumulative

Criteria	Score	Description
Environmental Score	-8	
Range Value	-A	Slight negative impact

7.2.17 Land Use

The Project is located within the main corridor for development identified for the Terengganu state as described in Section 3.3. The land uses as shown in Kuala Terengganu Local Plan 2020 indicated that the future land uses along the coastline are reserved for residential, institutional and public facilities development. The Project's key land uses include residential, mixed development (e.g. commercial, tourism, marine, light industry) and public facilities. These are in line with the future land uses earmarked in the local plan.

Impact Evaluation

The proposed Sunrise City development is in line with the land use plans, and hence no conflicts are expected for the Sunrise City conceptual land use. The land use impact is hence **no change.**

Criteria	Score	Description
Importance	2	Affects areas within 5 km from Project area
Magnitude	0	No change – in line with land use planning and policy
Permanence	3	Permanent with a new township
Reversibility	3	Irreversible
Cumulative	1	No change
Environmental Score	0	
Range Value	N	No change

7.2.18 Marine Traffic

7.2.18.1 Evaluation Framework

The impacts to marine traffic are based on the findings from the hazard identification (HAZID) workshop carried out on 21 August 2019 for the Marine Risk Assessment (MRA) for the Project. The report summarising the HAZID is attached as Appendix K.

Sensitive Receptors

The existing marine traffic in the area and navigation routes are described in Section 6.4.7. The key sensitive receptors with respect to navigation and marine traffic are:

- Ferry traffic operating between Kuala Terengganu to P. Redang which travel out of Sg. Terengganu northeast just over 4 km from the Project site;
- Fishing vessels ranging from small outboard vessels to larger Zone B vessels (only up to four Zone C and C2 vessels were registered in the Kuala Nerus fishing district);
- Offshore supply vessels with a daily transit of six inbound and six outbound vessels;
- Patrol boats from MMEA, Marine Department and Marine Police; and
- Other traffic including UMT research vessel and leisure yachts.
- Coastal cargo vessels with shipping routes in and out of Kuala Terengganu and along the coastline just over 5 km from the existing shoreline; with respect to the Project site the routes are located 2.5 to 3 km from the Project reclamation footprint, and around 1.44 km from the Project navigation channel.

7.2.18.2 Construction Phase

The Project has the potential to impact the existing marine traffic and navigation due to the additional marine traffic during both the construction and operation phases of the Project.

Risk of Collisions

The key potential impacts to navigation during the construction phase are linked to the additional shipping traffic for the marine construction works. This will include:

- Two Trailer Suction Hopper Dredgers (TSHDs), which will be used for the reclamation and dredging activities.
  - One TSHD will be making around two trips back and forth daily between the Project site and sand borrow area at Kijal (Figure 7.32).
  - One TSHD will remain around the Project site to carrying out the dredging works.
- Flat top barge and tug transporting rock from Hexatrend Quarry to the Project site with two trips per day (Figure 7.32);
- Cutter Suction Dredger for dredging the northern basin within the Project site;
- Other marine vessels such as crane and flat barges and tugboats, passenger boats (refer to Table 7.31) will be operating close to the working area during construction.

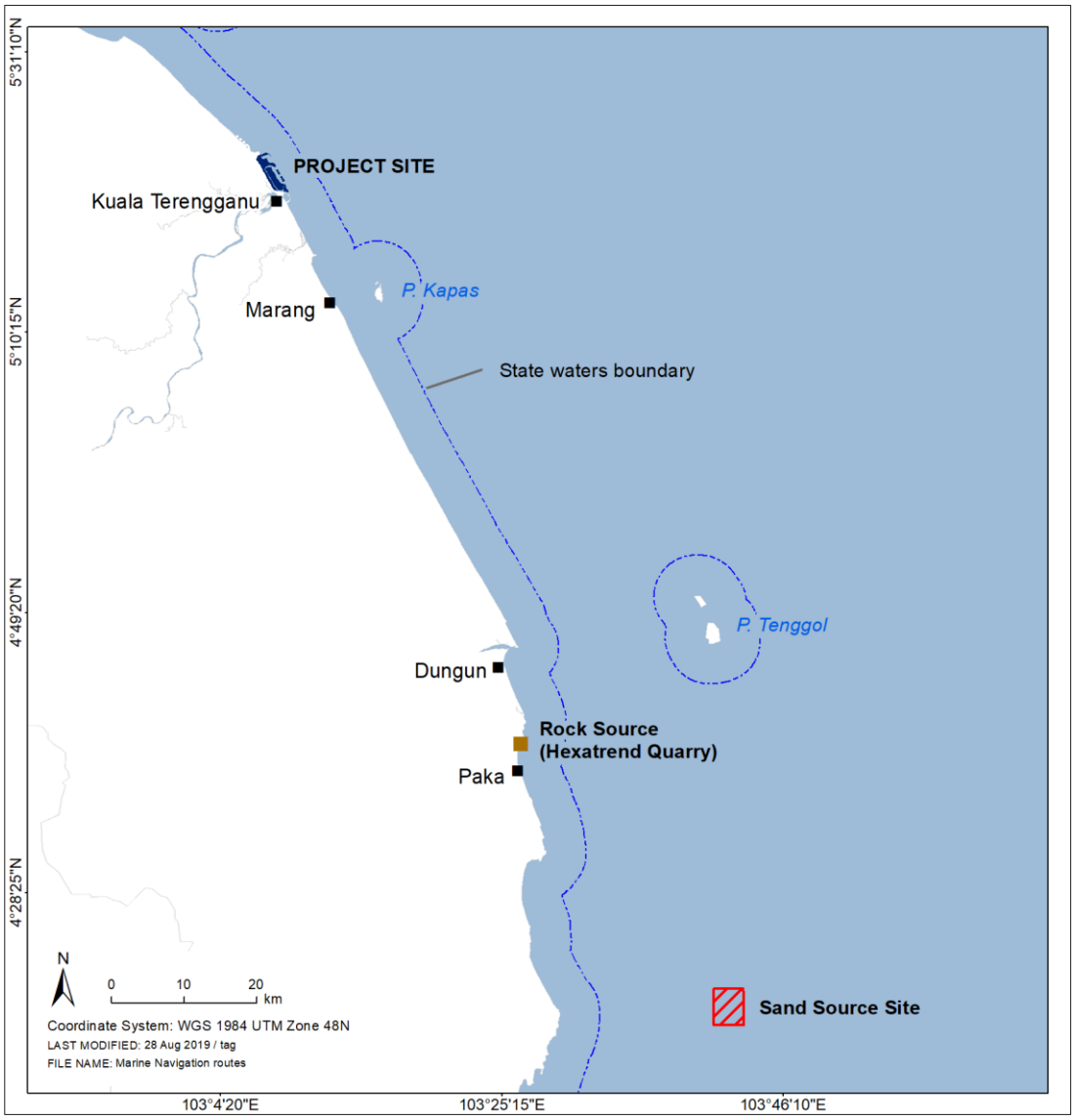

Figure 7.32 Sand and rock material source areas for construction in relation to the Project site.

Table 7.31 Marine vessels involved in the Project construction.

Item No.	Description	Function
1.	Trailing suction hopper dredger (TSHD)	Sand mining at the marine borrow area and transportation and pumping at the reclamation site
2.	Trailing suction hopper dredger (TSHD)	Dredging at breakwater / navigation channel and filling at reclamation site
3.	Cutter suction dredger (CSD)	Dredging at northern basin and filling at reclamation site
4.	Crane barge, flat barge, tug boat	Handling of floating / sub-sea pipeline Construction of revetment
5.	Flat top barge and tug	Supply of rock for revetment construction to the site from Hexatrend Quarry; two trips per day.

Item No.	Description	Function
6.	Passenger boat	Transport of personnel and small equipment and supplies
7.	Submarine pipeline, floating pipeline and onshore pipeline	Delivery of sand from the TSHD to the reclamation by hydraulic pumping

During construction, there is the possibility of collision between the TSHD and other vessels as identified below:

- Collision at sand source area / aggregate source;
- Collision with merchant vessels (OSV, commercial vessels) during transport of sand / rock;
- Collision with small crafts (fishing boats, fishing gears and other small crafts during transport of sand / rock;
- Collision with passenger ferries and fast crew boats during transport of sand / rock;
- Collision during reclamation;
- Capsizing, sinking and stranding of vessels during reclamation.

Possible causes of these collisions are:

- Lack of awareness of sand mining and reclamation activities;
- Equipment failure of passing vessel;
- Miscommunication (language, incorrect information);
- Unreported / unauthorised anchoring of vessels;
- Adverse weather affecting visibility (strong wind, haze, heavy rain).

Impact Evaluation

There are a low number of vessels and transits per day involved in the construction works, and most of the above-mentioned risks are readily mitigated through appropriate operating procedures which are described under Mitigation Measures in Section 7.2.18. As such, the impact is expected to be a **minor negative** impact.

Criteria	Score	Description
Importance	3	Collision can occur at the area between the sand source area and the Project site
Magnitude	-1	Minor changes to the marine traffic risk
Permanence	2	Temporary, only during construction
Reversibility	2	Reversible
Cumulative	2	Non-cumulative
Environmental Score	-B	

Criteria	Score	Description
Range Value	-18	Minor negative impact

7.2.18.3 Post-construction Phase

Changes in Current Patterns

Once complete, the Project reclamation footprint may induce changes in current speeds which could affect navigation safety through the Kuala Terengganu breakwater entrance, where the main commercial marine traffic flow is concentrated. The impact of the Project on current flows has been assessed as part of the hydraulic study for the NE, SW and inter-monsoon climatic conditions. The changes in predicted mean and maximum current speeds are presented in Figure 7.33 and Figure 7.34, which show that impacts on current patterns are localised to the vicinity of reclamation site. Very small decreases in current speeds (up to 0.03 m/s, ~0.06 knots) are predicted across the Kuala Terengganu breakwater entrance, and this will not adversely affect vessel manoeuvrability in and out of breakwater.

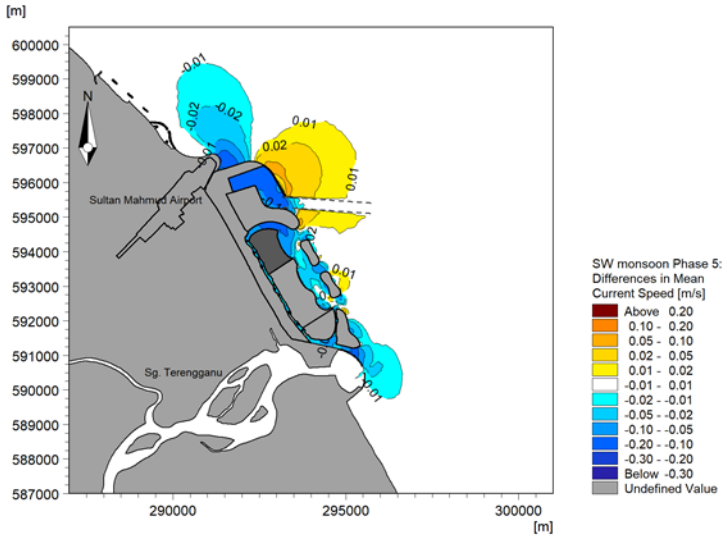

Figure 7.33 SW Monsoon: Predicted changes in mean current speeds between existing and post-construction.

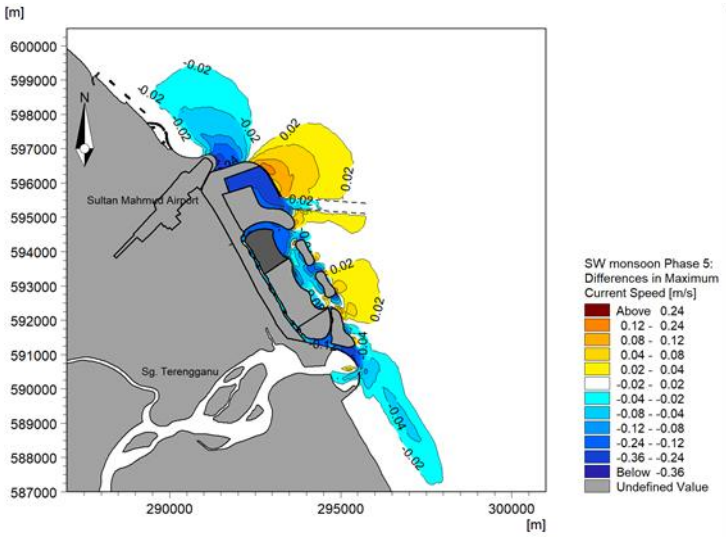

Figure 7.34 SW Monsoon: Predicted changes in maximum current speeds between existing and post construction .

Impact Evaluation

Most of these are readily mitigated through appropriate operating procedures which are described under Mitigation Measures in Section 7.2.18. As such, the impact is expected to be a **no change** impact.

Criteria	Score	Description
Importance	1	Change in current speed across Kuala Terengganu breakwater entrance.
Magnitude	0	No impact to marine navigation
Permanence	0	No change
Reversibility	0	No change
Cumulative	0	No change
Environmental Score	N	
Range Value		No change

7.3 Project Evaluation

This section contains an assessment of the environmental and development trade-offs anticipated from the Project. The EIA guidelines recommend a cost-benefit evaluation technique whereby the monetary value of all significant impacts that have been identified should be classified and assessed.

Determining the environmental benefits and costs for any project is often difficult due to the fact that assigning monetary values for intangible assets is controversial. Recognising these limitations, it is also useful to provide an overview of the non-

quantifiable environmental or social components. This qualitative assessment has been carried out for all identified impacts, positive and negative, using the Rapid Impact Assessment Matrix, and is presented below in Section 7.3.1.

The predicted impacts for which a monetary value could be estimated sensibly based on existing methods available in the field of environmental economics have been quantified as outlined in Section 7.3.2. The analysis has been undertaken with reference to the DOE Guidelines on The Economic Valuation of the Environmental Impacts for EIA Projects, 2008 /106/.

It is highlighted that, as per the Economic Valuation Guidelines /106/, the objective is not a cost-benefit analysis of the Project or economic costs and benefits of the Project, but rather the environmental costs and benefits of the Project.

7.3.1 Summary of Findings

This section presents a summary of the impact evaluation over the Project's construction and post-construction stages, based on the RIAM analysis. The overall impacts during the construction phase are presented in Figure 7.35 while the permanent, post-construction impacts are summarised in Figure 7.36.

The results show a number of moderate impacts during the construction phase from the biological-ecological (B/E) and socioeconomic (S/E) sectors. These are:

- B/E - potential impacts of ballast water release: introduction of contaminants or exotic plankton species, which could in turn affect the fisheries in the area.
- S/C – impact on security, social tension among local communities due to in-migration of foreign / non-local workers, with an estimated 500 workers required during peak construction.
- S/C – impact on navigation and access to sea for fishermen who utilise Pantai Teluk Ketapang for fish landing.

Post-construction, impacts to the biological-ecological environment have not been assessed as significant, with all impacts being *Slight* to *Minor*. The significant impacts are related to socioeconomics, as follows:

- Loss of beach attraction at Pantai Teluk Ketapang as it will be replaced by the new township landscape.
- Increase in values of property, housing and other close areas in Seberang Takir, but still considered manageable.
- Potential for social tension due to social differences and social inequality between newcomer populations and local communities.
- Impact to fishermen due to loss of fishing grounds / access to the sea.

The trade-offs relate to significant positive impacts in the economic sectors, related to:

- Expected vast job and economic opportunities from the Sunrise City project and indirect (induced) opportunities arising from the changes in size of the working population leading to the urbanisation of Seberang Takir.

- Induced development and enhancement of public facilities and transportation networks corresponding with the population growth.

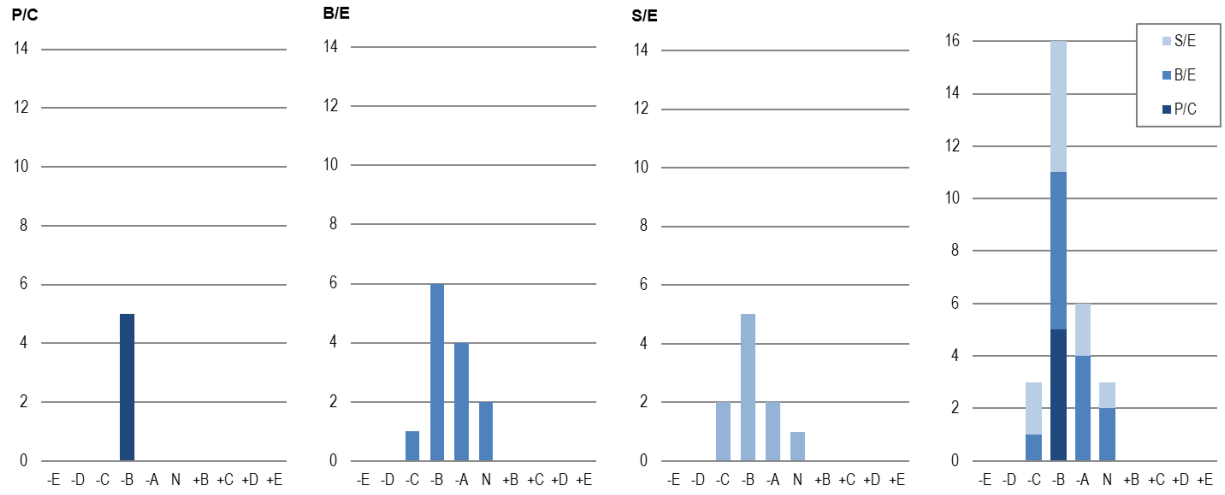

Figure 7.35 Summary of RIAM results for construction phase.

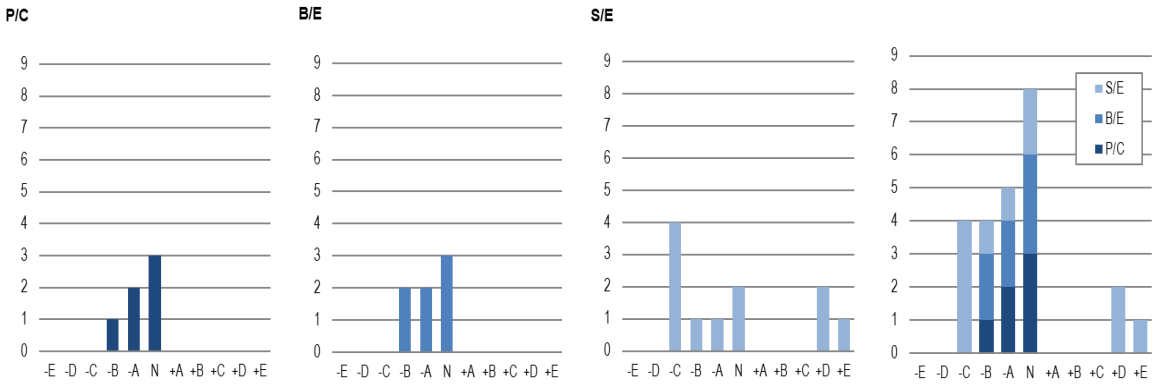

Figure 7.36 Summary of RIAM results for post-construction phase.

7.3.2 Economic Valuation of Environmental Impacts

This section contains an assessment of the economic value of impacts on environmental or ecosystem services arising from the Project. Ecosystem services are defined as the benefits people derive from ecosystems – the support of sustainable human well-being that ecosystems provide /107/. The scope of this assessment is based on the requirement for a cost-benefit evaluation to be conducted in the EIA for Project impacts, and more specifically, changes in flow of environmental services, as stated in the Guidelines on the Economic Valuation of the Environmental Impacts for EIA projects /106/:

"… a key issue is to identify and quantify the changes in the flow of goods and services produced by the environment which are impacted by a development project, and then to monetize these changes into costs or benefits".

The objective of this chapter is therefore to estimate the economic value of the gains or losses arising from the predicted environmental impacts of this Project. Impact prediction and evaluation has been carried out for the physical, biological and human environment in the preceding sections. Of these, only those related to changes in environmental, or ecosystem services are assessed here.

7.3.2.1 Methodology

The objective of the economic valuation is to quantify and monetize the impacts of the Project on the flow of environmental services. This requires valuation in monetary terms the changes (both negative and positive if any) in environmental services arising from the Project implementation.

The valuation process can be divided into the following steps:

- Step 1: Identification of environmental impacts. In this case the environmental impacts have been described in the preceding sections. These are reviewed in terms of those that can be quantified and monetised for the present economic valuation. These are discussed in Section 7.3.2.2.
- Step 2: Quantify the impacts on the environment over the duration of the Project. For the purposes of the economic valuation, this sets out the quantifiable impacts on the stakeholders in question for the given environmental service, as outlined in Section 7.3.2.3.
- Step 3: Economic valuation of environmental impacts (Section 7.3.2.3).
  - Monetize the impacts.
  - Determine the Net Present Value using different discount rates.
  - Perform sensitivity analysis Section 7.3.2.4.

The details on the valuation methodology for the impact in question is discussed in Section 7.3.2.3, however, overarching assumptions or variables are given as follows:

- An assessment period of **50 years** has been applied given the permanent nature of the Project;
- A range of discount rates from 3 to 8% has been used to calculate present value, as per DOE guidelines;
- All values are given in 2019 values. Where historical values in the literature are provided, these are adjusted for inflation based on the published rates given in the Knoema World Data Atlas /108/, Table 7.32.
- Monetary values from literature are given in USD, international dollars, and pounds. These are converted to Ringgit based on exchange rates as of 14 August 2019, as follows (MYR 1=):
  - USD 4.1847
  - Int. $ 1.28
  - GBP 5.0601

Table 7.32 Inflation rates for Malaysia applied in this study (Source Knoema World Data Atlas /108/).

Inflation	%	Inflation	%
1998	5.3%	2009	0.6%
1999	2.7%	2010	1.7%
2000	1.6%	2011	3.2%
2001	1.4%	2012	1.7%
2002	1.8%	2013	2.1%
2003	1.1%	2014	3.1%
2004	1.4%	2015	2.1%
2005	3.0%	2016	2.1%
2006	3.6%	2017	3.8%
2007	2.0%	2018	1.0%
2008	5.4%		

Studies assigning monetary values to ecosystem services are relatively rare in Malaysia. As such several primary sources have been used, including the following:

- Costanza *et al*. (2014) Changes in the global value of ecosystem services /109/;
- De Groot *et al.* (2012) Global estimates of the value of ecosystems and their services in monetary units /110/;
- van der Ploeg & de Groot (2010) The TEEB Valuation Database /111/.

Other references for specific services are discussed in their respective sections below.

7.3.2.2 Impacts to Environmental Services

Based on the impact assessment of all environmental components outlined in Section 7.2, a summary of the potentially quantifiable environmental goods and services affected by the Project is given in Table 7.33. It is highlighted that the potential for mitigation must also be considered, such that only net losses are accounted for. Mitigation measures are described in Section 8.

The key ‘environmental services’ is the aesthetic and amenity value afforded by the natural landscape and ocean views of Pantai Teluk Ketapang. The net loss is the ocean-views to the **residents** within the shoreline viewshed; the net effect for visitors and tourists is assumed to be the same after the Sunrise City project is implemented, with its offering of recreational areas, canals and new beaches.

Table 7.33 Summary of environmental services affected by the Project.

Components	Environmental Services Affected[6]	Location and Extent of Impacts /Stakeholders	Valuation Method
Aesthetic/ Recreational Value	Loss of sea-view, recreational value of Pantai Teluk Ketapang.	Local residents (within 200 m) with the sea-view. No net impact to visitors (as opposed to residents) is anticipated, since the Sunrise City project offers a replacement sea view and amenity on the reclaimed land.	The loss in aesthetic and recreational value using hedonic pricing method.
Subtidal benthic habitat (reclamation)	Productive services of the sandy seabed of the reclamation area (total loss of 768 ha) relating to macrobenthos community and fish fauna habitat.	Footprint of the reclaimed area. Fishermen and locals.	The loss is quantified using benefit transfer method where applicable resource values from literature are used.
Subtidal benthic habitat (capital dredging)	Productive services of the sandy seabed of the reclamation area (total loss of 178 ha) relating to macrobenthos community and fish fauna habitat.	Footprint of the reclaimed area. Fishermen and locals.	The loss is quantified using benefit transfer method where applicable resource values from literature are used.
Fisheries	The loss of Pantai Teluk Ketapang as a fish landing area for villages along the beach.	Reclaimed area of 768 ha, extending new shoreline 2 km from existing shoreline. The directly affected stakeholders fishermen from six fishing villages within 1 km from the Project area.	The value of loss of direct access to the sea is estimated by the additional fuel cost to go to the identified fishing grounds.

[6] Environmental services refer to qualitative functions of natural non-produced assets of land, water and air. They are typically categorized into: a) disposal services which reflect the functions of the natural environment as an absorptive sink, (b) productive services which reflect the economic functions of providing natural resource inputs and space for production and consumption, and (c) consumption services which provide for physiological as well as recreational and related needs of human beings. (Source: Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, United Nations, New York, 1997).

7.3.2.3 Valuation of Impacts to Environmental Services

As reviewed in the previous section, the Project will result in impacts to the following environmental services, which are valued in this section:

1 Loss of ocean-view amenity value
2 Loss of subtidal benthic habitat due to reclamation (permanent) and dredging (temporary)
3 Impact to subsistence fisheries

The quantification of these impacts, monetisation methodology and findings are described in the following subsections.

Loss of Subtidal Benthic Habitat

The characteristics of the intertidal areas in and around the Project have been discussed in sections 6.3.1, 6.3.2 and 6.3.4, and the key characteristics pertinent to the economic valuation are summarised below:

- Site is sandy subtidal area in depths 0 m to -8 m CD.
- Surveys indicated no natural benthic primary producing habitat except for isolated patches of seaweed;
- Artificial reefs have been placed in the area to boost productivity, however none will be affected by the Project;
- Fish fauna in the area include common and commercially important species, however of low to moderate density;
- Macrobenthos density was moderate and comparable to other similar sites along the East Coast, dominated by polychaetes, followed by gastropods. Very low numbers of bivalves and other organisms utilised for food were observed;
- Regional habitats / linkages may include corals in offshore islands of Pulau Kapas marine park, around 17 km from the Project and P. Bidong Marine Park, around 23 km from the Project, and mangroves in Sg. Terengganu.

Subtidal sandy areas provide erosion protection for upland and intertidal areas by forcing waves to break, reducing wave energy. They provide habitat for forage fish, juvenile fishery species, and several invertebrates. Although important habitat, they tend to be less productive than vegetated subtidal and intertidal areas, although the microphytobenthos can be a significant source of production.

In summary, the relevant environmental services for subtidal benthic habitat are summarised in Table 7.34.

Table 7.34 Ecosystem services provided by the sandy subtidal habitat.

Category	Relevant services for the Project site.	Monetary Value – sources
Provisioning Services	• Food (fish, shrimp, gastropods)	• Sasekumar (1998) /112/
Regulating Services	• Nutrient cycling • Climate regulation	• Costanza *et al*. (2014) /109/. • De Groot *et al.* (2012) /110/
Habitat / Supporting Services	• Nursery / life cycle maintenance • Genetic diversity	• De Groot *et al.* (2012) /110/

(i) Provisioning Services

The values for the provisioning services are based on a study for intertidal mud flats by Sasekumar (1998) /112/. The present site is sandy subtidal, and hence it is likely that the vales are overestimated for the present site. However, in the absence of specific data, benefit transfer from mudflat to sandy subtidal is used. For the site, it is assumed that fish, shrimp and gastropod food resources are supported by the area.

In the 1998 study, production values were estimated for the entire Peninsular Malaysia and the value was divided by the mudflat area in Malaysia (35,064 ha) to estimate the annual value per hectares of mudflat. Total production values provided for the above relevant food resources were:

- Gastropods/ snails – US$ 344,879 with net return factor of 30%;
- Shrimps – US$ 2.9 million with net return factor of 30%; and
- Fish – US $ 2.2. million with net return factor of 25%.

The loss in environmental service (RM/ ha/ year) by type of organisms has been adjusted for inflation and converted to Malaysian Ringgit (see Section 7.3.2.1) as shown in Table 7.35, with a resulting total of RM 296.93 per hectare per year.

Table 7.35 Estimated resource value of soft bottom area in RM/ ha / year (2018 price).

Type		RM/ha/yr
1	Fish	108.15
2	Shrimp	171.08
3	Gastropods	17.70
	Total	296.93

(ii) Regulating and habitat services

Permeable sands are a dominant sediment type along the coast of Terengganu. The importance of permeable sediments in the cycle of organic matter has been

recognized recently (Shum and Sundby 1996 /113/; Boudreau *et al.* 2001 /114/). Shallow subtidal permeable sands are thought to be an optimum habitat for microphytobenthos compared to the intertidal areas, and deeper subtidal. The shallow subtidal areas are in a “sweet spot” between intertidal - which is subject to desiccation during low tides and too much sunlight, and deeper subtidal, where light penetration would become a limiting factor.

Compared to muddy sediments, light can penetrate further in sandy sediments, where the euphotic zone in coarse sandy sediments is up to 4 mm. Permanent advection due to strong currents and wind induced waves is also important in supplying organic material from the overlying water column into the sediment, and studies have shown that this can result in higher nutrient concentrations in the sediment than in the overlying water column. In contrast, in the intertidal, supply of organic material and nutrients through the water column is only possible when the tide is in. Therefore primary productivity of sandy subtidal is comparable or higher than intertidal or fine-grained, organic-rich sediments /115/. The microphytobenthic biomass could be an important food source for meio- and macrofauna and the benthic primary productivity also contributes substantially to oceanic carbon fixation (Wollast, 2002; Gattuso *et al.*, 2006).

As such, the inclusion of the above services in the evaluation was considered necessary. Review of several sources as listed in Section 7.3.2.3 was carried out, and the nutrient cycling value for marine “Shelf” systems from Costanza 2014 /109/ was utilised.

Values for climate regulation, nursery and genetic diversity services were obtained from de Groot *et al.* (2012) /110/, which is a review and synthesis of various valuation studies. Values for climate regulation service for coastal systems was based on only one study, carried out in the USA, with an estimate of 479 Int.$/ha/year.

For nursery services, three valuation studies were provided, which included seagrass ecosystems which are generally thought to have significantly higher value that bare substrates; therefore the minimum value of 93 Int.$/ha/year was selected (based on a study in Tanzania) /110/. Only one study has estimated the value of coastal systems for genetic diversity services, with a stated value of 180 Int.$/ha/year.

(iii) Total Economic Value

Total economic value for ecosystem services for the sandy subtidal is therefore estimated at **RM 12,273.45/ ha / year** as shown in Table 7.36.

Table 7.36 Total economic value for sandy subtidal area.

	Ecosystem services of subtidal sand	RM/ha/yr
1	Regulating - Nutrient cycling	10,698.18
2	Provisioning - food	296.93
5	Regulating - Climate regulation	814.26
6	Habitat services - lifecycle maintenance (esp nursery)	158.09
7	Habitat services - gene pool protection (conservation)	305.98
	Total Economic Value	12,273.45

For the current Project, the value of the environmental services forgone from the loss of benthic area is obtained by multiplying the size of the affected area (768 ha permanent reclamation footprint and 178 ha due to capital dredging) by the total estimated value (i.e. RM12,273.45/ha/yr).

The removal of 768 ha of benthic area due to the reclamation footprint is a permanent loss, however, the capital dredging works is temporary (once-off) and the benthic communities are expected to recover in a short period (estimates from the literature range between one to five years). For this study, a relatively conservative base estimate of five years has been applied; with lower and upper estimates of two and eight years respectively used for sensitivity analysis.

It is assumed that the benthic community recovers at a constant rate over the five years after the cessation of dredging. Based on the Project schedule given in Section 5.3, the dredging will be carried out in two phases: Phase 1 in the first year of 16 ha, and 162 ha in the following year during Phase 2. The total benthic area lost and its value is summarised in Table 7.37.

Table 7.37 Assumptions for area loss due to reclamation and dredging over Project implementation.

Year	Reclamation (ha)	Dredging (Ha)	Dredging Area lost (ha)			Base estimate	
			Base estimate (5 yrs recovery)	Lower est (2 yrs recovery)	Upper est (8 yrs recovery)	Area Lost (ha)	Value (RM)
1	124	16	16	16	16	140	1,718,282.52
2	124	162	178	178	178	426	5,228,488.23
3	174		142.4	89	155.75	564.4	6,927,133.23
4	98		106.8	0	133.5	626.8	7,692,996.30
5	155		71.2	0	111.25	746.2	9,158,445.82
6	93		35.6	0	89	803.6	9,862,941.65
7			0	0	66.75	768	9,426,006.95
8					44.5		9,426,006.95
9					22.25		9,426,006.95
10					0		9,426,006.95

Impacts to Subsistence Fisheries

Coastal areas reported used for fishing by these nearshore fishermen extend from around 3 km off the coast and beyond to areas up to 5 nm from the shoreline. The Project site itself is not a reported fishing ground, likely owing to the shallow waters (between 0 to -8m depth). Nonetheless, the value of the habitat lost due to the Project footprint, which may support fisheries, is already captured in the computation of the loss of the subtidal sandy habitat in the preceding section, and hence double counting any potential future loss in catch must be avoided.

Subsistence fishermen who use small outboard powered boats from the beach will lose the direct access to the sea. These fishermen will still be able to access their fishing grounds offshore, however, they can only do so at a higher cost since they will have to travel further to the fishing ground. During construction, alternative fish landing areas will need to be used; the nearest facilities are at Seberang Takir jetty inside Sg. Terengganu, and north of the site at the Tok Jembal breakwaters. Upon completion of the Sunrise City development, a new fishing jetty will be provided within the project. Nevertheless, this will be further from their homes currently across the road from the existing beach and as such the fishermen will incur additional cost of utilising alternative routes to the fishing grounds offshore or north of the Project.

The directly affected stakeholders are the fishermen with outboard powered boats from the fishing villages located within 1 km from the Project. Based on site observations, there are a few informal landing areas along Pantai Teluk Ketapang, with less than 20 boats observed on the beaches in total (over a number of observations). Upon landing, the fishermen remove their engines and leave the boats

along the beach, hence these would be restricted to those vessels with relatively small engines (40 HP to up to 60 HP). Boats with large outboard or inboard engines would have to use the landing jetties in Sg. Terengganu or at Tok Jembal). There are six fishing villages located within 1 km of the Project:

(i) Kg. Ketapang,

(ii) Kg. Telaga Daing,

(iii) Kg. Baharu Seberang Takir,

(iv) Kg. Hulu Takir,

(v) Kg. Seberang Takir; and

(vi) Kg. Tanjung Seberang Takir.

However, the affected villages are assumed to be five, as Kg. Tg. Seberang Takir uses the fishing jetties inside Sg. Terengganu.

The total number of registered outboard powered vessels in the Kuala Nerus fishing district is 85 (2018) (see Section 6.4.4).

The additional cost is estimated by the fuel cost to use these alternative routes. This may be significant as the use of fuel represents a substantial component of the costs involved in fishing, whereby the cost of fuel for fishing boats normally accounts for more than 50% of annual operating expenses /116/.

Estimating fuel costs

The value of direct access to the sea for the fishermen is estimated by the increased cost of land travel and transportation to the alternative jetties. This is assumed for the construction and operational stages in the event that fishermen continue to use the alternative landing site as opposed to the new facilities on Sunrise City. This additional cost is incurred for each fishing trip.

The additional distance travelled has been estimated for each affected village in Table 7.38 based on the distance from the affected village to the new landing area (covered by car); and the distance via sea from the alternative landing area to a representative central preferred fishing area as shown in Figure 7.37.

Fuel costs incurred for this additional overland travel has been estimated using the assumptions summarised in Table 7.39. Fuel costs for marine vessels also depends on several variables, not the least the engine size, but also boat configuration and travel speed. A survey by Zainol *et al.* (2016) /116/ found that most inshore fishing boats have average cruising speeds of around 22 kn up to a maximum of 26 kn, however in the initial part of the trip from port, the average speed is 15.56 knots.

In the present study area, most nearshore fishermen operate on daily trips, with the most common fishing grounds between 3 to 5 km offshore; hence the nearshore speed of 15.56 knots from /116/ is used. An engine size of 60 HP is assumed as a conservative estimate, for which fuel consumption estimates from Zainol *et al.* (2016) is 15.22 L/ hr /116/ as listed in Table 7.40. The other key assumption is the number

of affected fishermen estimated at 43. This number represents half the number of registered outboard powered boats in the district (85 vessels), which was derived on the basis that the affected number of villages is five out of the 12 fishing villages in the study area (just under 50%).

As fishermen report to fish year-round, this figure is multiplied by 12 to provide an annual estimate. The total additional fuel cost per year is estimated at **RM 87,047**.

Table 7.38 Distances and assumptions used in terms of travel times, based on the preferred fishing area as shown in Figure 7.37.

	Fishing Villages on Beach	Current distance to fishing ground (m)	Alternative landing site	New distance by road (m)	New distance by sea (m)	Additional land distance	Additional sea distance
1	Kg. Seberang Takir	4,300	Seberang Takir	200	6,500	110	2,200
2	Kg. Baharu Seberang Takir	4,300	Seberang Takir	1,500	6,500	1,370	2,200
3	Kg. Telaga Daing	4,400	Seberang Takir	2,000	6,500	1,745	2,100
4	Kg. Ketapang	4,800	Seberang Takir or Tok Jembal	4,800	6,500	4,480	1,700
5	Kg. Hulu Takir	4,300	Seberang Takir	1,340	6,500	950	2,200
Base estimate (Average distance)						1,731	2,080

Table 7.39 Summary of assumptions used to calculate cost of addition overland travel time.

Key Assumptions	Base estimate	Remarks
Car fuel consumption (km/L)	10.8	Average fuel efficiency from data given in /117/
Unsubsidised fuel price RM/L	2.06	Average Jan – May 2019 /118/
Average additional mileage km	3.462	Return mileage based on Table 7.38.
Assumed price per KM	0.19	Fuel price (consumption/ price /L)
Total cost for additional distance / trip (RM)	0.66	Fuel price multiplied by additional mileage.
Number of fishermen	43	Based on 1/2 number of registered outboard powered vessels 2018 (of 85)
Fishing days / month	26	
Additional cost (RM)	737.03	per month

Table 7.40 Summary of assumptions used to calculate cost of addition oversea travel time.

Key Assumptions	Base estimate	Remarks
Speed	15.56 kn	Zainol *et al.* (2016) /116/
Additional distance (km)	4.16	Round trip, based on Table 7.38
Fuel consumed L/hr	15.22	Zainol *et al.* (2016) /116/
travelling time (MM:SS)	08:40	
Fuel consumed (L)	2.20	
Price of additional fuel (RM)	4.52	Per fisherman per trip
Number of fishermen	43	Based on number of Zone A outboard powered vessels 2018
Fishing days / month	26	
Additional cost (RM / month)	5,054.74	Per month

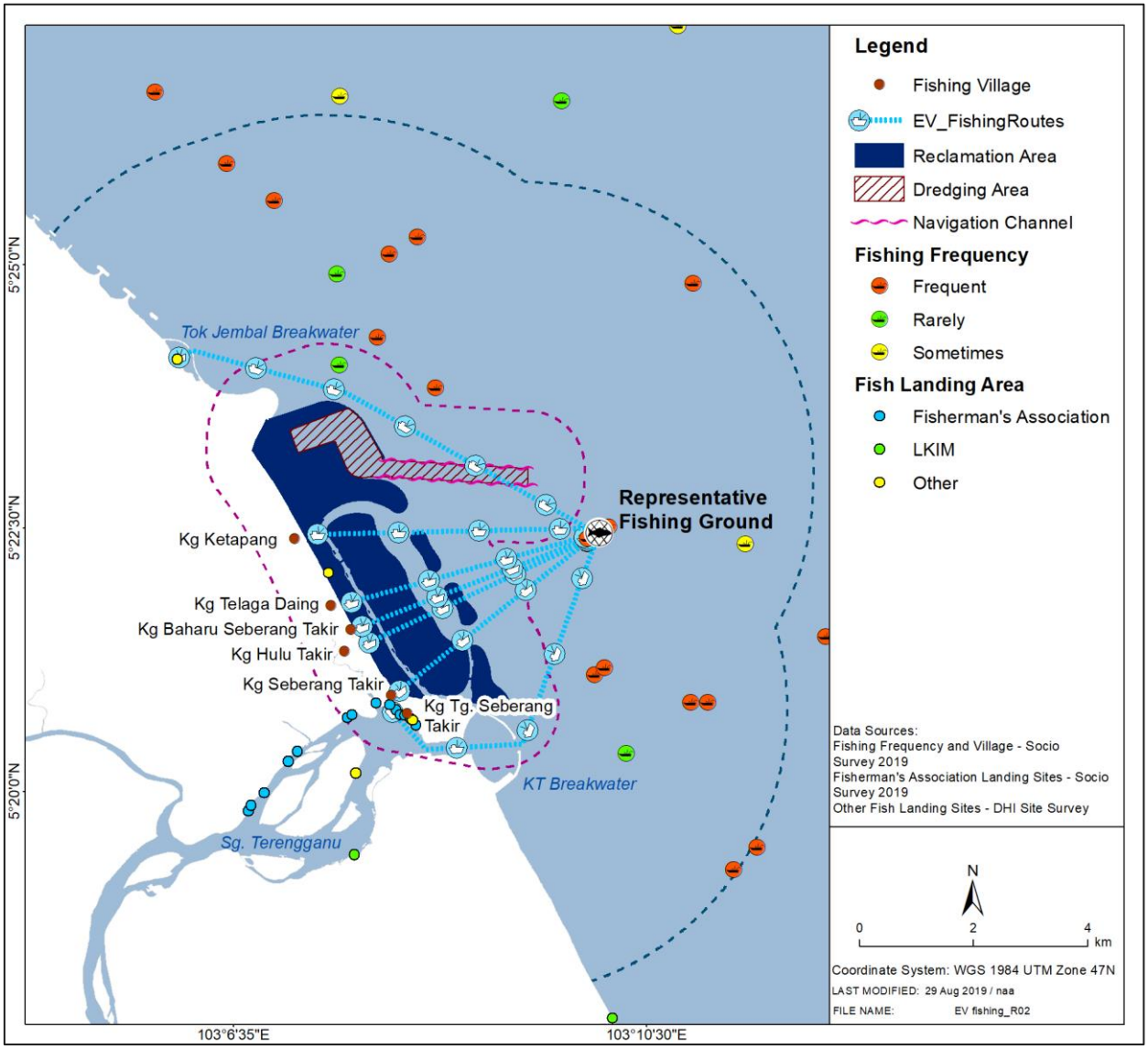

Figure 7.37 Locations of affected fishing villages and assumed preferred fishing ground location.

Key Assumptions	Base estimate	Remarks
Speed	15.56 kn	Zainol *et al.* (2016) /116/
Additional distance (km)	4.16	Round trip, based on Table 7.38
Fuel consumed L/hr	15.22	Zainol *et al.* (2016) /116/
travelling time (MM:SS)	08:40	
Fuel consumed (L)	2.20	
Price of additional fuel (RM)	4.52	Per fisherman per trip
Number of fishermen	43	Based on number of Zone A outboard powered vessels 2018
Fishing days / month	26	
Additional cost (RM / month)	5,054.74	Per month

Loss of Shoreline / Change in Aesthetic Value

The impact on aesthetic and recreational value arises because of the loss of the beach and sea-view, recreational value of Pantai Teluk Ketapang and the change from natural environment into a built (mixed use) environment. The affected beach front extends for about a total of 5 km in length.

Given that the proposed Sunrise City development will provide new beaches, water fronts and canal areas, there is considered to be no net loss to visitors to Pantai Teluk Ketapang, rather the loss is for the permanent residents of the villages along the shoreline, who will lose the shorefront location and sea views.

When the Project is implemented, the villages along the shoreline will no longer have the sea-view. This affects five villages along the beach stretch: Kg. Ketapang, Taman Perumahan Telaga Daing, Kg. Telaga Daing, Kg. Baharu Seberang Takir and Kg. Seberang Takir.

Taking only the lots directly fronting the shoreline, the loss of sea view will be borne by approximately 281 lots, with a total of around 120 ha of land (Figure 7.38). This loss of ocean-view amenity and proximity to the beach for the residents along the shoreline is an environmental cost of the Project.

The technique most used to value the benefits of visual amenities from property is referred to as the hedonic method, where house price data are used as the basis for calculating premiums placed on houses in locations with different landscape attributes. In this section studies that value ocean views are reported.

Without the Project and the Sunrise City development it is assumed that the status quo, with primarily *kampung*-style homes, will persist in the area. The residential lot sizes in these villages tend to be small and the houses crowded together.

Therefore, this study thus takes the pragmatic approach of basing the value of aesthetics of sea view and frontage on a premium over current residential property prices.

Figure 7.38 Affected lots with ocean view along Pantai Teluk Ketapang.

Current Property Values

Review of residential property prices in Kuala Nerus vary from around RM112,099.21 for a low-cost house to up to RM 364,804.62 for a detached house (see Table 7.41). Based on site inspection, the types of houses and land present in the affected area are closer to low cost / single storey terrace type housing.

A search and review of current real estate listings in the area show for example a one-storey terrace in Tok Jembal listed for RM 173,867.00, and a two-storey terrace around the airport at RM 360,000 (see Table 7.42).

Based on the average price data and real estate listings, for the present valuation, an average price based on single-, 2-3 storey terrace and detached house from Table 7.41 is used, which is **RM 312,367.03** per lot.

Table 7.41 Average value in Q1 2019 for residential properties by type in Kuala Nerus District /119/. * indicate values used to calculate an average price for the study area shoreline.

Property Type	**Average Value (RM)**
Vacant Plot	105,086.86
Single Storey Terrace*	227,458.69
2 - 3 Storey Terrace*	344,837.80
Single Storey Semi-Detached	340,314.58
2 - 3 Storey Semi-Detached	413,000.00
Detached*	364,804.62
Town House	112,000.00
Low-Cost House	112,099.21
Others	281,333.33
Average	255,659.45

Table 7.42 Examples of current property listings in the area (various real estate's websites).

Location	Type	Title	Built-up area (Sqft)	Land area (ha)	Price (RM)	RM/sqft
Taman KTGR, Tok Jembal	2 Storey Detached	Leasehold		0.0653	567,000.00	80.67
Taman Chendering Utama, Chendering	2 Storey detached	Leasehold	5,021.00	0.0911	810,000.00	82.60
Taman Pinggiran Airport, Kuala Nerus	2-Storey Terrace	-	1,700.00	0.0158	360,000.00	211.76
Tok Jembal, Kuala Nerus	1- Storey Terrace	Freehold (Malay reserve)	1,588.00	0.0250	173,867.00	109.49

Photo 7.2 Typical low cost houses around Jalan Pantai Teluk Ketapang.

Premium on Ocean-Views

A study in Terengganu by Iman & Tan (2013) /120/ suggests that property with a view of the ocean carries a premium of around 50%. This is somewhat consistent with studies in developed countries where premiums of ocean view has ranged from 8% (for good quality view) to up to 60% for high quality ocean views /121/. In contrast, in another study in Johor, information from real estate agents have indicated a premium of only around 10 – 15% /122/. In this study, a premium of 50% is applied as the base case.

This premium on aesthetics and recreational value is then applied to the 281 land lots (comprising approximately 120 ha directly fronting the 5 km beach stretch (i.e., adjacent to the Project footprint) along the coast. The services (aesthetics and

recreation) will be provided over time and the premium in property value is taken to represent the capitalised value of the future services. In order to arrive at the annual value of the service, annual payment of perpetuity is considered as an approximation to the service flow.

7.3.2.4 Overall Assessment

Flow of environmental costs

The total annual costs over a 10-year period is given in Table 7.43. From Year 7 onwards, the annual cost is constant, at RM 53,400,621.

Table 7.43 Value of assessed losses in environmental services and total value over 10 years.

Year	Loss of Marine Habitat	Loss of Beachfront Amenity	Fishing - Loss of Beach Access	Total
1	1,718,282.52	43,887,568.29	87,046.55	45,692,897.36
2	5,228,488.23	43,887,568.29	87,046.55	49,203,103.08
3	6,927,133.23	43,887,568.29	87,046.55	50,901,748.08
4	7,692,996.30	43,887,568.29	87,046.55	51,667,611.14
5	9,158,445.82	43,887,568.29	87,046.55	53,133,060.66
6	9,862,941.65	43,887,568.29	87,046.55	53,837,556.49
7	9,426,006.95	43,887,568.29	87,046.55	53,400,621.80
8	9,426,006.95	43,887,568.29	87,046.55	53,400,621.80
9	9,426,006.95	43,887,568.29	87,046.55	53,400,621.80
10	9,426,006.95	43,887,568.29	87,046.55	53,400,621.80

Present Value of Environmental Costs

In accordance with the DOE guidelines on economic valuation /106/, the present value of environmental costs and benefits have been calculated for varying discount rates from 3 to 8% for a 50-year valuation period. The individual and total present value of changes in environmental service flows are provided in Table 7.44.

After discounting at the rate of 8%, the total present value of the annual stream of losses amounts to RM 638.2 million over a 50-year period. At 6% and 3% discount rates, the corresponding values are RM 825.8 million and RM 1,356.4 million respectively.

Table 7.44 Estimates of the total discounted loss in environmental services at the range of discount rates used in the assessment.

Discount Rate	Loss of Marine Habitat	Landscape / Aesthetic Value	Fishing - Loss of Beach Access	Net Loss
3%	227,036,445.29	1,129,216,774.98	183,349.71	1,356,436,569.97
4%	187,318,786.10	942,800,844.41	153,081.55	1,130,272,712.07
5%	157,206,184.24	801,208,175.37	130,091.31	958,544,450.92
6%	133,977,597.31	691,749,735.08	112,318.66	825,839,651.05
7%	115,757,973.69	605,681,195.45	98,343.80	721,537,512.94
8%	101,238,365.92	536,897,892.71	87,175.53	638,223,434.17

Sensitivity Analysis

A sensitivity analysis has been conducted according to the DOE guidelines /106/. The economic valuation presented has been based on the predicted impact (identification), quantum of impact (quantification) and best estimates of market values (monetization).

The sensitivity analysis varies either the quantum of impact or market estimates as shown in Table 7.45. In the case of marine habitat loss, the time to recovery for the benthic habitats within the dredging area has been adjusted, whereby the base case assumes a recovery time of five years and for the lower estimate a more optimistic assumption of recovery in two years is given, while for the upper estimate a conservative assumption of 8 years to recovery is assumed.

In the case of loss of sea view, the premium applied in the base case was 50% of the land value, based on available literature; a 10% variance to this was applied in the sensitivity analysis. Meanwhile the cost estimates for the additional travelling distance for fishermen was varied based on the estimated travel distance, where the base case was the average additional distance for the five affected villages; the lower estimate was the median, which was slightly lower, while the maximum additional distance was used in the upper estimate (Table 7.46).

Table 7.45 Variables used in sensitivity analysis.

Environmental impact / variable	Base Case	Lower Estimate	Upper Estimate
Loss of marine habitat: Recovery time from capital dredging	5 years	2 years	8 years
Loss of sea view: Premium on ocean view	50%	40%	60%
Loss of beach access for fish landing: Additional travel distance (see Table 7.46)	Average additional distance	Median additional distance	Maximum additional distance.

Table 7.46 Variables used in sensitivity analysis to value loss of beach access for beach landing – travel distance in metres.

Village / additional travel distances	Additional land distance	Additional sea distance
Kg. Seberang Takir	110	2200
Kg. Baharu Seberang Takir	1370	2200
Kg. Telaga Daing	1745	2100
Kg. Ketapang	4480	1700
Kg. Hulu Takir	950	2200
Base estimate (average)	1731	2080
Lower estimate (median)	1370	2200
Upper estimate (max distance)	4480	2200

The resulting estimates are illustrated in Figure 7.39, showing the present value at 3, 6 and 8% discount rates for the base case (most likely case) presented earlier, compared to the lower estimate (best case) and upper estimate (worst case). At an 8% discount rate, the difference in NPV between the base and lower and upper estimates is around ±RM109.6 million (Table 7.47).

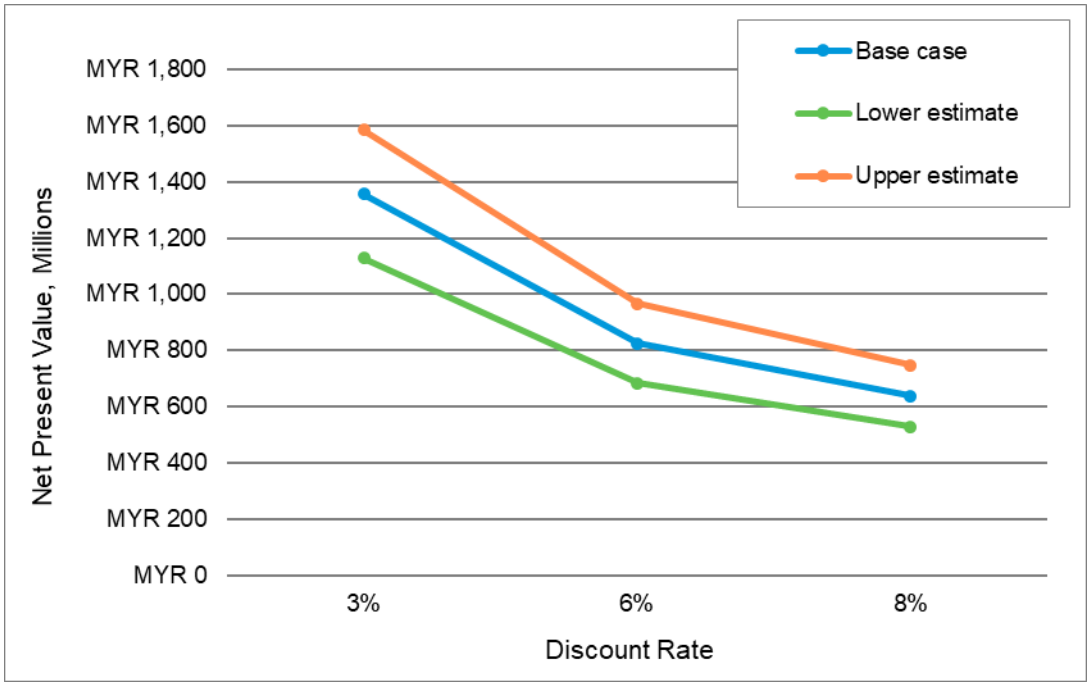

Figure 7.39 Results of sensitivity analysis – net present value for selected discount rates for the base case, lower estimate and upper estimates.

Table 7.47 Difference in lower and upper estimates compared to the base case.

Discount rate	3%	6%	8%
Base case	1,358,402,715.08	827,046,673.63	639,161,314.14
Lower estimate	-228,684,925.31	-140,873,457.67	-109,713,176.08
Upper estimate	229,015,373.45	140,902,143.42	109,622,427.62

It is clear from results of the valuation exercise that a significant amount of environmental service loss is to be expected following Project implementation, although it is noted that in all cases except the loss of marine habitat, the affected stakeholders represent a very localized and small segment of the population.

It is again highlighted that the values presented here should not be construed as indicating Project feasibility. They rather provide some indication of the magnitude, in monetary terms, of the reduction in the flow of environmental services as a result of the implementation of the Project over the 50-year evaluation period.

8 Mitigation Measures

8.1 Adherence to DOE Guidelines

The mitigation and abatement measures recommended below have been based on a review of available best practices and DOE guidelines, and an assessment of their efficacy with respect to the specific Project activities and characteristics of the surrounding environment at the Project site. In general, mitigation measures have been considered based on the hierarchy of avoidance or prevention, minimisation, compensation or offset.

8.2 Proposed Mitigation Measures

8.2.1 Water quality

8.2.1.1 Construction Phase

To control the spill of suspended sediments and their subsequent deposition, pre-bunding and installation of silt curtains around the reclamation area is recommended as outlined below. The Project Proponent shall include the recommended mitigation measures in the tender documents to ensure that the contractor's proposed work methodology incorporates the environmental management requirements.

Bunding in Reclamation

Perimeter bund of the reclamation frontage will be constructed prior to the filling of material. Figure 8.1 depicts the conceptual bund and reclamation sequence for Phase 1 reclamation. Pre-bunding the reclamation site will isolate the sediment filled into the reclamation area from the ambient currents and will allow the release of the excess water at selected locations that will minimize the impacts to water quality. Bunds must be well maintained to minimise risks of breaching.

Installation of Silt Curtain

Physical measures as silt curtains can be an effective way of reducing the dispersion of sediment spilled during dredging and reclamation works. However, their performance is largely dependent on the ambient conditions such as currents, water depths, tidal range and wave actions. Along the proposed navigation channel where dredging works will be carried out, a combination of depth at the dredging site (max depth 12 m) and slightly stronger currents, where the mean current speed is 0.14 to 0.16 m/s during SW monsoon and 0.12 to 0.14 m/s during inter-monsoon, would mean that using silt curtains will not be effective. Therefore, silt curtains are not considered a viable option for use to mitigate the dredging spill for this Project.

However, silt curtains can be used in the shallow water areas as shown in Photo 8.1 and can be a useful mitigation measure during reclamation works. Therefore, it is

recommended that silt curtains are installed along the perimeter of the reclamation plot to control sediment spills in the nearshore areas. The assembled silt curtain will be secured with anchor blocks to maintain its position. Regular checking and maintenance of silt curtains will be carried out throughout the reclamation to ensure that they are in good working condition. Any tears or otherwise damaged silt curtains will be repaired as soon as possible.

Figure 8.1 Conceptual bund and silt curtain placement for Phase 1 reclamation sequence.

Photo 8.1 An example of a double-layer silt curtain surrounding a reclamation site in Johor.

Other General Mitigation Measures

Other than the mitigation measures mentioned, other recommended best management practices to alleviate the deterioration of water quality during construction phase are listed below.

Sediment Control

Additional mitigation measures to minimise sediments from entering the watercourses include:

- All equipment must be properly maintained to minimise spillages and risks of accidental spillages; and
- Spill of sediment by vessels in transit between the sand source site and the reclamation site must be avoided - i.e. no discharges of excess water should be allowed while in transit between the sand source site and reclamation site and the barge / hopper doors must be well maintained and not leaking.

Waste Management

Recommendations to prevent pollutants from entering watercourses during construction phase include:

- Construction waste to be collected and disposed of at designated locations and containers or trash bins to eliminate the discharge of pollutants into watercourses;
- Adequate and well-maintained sanitary provisions for on-site workers quarters and offices. This includes temporary toilet facilities at site office and workers' camp and sullage water system from canteen at site office.
- Adequate containers/bins shall be provided for solid wastes

- A designated area must be prepared for storage of scheduled waste. Practices and handling must conform and comply to the requirements stipulated in Environmental Quality (Scheduled Waste) Regulations 2005; and
- Septic waste must not directly discharge into any watercourses without firstly being treated to a standard requirement and compliance. Any temporary toilets at the construction site must be approved by the local authority.

Fuel Oil and Grease

Measures to be taken include:

- Best management practice in usage of the heavy machinery;
- Discharge of oily wastewater from sea vehicles' engine rooms should be channelled into an oil separator. The waste oil should then be stored in slop tanks and managed as scheduled waste;
- Discharge of floatables, chemicals, or other polluting substances from dredge and other construction vessels, the reclamation site offices and workers' quarters are not allowed; collection of such wastes shall be made on a regular basis and disposal of any prescribed substances shall follow existing State/Federal regulations;
- Oil refill station on land to be located away from the shoreline and stored in a bunded storage area;
- Bunkering operations must also be planned and executed in accordance with MARPOL regulations. Prior to bunkering operation, all pre-loading checks must be carried out, loading rate should also be checked regularly and all hoses and lines should be drained to suitable storage tanks prior to disconnection;
- Dredger shall carry a spill response kit in case fuel is spilt;
- A vessel management plan shall be prepared for all construction vessels and shall include contingency plans for petroleum spills.
- An Emergency Response Plan (ERP) which includes oil spill prevention and response must be developed.

Residual Impacts

Even with the implementation of sediment spill control (silt curtain and perimeter bunds), there is no change to the impact significance for sediment plumes. This is because the capital dredging plumes (as opposed to those from the reclamation) will still remain as shown in Section 7.2.1.2. As discussed above, there are no suitable mitigation measures to further minimise the impact of dredging. It is highlighted that the impacts are in any case predicted to be minor.

8.2.1.2 Post-construction Phase

Due to the low flushing capacity within the Project site, particularly at the inner channels, the watercourses must be well managed to ensure that no pollutants are discharged into the waterways. Detailed design and development planning, including EIA, for the future topside developments shall focus on prevention of pollutant discharges into the waterways to safeguard the watercourses from pollution loading.

Residual Impacts

No change to the impact significance for flushing capacity.

8.2.2 Coastal Morphology

8.2.2.1 Construction

The mitigation measures as outlined in Section 8.2.1.1 will further reduce the impact of siltation during construction stage.

Residual Impact

With the implementation of the above mitigation measures, the residual impact due to siltation due to reclamation and dredging activity will not change the impact significance for sediment plumes as there are no suitable mitigation measures to further minimise the impact of dredging (as opposed to reclamation).

8.2.2.2 Post-Construction Phase

No mitigation measures required; monitoring is however recommended.

Residual Impact

No change to the impact significance

8.2.3 Hydrology and Drainage

8.2.3.1 Construction Phase

Mitigation measures to ensure the airport drainage outlet is not blocked during construction are recommended as follows:

- Temporary or permanent drain outlet to be kept clear of any blockage due to reclamation works and runoff and sedimentation from dredging and reclamation works;
- To create temporary or permanent drain which connects with airport outlet extending to the discharge outlet at the marine area in parallel with the commencement of the reclamation work during Phase 1;
- The channel shall be protected either by rock-lined channel bed with protected side slope using turf reinforcement mat (TRM) or plastic sheeting or by installing plastic sheeting canvas along the channel, extending across the side slope, in combination with check dams or sump slot checks;
- Mitigation measures related to control of suspended sediments as outlined in Section 8.2.1 will serve to reduce impacts of sedimentation of the new extended airport outlet during construction.

Residual Impact

With the implementation of control measures, in particular to minimise any blockage of the airport outlet, the residual impact can be reduced to a **slight negative impact.**

8.2.3.2 Post-construction Phase

The integration of the airport drain outlet into the new Sunrise City drainage system will need to be considered during the project design stage to ensure proper drainage management of the existing airport drain as well as the drainage system within the Project area. The drainage plan shall comply with DID MSMA Guidelines 2nd Edition /123/ to ensure runoff from the relevant runway subcatchment is catered for.

Residual Impact

No impact is expected if the drainage design on the development is carried out in accordance with DID guidelines.

8.2.4 Air Quality

8.2.4.1 Construction Phase

General good practice measures shall be applied during the construction phase to reduce the air quality impact:

- All entrance / exit roads to the site shall be stabilised and paved for a suitable distance from the access road's connection to the existing public roads.
- A washing bay shall be constructed along the paved access road area to ensure all vehicles' wheels are clean prior to exiting the site and entering public roads.
- Wheels of construction vehicles leaving the site must be cleaned thoroughly.
- In the event that sediment has been tracked-out from the Project site onto the off-site road, the deposited sediment shall be removed the end for the same work day by sweeping, shovelling or vacuuming the surfaces, or by using other similar effective means of sediment removal. Hosing or sweeping tracked-out sediments into any drainage is prohibited unless connected to a sediment basin, sediment trap or similarly effective control.
- Trucks used in construction should comply with requirements for exhaust emissions. It is also a good practice to switch off all engines, equipment and machinery when not in use to reduce emission and wastage.
- Establish hoarding along the site boundary to minimise the spread of airborne dust to the surroundings.
- All loaded vehicles going to and leaving the construction site should be adequately covered to prevent spillage of materials from the vehicle during transport.
- Regular water spraying of access internal roads and exposed areas within the Project site particularly during dry and windy weather conditions.
- Regular maintenance of vehicles and machinery to reduce their emissions of smoke and soot into the atmosphere.
- Open burning of biomass and construction debris is strictly prohibited.

- Speed limits for construction zone as per Jabatan Kerja Raya (JKR) guideline /124/ shall be imposed on all vehicles entering and leaving the Project site to prevent dust turbulence.
- Green and open spaces should be vegetated as soon as possible.

Residual Impact

With the implementation of dust control measures, in particular to minimise the releases at source, the residual impact can be reduced to a **slight negative impact**.

8.2.5 Ambient Noise

8.2.5.1 Construction Phase

The following noise control measures are recommended during the construction phase:

- Impact during night time can be mitigated by avoiding high noise emitting activities (above 90 dB(A)) (e.g. piling/onshore works) between 10 p.m. – 7 a.m.
- All vehicles and machinery shall be properly serviced and maintained to ensure good working condition, thereby reducing the possible noise emission.
- Construction vehicles must comply with the noise control requirements of the Environmental Quality (Motor Vehicle Noise) Regulations 1987. The maximum sound level permitted for trucks transporting goods or materials is 88 dB(A).
- Fitting of supplemental noise suppressors recommended by the manufacturer: Supplemental noise suppressors where recommended by the manufacturer should be fitted on machinery. This is a relatively easy mitigation measure which does not generally cause any interference with operation and/or economics.
- Installation of enclosures around power generators and other stationary machinery with high noise emissions (above 90 dB(A)).
- Hoarding installation around Project boundary – acoustic hoarding barrier near dwellings.
- Establish noise complaint register.

Residual Impact

It is expected that the implementation of the mitigation measures recommended above can reduce the noise impact to **slight negative**.

8.2.6 Primary Producer Benthic Habitat

8.2.6.1 Construction Phase

Mitigation measures are focused on those to protect the FADs around the Project site and in particular those off the southern part of the Project area are required:

- Suspended sediment and siltation – no mitigation measures specific to the protection of the FADs; however, water quality mitigation measures as outlined in Section 8.2.3 will further reduce the impact.
- Accidental damage due to marine construction machinery and activities – establish exclusion zone around FADs (100 m radius from FADs), to prevent vessels from anchoring within the exclusion zone. Demarcation on site (with buoys, see Photo 8.2) of exclusion zones (FADs at south) to prevent vessels from anchoring or operating in any way within the exclusion zone.

Photo 8.2 Example of navigation/demarcation buoys.

Residual Impact

Suspended Sediment

No change to impact significance.

Sedimentation

As outlined in Section 8.2.1, there will be no change to impact significance.

Risk of Damage to FADs

With establishment of exclusion zone for FADs, the impact is reduced to **no change**.

8.2.7 Macrobenthos

8.2.7.1 Construction Phase

- Suspended sediments – no specific mitigation measures for the protection of macrobenthos as the measures related to control of suspended sediments as outlined in Section 8.2.3 will serve to reduce impacts to the macrobenthos during construction.
- Sedimentation – as above, measures related to the control of suspended sediments will also serve to reduce impacts to macrobenthos.
- Habitat loss due to capital dredging – no mitigation measures available.

Residual Impacts

- Suspended sediments - No change in impact significance (minor negative) as the main source of impact is from the dredging activity, for which there are no suitable mitigation measures.
- Sedimentation – no change in impact significance
- Habitat loss due to dredging – no change in impact significance

8.2.7.2 Post-construction Phase

Permanent Loss of Habitat - No mitigation measures available.

Residual Impacts

No change in impact significance - minor negative impact.

8.2.8 Plankton

8.2.8.1 Construction Phase

Water Quality

To prevent or control the release of oil or hazardous materials and wastewater from vessels, the relevant international regulations and guidelines for management of sewage and oil pollution (as per Annex IV and Annex I respectively of MARPOL) shall be complied with /125, 126/.

Temporary toilets with septic tanks and/or portable toilets shall be provided in adequate numbers and locations at the working area. The septic tanks and portable toilets shall be periodically de-sludged.

Ship Ballast Water

The dredger and other marine vessels will be required to demonstrate adherence to a ballast water management plan in accordance to the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) adopted

by International Maritime Organisation (IMO) Guidelines /127/. In accordance with these guidelines, to prevent the transfer of invasive alien species (HAB species), the dredge operators shall comply to the following measures for management of ballast water during mobilisation to the Project site:

- Vessel to maintain a record on when ballast water is taken on board; circulated or treated and discharged into the sea.
- Vessel using ballast water exchange to conduct ballast water exchange at least 200 nautical miles from the nearest land and in water at least 200 m depth.
- In cases where the ship is unable to conduct ballast water exchange as above, this should be as far from the nearest land as possible, and in all cases at least 50 nautical miles from the nearest land and in water at least 200 m in depth.

- Uptake of organisms in ballast water should be avoided (e.g. by avoiding uptake in darkness, in very shallow water, where propellers disturb the sediment, or in other areas identified by local authorities).

Sediment Plume

No mitigation measures specific to plankton are available, however measures to control suspended sediments as outlined in Section 8.2.1.1 will also serve to reduce impacts to the plankton from sediment plume during construction.

Residual Impact

Water Quality

With the implementation of water pollution control measures and adherence to international regulations and guideline, the residual impact can be reduced to a **slight negative impact.**

Ship Ballast Water

With adherence to International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM), the residual impact can be reduced to a **slight negative impact.**

Sediment Plume

No change to impact significance, although the likelihood of the impact is reduced.

8.2.8.2 Post-construction Phase

Eutrophication

No specific mitigation measures required.

Residual Impact

No change to impact significance.

8.2.9 Fish Fauna

8.2.9.1 Construction Phase

Suspended Sediment

Mitigation measures related to control of suspended sediments as outlined in Section 8.2.1 will serve to reduce impacts to the fish fauna during construction.

Residual Impact

No change in impact significance of minor negative impact.

8.2.9.2 Post-construction Phase

Loss of Habitat

The loss of habitat within the Project area due to reclamation is a permanent impact with no mitigation measures available.

Residual Impact

The impact significance due to loss of habitat will remain as minor negative impact as there are no mitigation measures available.

8.2.10 Marine Megafauna

8.2.10.1 Construction Stage

Boat Strike

Any presence of marine megafauna in the Project area has to be recorded. Accidental injury or strike of any marine megafauna shall be covered under the contractor's emergency response plan which may include implementation of mitigation measures against future incidents such as installation of tickler chains or other more advanced methods. Any reports on injury or strikes must be forwarded to the Department of Fisheries, Terengganu.

Residual Impact

No change in impact significance of minor negative impact.

8.2.11 Mangrove

No impacts are predicted during construction and operations therefore no mitigation measures are required.

8.2.12 Terrestrial Ecology

Loss of Habitat

The loss of habitat within the Project area is a permanent, residual impact. However, some compensatory steps can be made, including re-vegetating open spaces wherever available. This will also serve to reduce runoff and improve site aesthetics. Existing trees should also be preserved or reused in the Sunrise City project landscaping wherever possible and the new beach vegetation should include similar species as the existing beach such as the *rhu* and *ketapang* trees to create a similar environment.

Nevertheless, there is no change in impact significance.

8.2.13 Socioeconomics

8.2.13.1 Construction Phase

Health and Social Well-Being

No specific mitigation measures are proposed; measures to reduce air and noise impacts as outlined in Section 8.2.4.1 and Section 8.2.5.1 respectively will serve to reduce impacts to nearby residents.

With the implementation of these measures the impact is expected to be reduced to **Slight negative impact**.

Aesthetic Value

Hoarding to be established along the boundary of the Project site and Jalan Teluk Ketapang to minimise visual and noise impacts. This hoarding should be decorated with art, e.g. beach scenery or other coastal or cultural visuals to make it visually appealing to the passers-by. Height of the hoarding will need to follow local council guidelines as well as consider optimum height for noise attenuation.

Although such artwork will soften the visual impact, the hoarding nonetheless remains a visual intrusion, and thus the residual impact remains as **Minor negative impact**.

Public Safety

- If any temporary obstruction of public roads is required during construction, suitable warning signs, lights and traffic guides should be implemented to JKR and local authority standards;
- All public roads involved for the transportation under construction stage will be regularly maintained and cleaned. The contractor will be responsible for the reinstatement and repair of any damage to public and private roads caused by the movement of the heavy vehicles;
- Speed limit at settlements/villages that is located at routes leading towards the Project site; and

- Placement of proper signage to warn the public of the work progress.

Although the above measures will mitigate the risk to public safety, this risk cannot be entirely eliminated. As such, the residual impact remains as **Slight negative impact**.

In-Migration

- Prepare labour management plan highlighting the management of foreign workers activities.
- Siting of workers' quarters to consider sensitivity of neighboring villages/ residential areas.

With the above mitigation measures, and in consideration of the anticipated number of workers involved, the residual impact is anticipated to be **Minor negative**.

Job Opportunities

Priority shall be given to locals for all employment opportunities. The residual impact remains **Slight positive**.

Economic Activity

Project Proponent in coordination with the local authority to:

- Establish areas for (existing) hawkers to operate nearby to the development area to cater for the construction workers as well as locals.
- Consider utilising the chalets, hotels or homestays available within the 1 km from the Project for the accommodation needs of the construction workers.

With the implementation of the above measures, the residual impact is anticipated to be reduced to no net impact, i.e. **no change**.

8.2.13.2 Post-construction Phase

Aesthetic Value

- **Mitigation Measure:** Local authority to ensure development planning of Sunrise City project conforms to guidelines and incorporates local culture in the design
- **Residual Impact:** the permanent change in aesthetics along the existing shoreline will still be incurred, hence the residual impact remains **Moderate Negative**.

Property Value

No mitigation measures are available and hence the impact remains **Moderate negative**.

Social Differences and Social Network

- **Mitigation Measure:** Project Proponent and local authority to coordinate outreach programmes such as festivals / events, focus group discussion/workshop, to allow better integration between local communities and newcomers.
- **Residual Impact:** some level of social differences may be unavoidable despite the implementation of such mitigation measures, hence the residual impact remains **Moderate Negative**.

8.2.14 Fisheries

Navigation

- Mitigation measures recommended in Section 8.2.17 (Marine Traffic) for fishing vessel navigation should be adhered to.

Engagement with Fishermen

Regular engagement with fishermen over the course of the six-year construction period is required to ensure the fishermen are kept informed of the Project progress, working areas and schedules. A Fishermen's Working Group should be established prior to construction start to facilitate this; this shall comprise representatives from the Fishermen's Association, LKIM, and key representatives of the fishing community.

The FWG shall meet at least quarterly during construction.

Agenda of the meetings to include:

- Project Proponent to brief on Project progress:
  - Work schedules
  - Safety buffer zones and restricted areas
- Q&A / feedback – where the participants can raise questions, concerns or complaints.

8.2.14.1 Provision of Alternative Fish Landing Area

Construction Phase

An alternative landing site to be prepared for fishermen during the construction. Based on discussions with LKIM Chendering (21 August 2019), given that Tok Jembal and landing areas inside Sg. Terengganu (e.g. Seberang Takir) are presently relatively congested, a new site along the tributary around Hulu Takir should be considered. Further discussions with LKIM and the Fishermen's Association Terengganu Utara will need to be carried out by the Project Proponent to finalise the location of the alternative jetty. This jetty will need to cater for up to 20 boats, as this is the estimated number currently utilising Pantai Teluk Ketapang.

Post-construction Phase

A fishing wharf is to be provided on the Sunrise City development. The Project Proponent shall again consult with LKIM and the Fishermen's Associations in order to ensure the design is sufficient to cater for the needs of the fishermen. Initial discussions with LKIM have highlighted their concerns with respect to the following design issues:

- Ensure sufficient capacity – at least around 140 boats (based 2018 data of 85 outboard powered boats and 52 inboard Zone A boats);
- Ensure congestion / conflict with other maritime activities within the marine facilities area is avoided

8.2.14.2 Compensation Payments to Fishermen

Fishermen that fish within the study area may be affected due to the Project activities during and after construction, hence compensation was brought up during the Fishermen's FGD, townhall and consultations with LKIM to address the disruption in the fishing activities, damages to fishing habitat as well as the loss of fish landing site and nearshore fishing grounds. Some form of compensation should be provided, and the following recommendations are to be considered in finalising the details of the compensation:

- Affected Fishermen:
  - fishermen who stay in the six fishing villages alongside the shoreline that are directly affected by the Project due to loss of landing site and access to the sea.
  - other fishermen who use the affected fishing grounds (loss of fishing ground in Project site or zone of minor impacts due to sediment plumes, primarily north of Project site)

- Conduct a more detailed and comprehensive estimate of income and earnings from the fishing activity if such data is to be used as input to the compensation package. The cursory work done in terms of asking for household income is based on voluntary response and has not been validated.

- The compensation package shall be determined based on such study and in consultation with the State Economic Planning Unit, Department of Fisheries, LKIM and other relevant State Government authorities.

8.2.14.3 Offset Compensation of FADs

To offset the loss of fish habitat within the Project footprint, the Project Proponent shall install at least three artificial reefs within Zone A fishing grounds in Kuala Nerus. Again, further discussion with DOF / LKIM shall be carried out to determine the optimum location for the deployment of the artificial reefs.

The estimated cost of installation of reefs is approximately RM 20,000 each, based on the recent deployment of 23 artificial reefs in coastal waters of Batu Rakit, Kuala Nerus and Merang at a reported cost of RM 450,000 /128/.

8.2.14.4 Residual Impact

With the implementation of the mitigation measures, the residual impact is expected to be reduced for impact to navigation and access to sea from moderate to **minor**.

Meanwhile, a **slight negative** residual impact is expected for decrease/loss in fish catch during construction.

The residual impact for post-construction phase is expected to reduce to **minor negative impact**.

8.2.15 Tourism and Recreational activities

Mitigation measures recommended for tourism and recreational activities during construction include promoting Pantai Tok Jembal and Pantai Batu Burok as alternative sites for recreational activities through collaboration between Project Proponent and local authority by arranging or upgrading existing facilities to accommodate more people where deemed necessary. These may include facilities such as picnic huts, additional restrooms, or spaces for hawker stalls. In addition, the mitigation measures proposed in Section 8.2.13.1 for aesthetic impact should be adhered to.

Meanwhile, during the post-construction phase, mitigation measures include provision of new recreational amenities within the new township or the new beach and to promote the Sunrise City project and its new beaches as a new tourism attraction.

Public access to the new beaches shall be ensured and clearly demarcated in the development plan for approval by the local authority. Free and unlimited access to the new beaches by locals shall be ensured at the new beaches. Nevertheless, there will be a change in nature from an uninterrupted 5 km stretch of beach to smaller pocket beaches within the Project, which may be perceived by some as a negative impact.

The residual impact significance for both construction and post-construction phase is **slight negative.**

8.2.16 Cultural Heritage / Archaeology

The mitigation measures recommended during the post-construction phase are to incorporate heritage elements in the future development of the Sunrise City project by taking into account the original identity and urban design of Seberang Takir or Terengganu as a whole. By instilling the heritage and cultural elements in the facilities can promote a sense of belonging to the community. The residual impact significance for post-construction phase is **no change**.

8.2.17 Marine Traffic

8.2.17.1 Construction Phase

The following mitigation measures are proposed to ensure vessel collisions are prevented; these shall be the responsibility of the Project Proponent and its Contractors, unless otherwise indicated:

- Issuance of Notices to Mariners by Marine Department
- Engagement with stakeholders to inform of Project schedule
- Through Fishermen's Associations, educate/request fishing vessels to clearly mark and light their fishing gears
- Announcement of Project operations through Radio Channel
- All Project construction vessels to ensure:
  - At least one member of the crew who is conversant in Malay as the main language of communication and English as the secondary language (as per requirement by Marine Department)
  - Ensure competent crew to be on watch
  - anchoring equipment is sufficient and maintain in good condition
- Suspend operations during adverse weather conditions and seek shelter area as contingency
- Report to Kemaman Port Authority on the sand source location, vessel information, etc.
- Ensure competent crew to be on watch
- Establish communication loop, e.g. VHF Channel, mobile tele-communication, public website to advertise movement, Person-In-Charge on marine coordination
- Crew to be vigilant about likelihood of engine failure
- Installation of Aids to Navigation (AtoNs)
- Report to Lima Tango Reporting Authority (Kuala Terengganu, Jabatan Laut)

With the implementation of these mitigation measures, the risk is expected to be reduced to **slight negative impact**.

8.2.17.2 Post-construction Phase

No mitigation measures are required.

8.3 Residual Impacts

The residual impact significance assessed for all the above issues are summarised in Table 8.1 and Table 8.2 for the construction and post-construction phases respectively.

Table 8.1 Summary of impact assessment for the construction phase.

Component	Potential Impact	Impact Significance	Mitigation	Residual Impact
Water Quality	Suspended sediment	Minor negative	Installation of silt curtain and perimeter bunding at reclamation area and other mitigation measures as outlined in Section 8.2.1.1.	Minor negative
Coastal Morphology	Sedimentation	Minor negative	Pre-bunding and silt curtains (Section 8.2.1).	Minor negative
Hydrology and Drainage	Airport drainage outlet blockage	Minor negative	Provision of temporary or permanent drain at start of construction (see Section 8.2.3.1).	Slight negative
Air Quality	Airborne dust	Minor negative	Best management practices outlined in Section 8.2.4.1.	Slight negative
Ambient Noise	Increased noise exposure	Minor negative	Best management practices as detailed in Section 8.2.5.1.	Slight negative
Primary Producer Benthic Habitats	Suspended sediment and siltation impact to FADs	Minor negative	No specific mitigation measures.	Minor negative
	Sedimentation	Minor negative	No specific mitigation measures.	Minor negative
	Risk of damage to FADs	Slight negative	Demarcate an exclusion zone around FADs at southern end of Project site (Section 8.2.6.1).	No change
Macrobenthos	Suspended sediment	Minor negative	No specific mitigation measures.	Minor negative
	Sedimentation	Slight negative	No specific mitigation measures.	Slight negative
	Loss of habitat	Slight negative	No mitigation measures available.	Slight negative
Plankton	Change to water quality	Minor negative	Adhere to IMO guidelines for control of wastewater (Section 8.2.8.1).	Slight negative
	Release of trace metals and foreign planktonic organism from ship ballast water	Moderate negative	Compliance with IMO guidelines as outlined in Section 8.2.8.1.	Slight negative
	Sediment plume	Slight negative	No specific mitigation measures.	Slight negative

Component	Potential Impact	Impact Significance	Mitigation	Residual Impact
Fish Fauna	Suspended sediment and sedimentation	Minor negative	No specific mitigation measures.	Minor negative
Marine Megafauna	Boat strikes	Minor negative	Presence of marine megafauna in Project area to be recorded. Contractor to include accidental injury or strike in emergency response plan.	Minor negative
Mangrove	Sedimentation	No change	No mitigation measures required.	No change
Terrestrial Ecology	Not applicable	No change	No mitigation measures required	No change
Socioeconomics	Health and social wellbeing	Moderate negative	No specific measures.	Slight negative
	Aesthetic value	Minor negative	Establish art decorated hoarding along the boundary of the Project site and Jalan Pantai Teluk Ketapang as outlined in Section 8.2.13.1.	Minor negative
	Public safety	Slight negative	Proper and suitable warning signage to be place; reinstatement and repairment of any damage to public and private roads by the contractor; comply to traffic rules (Section 8.2.13.1).	Slight negative
	In-migration	Moderate negative	Prepare labour management plan and provide adequate quarters for foreign workers (Section 8.2.13.1).	Minor negative
	Job opportunities	Slight positive	Prioritize local employment opportunities.	Slight positive
	Economic activity	Slight negative	Establish areas for existing hawkers to operate nearby to the development area and utilise the existing accommodation within 1 km for the construction workers (Section 8.2.13.1).	No change

Component	Potential Impact	Impact Significance	Mitigation	Residual Impact
Fisheries	Decrease in fish catch	Minor negative	• Provision of alternative fish landing area • Compensation payments to fishermen • Offset compensation of FADs	Slight negative
	Increase navigation risk and loss of access to sea	Moderate negative	• Adhered to fishing vessel navigation (Section 8.2.17). • To form a Fishermen's Working Group to ensure fishermen are kept informed of the Project progress	Minor negative
Tourism and Recreational Activities	Loss of recreational areas	Minor negative	Promote alternative site for tourism and recreational activities as outlined in Section 8.2.15.	Slight negative
Cultural Heritage / Archaeology	Impacts to cultural heritage facilities or function	No change	Instil local heritage and cultural elements in the facilities.	No change
Marine Traffic	Risk of collisions	Minor negative	Standard operating procedures as per Section 8.2.17.1.	Slight negative

Table 8.2 Summary of impact assessment for post-construction phase.

Component	Potential Impact	Impact Significance	Mitigation	Residual Impact
Water Quality	Flushing capacity	Minor negative	No discharges into the channel from topside development.	Minor negative
Coastal Morphology	Changes of coastline morphology due to Project footprint	Slight negative	No mitigation measures required.	Slight negative
Hydrology and Drainage	Blockage of the airport drainage outlet within the Project area	Slight negative	Drainage system on topside development to cater for flows from airport catchment; design based on DID MSMA guidelines as outlined in Section 8.2.3.2.	No change
Macrobenthos	Permanent loss of habitat	Minor negative	No mitigation measures available.	Minor negative
Plankton	Impact of eutrophication due to change in flushing capacity	Slight negative	No specific mitigation measures required.	Slight negative
Fish Fauna	Permanent habitat loss	Minor negative	No mitigation measures available.	Minor negative
Mangrove	No impact	No change	No mitigation measures required.	No change
Terrestrial Ecology	Loss of habitat	Slight negative	Re-vegetated and reused or preserved the existing trees as outlined in Section 8.2.12.	Slight negative
Socioeconomics	Aesthetic value	Moderate negative	Ensure free and unlimited access to beaches and other amenity areas for public (Section 8.2.13.2).	Moderate negative
	Property value	Moderate negative	No mitigation measures available.	Moderate negative
	Social differences and social network	Moderate negative	Coordinate outreach programmes to allow better integration between local communities and newcomers (Section 8.2.13.2).	Minor negative
	Job opportunities	Significant positive	No mitigation measures required.	Significant positive
	Economic activities	Major positive	No mitigation measures required.	Major positive

Component	Potential Impact	Impact Significance	Mitigation	Residual Impact
	Transportation and rural accessibility	Significant positive	No mitigation measures required.	Significant positive
Fisheries	Loss of direct access to the sea along Pantai Teluk Ketapang for some fishermen	Moderate negative	Prepare alternative fish landing site for fishermen as outlined in Section 8.2.14	Minor negative
Tourism and Recreational Activities	Loss of attraction of Pantai Teluk Ketapang	Minor negative	Introduce new recreational activities at new beach as to promote new tourism attraction.	Slight negative
Cultural Heritage / Archaeology	Effect on value of existing cultural heritage features	Slight negative	Instilling local heritage and cultural elements in the Sunrise City development.	No change
Land Use	Compatibility	No change	No mitigation measures required	No change
Marine Traffic	Changes in current patterns	No change	No mitigation measures required	No change

9 Environmental Management Plan (EMP)

9.1 Introduction

The Environmental Management Plan (EMP) outlined in this chapter establishes a strategy to manage environmental issues throughout all stages of the development. It also provides a framework specification upon which the Project Proponent will set the environmental control requirements for the Project through its tender contract documentation.

This EMP is prepared as a preliminary EMP specification. A final EMP will be prepared after the EIA approval based on the conditions specified by DOE and before the commencement of any construction works. This allows comments during the DOE review stage to be taken into consideration in the final EMP together with the details of the appointed contractor and final, detailed construction methodology.

9.1.1 EMP Objective

The objectives of the Project Proponent in the preparation and implementation of the Environmental Management Plan are to ensure all development activities comply with the existing laws, regulations and/or guidelines as stipulated by the DOE and other guidelines pertaining to the Project activities, in order to reduce the magnitude of negative impacts caused by the Project activities. The environmental monitoring and audit programme will be used as an indicator of the realised environmental performance, such that corrective action may be taken if impacts exceed acceptable limits.

The main objectives of this EMP chapter are as follows:

- To highlight potential environmental issues arising from the Project;
- To catalogue the legislative requirements and regulations that must be observed and complied with during the Project lifecycle;
- To set out an environmental monitoring and management programme to be carried out to ensure mitigation measures are implemented and legislative requirements are complied with; and
- To outline environmental contingency plan requirements for environmental emergencies encountered during the construction phase.

It is the Project Proponent's intention as well as their contractors that they will, to their best ability, endeavour to minimise environmental impacts from the development.

9.2 Land Disturbing Pollution Prevention and Mitigation Measures (P2M2s)

The focus of the LD-P2M2 is on the prevention, mitigation and control of the discharge from the development area containing the major pollutant (suspended solids) resulting from land disturbing activities. During reclamation activity, the following basic principles of the pollution prevention and mitigation measures are to be implemented:

The Project Proponent shall ensure that:

- LD-P2M2 are included in tender specifications as minimum requirements.
- All relevant parties including consultants, contractors, and Environmental Officer (EO) understand LD-P2M2 in order to facilitate compliance with the minimum standards requirements.
- All relevant P2M2s especially temporary BMPs during the construction phase are installed and maintained to mitigate the potential pollution due to land disturbing activities.

Table 9.1 sets out the P2M2s (which include BMPs) to be implemented.

Table 9.1 P2M2 to be implemented.

P2M2 Activity	Description
Schedule of Phasing, Staging and Sequencing	• A Project schedule shall be prepared in advance to ensure the tasks involved in Project implementation are properly scheduled in order to effectively address and manage environmental pollution. Specifically, for this project, the schedule shall consider the following activities: - P2M2s for vegetation clearing - P2M2s for temporary site office; - temporary drain for the airport runway drainage outlet need to be scheduled. - bunding and silt curtain installation in reclamation subplots. • Critical Path Method (CPM) may be adopted in establishing work program that shall fit in the elements of pollution prevention and mitigation measures for each phase, stage and sequence of Project development.
Scheduled Site Meeting	Site meeting to be held periodically during construction phase to ensure Project Proponent, environmental officer, contractors to discuss all relevant scopes of work that have relevance to P2M2
Stabilized Construction Entrance	• All entrance and exit roads to the site shall be stabilised and paved to the adjoining existing paved roads alongside with stabilized construction entrance P2M2 and/or tires washing facility. • Any swept soil or sediment accumulated on pavement within the stabilized construction entrance P2M2 and sediment-laden washed water from tires washing facility are not allowed to be hosted down into any drainage unless it is being channel to sediment basin or sediment trap.
Perimeter Control	Perimeter control around the reclamation work to be equipped with hoarding to control discharges from the site.
Runoff Management	Before land-disturbing activities are executed, key runoff control measures shall be first constructed and made operational. The runoff control measures shall include temporary earth drain and where required around the temporary site office, sediment basin/ trap, as part of runoff management to contain the sediment runoff before being released to the marine environment with minimal sediment content in the overflow water.

P2M2 Activity	Description
Temporary or Permanent Watercourse Diversion	The temporary or permanent diversion channel for the airport runway outlet shall be protected either by rock-lined channel bed with protected side slope using Turf Reinforcement Mat (TRM) or plastic sheeting or by installing plastic sheeting canvas along the channel, extending across the side slope, in combination with check dams or sump slot checks.
Stockpile Soil Management	Any stockpiled soil shall be protected from contact with runoff water using a temporary perimeter control such as silt fences, sandbag and gravel bag.
Site Inspection	• Site inspections shall be conducted to ensure all P2M2 relevant to this Project have been properly installed and maintained as well as to determine whether the installed P2M2 is required. The site inspections shall also assess if pollution is effectively being controlled in compliance with the EIA approval conditions. • All inspection activities shall be recorded in the logbook.

9.3 Proposed Monitoring Programme

9.3.1 Compliance Monitoring

This section describes the compliance monitoring for all pollution prevention and mitigation measures (P2M2) identified in Section 8 Mitigation Measures. In the present case these largely focus on the implementation status of these P2M2, given that specific discharge or emission standards are not applicable for this Project.

9.3.1.1 Water Quality

Compliance monitoring activities for the control of suspended sediments during dredging and reclamation works are outlined Table 9.2. Compliance measures relating to mitigating other sources of water pollution during construction are outlined in Table 9.3 with the relevant monitoring requirements.

Table 9.2 Compliance monitoring activities for suspended sediment control.

Required activity	Compliance monitoring	Frequency
Construction of bund	Layout plan and photographs of the bund and temporary protection.	At construction start and as required.
	Inspection and maintenance of bund to be carried out monthly / after storm events.	Monthly and after major storm events.
	Contractor to keep a log of regular inspection and any maintenance events, including photographs with a date stamp.	Monthly and after major storm events.

Required activity	Compliance monitoring	Frequency
Installation of silt curtains around bunds	Layout plan and photographs of the silt curtains.	Monthly monitoring upon commencement of construction activity.
Maintenance of all equipment	All maintenance carried out must be documented properly and made available when required with as much details as possible.	Quarterly inspection of equipment.
Avoidance of spill of sediment by vessels	All maintenance carried out must be documented properly and made available when required with as much details as possible.	Quarterly inspection of equipment.
Construction of sediment basin	Layout plan and photographs of the sediment basin.	Upon commencement of reclamation.
Inspection of sediment basin	Contractor to keep a log of regular inspection and any maintenance events.	Weekly and after major rainfall event.

Table 9.3 Water pollution control measures and methods for monitoring compliance.

Required activity	Compliance monitoring	Frequency
Waste Management		
Construction waste to be collected and disposed of at designated locations and containers or trash bins to eliminate the discharge of pollutants into watercourses.	Inspection by Environmental Officer.	Daily
	Pictorial documentation.	Monthly
Adequate and well-maintained sanitary provisions for on-site workers quarters and offices. This includes temporary toilet facilities at site office and workers' camp and sullage water system from canteen at site office.	Site inspection by Environmental Officer.	Daily
	Pictorial documentation.	Monthly
Adequate containers/bins shall be provided for solid wastes.	Site inspection by Environmental Officer.	Daily
	Pictorial documentation.	Monthly
A designated area must be prepared for storage of scheduled waste. Practices and handling must conform and comply to the requirements stipulated in Environmental Quality (Scheduled Waste) Regulations 2005.	Requirement for a designated area for storage of scheduled waste to be included in tender documents.	At construction start and as required.
	An inventory of scheduled waste generated must be kept and updated.	Monthly

Required activity	Compliance monitoring	Frequency
Septic waste must not directly discharge into any watercourses without firstly being treated to a standard requirement and compliance. Any temporary toilets at the construction site must be approved by the local authority.	Desludging of portable toilets to be documented.	Monthly
Fuel Oil and Grease, Floatables		
Discharge of oily wastewater from sea vehicles' engine rooms should be channelled into an oil separator. The waste oil should then be stored in slop tanks and managed as scheduled waste.	Layout plan and photographs of the oily waste temporary storage area(s), garbage disposal site and sewage facility at reclamation site.	At construction start and as required.
	Site inspection by contractor.	Weekly
	Log of scheduled waste disposal.	As required.
	Requirement to be included in tender documents.	At construction start and as required.
	Contractors to keep a log of scheduled waste disposal.	Monthly.
Discharge of floatables, chemicals, or other polluting substances from dredge and other construction vessels, the reclamation site offices and workers' quarters are not allowed; collection of such wastes shall be made on a regular basis and disposal of any prescribed substances shall follow existing State/Federal regulations.	Site inspection by contractor.	Weekly
	Log of prescribed substances waste disposal.	As required.
	Requirement to be included in tender documents.	At construction start and as required.
	Contractors to keep a log of prescribed substances waste disposal.	Monthly.
Oil refill station on land to be located away from the shoreline and stored in a bunded storage area.	Any temporary onsite oil refill station areas should be located at least 30 m away from the shoreline to prevent accidental spillage into the marine environment.	At construction start and as required.
	Layout plan and photographs of storage areas.	At construction start and as required.
	Site inspection by contractor.	Weekly
Bunkering operations must also be planned and executed in accordance with MARPOL regulations.	Documentation and evidence of compliance to MARPOL.	As required by MARPOL.

Required activity	Compliance monitoring	Frequency
Dredger shall carry a spill response kit in case fuel is spilt.	No specific monitoring is proposed. It is suggested that this is addressed during the EMP stage.	Not applicable.
A vessel management plan shall be prepared for all construction vessels and shall include contingency plans for petroleum spills	Vessel management plan to be prepared.	At construction start and as required.
An Emergency Response Plan (ERP) which includes oil spill prevention and response must be developed.	An ERP is to be prepared (see Section 9.7 for framework ERP).	At construction start and as required.

9.3.1.2 Hydrology and Drainage

The following compliance monitoring for temporary drain for the airport runway shall be carried out as outline in Table 9.4.

Table 9.4 Drainage control measures and methods for monitoring compliance.

Required activity	Compliance monitoring	Frequency
Temporary or permanent drain outlet to be kept clear of any blockage due to reclamation works and runoff and sedimentation from dredging and reclamation works.	• Site inspection by contractor • Contractor to keep a log of maintenance activity	Fortnightly
To create temporary or permanent drain which connects with airport outlet extending to the discharge outlet at the marine area in parallel with the commencement of the reclamation work during Phase 1.	• Requirement to be included in tender documents • Pictorial documentation	• Once after completion of channel
The channel shall be protected either by rock-lined channel bed with protected side slope using turf reinforcement mat (TRM) or plastic sheeting or by installing plastic sheeting canvas along the channel, extending across the side slope, in combination with check dams or sump slot checks.		

9.3.1.3 Air Quality

The compliance monitoring for the recommended air emissions abatement measures are detailed in Table 9.5.

Table 9.5 Air emissions abatement measures and related compliance monitoring during the construction phase.

Required activity	Compliance monitoring	Frequency
All entrance / exit roads to the site shall be stabilised and paved for a suitable distance from the access road's connection to the existing public roads.	• Pictorial documentation • Site inspection by Environmental Officer	• Monthly • Daily
A washing bay shall be constructed along the paved access road area to ensure all vehicles' wheels are clean prior to exiting the site and entering public roads.	• Layout plan and photographs of tyre cleaning station • Site inspection • Public complaints	• At the start of construction • Monthly • As required
Wheels of construction vehicles leaving the site must be cleaned thoroughly.		
In the event that sediment has been tracked-out from the Project site onto the off-site road, the deposited sediment shall be removed by the end of the same work day by sweeping, shovelling or vacuuming the surfaces, or by using other similar effective means of sediment removal. Hosing or sweeping tracked-out sediments into any drainage is prohibited unless connected to a sediment basin, sediment trap or similarly effective control.		
Trucks used in construction should comply with requirements for exhaust emissions. It is also a good practice to switch off all engines, equipment and machinery when not in use to reduce emission and wastage.	• Equipment/ vehicle maintenance log to be kept by contractors • Construction machinery shall be maintained according to national standards for emissions	As required
Establish hoarding along the site boundary to minimise the spread of airborne dust to the surroundings.	• Pictorial documentation • Site inspection by Environmental Officer	• Monthly • Daily
All loaded vehicles going to and leaving the construction site should be adequately covered to prevent spillage of materials from the vehicle during transport.	• Pictorial documentation • Site inspection by Environmental Officer	• Monthly • Daily
Regular water spraying of access internal roads and exposed areas within the Project site particularly during dry and windy weather conditions.	• Pictorial documentation • Site inspection by Environmental Officer	• Monthly • Daily

Required activity	Compliance monitoring	Frequency
Regular maintenance of vehicles and machinery to reduce their emissions of smoke and soot into the atmosphere.	Documentation of maintenance activities.	Every maintenance activity.
Open burning of biomass and construction debris is strictly prohibited.	• Pictorial documentation • Site inspection by Environmental Officer	• Monthly • Daily
Speed limits for construction zone as per Jabatan Kerja Raya (JKR) guideline /124/ shall be imposed on all vehicles entering and leaving the Project site to prevent dust turbulence.	No specific monitoring is proposed. It is suggested that this is addressed during the EMP stage.	Not applicable
Green and open spaces should be vegetated as soon as possible.	Please see Section 9.3.1.9.	Not applicable

9.3.1.4 Noise

Noise abatement measures and the proposed monitoring with these measures are outlined Table 9.6.

Table 9.6 Noise management measures and compliance monitoring.

Required activity	Compliance monitoring	Frequency
Impact during night time can be mitigated by avoiding high noise emitting activities (above 90 dB(A)) (e.g. piling/onshore works) between 10 p.m. – 7 a.m.	Monitoring of noise at sensitive receptors (as per Section 9.3.1.4).	Monthly
All vehicles and machinery shall be properly serviced and maintained to ensure good working condition, thereby reducing the possible noise emission.	Documentation of maintenance activities.	Every maintenance activity.
Construction vehicles must comply with the noise control requirements of the Environmental Quality (Motor Vehicle Noise) Regulations 1987. The maximum sound level permitted for trucks transporting goods or materials is 88 dB(A).	Monitoring of noise at sensitive receptors (as per Section 9.3.1.4).	Monthly
Supplemental noise suppressors where recommended by the manufacturer should be fitted on machinery. This is a relatively easy mitigation measure which does not generally cause any interference with operation and/or economics.	Machinery/equipment specifications list.	To be included in contract.

Required activity	Compliance monitoring	Frequency
Installation of enclosures around power generators and other stationary machinery with high noise emissions (above 90 dB(A)).	Layout plan and photographs of physical noise barriers and equipment enclosures.	At construction start and when necessary.
Hoarding installation around Project boundary – acoustic hoarding barrier near dwellings	Layout plan and photographs of installed hoarding.	At construction start and when necessary.
Noise complaint register	• Set up and create public awareness of noise complaint register (local telephone number). • Noise complaints to be recorded in log book. • Complaints to be investigated within 24 hrs following lodgement. • Log book to be included in monitoring report. • Additional mitigation measures to be implemented where frequent or repeating noise complaints are received.	Per occurrence

9.3.1.5 Primary Producer Benthic Habitat

The compliance monitoring measures for FADs are outlined in Table 9.7.

Table 9.7 Compliance monitoring for FADs.

Required activity	Compliance monitoring	Frequency
Establish 100 m exclusion zone around FADs, to prevent vessels from anchoring within the exclusion zone. Demarcation on site (with buoys) of exclusion zones (FADs at south) to prevent vessels from anchoring or operating in any way within the exclusion zone.	Layout plan and photographs of anchorage and exclusion zones.	Once before work begins.

9.3.1.6 Plankton

Compliance monitoring for the proposed mitigation measures are set out in Table 9.8.

Table 9.8 Compliance monitoring programme for plankton.

Required activity	Compliance monitoring	Frequency
To prevent or control the release of oil or hazardous materials and wastewater from vessels, the relevant international regulations and guidelines for management of sewage and oil pollution (as per Annex IV and Annex I respectively of MARPOL) shall be complied with.	Documentation and evidence of compliance to Annex IV and Annex I of MARPOL.	As required by MARPOL.
The dredger and other marine vessels will be required to demonstrate adherence to a ballast water management plan in accordance to the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM) adopted by International Maritime Organisation (IMO) Guidelines.	In accordance with these guidelines, to prevent the transfer of invasive alien species (HAB species), the dredge operators shall comply to the following measures for management of ballast water during mobilisation to the Project site: • Ships to maintain a record on when ballast water is taken on board; circulated or treated and discharged into the sea. • Ships using ballast water exchange to conduct ballast water exchange at least 200 nautical miles from the nearest land and in water at least 200m depth. • In cases where the ship is unable to conduct ballast water exchange as above, this should be as far from the nearest land as possible, and in all cases at least 50 nautical miles from the nearest land and in water at least 200 m in depth. • Uptake of organisms in ballast water should be avoided (e.g. by avoiding uptake in darkness, in very shallow water, where propellers disturb the sediment, or in other areas identified by local authorities).	As required by MARPOL.

9.3.1.7 Fish Fauna

The compliance monitoring measures for fish fauna during construction will be the same as for the control of suspended sediments during dredging and reclamation works as outlined in Section 9.3.1.1, Table 9.2.

9.3.1.8 Marine Megafauna

The compliance monitoring measures for marine megafauna during construction are outlined in Table 9.9.

Table 9.9 Compliance monitoring for marine megafauna.

Required activity	Compliance monitoring	Frequency
Marine megafauna observation information / data to be collected on each vessel trip by contractor.	Observation reports to be provided to the Project Manager / EO and EMP consultants.	Monthly

9.3.1.9 Terrestrial Ecology

Compliance monitoring for the proposed mitigation measures are set out in Table 9.10.

Table 9.10 Compliance monitoring programme for terrestrial ecology.

Required activity	Compliance monitoring	Frequency
Revegetating open spaces	Submission of landscape plan that specifies re-vegetation plan, species, preservation of vegetation, etc.	Prior to construction start
Preserve or reuse existing trees for landscaping where possible		
New beach vegetation should include similar species as the existing beach such as the *rhu* and *ketapang* trees to create a similar environment		

9.3.1.10 Social Impact

Compliance monitoring for the proposed mitigation measures are set out in Table 9.11.

Table 9.11 Socioeconomics compliance monitoring programme.

Required Activity	Compliance monitoring	Frequency
Construction Phase		
Aesthetic value Establishment of hoarding to consider making it visually appealing to passers-by. Height of the hoarding will need to follow local council guidelines as well as consider optimum height for noise attenuation.	Photographic evidence and layout of installed hoarding.	At construction start/ then quarterly
Public safety Installation of warning signs, lights and traffic guides, where required.	Photographic evidence and layout plan of signages and traffic guides.	At construction start/ then quarterly

Required Activity	Compliance monitoring	Frequency
In-migration status Prepare labour management plan highlighting the management of foreign workers activities.	Submit labour management plan	Annually
Siting of workers' quarters to consider sensitivity of neighbouring villages/ residential areas - proposed location of workers' quarters and expected worker population to be submitted to local authority and discussed with local community leaders.	Submit documentation of consultations with local authority and local community leaders.	At construction start/ as required
Job Opportunities Preferential employment of locals	Provide statistical data of % local employment. This should include breakdown of job category (e.g. unskilled, skilled labour, management, etc.).	At construction start, then annually.
Economic Activity Establishment of hawker's stalls area	Submit the minute of meetings on the discussion with local authority to establish an area for the hawker's stalls to cater for both construction workers and local residents.	Before construction start
Post-construction Phase		
Aesthetic value • Local authority to ensure free and unlimited access for the public to the new beaches at the reclaimed land for the locals. • The new beaches shall allow recreational activities to be carried out such as horse riding, picnics, etc.	Development Plan for Sunrise City to clearly indicate public access areas. Final development plan as submitted to be included in EMP update.	Upon submission and endorsement of Development Plan.
Social differences and social network • Project Proponent and local authority to coordinate outreach programmes such as festivals/events, focus group discussion/workshop, to allow better integration between local communities and newcomers. • Initiate outreach programme to provide opportunities for integration between local communities and newcomers.	Compliance monitoring is beyond the scope of this EIA; oversight shall be the responsibility of the local authority during Sunrise City project operations.	

9.3.1.11 Fisheries

Continuous consultation with the local fishermen on any deleterious effect or losses is recommended. Specific activities and compliance monitoring are listed in Table 9.12.

Table 9.12 Compliance monitoring programme for mitigation of impacts to fisheries.

Required Activity	Compliance monitoring	Frequency
General		
Establishment of Fishermen's Working Group prior to construction start.	To submit committee members names and minutes of meetings.	Prior to construction start/ then quarterly.
Inform fishermen of work schedules, safety buffer zones and restricted areas before each construction phase and when required (e.g. any change in schedules, activities, etc.).	To submit schedule to Marine Department and schedule to be included in the EMP report.	At construction start/ then quarterly.
Alternative fish landing site to be prepared for fishermen during the construction and operation phase at nearby landing site inside the river mouth of Sg. Terengganu.	Submit location of final agreed location with accompanying minutes of consultations.	Prior to construction start.
Monetary compensation for affected fishermen	Summary of compensation programme and status to be included in monitoring report.	Prior to construction start. Before the start of Project.
Installation of three FADs within Zone A fishing grounds of Kuala Nerus.	• Submit FAD installation proposal with locations and type; consultations with relevant authorities to be attached. • Submit deployment report with photographic documentation.	Before the start of Project. To be included in Environmental Monitoring Report as and when ready.

9.3.1.12 Tourism and Recreational Activities

Compliance monitoring for tourism and recreational activities are listed in Table 9.13.

Table 9.13 Compliance monitoring programme for mitigation of impacts to tourism and recreational activities.

Required Activity	Compliance monitoring	Frequency
Promoting Pantai Tok Jembal and Pantai Batu Burok as alternative sites for tourism and recreational activities through collaboration between Project Proponent and local authority.	Submit minutes of consultation between Project Proponent and local authority and status of any action items.	Prior to construction start and as required.

Required Activity	Compliance monitoring	Frequency
Documenting Promoting the public recreational activities within the new township or new beach during operation.	The mitigation measures are related to the implementation of the Sunrise City topside development and hence compliance monitoring is beyond the scope of this EIA.	Not applicable.

9.3.1.13 Cultural Heritage / Archaeology

Proposed mitigation measures are related to the implementation of the Sunrise City topside development and hence compliance monitoring is beyond the scope of this EIA. The local authority shall be responsible for review and approval of the Sunrise City Development Plan, which will shall include design guidelines relating to cultural and heritage design elements.

9.3.1.14 Marine Traffic

In order to ensure risk mitigation measures are implemented, a log of communications and submissions to the Marine Department and any other relevant stakeholders shall be included in the monitoring reports.

9.3.2 Impact Monitoring

9.3.2.1 Water Quality

Frequency

A water quality monitoring programme will be carried out throughout the construction phase to ensure the impacts particularly on suspended sediment remains low during reclamation and dredging work. Pre-construction baseline surveys will be required in order to obtain up to date baseline measurements for the proposed monitoring locations against which the monitoring data will be compared. The proposed monitoring programme and its frequency are as shown in Table 9.14.

Table 9.14 Water quality monitoring frequency.

Construction stage	Frequency
Pre-construction	• Two occasions before the start of construction • Daily TSS for 2 weeks prior to commencement of dredging works.
Dredging and reclamation	Weekly for TSS
	Monthly for oil and grease, and heavy metals
Reclamation	Monthly for TSS, and oil and grease
Dredging	Daily TSS for 2 weeks upon commencement of the dredging works

Stations

The locations of the monitoring stations are shown in Figure 9.1 and the corresponding coordinates are given in Table 9.15.

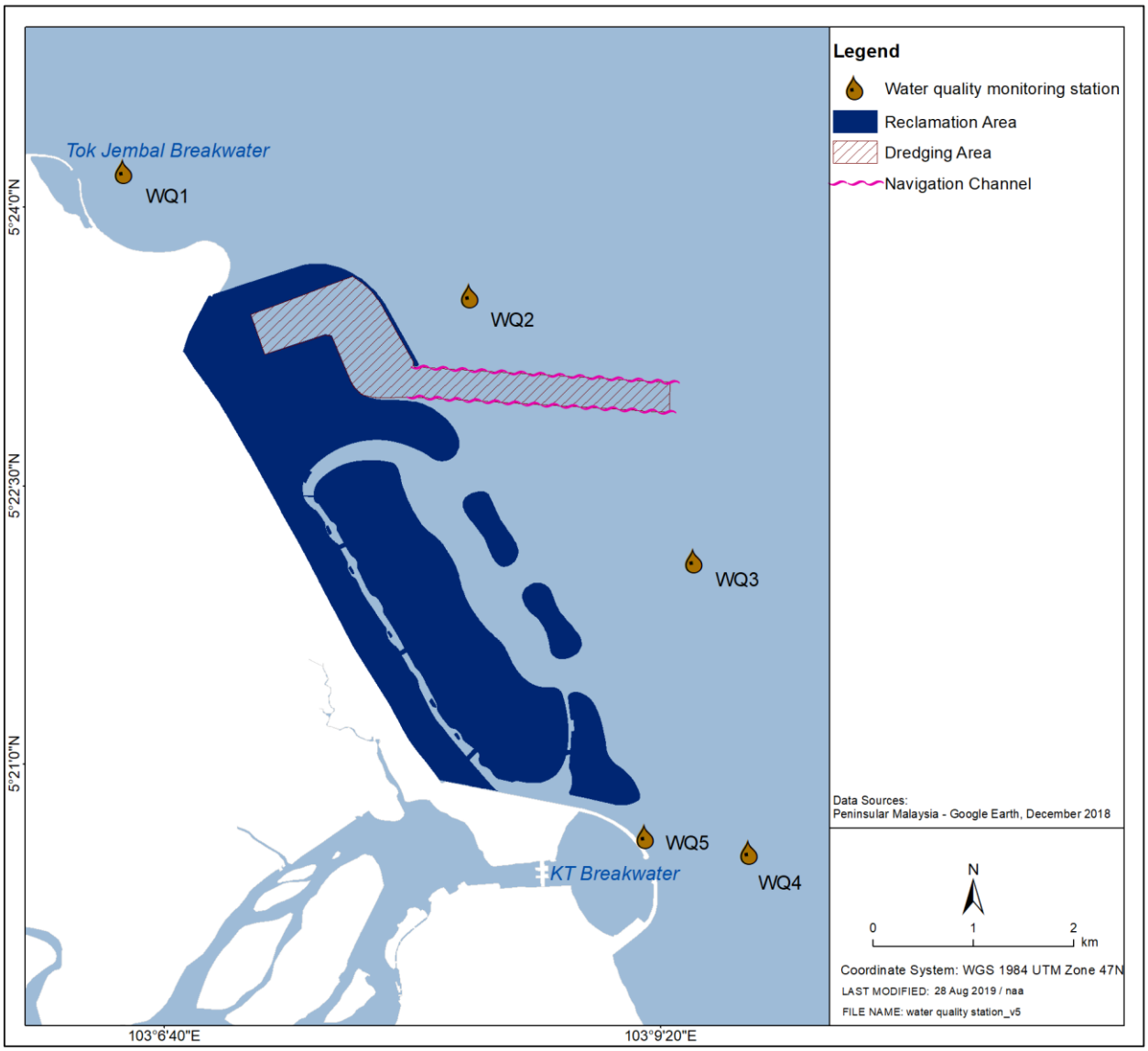

Figure 9.1 Water quality monitoring stations.

Table 9.15 Geographical coordinates and description of the water quality stations (WGS84 – degrees, minutes, seconds).

Sampling Stations	Latitude (°N)	Longitude (°E)	Description
WQ1	5° 24' 11.23"	103° 6' 28.66"	Tok Jembal recreational beach.
WQ2	5° 23' 30.41"	103° 8' 19.90"	Approximately 800 m of the project area (north of project).
WQ3	5° 22' 4.15"	103° 9' 31.5"	Reference station approximately 1.4 km offshore of the Project area.

Sampling Stations	Latitude (°N)	Longitude (°E)	Description
WQ4	5° 20' 29.94''	103° 9' 48.64''	Approximately 1 km offshore from Sg. Terengganu river mouth.
WQ5	5° 22' 4.15''	103° 9' 31.50''	Station between KT breakwater and reclamation area.

Parameters

The parameters to be analysed as shown in Table 9.16. The monitoring programme, which consists of TSS sampling, oil & grease sampling and verification of plume extent using satellite image, will be carried out weekly during dredging and reclamation phase and monthly during reclamation phase.

Table 9.16 Water quality parameters to be monitored.

Construction stage	Frequency	Parameters	Station
Dredging and reclamation	Weekly	TSS	5 fixed stations, three 3 depths (surface, middle, bottom)
	Monthly	Oil & grease; Mercury. Cadmium, Chromium, Copper, Cyanide, Zinc, Arsenic, Lead, Aluminium	
Reclamation	Monthly	TSS, oil and grease	
Dredging	Daily TSS for 2 weeks upon commencement of the dredging works	TSS	

9.3.2.2 Coastal Morphology

In order to monitor the potential impacts of the Project on the nearby coastline, bathymetric profile monitoring is recommended. Based on the coastal morphology impact assessment detailed in Section 7.2.2, the sediment transport resulting from the Project activity will only be confined within the Project area with no influence to adjacent area. Nevertheless, due to the large footprint of the Project, shoreline profile monitoring will be carried out to ensure no unanticipated impacts due to the Sunrise City development.

Frequency

The frequency of the coastal monitoring is:

- Once before construction starts
- Bi-annually during construction stage
- Bi-annually upon completion of all five stages reclamation for the first three years

Stations

These transects have been selected to cover the two sensitive receptors identified as critical areas in the National Coastal Erosion Study (2015) (Pantai Batu Buruk and shoreline fronting the UMT) as well as KT breakwater and Sultan Mahmud Airport Runway Extension. The profiles transects extend from the shoreline beach area above HAT up to -12 m CD contour to fully cover the active sediment transport area. The proposed shoreline monitoring profiles are presented in Figure 9.2 and the corresponding coordinates are given in Table 9.17.

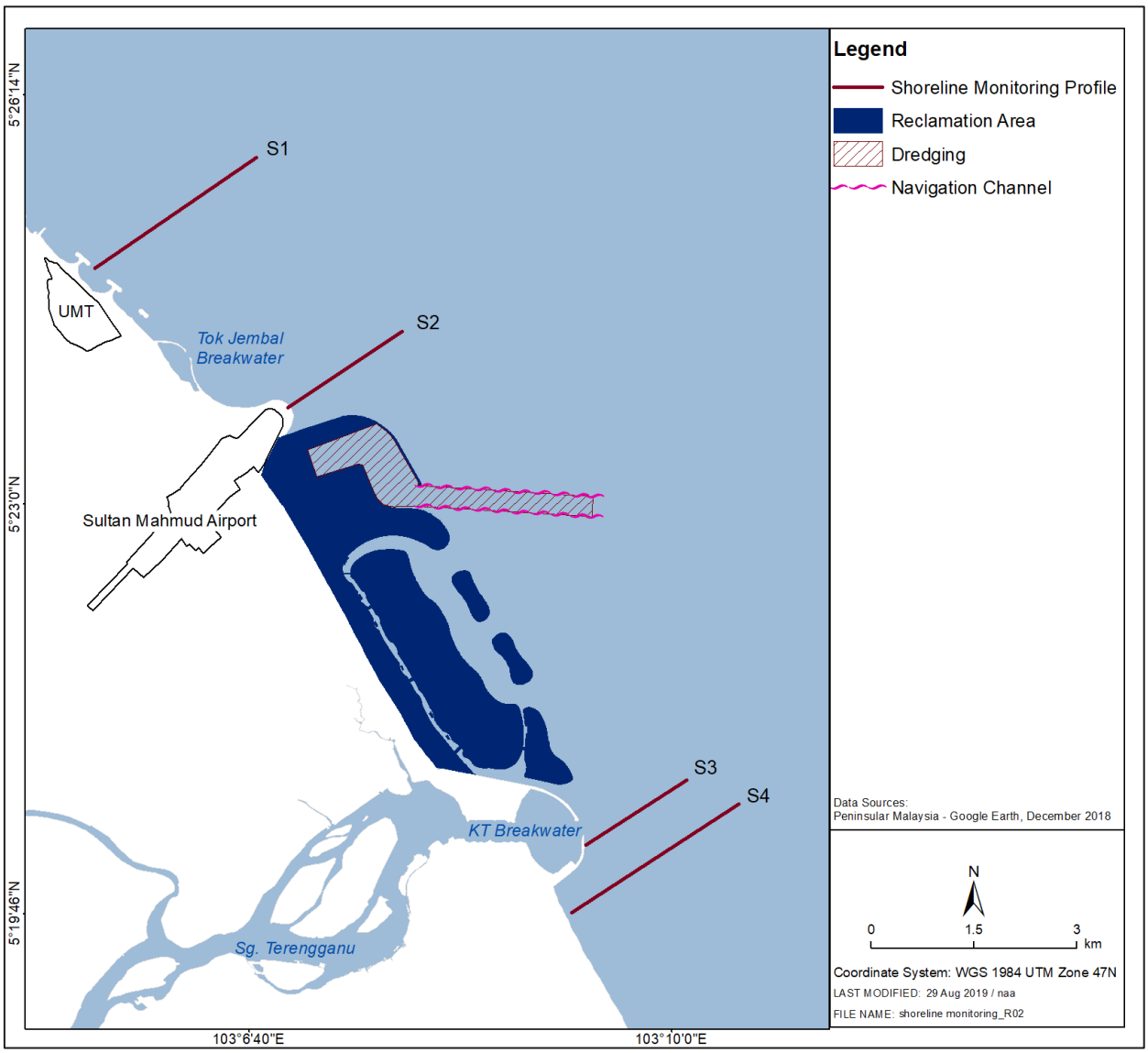

Figure 9.2 Proposed location for the shoreline monitoring profile.

Table 9.17 Coordinates of the shoreline monitoring profile (WGS84 – degrees, minutes, seconds).

Profiles	Start		End	
	Latitude (°N)	Longitude (°E)	Latitude (°N)	Longitude (°E)
S1	5° 24' 51.35"	103° 5' 29.13"	5° 25' 43.57"	103° 6' 45.98"
S2	5° 23' 45.00"	103° 7' 0.08"	5° 24' 20.52"	103° 7' 54.31"
S3	5° 20' 16.65"	103° 9' 19.68"	5° 20' 46.90"	103° 10' 7.66"
S4	5° 19' 44.57"	103° 9' 12.86"	5° 20' 35.48"	103° 10' 32.08"

9.3.2.3 Air Quality

Frequency

It is proposed that monitoring is carried out quarterly during construction.

Stations

Three monitoring stations for ambient air quality during construction are proposed as shown in Figure 9.3. The geographic location of the stations is given in Table 9.18. Note that the location and number of stations will be finalised in the final EMP in accordance with the detailed construction schedule to reflect timing of the stages of topside development.

Table 9.18 Coordinates of air quality and noise station (WGS84 - degrees, minutes, seconds).

Survey Stations	Latitude (N)	Longitude (E)	Description
AN1	5º 20’ 51.04’’	103º 8’ 13.31’’	Within Kg. Seberang Takir
AN2	5º 22’ 3.61’’	103º 7’ 26.58’’	Near Kg. Ketapang
AN3	5º 22’ 31.66’’	103º 6’ 59.33’’	Near Klinik Kesihatan, school and surau

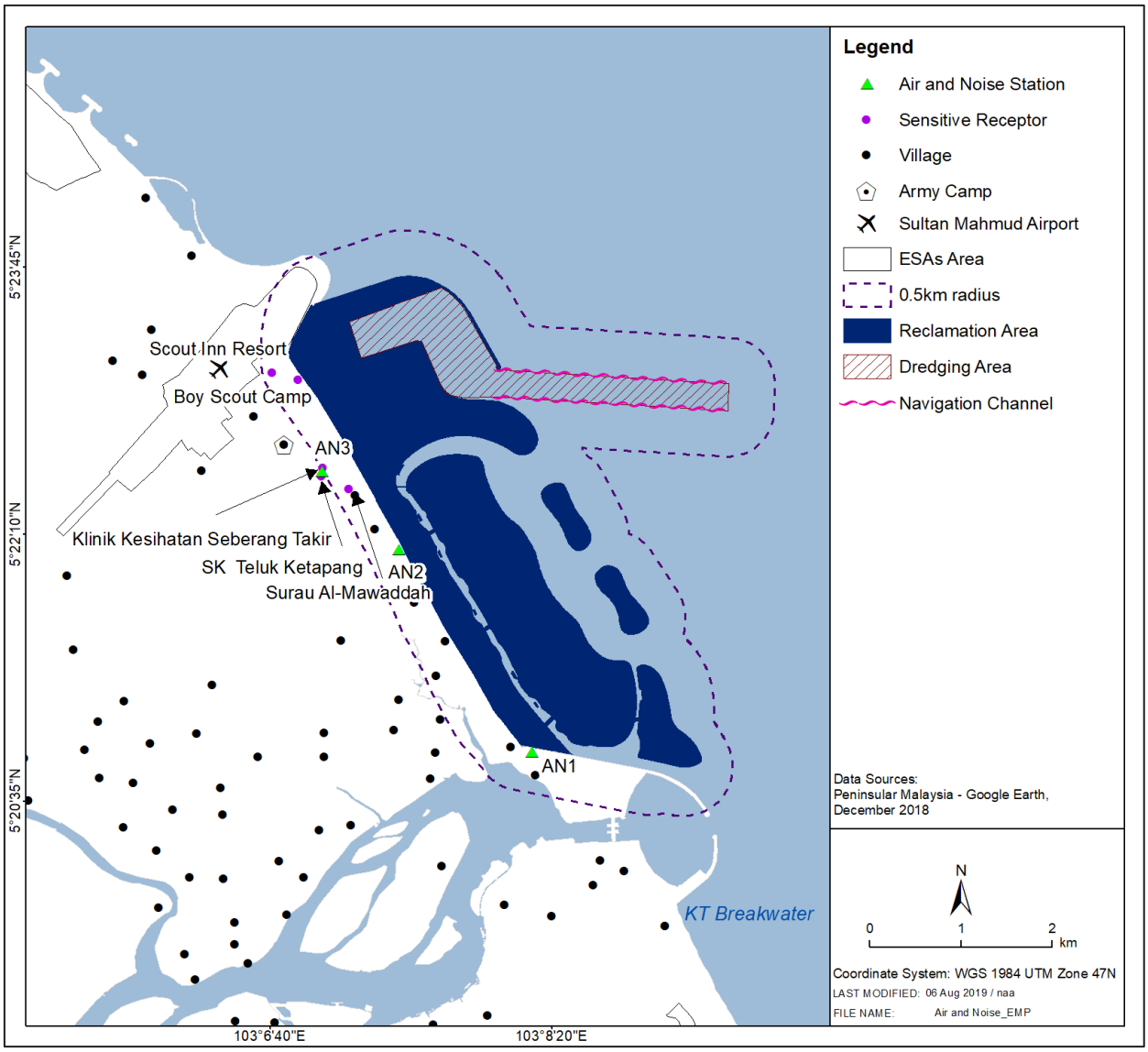

Figure 9.3 Air quality and noise monitoring stations.

Parameters

The monitoring schedule and parameters to be analysed during construction phase are listed Table 9.19.

Table 9.19 Parameters to be measured in the air quality monitoring and monitoring schedule.

Phase	Monitoring Schedule	Parameters to be measured
Construction	Quarterly	• Particulate matter (PM_{10}) • Particulate matter ($PM_{2.5}$)

9.3.2.4 Ambient Noise

Frequency

It is proposed that monitoring is carried out quarterly during construction.

Stations

Noise monitoring during the construction phase will be carried out at the same locations as the air quality stations shown in Figure 9.3 and Table 9.19 above. Note that the location and number of stations will be finalised in the EMP in accordance with the detailed construction schedule to reflect timing of the stages of topside development.

Parameters

Parameters to be recorded for ambient noise level monitoring during construction and operation are:

- Equivalent Continuous Sound (L_{eq})
- Maximum sound pressure level over monitoring period (L_{max})
- Statistical indices (L_{90}, L_{10})

"A" weighted noise levels should be monitored at each station over at least 24 hours continuously (12-hours day and 12-hours night) using a pre-calibrated precision integrating noise meter.

9.3.2.5 Macrobenthos

Macrobenthos monitoring is proposed to be carried out within the dredged channel to monitor the recolonization of macrobenthos.

Frequency

Monitoring should be carried out twice a year post-dredging.

Stations

Locations of the monitoring stations are shown in Figure 9.4 and their respective coordinates in Table 9.20. Three replicates (n=3) should be sampled at each station.

Parameters

- Abundance and biodiversity of macrobenthos

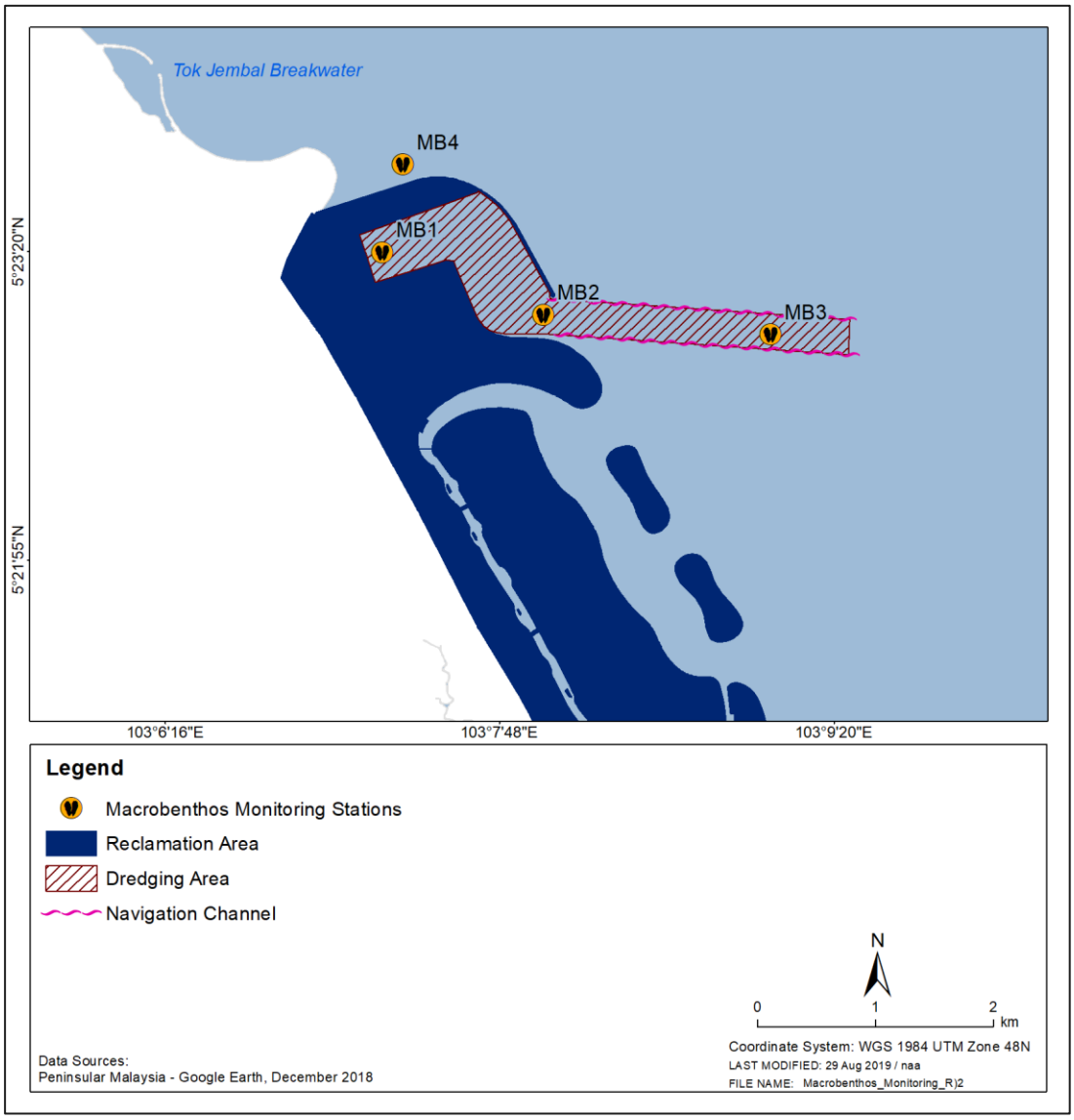

Figure 9.4 Macrobenthos monitoring stations.

Table 9.20 Coordinates of the macrobenthos monitoring stations (WGS84 – degrees, minutes, seconds).

Sampling Station	Latitude (°N)	Longitude (°E)	Justification
MB1	5° 23' 20.005"	103° 7' 15.545"	Within dredging channel
MB2	5° 23' 2.901"	103° 7' 59.894"	Within dredging channel
MB3	5° 22' 57.670"	103° 9' 2.506"	Within dredging channel
MB4	5° 23' 44.218"	103° 7' 21.128"	Reference station