

Criteria	Score	Description
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-7	
Description	-A	Slight negative impact

6.14 Marine Megafauna

6.14.1 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 area based on previous studies. These include the dugong (*Dugong dugon*), turtles (Green turtle - *Chelonia mydas* and Hawksbill turtle- *Eretmochelys imbricata*), dolphins (Indo-Pacific Humpbacked Dolphin, *Sousa chinensis*), and porpoises (Indo-Pacific Finless Porpoise, *Neophocaena phocaenoides*). Dugong is currently classified under the **Vulnerable** category in the IUCN¹ Red List while the green turtle is listed as **Endangered** and the hawksbill turtle is listed as **Critically Endangered**.

The evaluation assessment will be carried out using the RIAM approach based on the following predicted impacts:

- Suspended sediments,
- Loss of habitat
- Underwater noise and disturbance
- Boat strike
- Oil Spill

6.14.1.1 Scope

The impact assessment identifies the consequences of the construction and operation activities of the proposed project on the dugong and turtles. The scope covers the extent to which these marine megafauna will be affected, by considering the vulnerability, resilience and the adaptive capacity of these species based on scientific literatures.

6.14.2 Sensitive Receptors

Due to the nature of the proposed project, the reclamation would directly reduce the marine area at the site and adversely affect the current water quality. These will impact the marine ecology as a whole, both which will directly or indirectly affect the wellbeing of the marine megafauna; dugongs, dolphins, porpoise, whales and sea turtles at the project site. These megafauna were identified to be within the migratory pathway of the project area and the 5

¹ IUCN - International Union for Conservation of Nature and Natural Resources.

km study area. Subsequently during project operation, the marine megafauna are directly exposed to the risk of physical harm such as boat strikes and oil spills.

6.14.3 Construction

6.14.3.1 Potential Impact

Suspended Sediment Plumes

The second most prominent direct effect from the project construction works would be the suspended sediment plumes from the reclamation activities. The increase of turbidity in the marine waters may pose a challenge to the marine megafauna as they attempt to navigate around the waters.

Impact Evaluation

Based on the RIAM, the impact is categorised as **Minor Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-14	
Description	-B	Minor negative impact

Underwater Noise

Underwater noise is an important issue as many marine mammals use sound as a primary means for underwater communication and sensing. The soundscapes of the ocean is hence an important aspect of marine mammal habitat, and natural and anthropogenic sounds influence the location choice and behaviours of these marine fauna.

Sea turtles lack external ears /55/. The anatomy of the hearing apparatus is such that sea turtles can hear low frequency sounds whilst underwater and very little sound above water /56/. Vibrations, however, can be conducted through the bones of the carapace to reach the middle ear. This would further enhance their response to low frequency sounds whilst underwater. It has been found that juvenile green turtles have a slightly broader hearing range (100-800 Hz; best sensitivity 600-700 Hz) than sub-adults (range 100-500 Hz). As turtle auditory detection is less than one kHz, this might make dredging activities undetectable as a threat /57/.

Dolphins however are dependent on sound to understand the conditions of their surroundings and their acoustically sensitive ears are vulnerable to noise disturbances or disruption of communication signals, with impacts including displacement, avoidance, increased dive time and shortened surface intervals and changes in underwater acoustic behaviours /58/. The underwater hearing range for dolphins has been recorded to be between 75 Hz to 150 Hz /59/. The zone of responsiveness predicts over what ranges animals are likely to react to boat noise; this reaction threshold may depend on a variety of

factors including the noise level emissions, the bandwidth and the amount of ambient (background) noise, past experience (habituation). For marine mammals, a broadband sound pressure level of 120 dB per 1 μ Pa is used as a threshold of responsiveness /60/.

Reclamation and Piling

The reclamation and piling works of the proposed project will inevitably increase the level of underwater noise in an unprecedented level. The anthropogenic noise is a will pose a significant disruption in a sound sensitive environment as most marine life are attuned to the changes in sound level in various aspects of their life including reproduction, feeding, avoiding hazards like predators, and navigation /61/. Commonly expected response to this is that the marine megafauna would avoid the area where the construction sound is generated. Nevertheless, the likelihood of an adverse noise impact upon a species would depend on the likelihood to which the species will be found around that area. Due to the nature of the project construction, long term detrimental effects on marine megafauna due to the project construction are not expected.

Vessel Noise

Increased underwater noise can be expected during construction and operations owing to the increased vessel activity due to the presence of tankers and Very Large Crude Carriers (VLCC). Given the number of these, the big vessels are likely to be significant local sound sources.

Studies of noise levels from oil tankers showed that each vessel would emit an average source level estimate (71–141 Hz, root-mean-square pressure re 1 μ Pa \pm SE) of 186 ± 2 dB. Tankers produce two times more acoustic power than cargo ships and 100 times more than research vessels. A combination of many tankers at one go around the project site may cause disruption for acoustic contact for the dolphins and porpoises /62/.

Impact Evaluation

Based on the RIAM, the impact is categorised as **Minor Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-14	
Description	-B	Minor negative impact

Boat Strike

Due to the various navigation challenges posed to the marine megafauna while travelling in the waters around the project construction (e.g. limited marine area may push them out to the busy marine traffic lanes, low visibility in the water, underwater noise), these animals are further exposed to the risk of boat strike accidents that could often cause mortal wounds /63/. Boat speed also affects the severity of collision impacts with marine megafauna. Sea turtles need to surface above the water to breathe air and are hence prone to boat propeller strikes as common cause to mortality cases.

An estimated additional 11, 000 tankers will be using the jetties at the project area. Historical conditions till present show that the marine waters of Tg. Piai is already an important navigation pathway to different boats and tankers. These tankers will ply the waters at depths at more than 10 m. The risk of a strike by these tankers are low compared to small boats. For example, the dugong will have a low risk of being impacted due to its foraging range only around the seagrass area hence away from the tankers expected pathway of water level more than 10 m depth. It's only in special cases that dugongs forage for food in deeper waters /64/. However, other types of marine megafauna such as dolphins and whales that ply deeper waters will have higher risk of marine vessel strikes /65/.

Impact Evaluation

According to the RIAM, the impact is categorised as **Minor Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-14	
Description	-B	Minor negative impact

6.14.3.2 Proposed Mitigation Measures

Below are among some of the proposed mitigation measures that could reduce the risk and the severity of the impacts mentioned in the section above:

- To manage and monitor the amount of sediment plumes through controlling the dredging rate and sediment spill according to the limit set by hydraulic modelling results
- Protect the marine megafauna from underwater noise through the establishment of exclusion zones around the noise generating activity – from within which specific management measures can be instigated. The zone is to be established according to the results of an underwater noise modelling.
- Prevent from startling dugong or sea turtles that may be found in the area at the start of impact piling in deeper water (>3m) by observing if these marine megafauna are found within the 350m radius around the pile before commencement on any day or after an extended time when piling has stopped. Should any of these marine megafauna are spotted; impact piling should be delayed until they clear the area. Alternatively, a soft start to piling may be considered. Alternatively, if piling in water less than 3m depth, the radius of observance should be narrowed to 150m.
- Reduce the risk of boat strikes by slowing the travelling speed of all vessels and boats, especially at the shallower areas where the chances of striking a marine megafauna is high
- Regular observations and inspections should be conducted during the day to identify any marine megafauna in the vicinity of the reclamation area and initiate avoidance procedures when necessary
- The accidental injury or strike of marine megafauna should be covered under the reclamation operator's emergency response plan

6.14.3.3 Residual Impacts

With the mitigation measures in place, the only irreversible negative impact left due to the project construction would be the permanent loss of marine space.

Impact Evaluation

According to the RIAM, the impact is categorised as **Minor Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-14	
Description	-B	Minor negative impact

6.14.4 Operation

6.14.4.1 Potential Impacts

Loss of Foraging Habitat

As a direct impact of the project reclamation, there will be a permanent loss of marine area as much as 1,411 ha (3,487 ac). Due to its location at the eastern opening of the Johor Straits, it could potentially hinder the route where dugongs may travel from the Straits of Malacca through Straits of Johor to arrive at its foraging areas where the Sg. Pulai seagrass meadows are found.

Impact Evaluation

According to the RIAM, the impact is categorised as **Minor Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	-1	Negative change
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulativity	3	Cumulative
Environmental Score	-18	
Description	-B	Minor negative impact

Oil Spill

The risk of oil spill is a common threat to the marine animals due to the nature of the operational phase in such industries. All living marine organisms including the marine megafauna, are very vulnerable to oil spills whereby they are either smothered by the oil slicks or experience physiological toxicity due to ingestion of the oil spill (e.g. ulceration of intestinal tract, damaged respiratory system, superficial lesions and eye infection) /66/.

Impact Evaluation

According to the RIAM, the impact is categorised as **Minor Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-14	
Description	-B	Minor negative impact

Boat Strike

Although risks of boat strikes will continue to pose a threat to the marine megafauna during the operational phase, vessels are expected to travel at slower speed as they approach berths therefore reducing the probability of boat strikes.

Impact Evaluation

According to the RIAM, the impact is categorised as **Minor Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-14	
Description	-B	Minor negative impact

6.14.4.2 Proposed Mitigation Measures

Since the nature of impacts is quite similar to that of the construction phase, the proposed mitigation measures should be reinforced especially in the avoidance of boat strike

incidence. Apart from that, oil spill accidents can be mitigated and managed via an Oil Spill Prevention and Response Plan, which requires the approval of the Johor Port Authority, the Marine Department of Peninsula Malaysia, the Department of Environment as well as other relevant authorities.

6.14.4.3 Residual Impacts

With the mitigation measures in place, it is expected that the risks of oil spill and boat strikes would be lowered significantly as long as the implementation of the mitigation is vigilantly implemented. Therefore, no residual impacts are expected with the consideration of mitigation measures in place.

Impact Evaluation

According to the RIAM, the impact is categorised as **No Change**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	0	No change
Permanence	1	No Change
Reversibility	1	No Change
Cumulativity	1	No Change
Environmental Score	0	
Description	N	No change

6.15 Seagrass

6.15.1 Evaluation Framework

The assessment of impacts to seagrass is mainly carried out by assessing the severity of the suspended sediment plume and the sedimentation due to reclamation and dredging. This is based the matrix in Table 6.37. Apart from that, other impacts related to the construction and operation activities were also done (assessed based on available literature) for the following:

- Change in water temperature; and
- Change in salinity.

Table 6.37 Impact severity matrix for sedimentation impact on seagrass.

Severity	Definitions
No Impact	Sedimentation < 0.1 kg/m ² /day (< 0.25 mm/day)
Slight Impact	Sedimentation < 0.2 5kg/m ² /day (< 0.63 mm/day)
Minor Impact	Sedimentation < 0.5 kg/m ² /day (< 1.25 mm/day)
Moderate Impact	Sedimentation < 1.0 kg/m ² /day (< 2.5 mm/day)

Severity	Definitions
Major Impact	Sedimentation > 1.0 kg/m ² /day (> 2.5 mm/day)

6.15.2 Sensitive Receptors

Seagrass beds can be found within 5 km from the project area. These beds are mainly located at the estuary of Sg. Pulai, off PTP and the Merambong Shoal. Species found within these areas comprise of *Enhalus acoroides*, *Halophila ovalis*, *Halophila minor*, *Halophila spinulosa*, *Halodule uninervis*, *Halodule pinifolia*, *Cymodocea serrulata*, *Cymodocea rotundata*, *Thalassia hemprichii* and *Syringodium isoetifolium*.

6.15.3 Construction

6.15.3.1 Potential Impacts

Suspended Sediment Plumes

Reclamation, dredging and piling activities would not only impact on the immediate environment but also the surrounding areas. Much of the effect will be on the water clarity, where it will be reduced because of increased turbidity. Seagrass propagation is very much influenced by the light penetration into the water, as they need the light for photosynthesis process /67/. The suspended particles (coarse to fine) either would settle near the dredged area or further away depending on the currents. This suspended material represents the most damaging factor seagrass and seaweeds and its associated fauna because these organisms are very sensitive to sedimentations and need long periods for recolonisation /47, 68, 69, 70/.

However, the results of the numerical modelling indicate that the suspended sediment concentrations will not exceed 10 mg/l for more than 5 % of the time during any phase of the construction. Therefore, no impact on seagrass are predicted.

The modelling also predicts no siltation as a result of the suspended sediments generated from dredging and reclamation will affect any seagrass areas.

Impact Evaluation

According to the RIAM, the impact is categorised as **No Change**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	0	No change
Permanence	1	No Change
Reversibility	1	No Change
Cumulativity	1	No Change
Environmental Score	0	
Description	N	No change

6.15.3.2 Proposed Mitigation Measures

No mitigation measures for suspended sediments specific to seagrass are proposed; however, mitigation measures related to the control of suspended sediments as outlined in Section 6.4 (Water quality) will also further minimise impacts to the seagrass.

6.15.3.3 Residual Impacts

No changes to impact significance.

6.15.4 Operation

6.15.4.1 Potential Impacts

Change in Water Temperature

The project footprint will result in changes to the hydrodynamic regime in the area, which has an impact on the dispersion of the thermal plume currently released from the Tg. Bin coal-fired power plant. According to Lee *et al.* (2007), the optimal growth temperatures for tropical seagrass species are between 23°C and 32°C /71/. However, many previous studies agreed that an adverse impact on tropical seagrass occurs when temperature exceeds 43°C /72, 73, 74, 75, 76/. In addition, Campbell *et al.* (2006) reported the photosynthetic mechanism of seagrass becomes irreversibly damaged at temperatures of 40 - 45°C /75/. Temperature stress on seagrass will result in distribution shifts, changes in patterns of sexual reproduction, altered seagrass growth rates and metabolism and changes in their carbon balance /77, 78/.

The result from the thermal plume dispersion model showed that the temperature at the seagrass beds located off PTP and Merambong Shoals were slightly low, i.e. <31.2 – 31.6°C. Based on the study by Lee *et al.* (2007), all these levels were found to be well within the optimal growth temperatures for tropical seagrass species i.e. between 23°C and 32°C /71/. However, at Sg. Pulau, slightly high temperature levels (above 32.0°C) were recorded during certain seasons. The temperatures were recorded 32.0 – 32.5°C during northeast monsoon for Phase 1 and 32.0 – 33.5°C during southwest monsoon for Phase 2. For Phase 3, high temperature levels were expected to occur throughout the year i.e. northeast monsoon (32.0 – 33.0°C), southwest monsoon (32.0 – 33.5°C) and inter monsoon (32.5 – 33.0°C).

Impact Evaluation

According to the RIAM, the impact is categorised as **Minor Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulau) and Johor Straits
Magnitude	-1	Negative change
Permanence	3	Permanent
Reversibility	2	Reversible
Cumulativity	2	Non-cumulative
Environmental Score	-14	
Description	-B	Minor negative impact

Change in Salinity

With respect to salinity levels, previous studies reported that seagrass normally survive in a wide range of salinities i.e. 5 - 60 psu /79, 80/. Data from the hydraulic study indicates that dispersion of salinity levels at the seagrass beds located in Sg. Pulau, off PTP and Merambong Shoals are expected to be within the range of 28 - >30 psu during all phases (Phase 1,2 and 3). As such, no significant impact is expected on seagrass beds adjacent to the proposed project site.

Impact Evaluation

According to the RIAM, the impact is categorised as **No Change**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulau) and Johor Straits
Magnitude	0	No change
Permanence	1	No Change
Reversibility	1	No Change
Cumulativity	1	No Change
Environmental Score	0	
Description	N	No change

Oil Spill

Based on the hydraulic study, the accidental oil spills are expected to reach the sensitive habitats which include seagrass meadows off Tg. Pelepas Port and Merambong Shoal.

At the seagrass areas, the maximum oil thickness also expected to reach 0.001 - 5.000 mm within 1 – 48 hours. Under the worst case scenario (Scenario D), the most impacted seagrass beds would be off Tg. Pelepas Port with maximum oil thickness predicted at 0.5 – 5.00 mm within 1 – 12 hours.

McKenzie *et al.* (2010) reported that oil spills can also have significant impacts on seagrasses. Intertidal seagrass can be smothered by oil, which lead to reduced growth rates, blackened leaves and mortality. In addition, oil can also affect flowering and leaf chlorophyll content of seagrass (McKenzie *et al.*, 2010).

Seaweed that found associated with the seagrasses will also be effected by the of oil spills. Seaweed responds variably to oil spill, however, the oil may result in die-offs for seaweed since the oil can prevent its germination and growth. This will happen through inhibition of respiration and sexual reproduction (Lobban and Harrison, 2000).

Impact Evaluation

According to the RIAM, the impact is categorised as **Moderate Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulau) and Johor Straits
Magnitude	-3	Major negative change

Criteria	Score	Description
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-28	
Description	-C	Moderate negative

6.15.4.2 Proposed Mitigation Measures

No mitigation measures specific to protection of the seagrass habitats are proposed apart from mitigation measures for oil spill and thermal plumes identified above.

6.15.4.3 Residual Impacts

Temperature

No significant change in temperatures around the Tg. Bin Power Plant cooling water outfall are predicted to occur with the construction of PTP Phase 3 in place. Accordingly, the residual impact is categorised as **No change**.

Criteria	Score	Description
Importance	2	Important to project site and Sg. Pulai
Magnitude	0	No change
Permanence	0	No change
Reversibility	0	No change
Cumulativity	0	No change
Environmental Score	0	
Description	N	No change

Salinity

No change in impact significance.

Oil Spill

Assuming the mitigation measures proposed are able to prevent the spill from spreading beyond the project site, the residual impact is categorised as **Slight Negative**.

Criteria	Score	Description
Importance	1	Oil dispersion will be contained within the Project site.
Magnitude	-1	Negative change

Criteria	Score	Description
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-7	
Description	-A	Slight negative impact

6.16 Coral

6.16.1 Evaluation Framework and Scope

The assessment of impacts to coral is mainly carried out by assessing the severity of the suspended sediment plume and the sedimentation due to reclamation and dredging (during construction) (Table 6.38) while impacts during operation is based on the responses of the corals to oil spill.

Table 6.38 Impact severity matrix for sedimentation impacts on coral.

Severity	Definition
No impact	Sedimentation <1.7 mm/14 days (<0.05 kg/m ² /day)
Slight impact	Sedimentation <3.5 mm/14 days (<0.1 kg/m ² /day)
Minor impact	Sedimentation <7.0 mm/14 days (<0.2 kg/m ² /day)
Moderate impact	Sedimentation <17.5 mm/14 days (<0.5 kg/m ² /day)
Major impact	Sedimentation >17.5 mm/14 days (>0.5 kg/m ² /day)

6.16.2 Sensitive Receptors

Corals could only be found within Pulau Merambong. Hard coral cover ranged from 2% to 10% of the substrate while the abiotic components (i.e. rock, sand and rubble) ranged from 0% to 50%. A total of 10 taxa of hard corals, 10 taxa of soft corals and two (2) taxa of gorgonians were recorded.

6.16.3 Construction

6.16.3.1 Potential Impacts

Suspended Sediment and Sedimentation

The hydraulic study has shown that the suspended sediment plume will not travel to the corals of Pulau Merambong and it has also shown that no sedimentation is expected at the area. So, no impact is expected.

Impact Evaluation

According to the RIAM, the impact is categorised as **No Change**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	0	No change
Permanence	1	No Change
Reversibility	1	No Change
Cumulativity	1	No Change
Environmental Score	0	
Description	N	No change

6.16.3.2 Mitigation Measures

No mitigation measures required.

6.16.3.3 Residual Impacts

No change in impact significance.

6.16.4 Operation

6.16.4.1 Potential Impacts

Temperature Change

Coral reefs are sensitive to changes in sea temperature level. Severe damage occurs on corals when exposed to high temperature levels. The ideal temperature for corals to live in is between 25°C and 29°C. An increase in temperature of 4 - 5°C above ambient could kill most corals in shallow waters. When water temperature increases, corals expel most of their pigmented microalgal endosymbionts (called zooxanthellae) to become pale or white (i.e. bleached) /81/.

Data from the hydraulic study showed that the thermal plume that reaches the coral reefs at Pulau Merambong is below 31.2°C with no change from existing conditions. Therefore, there will be no thermal plume impact on coral reefs.

Impact Evaluation

According to the RIAM, the impact is categorised as **No Change**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	0	No change
Permanence	1	No Change
Reversibility	1	No Change

Criteria	Score	Description
Cumulativity	1	No Change
Environmental Score	0	
Description	N	No change

Change in Salinity

Corals can tolerate a wide range of salinities between 25 and 42 psu /82, 83/. However, most of the coral species has a lethal effect at a salinity of less than 10 psu. Detrimental effects of salinity on corals can occur due to physiological stress on the coral animal or the corals' algal symbionts. If the symbiotic relationship between coral and algae is disrupted due to salinity stress, there may be a profound effect on coral metabolism, which is derived from the photosynthetic products of symbiotic zooxanthellae /84, 85/.

Data from the hydraulic study indicates that no changes in salinity are expected at Pulau Merambong for all phases (Phase 1, 2 and 3). Therefore, no impacts on corals are predicted.

Impact Evaluation

According to the RIAM, the impact is categorised as **No Change**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	0	No change
Permanence	1	No Change
Reversibility	1	No Change
Cumulativity	1	No Change
Environmental Score	0	
Description	N	No change

Oil Spill

Based on the hydraulic study, the accidental oil spills are expected to reach the sensitive habitat which includes the coral reefs at Pulau Merambong. The maximum oil thickness expected to reach 0.001 - 0.05 mm (within 24 hours).

Coral reefs are known be affected when exposed to oil spills such as reduced photosynthesis, growth and reproduction. This could lead to coral death, however, it also depends on the coral species, growth form, life stage and duration of oil exposure (Loya and Rinkevich, 1980). However, the recovery of coral reefs in the Straits of Malacca that affected by oil spills has been reported very slow (Dow, 1977).

Impact Evaluation

According to the RIAM, the impact is categorised as **Moderate Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	-2	Significant negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-28	
Description	-C	Moderate negative

6.16.4.2 Proposed Mitigation Measures

No mitigation specific to the protection of coral reefs are recommended. Mitigation measures for oil spill as mentioned above will mitigate potential oil spill effects on corals.

6.16.4.3 Residual Impacts

Thermal Plume

No change in impact significance.

Salinity

No change in impact significance.

Oil Spill

Assuming the mitigation measures proposed are able to prevent the spill from spreading beyond the project site, the residual impact is categorised as **Slight Negative**.

Criteria	Score	Description
Importance	1	Oil dispersion will be contained within the Project site.
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-7	
Description	-A	Slight negative impact

6.17 Socio-Economic

6.17.1 Evaluation Framework

The socioeconomic impacts are evaluated based on indicators such as the impact on the livelihood of the local community and the permanence of this impact.

The assessment of the magnitude of an impact has been guided by the values summarised in Table 6.39 below.

Table 6.39 Significance rating categories used in the social impacts assessment

Rating	Explanation
Very high	These impacts would be considered by society as constituting a major and usually permanent change to the social environment, and usually result in severe or very severe effects or, alternatively, beneficial or very beneficial ones
High	These impacts would be considered by society as constituting an important and usually long term change to the social environment, and would be viewed in either a serious or a very positive light.
Moderate	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.
Low	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
No significance	These impacts have no primary or secondary consequences that are important to the public.

6.17.1.1 Scope

This section describes the impact prediction and evaluation carried out for the identified key socioeconomic issues as per the scoping exercise described in the TOR, and taking into account inputs and comments from the TOR review panel. These have been assessed as focus issues, issues of note and any remaining issues as described below:

Focus Issues

- Impact to local fishermen due to permanent loss of fishing grounds and potential reduction in fisheries resources
- Impacts on tourism
- Social impacts on the community due to change in land use/ character
- Impacts on public health and safety during operations
- Increased employment and local business opportunity

Issues of Note

- Construction stage impacts on fishing activity and fisheries resources
- Aesthetic impacts during construction stage
- Socio-cultural impacts due to construction workforce
- Loss of fish landing areas due to project footprint.

Remaining Issues

- Public health, safety and well-being due to construction (owing to air and noise impacts and land traffic risks).

It is noted that impacts to public health are assessed separately in Section 6.19, while land traffic impacts are addressed in Section 6.20.4.

6.17.2 Sensitive Receptors

The socioeconomic aspect of which will be impacted the most is the fishing community that relies on the Tg Piai marine area for their livelihood. There is an estimated 373 fishermen residing in southern Mukim Serkat that would be affected, as well as, to a lesser known extent, the indigenous Orang Asli Seletar that live in the inner region of Sungai Pulai. The other sensitive receptors are Tg Piai National Park and Tg Piai Resort which receives tourists throughout the year. The following table shows the relative distance of the fishing village and jetties from the proposed project area.

Table 6.40 Fishing Village and Jetty that would be affected within 5 km radius

Fishing villages	Jetties	Distance from the Jetty (m)	Distance from the Proposed Project (m)
Kg Perpat Pasir	Perpat Pasir	500	800
Kg Serong Laut		500	800
Kg Serong Darat		1000	1500
Kg Perpat Darat		1500	2000
Kg Serkat Timur	Parit Penghulu (Serkat)	3000	4000
Kg Serkat Barat		2000	4000
Kg Serkat Laut		800	3000
Pekan Serkat		1200	3000
Kg Sungai Belukang	Sungai Belukang	500	800
Kg Perpat Punggor		800	800
Kg Sungai Boh	Sungai Boh	500	5000
Kg Sg Cengkih	Sungai Cengkih	500	3000
Kg Sg Dinar	Sungai Dinar	500	2000
Kg Sg Sam	Sungai Chokoh	1000	1500
Kg Chokoh Kechil		800	1500
Kg Chokoh		500	2300
Kg Chokoh Besar		500	1800

6.17.3 Construction

6.17.3.1 Predicted Impacts

Local Fisheries Sector

The nature of reclamation is such that it will lead to an irreversible change in the area available as a fisheries resource and the physical presence of the project itself results in a

direct loss of available fishing grounds for the fishermen presently utilising the area. The impacts of this loss to macrobenthos and fish fauna have been assessed in Sections 6.11 and 6.13 above.

The small scale fishermen and the local communities are both directly and indirectly dependent on the sea for their livelihood. These artisanal fishermen affected largely fish for shrimp in the foreshore and nearshore areas that are to be reclaimed. A total of 11 fish landing areas within 500 m to 5 km off the coast of Mukim Serkat (Figure 6.92) have been facing declining revenue for the last five years due to the deterioration and loss of the fishing grounds from the current development at Tg. Pelepas Port (PTP) and the Tg. Bin Power Plant.

Prior to 2002, fishermen in Pengkalan Sg. Dinar, Sg. Boh and Sg. Chengkeh were fishing in Sg. Pulai, Tanjung Piai (within and around the project footprint) and up to Pulau Merambong. However after the Tanjung Bin Power Plant was constructed, the fish and prawn harvest in Sg. Pulai has reportedly decreased. Therefore, the fishermen's options are limited to around Tanjung Piai and Pulau Merambong. The fishermen in Pengkalan Penghulu (Serkat) fish in the Malacca Straits and Tanjung Piai. However, they face safety risks when fishing in the waters of Malacca Straits due to the presence of large vessels and pirates. Also due to the presence of big vessels, the fishermen from Pengkalan Sg. Belukang, Sg. Chukoh and Perpat Pasir prefer fishing around Tanjung Piai up to Pulau Merambong.

To estimate the severity of the impact, the existing main nearshore fishing grounds for the fishermen in the study area has been estimated based on survey information and spatial analysis (exclusion) of the anchorage areas and main marine navigation lanes which are currently conflicting uses of the sea space. This is estimated at approximately 13,300 ha from P. Kukup to the entrance to the Johor Strait (Figure 6.92). The project footprint of 1,411 ha will result in a reduction of almost 11 % of the available nearshore fishing grounds.

In summary, the fishermen from Sg. Belukang, Perpat Pasir, Sg. Chokoh, Sg. Dinar, Sg. Chengkeh, Sg. Boh, Sg. Karang, Sg. Redan and Sg. Punai will permanently lose part of their fishing grounds due to the proposed reclamation project. The fishing activities are expected to be shifted and concentrated at other areas such as off Sg. Pulai estuary, seagrass area off Tg. Pelepas Port and Merambong Shoals, Pulau Merambong and Pulau Kukup, which may lead to conflicts with fishermen from other fish landing points who fish in these areas.

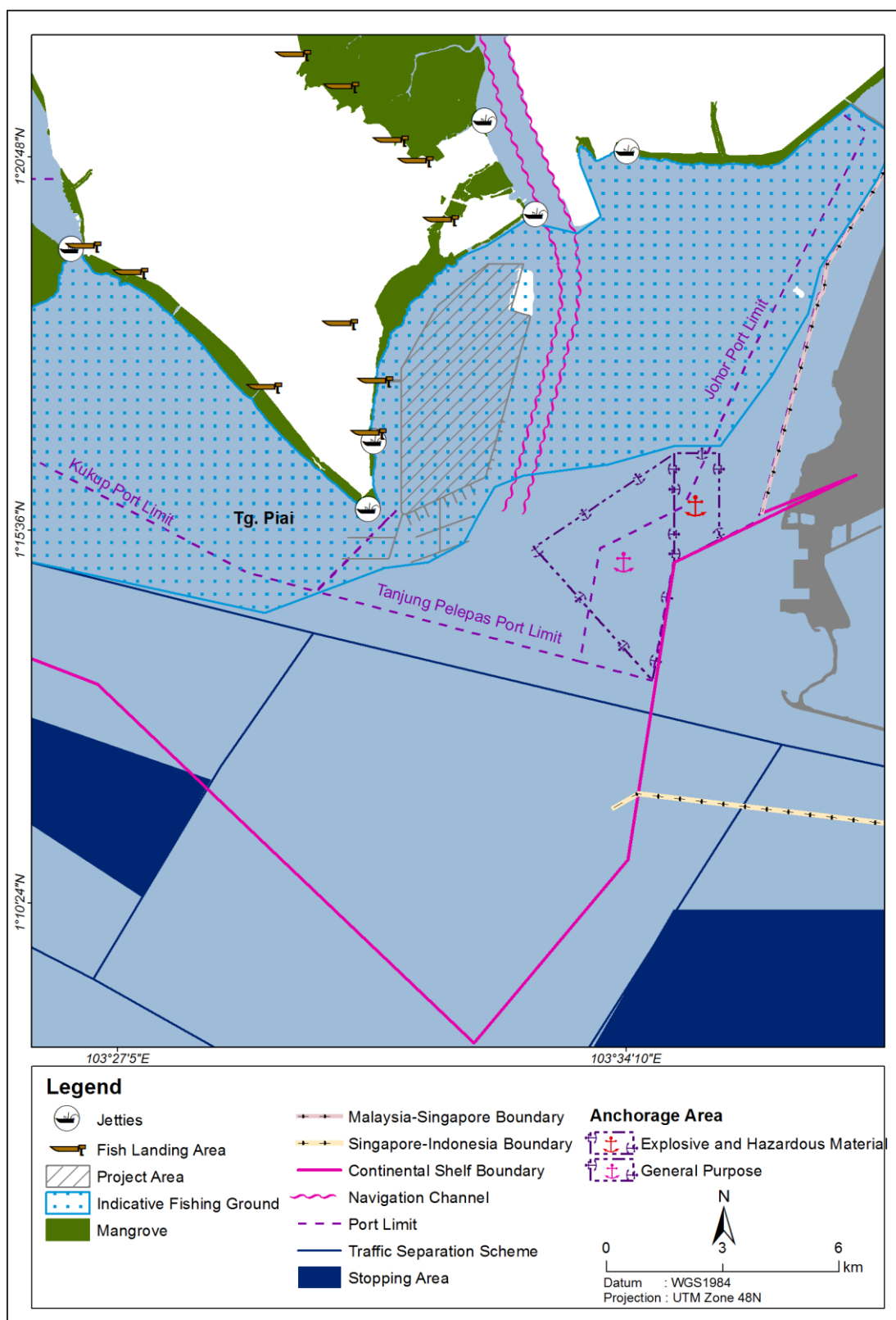


Figure 6.92 Fish landing areas around the project site

The reduction of fishing grounds will result in a decline in the numbers of active fishermen, which will result in a reduction in annual fish catch for the area with consequent impacts on the economic contribution of the local fishing industry.

Based on the discussions with fishermen and their representatives at Serkat Town and in the focus group discussions (FGD) the fishing industry prior to 2002 (before Tanjung Bin Power Plant and PTP were developed) was very productive - with income as high as RM500-RM800 (in 2005) per fishing trip. However, after the development of the Tg. Bin Power Plant (operating since 2005) and Tg Pelepas Port (operating since 1999), the fishing grounds around the study areas have been declining.

Local fishermen in Kampung Serkat estimate fish and prawn landings were usually in the range of 50 kg to about 80 kg per trip, which makes an annual total catch of about 3,000 tonnes (0.05 tons fishes/trip, 20 day trips/month, 12 months and 250 fishermen at that time) before the existence of Tg Bin Power Plant and the Tg Pelepas Port.

Compared with 2005, in 2014 their catches have decreased to 1,594 tonnes per year (0.02 tons fishes/trip, 20 days/month, 12 months/year and 373 fishermen) at an estimated monetary loss RM4.03 million (fish price estimation: RM4/kg in 2002 and RM5/kg in 2014).

For these fishermen to continue their livelihood they believe they will be forced to venture further offshore (beyond 12 nautical miles from coast) to fish, while trying to avoid from encroaching into the international borders of Singapore and also Indonesia. This will inadvertently increase the capital costs as the fishermen will have to acquire larger vessels and face elevated costs for additional fuel usage, possibly heavier fishing gear and greater labour costs.

For those forced out of the industry a major hardship will be the lack of experience and skills as 80% have been in this profession from a young age and are now in the 40-65 year age bracket, making alternative employment prospects very poor.

Orang Asli Seletar

Another potentially affected group within the community is the indigenous group of Orang Asli Seletar who have settlements located in Kampung Simpang Arang (679 population, JAKOA, Johor Bahru, 2009) in Gelang Patah. While this is about 20 km radius from the proposed project site they depend on Sungai Pulai for food supply and they also harvest mangrove wood for charcoal. They are artisanal fishermen depending on fish for their own sustenance.

Sungai Pulai and Muara Sungai Pulai have been able to support their need for fish, crabs and shrimps up until Tanjung Bin and Tanjung Pelepas were constructed. Due to these two developments, most of the mangrove in the vicinity of their settlements has been destroyed, with a significant loss marine habitat. This affects their livelihood as the amount of fish, crabs and shrimps at their fishing ground became less. They now fish further downstream including fishing in Tanjung Piai waters but face the risk of accidents with larger vessels. Any farther loss of fishing grounds in the region will undoubtedly lead to greater hardship for this group in particular.

Impact Evaluation

Due to the nature and extent of the impacts on the fishing community and the indigenous group of Orang Asli Seletar, the impact of this proposed project on the fishing community is categorised as Moderate Negative Impact.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	-2	Significant negative change
Permanence	3	Permanent

Criteria	Score	Description
Reversibility	3	Irreversible
Cumulativity	2	Non-cumulative
Environmental Score	-32	
Description	-C	Moderate negative impact

Job Opportunities

In general, this project the creation of job opportunities stemming from this proposed development represents a positive impact for the State and Malaysia as a whole. Individuals from the younger generation in the community anticipate some positive impacts from the proposed project as it is perceived to create job opportunities for them. The region has 46% of the population below the age of 24 years and 27% below the age of 14 years.

During the three construction phases, is estimated that around 2,000 construction workers will be required, mainly consisting of skilled and semi-skilled workers. However, most of the locals are not equipped with the required skills for the job and there is a high likelihood that these positions will be filled by employees hired from outside of Mukim Serkat unless adequate training is provided. This comment was raised by survey participants based on their past experience with the Tg. Bin project whereby the project hired individuals from outside of the local area to fulfil the workforce demand.

Noting that at present there is a total of 5,167 in the working age population within Mukim Serkat it is inevitable that a component of the required workforce for the project will come from outside the Mukim.

Impact Evaluation

Since the expected outcome in regards to the availability of job opportunities for the local is low, it is considered as a **Negative Impact** on the affected community.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-2	Significant negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	2	Non-cumulative
Environmental Score	-12	
Description	-B	Negative impact

Business Opportunities

The anticipated entry of foreign workers for the proposed project will further increase the existing number of foreign workers that are living in the local area. Even at present time, the local villagers are facing a certain extent of discomfort due to the differences in culture. However, the locals are rather optimistic that this may bring forth a potential spin-off effect to the local small business community. They foresee a demand for residence (e.g. homestay,

rental of rooms and houses) and food (e.g. restaurants and grocery shops), among others of which the local traders are able to provide. It is estimated that the daily expenditure spent on food alone for an average of 3000 workers in the proposed project area would amount to about RM45,000 daily.

Impact Evaluation

The local community will be facing an impending change in their local community where some small businesses will thrive if they meet the demands of the future market generated from the proposed project. Therefore impact of the project construction to the general public is categorised as **Slight Positive Impact**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	1	Improvement to status quo
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulativity	2	Non-cumulative
Environmental Score	7	
Description	A	Slight positive impact

Local Tourism Industry

However, one local business that would be impacted directly by the proposed project is the tourism industry, i.e. Tg. Piai Resort and the Tg Piai National Park. The main attraction of the Tg Piai Resort is its waterscape and this would be lost once the proposed project reclamation is in place. With the close proximity of the resort to a large scale industrial area such as the proposed project – it would not be suitable for the resort to operate as water sport activities conducted by the resort are no longer safe to be carried out in the area. The deterioration of the resort's business will affect the local community that are dependent on it as the source of their livelihood. Based on a discussion with the resort owner and workers in December 2013, the business is expected to lose an annual income of approximately RM3.0 million from room rentals and another RM2.5 million from the sale of food and beverage at the resort annually.

Impact Evaluation

Therefore, the consequence of the proposed project on the local tourism industry receives a score of **Negative Impact**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-2	Significant negative change
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulativity	3	Cumulative

Criteria	Score	Description
Environmental Score	-18	
Description	-B	Negative impact

Influx of Foreign Workers

Due to the manpower needs in the construction of the proposed project, it is anticipated that there will be an increase of foreign workers into this area to the existing number of foreign workers that are presently residing in this area. In general assumption, the majority that forms the construction force would consist of foreign workers. It is estimated that there would be an average of 3,000 construction workers that would be required for the proposed Project in each Phase. This number of foreign workers can be considered significant, when compared to the existing total of 5,167 in the working age population and an overall total population of 7,994 living in the entire Mukim Serkat (2013 estimate). The foreign workers would consists at a maximum 37% of the current local population. The local community has expressed their discomfort with the presence of foreigners in their villages and are concerned about the rise of social impacts stemming from cultural differences as new cultures, values and practices that will gradually encroach into the local community.

Impact Evaluation

Due to the perceptions and fears of the local community while also considering the duration of of this impact (given the construction period of 15 years for all three phases), the increase of foreign workers is categorised as **Slight Negative Impact**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-7	
Description	-A	Slight negative impact

Air Pollution from Dust

During reclamation phase during construction, the potential impact would be the dust generated in the air from the reclamation works in the event when it is not well controlled from the uncompact sand or earth. Any dust being blown towards the land and the settlement areas it would become a nuisance to the local people as it will affect the health of people especially with allergies and asthma. This issue will be further elaborated in the health impact sector of the study.

Impact Evaluation

Due to the extent of the reclamation works, the anticipated air pollution from dust is a **Slight Negative Impact**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	2	Non-cumulative
Environmental Score	-6	
Description	-A	Slight negative impact

6.17.3.2 Proposed Mitigation Measures

Local Fisheries Sector

The fate of the fishermen in study area remains uncertain as a rehabilitation programme has not been planned and governmental agencies still find difficulties in overcoming the complexity that determines possible futures for displaced fishermen. Due to the permanent loss of fishing grounds, the project proponent should plan to provide alternative jobs for the affected fishermen. Among the mitigation measures suggested to address the impacts from the proposed project are as below:

- **Aquaculture Entrepreneurship** – While the industry of aquaculture is not new to the fishermen affected at the Mukim Serkat, they have not been succeeding due to the lack of knowledge, poor understanding of the industry, funding issues, lacking marketing and business know-how, to name a few. Among the actions that can be taken are as below:
 - Professional Training and Output:
 - Recruit fishermen who are interested in this industry to equip them with trainings that incorporate the basic handlings of infrastructure (ponds or cages), selection of appropriate locations, nursery selection and management, handlings during operation, fish health and diseases, marketing and other necessary accounting and housekeeping exercises. This training can be provided by the Department of Fisheries Malaysia (DOF) who has conducted courses and training in aquaculture.
 - There is an e-aquaculture system that provides assistance to small scale culturist, private investors, entrepreneurs and those that are involved in aquaculture activities and information and assistance in accessing this support needs to be planned and implemented.
 - Aquaculture Ventures:
 - The first approach is to identify the appropriate sites for the along the coastal areas of Mukim Serkat. Areas which are within mangroves forests would require the approval of the Forestry Department and other relevant agencies for operating in these sensitive areas. It could start on a small time venture with a handful of fishermen. The second approach is to venture into other aquaculture business outside the Mukim Serkat area. They have an administrative centre in Serkat but the production areas are outside the Mukim Serkat. The fishermen corporations can get assistance from the relevant government agencies with a nominal capital expenditure of less than RM 1million (funding could also be provided by the project proponent through their CSR).
- **Joint venture with other fishing industry** - The proposal of joint venture with the existing operator of fish culture of Kukup Island should be taken only with careful

planning and execution. Sharing resources would most likely cause a commotion amongst the existing operators as fishery resources are limited and any additional fishermen introduced into the area will bring about pressure and tension. It is up to Lembaga Kemajuan Ikan Malaysia (LKIM) or the Department of Fishery (DOF) to approve some portion of areas at the channel of the existing Kukup aquaculture activity to the affected fishermen as part of a cooperative activity. Project proponent could provide fund through CSR for developing a fish culture industry (e.g: Kukup aquaculture) for the affected fishermen from Serkat. In order to ensure the effectiveness and sustainability of this venture, an organised establishment must be organised to carry out such venture with assistance from various sectors of the government agencies and the project proponent.

- **Artificial Reefs** - Apart from the above, compensatory mitigation measures specific to fish fauna is recommended by establishing artificial reefs in suitable areas to lure fish to aggregate. Suitable locations to deploy these artificial reefs need to be determined in consultation with LKIM and the local fishermen's associations prior to the start of operations

Job Opportunities

Among some of the recommended mitigation measures to address the impacts of the proposed project on job opportunities are as follows:

- **Funding for skills development** – The project proponent could provide funding to maximise employment of the local population through community outreach programmes, training, education and human capital development. At the same time, this would minimise situations where conflicts between foreign workers and the local communities in terms of securing job opportunities.
- **Provide training specifically for the project need** – The project proponent could also provide trainings to the local community to equip them and make them more employable for the job opportunities required in the construction work of the proposed project.
- **Provide training in reclamation industry** – Unskilled youngsters might be interested to become involved in the reclamation process or industrial sectors in the proposed project. The Project proponent could provide services training to them or guide them until they qualified. Therefore, the project proponent could provide a platform whereby the required training and guidance is given to this group of people until they receive proper qualifications.

Business Opportunities

In order to equip the local community to fully benefit from the proposed project, the step below is suggested:

- **Provide training for local entrepreneurs** - The local entrepreneurs are mainly small business owners that catered almost only to the local community. But with the projected market expansion around the area, these traders may be lacking the communication skills and the experience needed in managing medium size businesses to meet the increased demand for products and services. In collaboration with Small Medium Enterprise (SME) Corporation Malaysia, micro enterprise development training can be provided to these local traders to equip them with the right skills and knowledge to expand their businesses. This approach may be particularly effective if specific supply contract needs are placed with aspiring local business ventures and the SME Corporation provides mentoring and other business advice.

Local Tourism Industry

Two mitigation approaches are recommended to reduce the negative impacts that the local tourism industry faces:

- **Negotiation with Tg Piai Resort** – The project proponent should engage with the owner of Tg Piai Resort and discuss the suitable compensation for the Resort owner and workers from the losses they will experience

- **Agro-Tourism in Tg Piai** – The local authority, with the assistance of the project proponent could introduce agro-tourism activities such as the Bee-honey farm, Coconut court, Keropok Lekor production and hawker centres promoting local food and produce.
- **Buffer Zone for Tg Piai National Park**- The existence of this park is vital for the tourism industry in the region. Any ecological interference by human would hamper the tourist arrivals into this park. Therefore, the development of this proposed project should not encroach into this park area or its buffer zone. As far as the proposed project boundary limits, it does not directly affect the park area with a buffer zone of more than 500m from the coast.

Influx of Foreign Workers

- **Facilities and accommodation** - To address the increased foreign worker population in the area as a result of the Project, a critical measures to be taken is to include housing, supporting facilities and amenities as part of the Project infrastructure. In addition the local authority should ensure that land use conflicts with locals are avoided for employees wanting to live off site.

Air Pollution from Dust

- **Standard Operating Procedures:** During construction and reclamation phase, the contractor should follow the Standard Operation Procedure (SOP). Conduct dust management procedures and mitigations during construction to minimize air pollution impacts on the community as specified in the EMP.
- **Health Monitoring:** Work in collaboration with the local health agency to monitor public health amongst the local residents if any issues arise due to the development of the proposed project.

6.17.3.3 Residual Impacts

Fisheries Sector

There is no residual impact anticipated if the mitigation measures are implemented well and have achieved its objectives, especially in assisting the local fishermen to shift/upgrade their livelihood to aquaculture and deep sea fishing, which is a positive impact.

Impact Evaluation

Based on the RIAM, the impact is considered to be **Slight Positive**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	1	Improvement to status quo
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	2	Non-cumulative
Environmental Score	6	
Description	A	Slight positive impact

Job Opportunities

There is no residual impact anticipated if the mitigation measures are implemented well and the objectives are achieved. In addition, this may also contribute to the enhancement of

current skillsets within the local community to meet the demands of the growing industry at Tg. Pi ai.

Impact Evaluation

Overall there is an expected **Slight Positive Impact** arising from this mitigation.

Criteria	Score	Description
Importance	1	Important to Tg. Pi ai
Magnitude	1	Improvement to status quo
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	2	Non-cumulative
Environmental Score	6	
Description	A	Slight positive impact

Business Opportunities

There is not residual impact anticipated if the mitigation measures are implemented well and have achieved its objectives.

Impact Evaluation

Overall there is an expected **Slight Positive Impact** arising from this mitigation.

Criteria	Score	Description
Importance	1	Important to Tg. Pi ai
Magnitude	1	Improvement to status quo
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	2	Non-cumulative
Environmental Score	6	
Description	A	Slight positive impact

Local Tourism Industry

The mitigation measure proposed is aimed at compensation for the loss of business, as it is not able to remove or lessen the impact. Therefore, a minimal residual impact is anticipated after the mitigation measures are implemented because the loss of business of the tourism industry is permanent and irreversible.

Impact Evaluation

Based on the RIAM, the impact is considered to be **Slight Negative**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-1	Negative change
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulativity	3	Cumulative
Environmental Score	-9	
Description	-A	Slight negative impact

Influx of Foreign Workers

Through the cooperation of project proponent and the local authority, the mitigation measures if implemented according to its objectives, should be able to avoid conflicts in living spaces between the local community and the foreign workers.

Impact Evaluation

Based on the RIAM, the impact is considered to be **No Change**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	0	No change
Permanence	1	No change
Reversibility	2	Reversible
Cumulativity	2	Non-cumulative
Environmental Score	0	
Description	N	No change

Air Pollution from Dust

Mitigation measures applied to minimize the impacts of dust pollution by way of health monitoring and adherence to SOP (to control the release of dust) do not constitute stopping the inevitable (minimal) release of dust during reclamation works.

Impact Evaluation

As long as the construction work is carried out, some level of dust pollution will be present and therefore it remains as a **Slight Negative Impact**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-1	Negative change

Criteria	Score	Description
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	2	Non-cumulative
Environmental Score	-6	
Description	-A	Slight negative impact

6.17.4 Operations

6.17.4.1 Predicted Impacts

Most of the impacts from the proposed project are expected to take place right from the beginning at the construction phase - where many of which continue to be relevant in the operation phase. These impacts have been discussed in detail in the impact assessment of the construction phase (Section 6.17.2). Therefore, the following assessment of impact during operation phase will focus on the eventual changes in the socio-economic profile of Mukim Serkat due to the presence of the proposed project. It is anticipated that the local economy in Mukim Serkat may shift from traditional activities such as fishery and agriculture to a more industrialised economy. The community will most likely adapt to the major driving force of the economy as the area where they are living will be increasingly occupied by white and blue collar workers from the proposed project. With the entry of new market from this workforce, the local small businesses are expected to thrive with the increase demand for basic daily products and services, which includes providing accommodation.

Job Opportunities

It is expected that the operational part of the proposed project will generate 800 workers of various levels of expertise on completion of Phase 1 through to a total of 2,700 with the completion of Phase 3. The provision of jobs would mainly be for people who have the right qualification and skills that normally do not apply to local people (based on the level of their education). The local community, especially the younger generation will have to compete with peers from out of the state as they vie for job opportunities with the proposed development. Therefore majority of the local people will be left out the the main stream of the proposed development.

Impact Evaluation

Since the job opportunities which this proposed development would create are not directly suitable to the existing local community, it is categorised as **Slight Negative Impact**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-1	Negative change
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulativity	3	Cumulative

Criteria	Score	Description
Environmental Score	-9	
Description	-A	Slight negative impact

Business Opportunities

Although the local community does not have the right skillset to be part of the workforce for the proposed projects (as discussed in the Section 6.17.3 - Socioeconomic Impacts during Construction) – the local community could still find job opportunities at the burgeoning support industries (a spill-over effect due to the proposed project) such as in schools, clinics, security (police and guards) and other services. It is anticipated that Mukim Serkat would gradually become an urban settlement with more than 10,000 residents, based on the number of generated employments from the proposed project and the supporting services. And although the potential for entrepreneurship is present for small businesses, the locals may not be equipped with the right experience or have adequate amount of capital for investment in order to start their own business.

Impact Evaluation

Based on the RIAM, the impact is considered as **Slight Negative**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-1	Negative change
Permanence	3	Permanent
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-9	
Description	-A	Slight negative impact

Urban Transformation

The proposed development could be a catalyst which could transform the rural community and its economy into an urban community due to industrialisation and commercialisation. Although it would be more than 10 years before the transition to urbanisation fully materialises – the oil and gas industry would play a very important role in steering the direction of the local areas' development. Having said that, agriculture will still be the main thrust of the local economy but the creation of a workforce from a diverse background will change the rural landscape into a more urban landscape. It is expected that facilities and housing estates (either private or public projects), government agencies for public services (police, hospitals, schools, fire brigade and other public services) will need to increase to cater to more than 10,000 residents (based on the number of generated employments from the proposed project and supporting services).

Impact Evaluation

Due to the long term benefits that urbanisation could provide to the future of the local community and the adjacent area, the anticipated urban transformation is regarded as a **Significant Positive Impact**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tg. Piai, Sg. Pulau and Johor Straits)
Magnitude	2	Significant improvement to status quo
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulativity	3	Cumulative
Environmental Score	36	
Description	D	Significant positive impact

Increased Population

Following from the projected increase of population since the construction of project, the operational phase of the project will only bring in more workers from elsewhere within or out of the State to fill the positions available, as well as from the growth of the anticipated new development stemming from the proposed project (supporting businesses and industries).

Impact Evaluation

With the inevitable increase of population to the area, the pressure on public amenities, facilities, housing, land use, traffic activities, and the likes will cause a Slight Negative Impact if not addressed.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-1	Negative change
Permanence	3	Permanent
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-8	
Description	-A	Slight negative impact

Deterioration of the Surrounding Environment

With the increase of industrial activities at Tg Piai, to certain extent environmental pressure will persist on the existing habitat such as the mangrove and seagrass at the Sungai Pulau Ramsar Site, particularly with the increase in population to the region. If the operational aspects of the park operations are not well managed, deterioration of water quality may cause a negative impact on sensitive coastal habitats, and the adjacent aquaculture areas dependant on good water quality to sustain the health of their produce.

Impact Evaluation

The occurrence of increased shipping activity and the risk of illegal dischargers or spillage through accidents means that some level of environmental pressure will prevail resulting in an assessment of a **Slight Negative Impact**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-1	Negative change
Permanence	3	Permanent
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-8	
Description	-A	Slight negative impact

Increased Land Traffic Activities

Increases of traffic volume that will be utilizing the current road network are likely to cause some impacts. It is anticipated that large and heavy construction vehicles will frequent the roads which causes potential noise pollution, air pollution or accidents due to traffic growth; apart from decreasing the level of road safety for the local community. The increase of land traffic activities may not work in favour for the affected community as per status quo.

Impact Evaluation

Therefore, the impact assessment for the project operation on the community is **Slight Negative Impact**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-1	Negative change
Permanence	3	Permanent
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-8	
Description	-A	Slight negative impact

Aesthetic Impacts

The visual impact due to the Project will vary depending on the visual absorption capacity of the landscape, viewing distance, relative number of viewers and period of view. In principle, the further the distance away from the proposed Project, the less the visual there will be for the existing settlement structures and vegetation cover due to the flat terrain at Mukim Serkat.

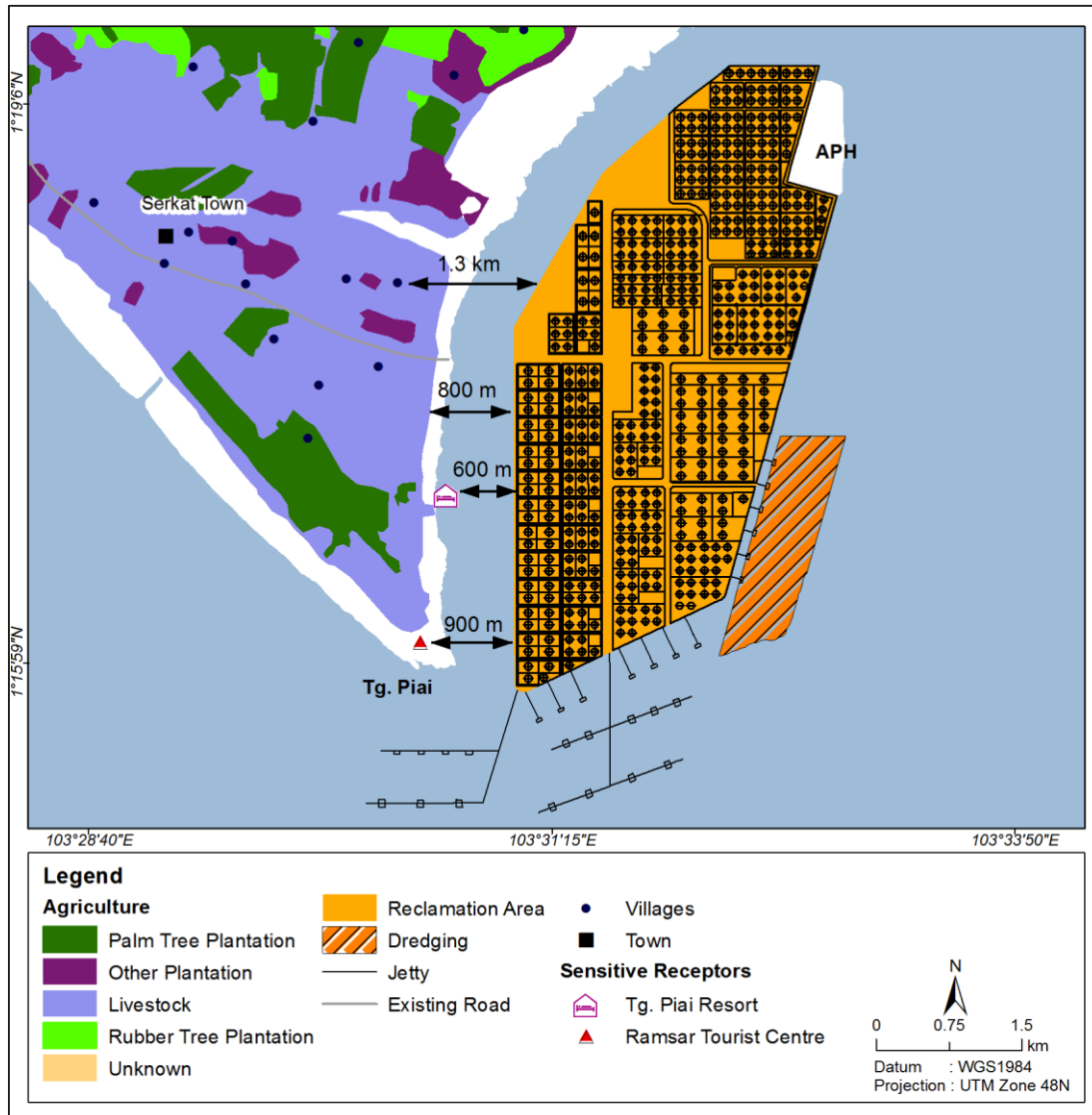


Figure 6.93 Distance of Project to the features along the coastal zone

The proposed Project will include the construction of a boiler stack release which is 28.0m in height for gaseous emissions from combustion activities and standard storage tanks that ranges from 16 m to 23 m in heights.

Given that the location and layout of the Project which occupies the entire eastern coastline of Mukim Serkat (Figure 6.93), the visual sensitivity boundary is identified from around Tg. Bin towards south, reaching Tg. Piai (approximately 9 km in distance). In general, the visual sensitivity boundary along coastline begins at approximately 700 m to 1 km where the villages are located. Within the boundary however (<1km from coastline) the land areas are predominantly agricultural area with minimal residential sites. From local view inland therefore, the proposed Project will generally have at most a low or zero visual impact as it is hidden by the vast existing agriculture areas along the coastal zone (Photo 6.2).

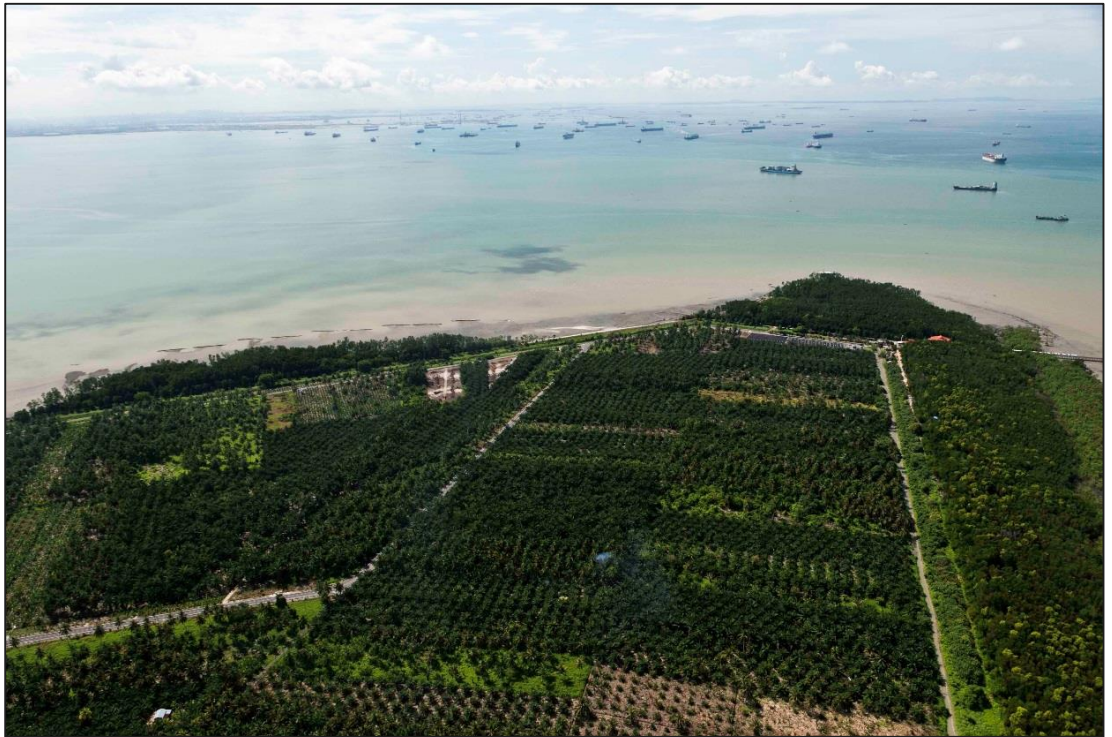


Photo 6.2 Aerial view of Tg Piai showing the agricultural area and the flat terrain

Nevertheless, two prominent visually sensitive areas which will be affected by the Project are the Tg Piai National Park and also the Tg Piai Resort. Both locations are heavily dependent on the view of the Straits of Johor as a major attraction for tourists. As these two locations are situated on the coastal zone, the visual absorption capacity of Tg. Piai Resort and Tg. Piai National Park is low, given that there will only be 900 m setback from the Project parameter (Figure 6.93). As a results of this, the Project will directly be visible from these two locations, which would also block the current view of the Straits of Johor waterscape.

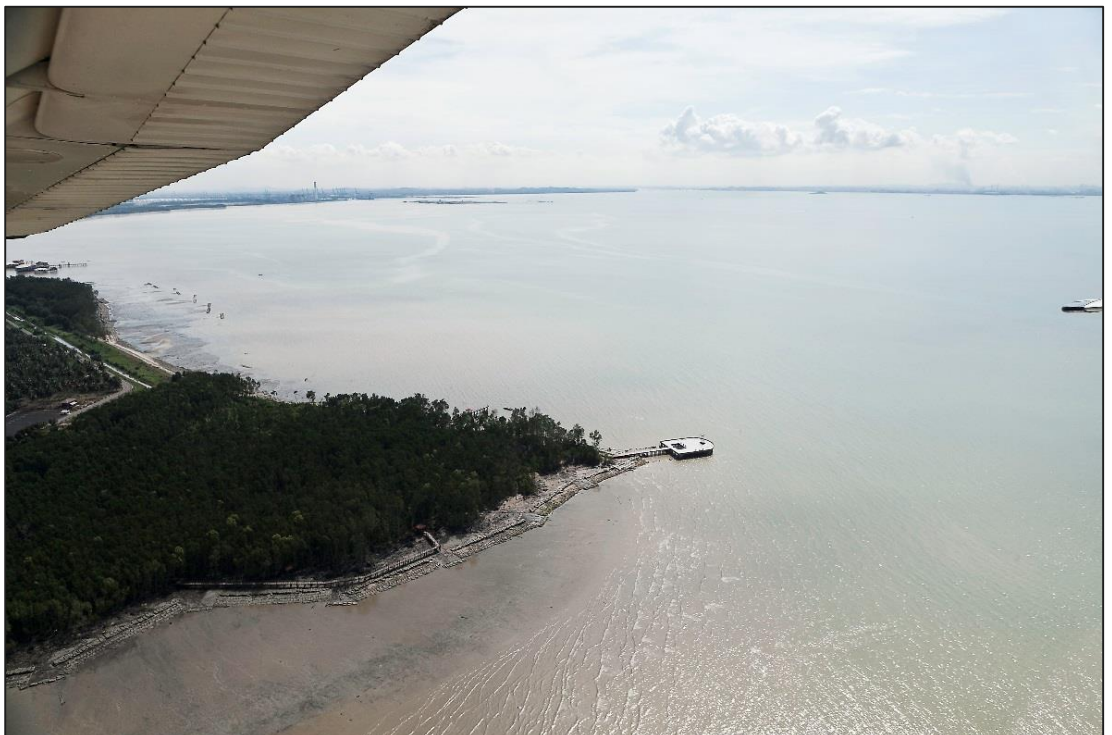


Photo 6.3 Tg Piai National Park

Table 6.41 Visual Impact Rating for Tg Piai National Park

Viewing Situation	Edge of Tg Piai coast, overlooking the waterscape where the Straits of Malacca meets the Straits of Johor
Category of view	Visitors to the National Park
Context of View	Panoramic view of Project and ongoing reclamation and operation at the waterscape
Likely period of View	Long term (Officers at the Tg Piai National Park) Moderate term (Visitors to the Tg Piai National Park)
Relative number of viewers	Moderate (65,000 visitors in 2011)
Distance of view	900 m
Visual absorption capacity	High
Visual impact rating	High
Comment	The visual impact of the Project from the Tg Piai National Park would be high. The high visual impact from this vantage point is due to the Project footprint that is parallel to the entire east coast of Tg Piai. When viewed from this vantage point, viewers will see the increased activity generated by the Project especially the reclamation and construction phases. A high number of visitors to the National Park will view whole process of reclamation, construction and operation activities from the National Park jetty during the daytime.



Photo 6.4 Tg Piai Resort

Table 6.42 Visual Impact Rating for Tg Piai Resort

Viewing Situation	Middle section of the east coast of Tg Piai, overlooking the waterscape of the Straits of Johor
Category of view	Visitors to the resort
Context of View	Panoramic view of Project and ongoing reclamation and operation at the waterscape
Likely period of View	Long term (Operators and staff at the Tg Piai Resort) Moderate term (Visitors to the Tg Piai Resort)
Relative number of viewers	Moderate (peak during weekends, public and school holidays with an average of 71 days/year)
Distance of view	600 m
Visual absorption capacity	High
Visual impact rating	High
Comment	The visual impact of the Project from the Tg Piai Resort would be high. The high visual impact from this vantage point is due to the Project footprint that is parallel to the entire east coast of Tg Piai. When viewed from this vantage point, viewers will see the increased activity generated by the Project especially the reclamation and construction phases. The resort operators and visitors will view whole process of reclamation, construction and operation activities from the rooms and resort facility during the daytime.

Impact Evaluation

Due to the significant change on the view of waterscape at Tg. Piai with the presence of the Project, it would adversely affect the characteristic and the normal operation of Tg Piai National Park and the Tg Piai Resort permanently, therefore the aesthetic change is categorised as a **Significant Negative Impact**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tg. Piai, Sg. Pulai and Johor Straits)
Magnitude	-3	Negative change
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulativity	2	Non-cumulative
Environmental Score	-48	
Description	-D	Significant negative impact

6.17.4.2 Proposed Mitigation Measures

Job Opportunities

The issues regarding job opportunities for the local community during operation of project would be of the same in nature as during the construction phase. Therefore, the proposed mitigation measure during the operation phase is anticipated to be one that is a continuity from the mitigation measures taken at the construction stage, as stated below:

- **Funding for skills development** – The project proponent could provide funding to maximise employment of the local population through community outreach programmes, training, education and human capital development. At the same time, this would minimise situations where conflicts between foreign workers and the local communities in terms of securing job opportunities.
- **Provide training specifically for the project need** – The project proponent could also provide trainings to the local community to equip them and make them more employable for the job that is required in the construction work of the proposed project.
- **Provide equal opportunities** - Qualified locals should be trained to undertake suitable managerial roles, as well as for positions in professional and technical areas to meet the job demand.

Business Opportunities

The issues regarding business opportunities for the local community during operation of the project would be of the same nature as during the construction phase. Therefore, the proposed mitigation measure would reflect the approaches which were taken during construction phase as a continuous effort as stated below:

- **Provide training for local entrepreneurs** - The local entrepreneurs are mainly small business owners that catered almost only to the local community. But with the projected market expansion around the area, these traders may be lacking the communication skills and the experience needed in managing medium size businesses to meet the increased demand for products and services. In collaboration with Small Medium Enterprise (SME) Corporation Malaysia, micro enterprise development training can be provided to these local traders to equip them with the right skills and knowledge to expand their businesses.

Urban Transformation

In general, urban transformation anticipated to take place in Mukim Serkat is viewed as a Significant Positive Impact to its community in the long run. Therefore, there is no requirement in proposing a mitigation measure.

Increased Population

- **Facilities and accommodation** - To address the increase of population in the area (from the workforce involved in the operation of the proposed project, as well as new ancillary businesses that bring in workers from out of state), the local authority should ensure that conflicts of land users should be avoided. One of the measures to be taken would increase the supply of housing, the availability supporting facilities and amenities to cater to the increased population demand.

Deterioration of Environment

- Initiate collaboration between the major industries in the area to rehabilitate, conserve and protect the degraded Sungai Pulai Ramsar site. Its potential as an aquaculture site has greatly plummeted due to the pollution from these developments.

Increased Land Traffic

- **Signal control (traffic light):** To be installed at the proposed stop junction from Tg. Piai to Pontian/ Johor Bahru in order to maintain acceptable level of service during operation stages

- **Road Signage:** Signs informing and pre-warning road users of the construction vehicles moving in and out of the construction sites should be displayed at strategic places before reaching the sites.

Aesthetic Impacts

A green belt of trees should be planted along the plant perimeter at the south eastern perimeter.

In the areas immediately opposite the Tg. Piai Ramsar site up to the Piai Resort, it is recommended that the tanks along the boundary are painted to reduce their visual impact. Since the tanks are viewed against the sky a horizontal band pattern of blue colours is recommended to break up the perceived verticality of the tanks and to attempt to give the impression that the tanks fade into the background. This has been done at an LNG facility in Glenmarvis in Scotland, where dark blue colours are used at the base to visually anchor it, while progressively lighter blue colours are used moving up the tank, to give the impression that the top part of the tanks merge with the clouds in the background sky.



Photo 6.5 Glenmarvis LNG tanks with blue colour treatment. Photo courtesy of The Neilston WebCam Photo Gallery. url: <http://www.drookitagain.co.uk>, downloaded October 24, 2014.

6.17.4.3 Residual Impacts

Job Opportunities

If the proposed mitigation impacts are implemented according to the objectives set, the newer generations within the local community should have received proper training and education needs in order to enhance their employability in the proposed project industry, as well as the ancillary services that comes with it.

Impact Evaluation

Therefore, it is anticipated that there will be **Slight Positive Impact** as a residual.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	1	Improvement in status quo

Criteria	Score	Description
Permanence	3	Permanent
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	8	
Description	A	Slight positive impact

Business Opportunities

Provided that the implementation of the proposed mitigation measures are executed well, the locals would be equipped with the right experience or have adequate amount of capital for investment in order to start their own business.

Impact Evaluation

Therefore, it is projected to be a **Slight Positive Impact**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	1	Improvement in status quo
Permanence	3	Permanent
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	8	
Description	A	Slight positive impact

Urban Transformation

In general, urban transformation anticipated to take place in Mukim Serkat is viewed as a Significant Positive Impact to its community in the long run. Therefore, there is no residual impacts as there is no requirement in proposing a mitigation measure for a positive impact.

Increased Population

Following from the projected increase of population since the construction of project, the operational phase of the project will only bring in more workers from out of State to fill the positions available as well as the anticipated new development stemming from the proposed project (supporting businesses and industries).

Impact Evaluation

With the inevitable increase of population to the area which currently consists of mainly small villages, the pressure on public amenities, facilities, housing, land use, traffic activities, and the likes will cause a **Slight Negative Impact** if not addressed.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-1	Negative change
Permanence	3	Permanent
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-8	
Description	-A	Slight negative impact

Deterioration of Environment

The mitigation measures aimed to ensure that the proposed development pay extra attention to the health of the sensitive environments around its area such as the mangrove and seagrasses at the Sungai Pulai Ramsar Site. Among the monitoring measures is the need to ensure that the good water quality of that area is maintained in order for the adjacent aquaculture areas to sustain the health of their produce.

Impact Evaluation

If the mitigation measures are strictly adhered to at all times, there should be **No Change** on status quo.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	0	No change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	0	
Description	N	No change

Increased Land Traffic Activities

Given that the mitigation measures are well implemented, enforced and adhered to at all times, there should be **No Change** to the status quo.

Impact Evaluation

Criteria	Score	Description
Importance	1	Important to Tg. Piai

Criteria	Score	Description
Magnitude	0	No change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	0	
Description	N	No change

6.18 Quantitative Risk Assessment

The objectives of the Quantitative Risk Assessment (QRA) study are to identify and quantify the probability and consequences of the possible accidents that may escalate from the proposed project to the surrounding offsite areas; to calculate the level of risk; and to suggest measures to reduce the level of risk if higher than acceptable levels.

The source of potential accidents considered are hazardous substances, i.e. flammable, explosive or toxic substances, which will be stored and piped on site during the operations stage.

The hazardous materials and their associated major hazards identified in this SEIA are crude oil and gasoline (representative of clean product). Both these substances are flammable.

6.18.1 Evaluation Framework and Methodology

The QRA for the Project focuses on the operations stage, as there are no significant risks associated with the construction stage. The operational risks have been assessed on a conservative basis, both in terms of consequences (e.g. use of the maximum inventories of hazardous substances in vessels, worst case process conditions, etc.) and frequency – i.e. no account has been taken of project site safety systems (e.g. isolation valves, detectors), operator intervention to prevent or minimise releases and no credit has been taken to account for the site Safety Management System.

The QRA assessment includes a worst-case scenario (WCS) and a worst-case credible scenario (WCCS). The WCS is a scenario with the furthest consequence distance, in this case thermal radiation, whereas the WCCS is a credible scenario (with event frequencies $\geq 1 \times 10^{-6}$ per year) with furthest consequence distance. Further details can be found in Appendix K.

6.18.1.1 Risk Criteria

The level of risk has been assessed against the DOE's risk criteria stipulated in the EIA Guidelines for Risk Assessment /86/, which are presented in terms of Individual Risk (IR). This is defined as the risk of fatality to a person in the vicinity of a hazard. It includes the nature of the fatality to the individual, the likelihood of the fatality occurring, and the period of time over which the fatality might occur. The individual is assumed to be unprotected and to be present during the total time of exposure (i.e. 24 hours a day, every day of the year).

The risk criteria are based on Individual Risk (IR) contours, with the following thresholds applied:

- The 1×10^{-5} fatalities/ person per year individual risk contour should not extend beyond industrial developments; and
- The 1×10^{-6} fatalities/ person per year individual risk contour should not encompass involuntary recipients of industrial risks such as residential areas, schools, hospitals and places of continuous occupancy.

6.18.1.2 Methodology

The scope of work for this study comprises the following:

Step	Description	Remarks
Stage 1	Hazard identification	Review of possible accidents that may occur (based on review of Project and activities; previous accident experience/ professional judgment). A representative set of discrete initiating events was short listed after a full review of the process and hazardous substances present onsite.
Stage 2	Frequency Analysis	Determination of the frequency of initiating events (based on historical data) and the frequency of hazardous event outcomes (such as fire, explosion)
Stage 3	Consequence Analysis	Determination of the consequences (impact) of hazardous events or outcomes on the surrounding population. Outcomes evaluated in this SEIA are Pool Fire and Jet Fire.
Stage 4	Event Tree Analysis	Analysis of how the initiating event may develop and the resulting likelihood of the hazardous outcome
Stage 5	Risk Summation	Combination of failure frequencies and all consequences to determine the individual risk levels posed by the Project operations. Comparison of risk results against DOE risk criteria (outlined in Section 6.18.1.1 above).
Stage 6	Risk Mitigation	Recommendation of risk mitigation measures to reduce the risks to levels that are As Low As Reasonably Practicable (ALARP).

6.18.2 Sensitive Receptors

The Project site vicinity comprises a mixture of residential area, fishing and mudflat areas with mangroves as shown in Figure 6.94. There are few site sensitive receptors within 1 km of the proposed project site. The residential lots are located on the western side are Kg. Serong Laut and Kg. Perpat Pasir. The other sensitive receptor areas include the mangrove at the Tg. Piai State Park, intertidal mudflats which are habitat for birds and the Ramsar sites near the impact area. Apart from that, fishing may also occur within the proposed area and the navigation channel for access also needs to be reviewed.

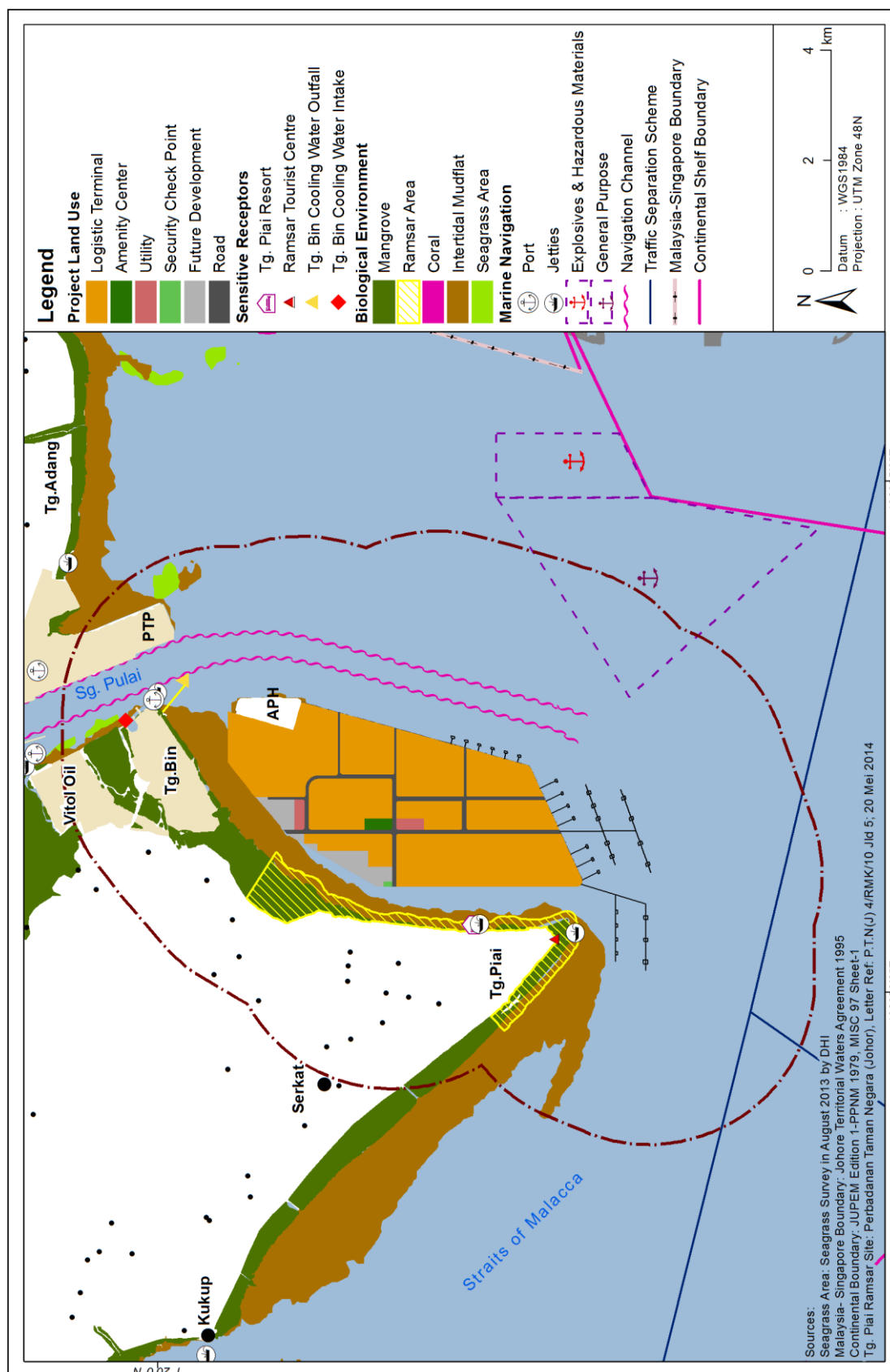


Figure 6.94 Hazard-sensitive receptors at the site.

6.18.3 Predicted Risk

The extent of all consequences assessed are in compliance with DOE's risk acceptance criteria as shown in Figure 6.95 and described below:

- **1 x 10⁻⁵ per year IR contour** - is confined within the Project area;
- **1 x 10⁻⁶ per year IR contour** - is within the 300 m Primary Buffer Zone. The IR contour does not encompass involuntary recipients of industrial risks such as residential areas, schools, hospitals, and places of continuous occupancy, etc.

The worst case scenario fire event also shows that the hazard remains within the 300 m Primary Buffer Zone as shown in Figure 6.96 and described in Table 6.43. These show:

- The hazard zones for bund fires, pool fire and jet fires do not extend into any existing residential areas or the Ramsar boundary.
- All radiation levels which result in immediate fatality levels (up to 100%) are confined within the Project boundary.

Table 6.43 Hazard zones criteria and predicted distance from Project boundary.

Hazard Zone	Consequence	Maximum distance from Project Boundary
4 kW/ m ²	This radiation level may result in up to 3% fatalities in the total population exposed, but below which no injuries or damage would be expected	252.1 m (west of project boundary)
12.5 kW / m ²	This radiation level may result in up to 50% fatalities in the total population exposed and cause damage to process equipment	102.6 m (west of project boundary)
37.5 kW/m ²	This radiation level may result in up to 100% fatalities in the total population exposed and cause significant damage to process equipment	Confined within project boundary

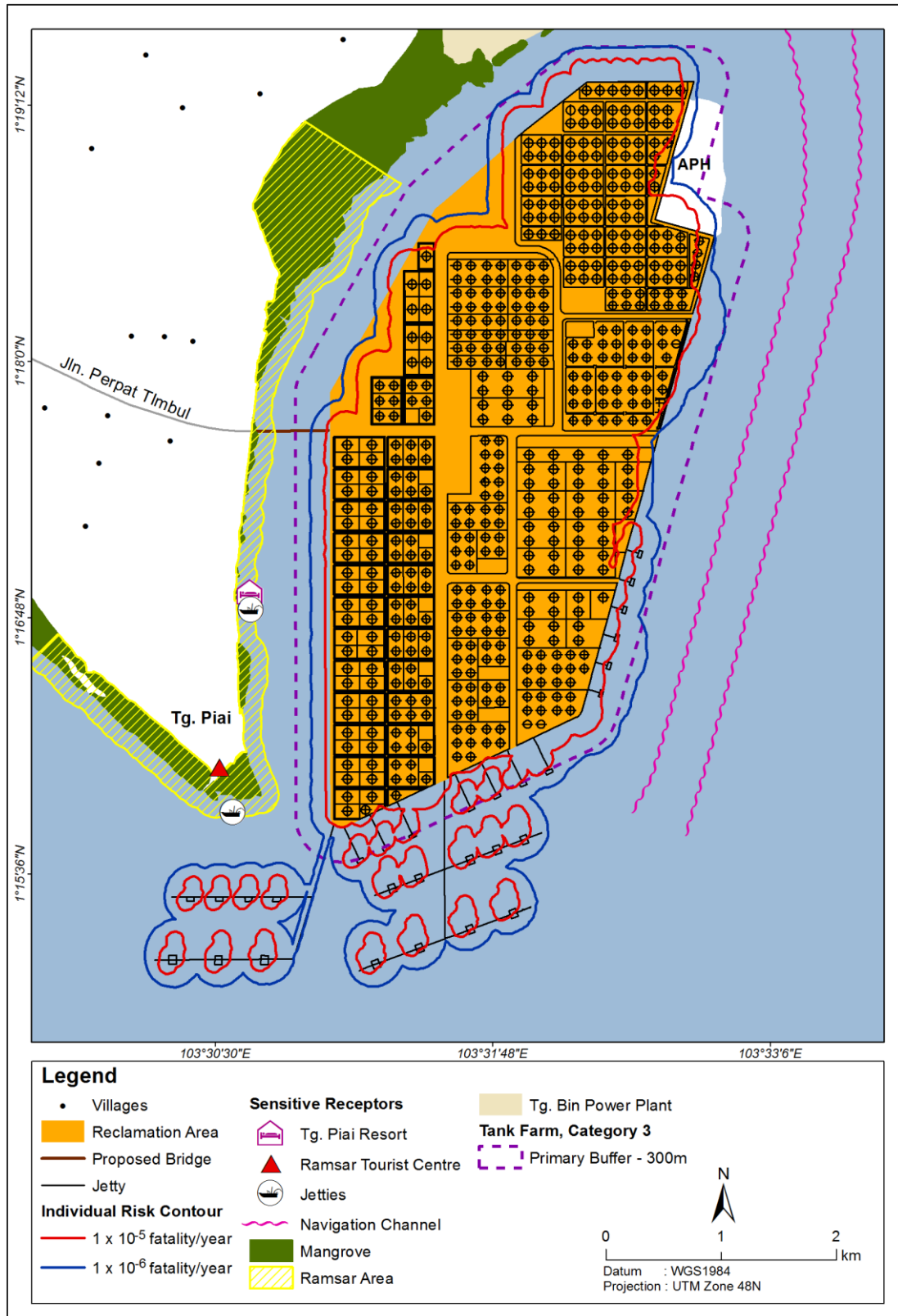


Figure 6.95 Individual risk contours.

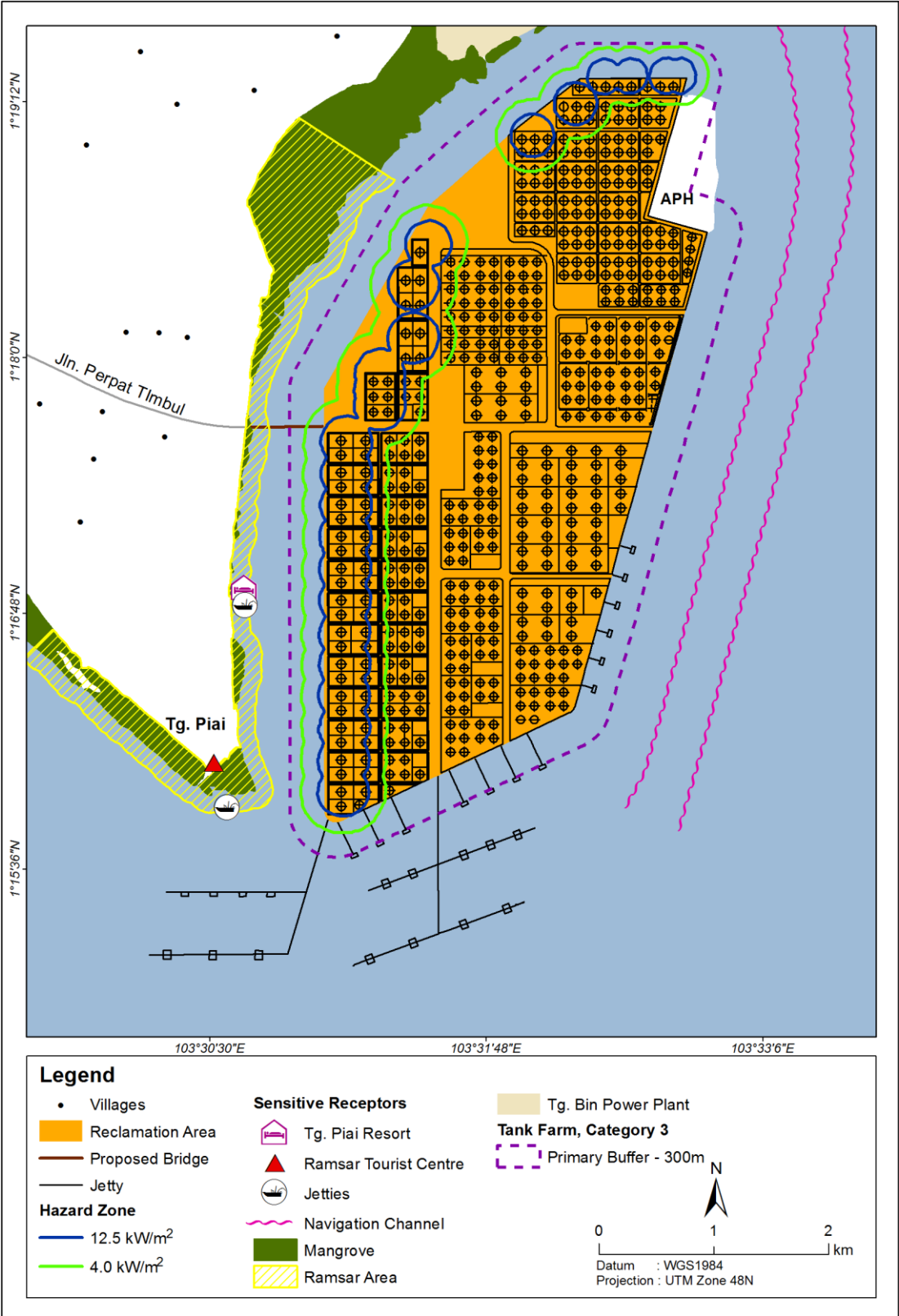


Figure 6.96 Worst case scenario fire event.

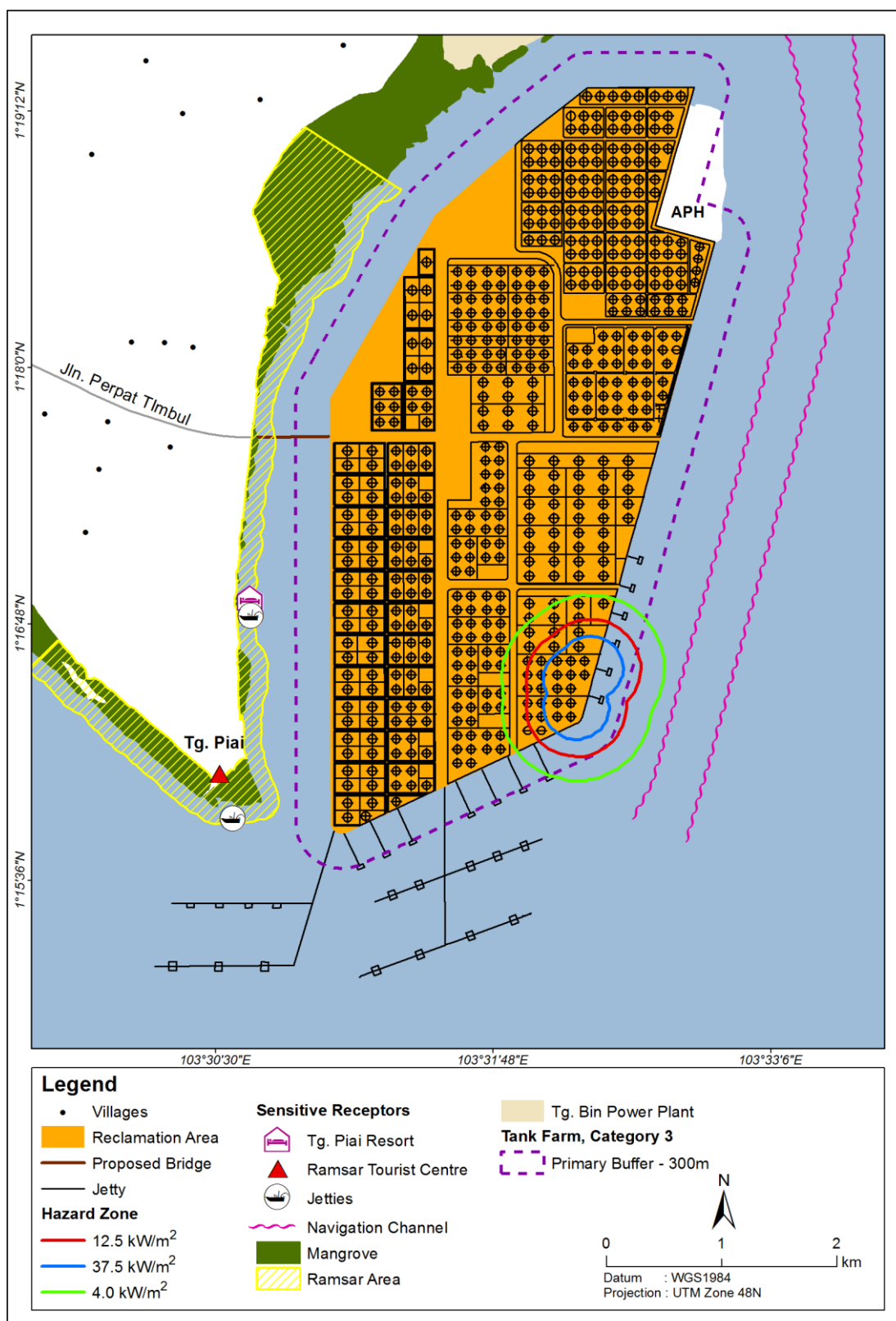


Figure 6.97 Worst case credible scenario fire event

Impact Evaluation

Criteria	Score	Description
Importance	1	Important only to the local condition; i.e. in the immediate vicinity of the Project site
Magnitude	-1	Negative impact (-1) – based on the IR criteria; no risk impact on sensitive receptors are identified; however, there is an increase in risk within the Project footprint.
Permanence	3	Permanent as long as the Project is operational
Reversibility	2	Reversible; no residual risk will remain after the Project ceases operations.
Cumulativity	2	Non-cumulative
Environmental Score	-7	
Description	-A	Slight negative impact

6.18.4 Proposed Mitigation Measures

Although the risk is minor, based on the ALARP principle, risk management should be implemented as described below.

6.18.4.1 Further Actions to Manage Risk

- Prepare an emergency response plan (ERP) to include possible emergency scenarios due to the operation of the proposed tank farms;
- Engineering design for the tanks shall ensure that sufficient reliability, redundancy and basic process control system along with the independent Emergency Shutdown System (ESD) is accounted for, to prevent tank overfilling, potential loss of containment which may eventually lead to a vapor cloud explosion scenario. This can be achieved by conducting Health Safety Environment (HSE) Engineering studies like Risk Assessment, Firewater Demand Calculation, QRA, Safety Integrity Level (SIL), Hazard and Operability Study (HAZOP), Hazard Identification (HAZID), etc. with adequately required design information and data;
- Depending on the composition of the crude oil, the need for draining water from the bottom of the storage tank to prevent potential boil over scenarios shall also be assessed;
- During the design phase, scenarios of tank rim seal fire and full tank surface fire should be assessed along with the identification of neighboring tanks potentially impacted by thermal radiation from the tank on fire. Radiation shields can be recommended to fight fire if deemed necessary based on the outcome of consequence analysis. The firewater demand calculations in the design phase must account for sufficient supplementary firewater and its application rates for cooling the tanks in the above-mentioned scenario;
- The capacity of the bunds shall be designed to comply with NFPA 30 standard and the bunds should be leak-tight and fire-resistant; and
- All the emergency shutdown valves (ESDV) provided shall be fire-proofed for adequate time duration and the remotely operated shut down valves can be considered to be provided to prevent escalation of fire.

6.18.4.2 Procedural: Operation

- Ensure only fully trained and competent personnel are employed for the proposed tank farm;
- Enforce safety procedures to ensure authorized access only to the tank farm and further restrictions are in place for limiting storage tank farm access to approved persons only;
- Ensure that the tanks in operation have enough headspace margin for the intake to be closed off in time;
- Ensure that all the protection systems are thoroughly inspected, maintained and tested periodically;
- Perform regular emergency response drills (including desktop exercises) as well as feedback and review sessions with the local fire and rescue services for handling and controlling the worst case scenario.

6.18.4.3 Maintenance

- Undertake regular maintenance of the process equipment i.e. tanks, piping, pumps and process vessels in accordance with manufacturers guidance. This will ensure that the integrity of these equipment will be maintained, hence minimizing any leaks/releases due to mechanical failure.

6.18.4.4 Fire Fighting System

- Conduct routine inspections of fire safety requirements (fire blankets, fire extinguishers, smoke detectors, sprinklers, emergency lighting and fire-rated doors).

6.18.5 Residual Impacts

Although the risk will be further reduced, the residual impact is unchanged at a *slight negative* impact. This reflects the fact that the presence of the project results in elevated risk within the project footprint that does not presently exist.

Impact Evaluation

Importance:	Important only to the local condition; i.e. in the immediate vicinity of the Project site (1).
Magnitude:	Negative impact (-1) – based on the IR criteria; no risk impact on sensitive receptors are identified; however, there is an increase in risk within the Project footprint.
Permanence:	Permanent (3); as long as the Project is operational
Reversibility:	Reversible (2); no residual risk will remain after the Project ceases operations.
Cumulative impact:	Non-cumulative (2)
Impact Significance:	-A Slight negative impact (-7)

6.19 Health Impact Assessment

6.19.1 Evaluation Framework

The health impact assessment was carried out to determine any additional burden to the existing health issues and health indicators due to construction and operation of the proposed project. In addition, excess risks from any potential hazards in environments within and around proposed project area also were assessed. The key steps involved in this assessment are as follows:

- Identification of potential health hazards
- Interpretation health risks
- Management of the health risks

The nature of the project which involves reclamation activity, construction and operation of petrochemical chemical facilities may affect the ambient air quality which eventually results in airborne diseases among human population within the study area. Considering this, ambient air quality and the potential hazards posed by each air quality parameter was assessed and compared against the respective guidelines to check on its compliance and safety level to people. The followings were the related guidelines used under this assessment:

- Recommended Malaysian Air Quality Guideline (RMAQG), Department of Environment Malaysia
- Office of Environmental Health Hazard Assessment (OEHHA) in Canada, 1999

The potential hazard was measured in terms of hazard quotient (HQ) and hazard index (HI) value with assumption that a hazard value less than one (1) as healthy or poses no risk. The HQ value was determined for each of the measured parameters by dividing its concentration with the limit specified under the guidelines. Subsequently, the HI value of a station was determined by adding all of the measured HQ values at that specific station. The maximum recommended limit and associated health effect of the potential pollutants are outlined in Table 6.44.

Table 6.44 Types of pollutants and their corresponding recommended limit as per RMAQG

Pollutant	Health Effect	Guideline
Total suspended solid (TSP)	Respiratory and skin problems	260 $\mu\text{g}/\text{m}^3$ (24 hours)
Particulate matter smaller than 10 micron (PM_{10})	Respiratory system	150 $\mu\text{g}/\text{m}^3$ (24 hours)
Nitrogen dioxide (NO_2)	Respiratory and skin problems	75 $\mu\text{g}/\text{m}^3$ (24 hours)
Sulphur dioxide (SO_2)	Respiratory and skin problems	105 $\mu\text{g}/\text{m}^3$ (24 hours)
VOC (Benzene)	Reproductive problem and carcinogenic	1300 $\mu\text{g}/\text{m}^3$ (6 hours)*

In addition, the proposed project was predicted to affect the ambient noise level during the construction and operation phase from various activities as described under Section 6.7. Therefore, the assessment of potential impacts of noise on public health was carried out based on baseline data compared against Schedule 2 for the operations stage. The related guideline and schedules are as listed:

The Planning Guidelines for Environmental Noise Limits and Control

- Schedule 1: Maximum Permissible Sound Level (LA_{eq}) by Receiving Land Use for Planning and New Development;
- Schedule 2 Maximum Permissible Sound Level

6.19.2 Scope

The impact towards human health due to indirect influence of effects from air quality and noise level deterioration was assessed within the 5 km radius from the proposed project area. The zone of impact (ZOI) was set to be within a 5 km radius from the proposed project area considering the nature of the project where the probability of pollutant travel will be

confined within this distance. In addition, all the affected human population areas were included within this ZOI. The assessment was carried out based on ambient air quality and noise level during construction and operation stages, which reflects the corresponding effect to human health during each of the development stage. Among the parameters measured under air quality were total suspended particulates (TSP), particulate matter below 10 micron (PM_{10}), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and volatile organic compounds (VOC) specifically benzene. As for ambient noise level, both the day time and night time L_{Aeq} and L_{90} values were measured.

6.19.3 Sensitive Receptors

The main sensitive receptor concerned under this assessment was mainly human population areas. This includes the schools, health centres, parks and religious buildings where human activities could be observed as shown in Figure 6.98.

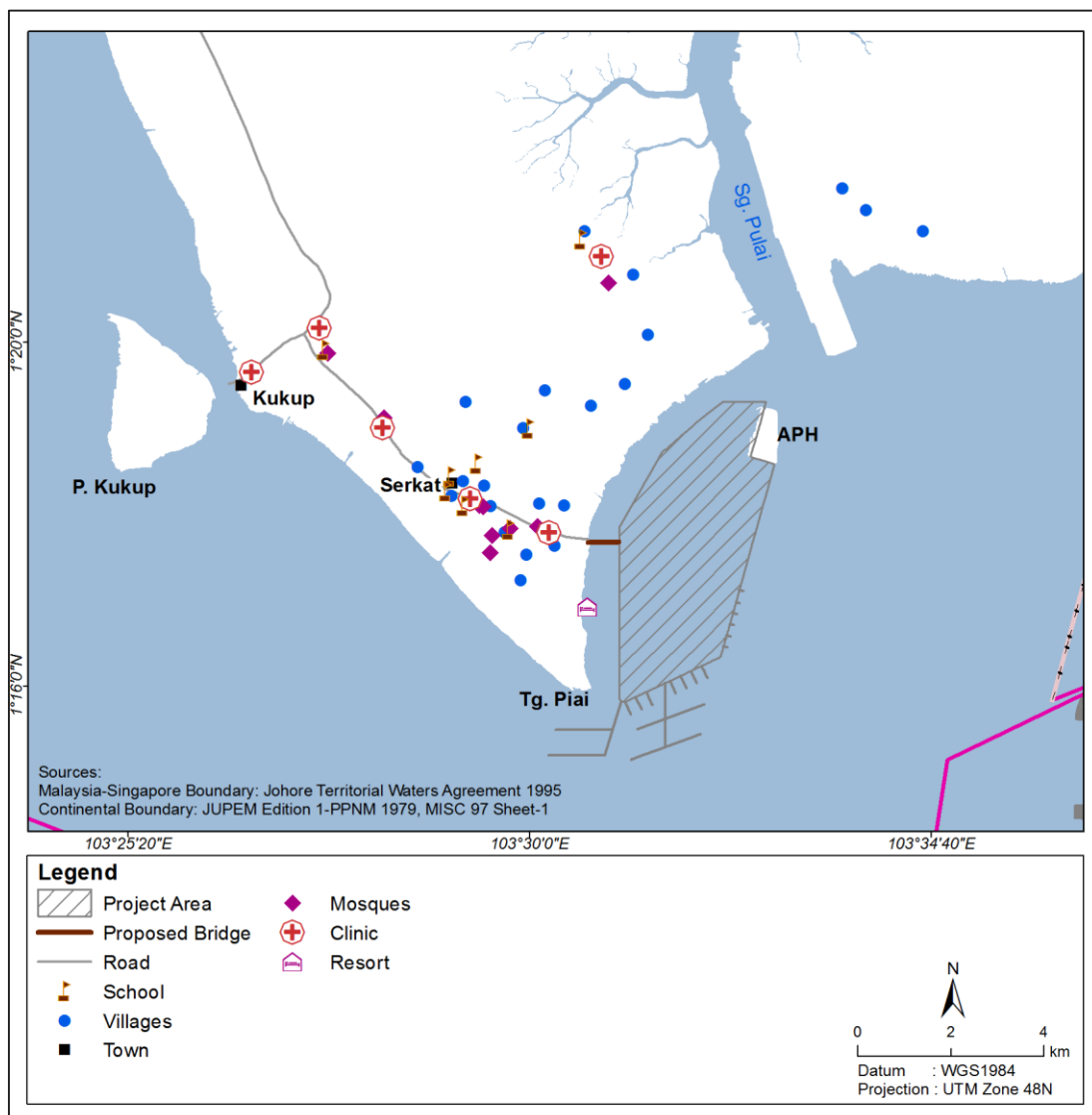


Figure 6.98 Sensitive receptors related to human activities around project area

6.19.4 Construction

6.19.4.1 Potential Impacts

Water Supply

Inadequate water supply in the worker base camp will facilitate the outbreak of certain diseases particularly food and waterborne diseases. Those diseases include food poisoning, cholera, typhoid, dysentery and acute gastroenteritis. Shortage of water supply has also been found to cause outbreaks of certain vector-borne diseases due to the presence of water collection for storage. This provides a suitable site for breeding of the vector, especially mosquito.

Presence of Temporary Toilets

Unhygienic inadequate latrines will encourage certain communicable diseases especially through faecal contamination. Poorly managed latrines may pollute the nearby surface and ground water and possibly contaminate food species, which may results in food poisoning and diarrhoea.

Presence of Garbage Collecting Facilities

Solid and construction wastes will be a major issue in the base camp as they may become a conducive breeding area for rodents and other disease vectors. Unmanaged solid waste and uncontrolled mosquito breeding sites will pose a risk of disease outbreak, especially dengue fever, malaria, Chikungunya and leptospirosis.

Social Well Being

The potential health impact is usually associated with mental stress due to unhealthy interactionss between foreign workers and local communities. In addition, increase in local food price due to high demand may limit access to nutritious food and cause malnutrition, particularly among the young and the extreme elderly.

Health Issues

The influx of a work force from neighbouring countries may also bring in certain agent of diseases, particularly for tuberculosis, and sexually transmitted diseases. With the presence of other current workers in the area these additional demands might place tremendous pressure onto the local health system if surveillance and monitoring are both neglected.

Impact Evaluation

According to the RIAM, the impact is categorised as **Minor Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-14	
Description	-B	Minor negative impact

6.19.4.2 Proposed Mitigation Measures

Water Supply

A clean and safe source of drinking water should be supplied to the construction worker camp to avoid waterborne diseases. Water taps should be provided at selected central location for easy access by the construction workers.

Presence of Temporary Toilets

Temporary sanitary toilets should be provided at a specific location for convenient access by the workers within the construction area. The waste from this toilet should be regularly disposed within the logical time interval to avoid the possibility of surface soil or water contamination.

Solid waste

Adequate number of rubbish bins or containers should be placed in strategic location by taking into account the ratio of workers at certain working area within the construction site. The solid waste collected in these bins should be disposed of based on appropriate time intervals by authorised waste collector. This will avoid vector borne diseases sourced from the construction area.

Social Well-being

To control social wellbeing, all workers need to be educated or advised on the local cultures, taboos and religions in ensuring no friction between them in a long term. Local authorities have to monitor the prices of the foods and control them based on the adequacy and affordability of the local communities.

6.19.4.3 Residual Impacts

No residual impacts.

6.19.5 Operation

6.19.5.1 Potential Impacts

Exposure to Ambient Air

Based on the air quality impact assessment, the concentrations of a few parameters was expected to increase during the operation stage. The ground level concentration of those parameters during the operation stage was derived from the baseline survey values. The hazard indexes of the parameters are given in Figure 6.99.

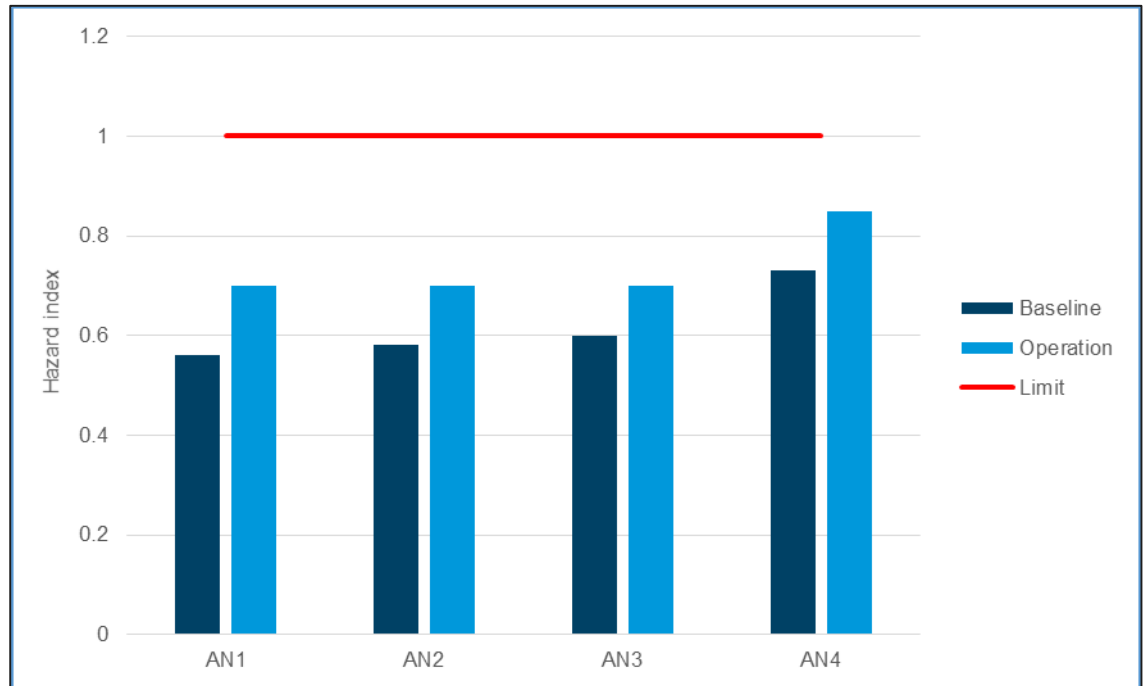


Figure 6.99 Air Quality Hazard Index within Study Area

The hazard index at all stations was less than one. In addition, the risk of carcinogens is absent within the proposed project due to low concentration of VOCs which are well below the limit set under the referred guidelines. Therefore no health effects are anticipated from the proposed project's operation.

Exposure to Ambient Noise Level

Ambient noise level during the operation stage was envisioned as one of the potential community hazards within the zone of impact. Noise from machines and equipment in addition to a high baseline noise level both during day and night is expected to create a nuisance to the community. The maximum permissible sound level based on the existing high background noise was computed and is presented in Figure 6.100.

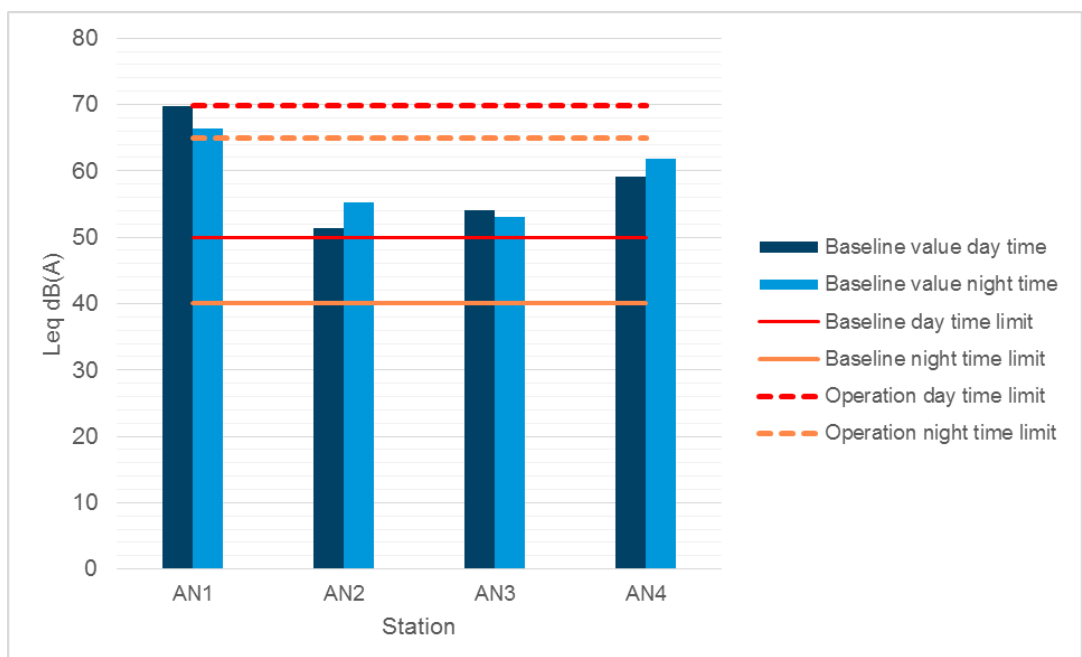


Figure 6.100 Baseline Noise Level and the Permissible Noise Level during Operation Stage

Based on the values, communities around station N1 are subjected to excessive noise exposure particularly at night. This may affect their mental health due to stress and lack of sleep. However, owing to the absence of housing areas around this station and limited tourist activity during day time, this impact is considered negligible.

Water Supply

Inadequate water supply during the operational phase will not be an issue. All buildings will have enough water supplies, including the canteen, toilet, masjid, surau, and administrative buildings.

Garbage Collecting Facilities

Solid wastes are also normally not an issue during operations of this type of industry. However, improper management may cause those wastes to become a breeding area for vectors or rodents. If this occurs it will pose a risk of disease outbreak, especially dengue fever, and leptospirosis.

Social Well Being

Considering the smaller number of workers during the operation phase, social well-being may not be affected. However, improper security and limitation of foreign worker's movement may cause slight mental stress which needs attention from the local authorities. Accessibility to the nearest education centres might be limited for the workers children if the existing education centres could not support them such that basic knowledge of hygiene and nutrition could not be delivered to them.

Impact Evaluation

According to the RIAM, the impact is categorised as **Minor Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-14	
Description	-B	Minor negative impact

6.19.5.2 Proposed Mitigation Measures

Although the impact to health due to deterioration of ambient air quality and noise level is considered minimal, application of mitigation measures as outlined under Section 6.6.4.3 and Section 6.7.4.2 will ensure the air quality and noise level are kept well within acceptable limits. The appropriate government agencies should ensure adequate accessibility to education centres from the future housing area of the workers such that basic knowledge of health can be delivered to their children. As for other health indicator factors and health issues, no mitigation measures are required as the predicted potential impacts were considered negligible during operation stage.

6.19.5.3 Residual Impacts

No residual impacts.

6.20 Land Use Compatibility Assessment

The proposed project is located at the western part of the State of Johor and the southwest part of Pelabuhan Tanjung Pelepas (PTP) and Tanjung Bin Development. Based on the Iskandar Regional Development Comprehensive Development Plan, the proposed project is located within the Economic Development Zone - Flagship 'C', which is located within the southwest region of Iskandar Malaysia.

6.20.1 Evaluation Framework

The issue of Land Use Compatibility is considered an operational one as it is a long term impact associated with the full development of the park

A land use compatibility assessment has been carried out to assess the land uses or policy changes required should the project be implemented. The overall approach is to:

- Identify natural constraints to development (sensitive land use);
- Identify features that create the land attractive to development (area of influence);
- Incorporating planning tool such as GIS for the analysis of Compatibility for current and future land use; and
- Identify additional incentives and opportunities that would improve and mitigate incompatibility conflicts of land use.

6.20.2 Potential Impacts

The analysis is summarised in Table 6.45 and the full report is provided in Appendix L.

Table 6.45 Land use Compatibility Analysis

Land use type	Analysis
River and Water Way	<p>There are several existing rivers (upstream) surrounding proposed project as below:-</p> <ul style="list-style-type: none"> • Sg. Seligi • Sg. Karang • Sg. Boh Kanan • Sg. Bhd Kiri • Sg. Tiram Duku • Sg Simpang Gelama • Sg. Tiram Duku Kechil • Sg. Chengkel kechil • Sg. Pulai <p>All the existing rivers are flowing to Straits of Johor. All the rivers crossing are governed by the JPS design requirement except Sungai Pulai which is governing by Jabatan Laut's ship navigation clearance.</p>

Land use type	Analysis
Sea grass beds	Seagrass beds are present along Sungai Pulai, and at the mouth of Sungai Pulai (Merambong shoal, Tanjung Adang, Tanjung Kupang and Tanjung Bin) and Sungai Lebam
Aquaculture	The aquaculture activity are located at mid Sg.Pulai
Settlement	<p>The nearest settlement to the proposed site as below:</p> <ul style="list-style-type: none"> • Kg. Tiram Duku • Kg. Pekajang Bengkok • Kg. Pekajang Lurus • Kg. Ladang • Kg. Sungai Boh • Kg. Sungai Chengkeh • Kg Serkat Laut
Environmentally Sensitive Area (EASs)-mangroves	<p>ESAS Rank 1: Core Conservation Area</p> <ol style="list-style-type: none"> 1. No further development allowed, except for eco- tourism, research, education and reduced impact logging 2. Sites should have adequate legal protection.
Neighbourhood / International Boundary Singapore	There are two international borders within 6-7km from the project, namely the Continental Shelf Boundary and the Malaysia-Singapore Border.
Industrial Area	<p>Some of the major projects that has been committed at the surrounding includes:</p> <ul style="list-style-type: none"> • Malaysia <p>Port of Tanjung Pelepas</p> <p>Integrated Container Terminal (ICT) Tanjung Bin Power Plant</p> <p>Sungai Pulai Bridge Project (New)</p> <ul style="list-style-type: none"> • Singapore
Analysis Summary	
<p>The proposal is consistent with the goals of Economic Development Zone - Flagship 'C'</p> <p>The present site is not zoned for any other use as it is open water</p> <p>There is already a significant commitment to comparable industrial development projects within proximity to the proposal</p> <p>There is a strategic commitment to transform the area from rural to urban industrial and this project will facilitate this through the development of infrastructure, employment, skills training, SME business development</p> <p>Although there are significant ESA within a short distance of the project the inclusion of the required buffer zone for Category 3 industries is a 300 m primary buffer and this will provide significant mitigation of key impacts from noise and light, chemical hazards etc.</p> <p>The EMP and Project CSR program proposed will further ensure appropriate mitigations to protect the ESA are put in place</p> <p>Area safety and health aspect is very crucial</p>	

Land use type	Analysis
Conclusion	
<p>The land use compatibility of the proposed development compliment to the existing heavy industries</p> <p>It will reflect the development of the entire area into one of prominent Petroleum and Petrochemical Hub and Maritime Industrial Park in this region.</p> <p>It is recommended the proposed area needs close monitor due to some of the activities may affect the surrounding ESAS's</p>	
Project compatibility with adjacent and nearby land uses	
A suitability analysis shows that the site is suitable for the proposed project. The project is compatible with adjacent and nearby uses especially on the industrial demand.	

Impact Evaluation

According to the RIAM, the impact is categorised a **Moderate Benefit**.

Criteria	Score	Description
Importance	3	Important to Johor and Peninsular Malaysia
Magnitude	1	Compatible with industrial land uses; location offshore minimises direct impacts to onshore sensitive land uses.
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulativity	3	Cumulative
Environmental Score	+27	
Description	+C	Moderate Benefit

6.20.3 Proposed Mitigation Measures

No mitigation measures on the part of the Proponent are proposed with respect to land use compatibility. However, it is recommended that the planning authorities monitor induced development in the area.

6.20.4 Residual Impact

No change to impact significance

6.21 Land Traffic

6.21.1 Evaluation Framework

The land traffic assessment was carried out in five stages involving the following key tasks:

- Data assembly and survey

- Traffic modelling and forecasting
- Traffic assessment and problem identification
- Formulation and evaluation of traffic improvement schemes
- Integrated implementation plan

For the purpose of land traffic impact assessment, a comprehensive understanding of traffic condition, roadway performance and junction performance of the affected roads was developed.

6.21.1.1 Traffic Condition

In order to determine the future traffic condition during the construction and operations stages, two key items were determined:

Background condition traffic

The future background condition traffic (during construction and operation stage) was projected based on the annual traffic growth factor of the affected road applied to the traffic volume of the given development stage. The annual traffic growth rate of the affected road; RF95 is 3.3% which was derived from the traffic census data produced by Highway Planning Unit (HPU). The resultant background condition traffic volumes for morning (AM) and afternoon (PM) peak hour were determined by applying the growth rate of 2.00 - 3.00% per annum with assumption that selected growth factors will provide realistic forecast of future background traffic condition.

Trip / traffic generation

Trip generation is typically the number of inbound and outbound vehicle trips that are expected to be generated by proposed development during peak hour traffic. In order to determine the trip generation during construction stage, the number of estimated construction workers and number of vehicles used to transport construction materials and/or used by the construction workers to commute to the proposed development area was determined. The expected number of construction workers was derived based on recent adjacent development; Tg. Bin which covers 2255 acres of land with 500 workers at construction site on daily basis. Gross estimate number of vehicles by types needed to cater the estimated workers was then determined and grouped into passenger car unit (pcu).

Trip generation during operation stage was determined based on trip generation rate (Code 08 03 00) produced by Highway Planning Unit (HPU), Ministry of Works Malaysia where the expected traffic was based on the number of employee. The number of employee by phase was estimated using employee per acre density factor derived from other similar development within Johor. The range of employment density was between 0.22 employment/acre to 2.2 employment/acre in which an average of 0.76 employment/acre was used for this assessment. Table 6.46 shows the estimated number of construction workers and employee by phase.

Table 6.46 Estimated employment for the proposed development by phase

Development Phase	Total Area (acres)	Total Employment	Construction Workers
Phase 1	1050	803	2561
Phase 2	1125	860	2744
Phase 3	1323	1011	3227
Total	3498	2674	8532

Roadway Performance

The roadway performance was determined via midblock analysis which computes the ratio of the maximum peak hour traffic volume and carrying capacity of the road sections. Subsequently the ratio will be compared against its corresponding level of service (LOS) which reflects the performance of the assessed road section. The definition of the LOS is given in Table 6.47.

Table 6.47 Description of level of services (LOA) to reflect the road performance

LOS	V/C Ratio	Definition
A	< 0.28	Free flow with volume densities and high speeds. Drivers can maintain their desired speeds with little or no delay.
B	0.28-0.44	Stable flow. Operating speeds beginning to be restricted somewhat by traffic conditions. Some slight delay.
C	0.45-0.64	Stable flow. Speed and manoeuvrability are more closely controlled by higher volume. Acceptable delay.
D	0.65-0.85	Approaching unstable flow. Tolerable operating speeds, which are considerably affected by operating conditions. Tolerable delay.
E	0.90-1.00	Unstable flow. Yet lower operating speeds and perhaps stoppages of momentary duration. Volumes are at or near capacity. Congestion and intolerable delay.
F	>1.00	Forced flow. Speeds and volume can drop to zero. Stoppages can occur for long periods. Queues of vehicles backing up from a restriction downstream.

Junction Performance

Evaluation of the existing junction operational performance was carried out using Signalised and Unsignalised Intersection Design and Research Aid (SIDRA) program. The junction performance was measured on degree of saturation and classified based on level of service (LOS) as outline in Table 6.48.

Table 6.48 Degree of saturation threshold and its corresponding level of service (LOS)

Level of Service	Degree of Saturation (x)		Description
	Stop Control Junction	Signalised Junction	
A	$x \leq 0.50$	$x \leq 0.60$	Little or no delay
B	$0.50 < x \leq 0.70$	$0.60 < x \leq 0.75$	Short traffic delays
C	$0.70 < x \leq 0.80$	$0.75 < x \leq 0.90$	Average Traffic delays
D	$0.80 < x \leq 0.90$	$0.90 < x \leq 0.95$	Long Traffic Delays
E	$0.90 < x \leq 1.00$	$0.95 < x \leq 1.00$	Very Long Delays
F	$x > 1.00$	$x > 1.00$	Failure of Junction

For the purpose of determining the need for signal control, both the traffic volumes on the major and minor roads was considered. A signal control is warranted if the traffic volume for

each of any 8 hour of an average day meets the minimum requirements as per Table 6.49. For the major road, the total traffic volume of both approaches was used while for the minor road, either direction with higher traffic volume was used.

Table 6.49 Vehicular volume requirements to warrant signal control

Number of Lanes for Each Approach		Minimum Requirements			
		Major Road (1)		Minor Road(2)	
Major Road	Minor Road	Urban	Rural	Urban	Rural
1	1	500	350	150	105
2 or more	1	600	420	150	105
2 or more	2 or more	600	420	200	140
1	2 or more	500	350	200	140

6.21.2 Scope

The traffic impact assessment was focused on affected road sections which would be used by construction vehicles to get access to the proposed project area. Those road sections were Section 1; Federal Route 95 towards Kukup, Section 2; Federal Route 95 towards Pontian and Section 3; Jalan Serkat (J111) towards Tg. Piai. Assessment of potential impact towards existing land traffic condition within the affected road was based on fifteen (15) years of construction period by phases followed by operation stage as listed below:

- Construction of Phase 1 (2015 – 2019)
- Construction of Phase 2 (2020 – 2025)
- Construction of Phase 3 (2026 – 2030)
- Operational stage (2030 onwards)

The assessment was focused on two critical hours including morning and afternoon peak hours with assumption that the highest traffic volume occur during these hours on a typical weekday. In addition, it was expected that such critical condition may exert greatest test to the roadway and junction performance. Based on that, appropriate mitigation measures were identified to reduce the predicted burden to the existing roadway and junctions.

6.21.3 Sensitive Receptors

The sensitive receptors along the affected roads; Jalan Serkat (J111) and Federal Route (FR95) which are likely to be affected by the change in traffic condition during construction and operation stage were identified. These sensitive receptors were determined based on vulnerability to be affected by potential noise pollution, air pollution or accidents which might be created due to traffic growth. Among the sensitive receptors which have been identified are schools, religious buildings, hospitals, villages, public facilities and other ongoing construction activities as shown in Figure 6.101.

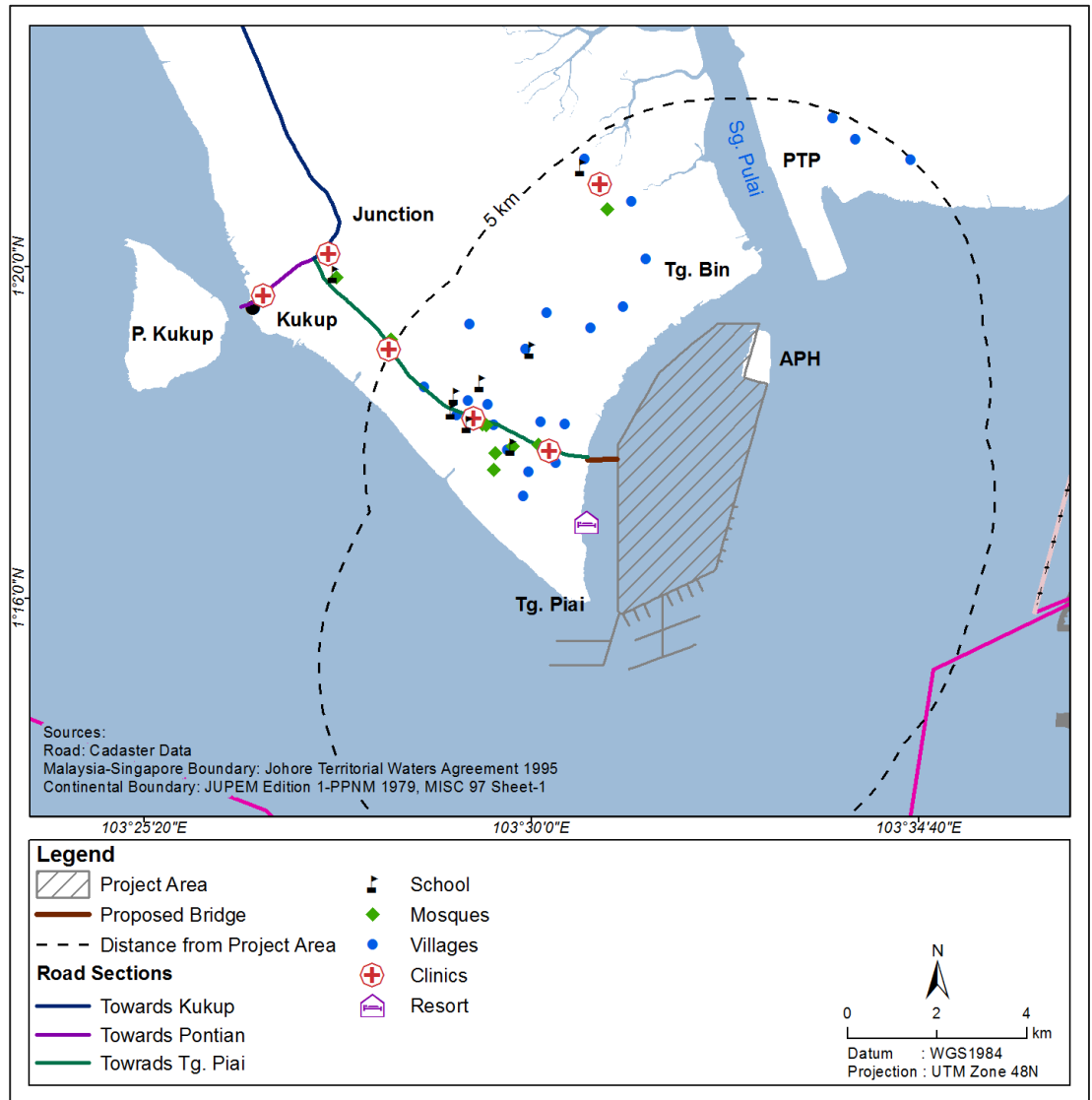


Figure 6.101 Sensitive receptors along the affected road

6.21.4 Construction

Most of the heavy bulk of construction materials will be delivered to the proposed development site primarily via barge such that impact to land traffic was deemed to be minimum. However development of onshore Industrial Park which includes construction of pipelines and pumps, buildings and services, internal road, bridge connected to the reclaimed island, piling activities, erection of tanks, drainage system and landscaping works was seen as key factor which may affect the traffic generation during construction stage. In addition increased traffic volume affects the existing roadway and junction performance.

6.21.4.1 Traffic Generation

The estimated peak traffic flow during construction stage was determined by adding the background traffic condition (Appendix O) with the traffic generation estimated for each phase of construction stage. The peak period traffic condition during construction stage of phase 1, 2 and 3 is shown in Figure 6.102 to Figure 6.105. The largest number of traffic movements (544 pcu's) on each route was estimated to occur during construction of phase 3.

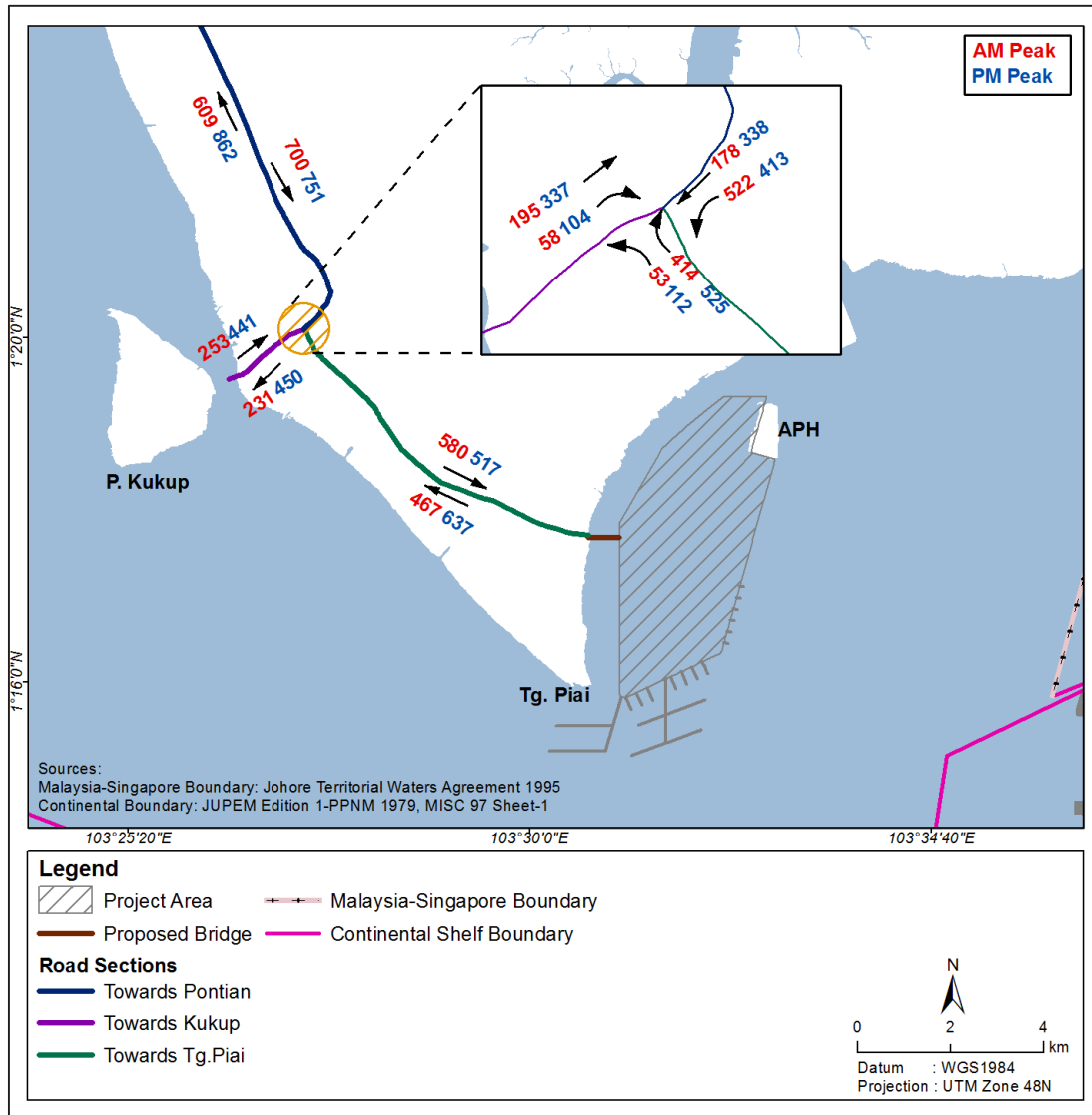


Figure 6.102 Estimated peak traffic flow (background + construction) in 2015

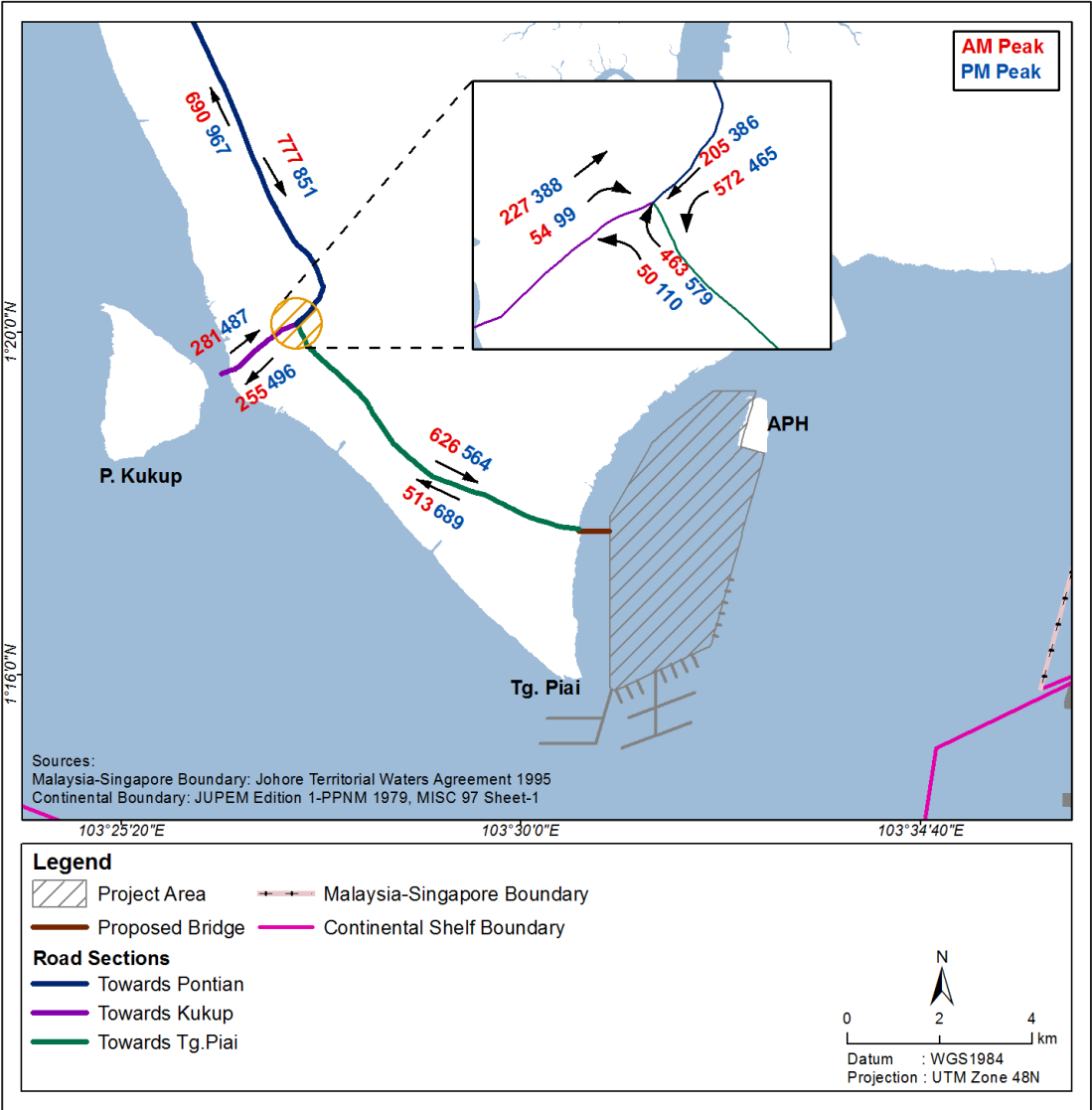


Figure 6.103 Estimated peak traffic flow (background + construction) in 2020

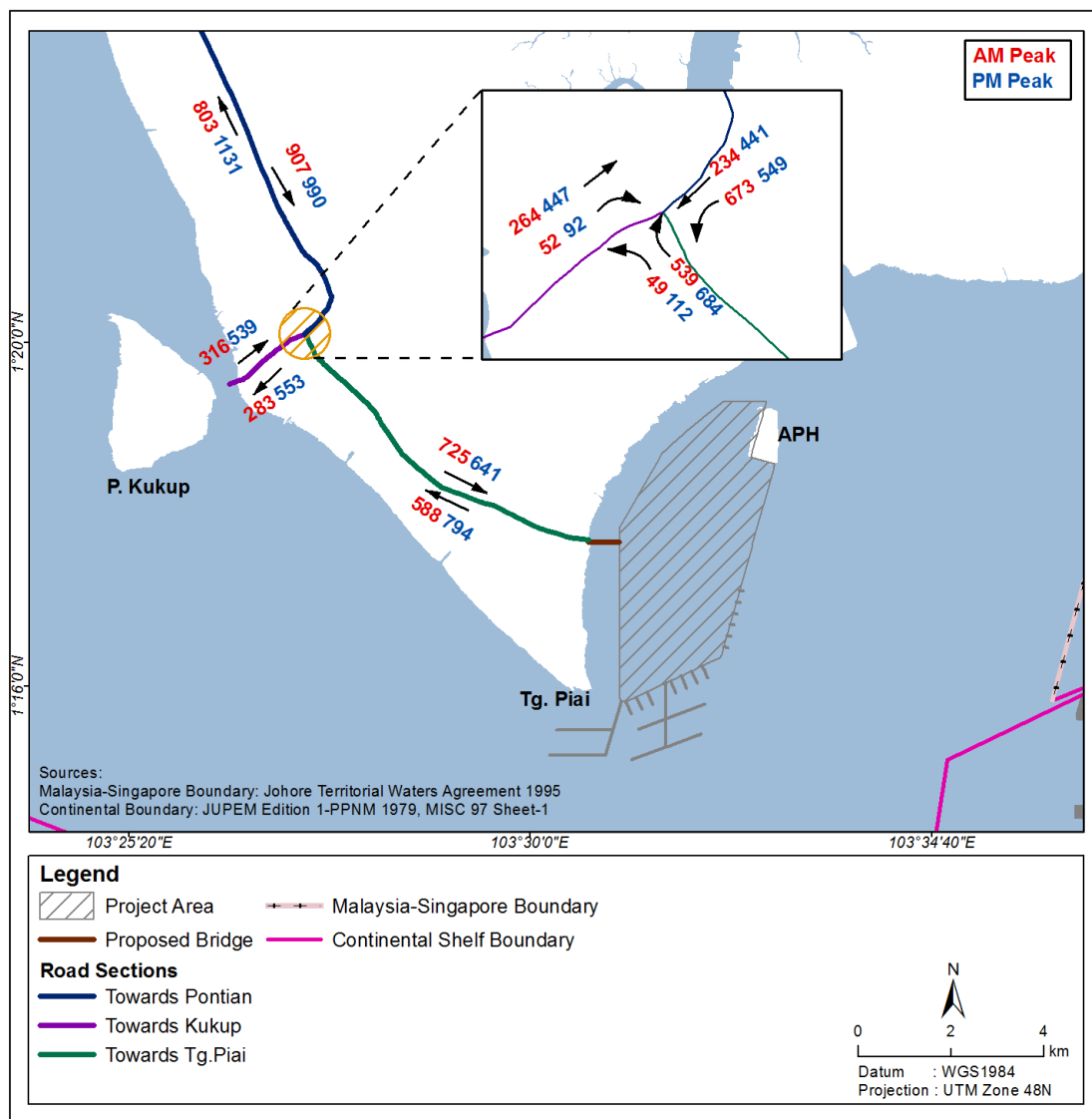


Figure 6.104 Estimated peak traffic flow (background + construction) in 2025

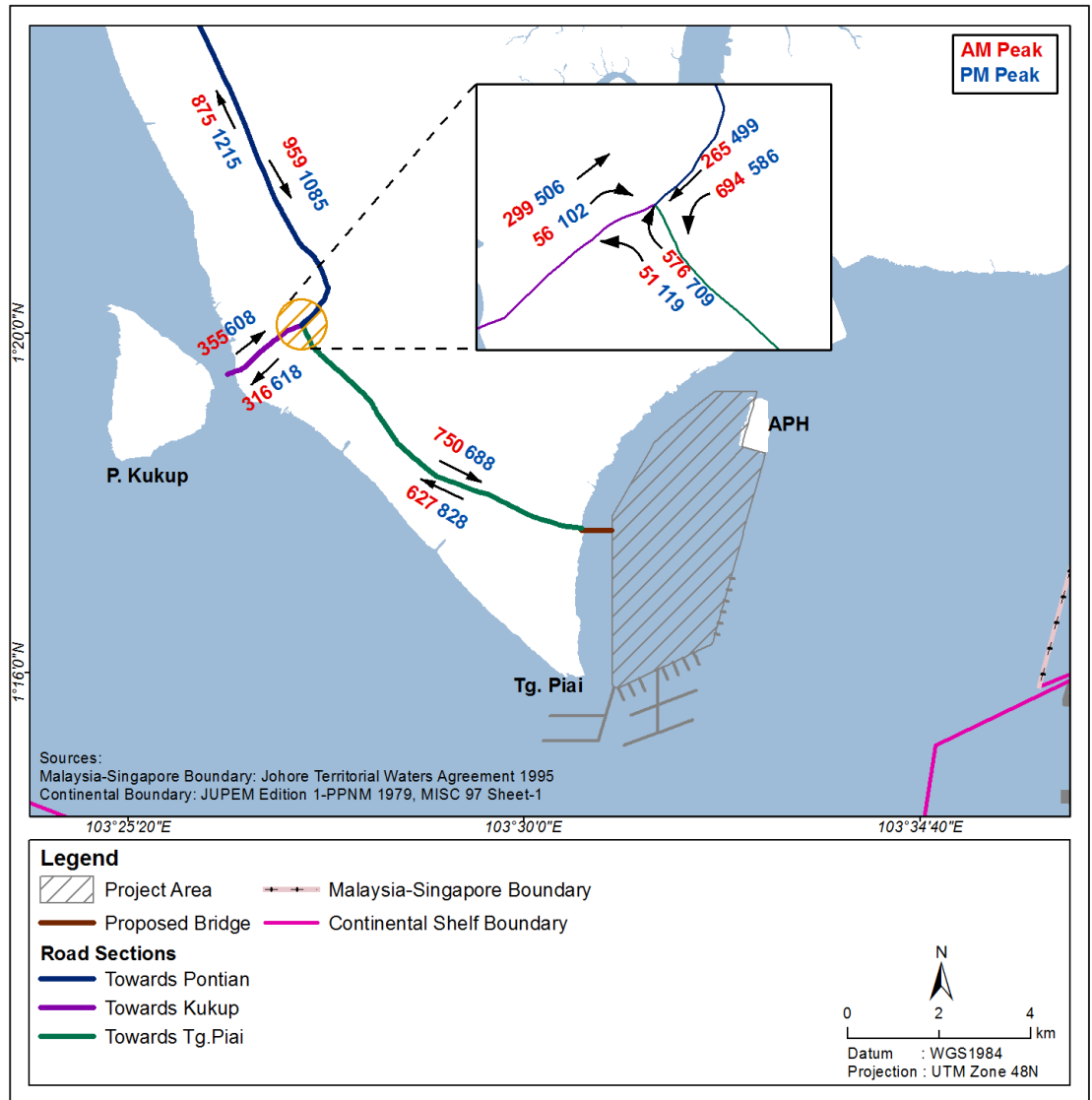


Figure 6.105 Estimated peak traffic flow (background + construction) in 2030

6.21.4.2 Roadway Performance

Based on estimated traffic flow during construction stage, the existing road condition would not be able to support movement of heavy trucks along Jalan Serkat (J111). Besides, the mid-block capacity analysis indicated that the present capacity of the affected road sections was expected to have the V/C ratios less than 0.8. The roadway analysis indicated that single lane of Federal Route 95 and Jalan Serkat (J111) was anticipated to operate at the worse level of service "C" and "B" during morning and evening peak hours by year 2030.

Junction Performance

The junction operational analysis indicated that the proposed junction upgrading of Jalan Serkat (J111) / Jalan Federal FR95 signalised junction is anticipated to operate at acceptable traffic condition during construction until year 2025. The LOS was B during morning peak period and C during evening peak period.

Impact Evaluation

According to the RIAM, the impact is categorised as **Minor Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	3	Cumulative
Environmental Score	-14	
Description	-B	Minor negative impact

6.21.4.3 Proposed Mitigation Measures

Traffic

In order to enhance accessibility for the proposed development site as well as to ensure smooth flow of traffic and acceptable level of service performance, the following steps should be implemented

- Jalan Sekat(J111) was recommended to be widened to four (4) lane where each lane should be 3.5m width along with proper road marking. This is mainly to cater accessibility of additional heavy truck to the development site.
- 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
- Transportation for construction activities to be scheduled on off-peak periods, such as, hour 1000 – 1600
- Provision of egress and ingress that are adequately wide to facilitate turning and maneuver of heavy trucks to and from the site;
- Speed limit shall be imposed for all vehicles within the site using the temporary access and logistics roads
- Movement of equipment and machinery shall be planned and closely monitored at various locations and stages of work to ensure smooth and safe flow of traffic
- Warning Sign' indicating transport of quarrying products will be placed to alert oncoming vehicles. The sign will be placed at junction, 100m, and 200 m respectively off the proposed project
- Suitable warning signs and traffic guides should be implemented.

Roadway Performance

Roadway upgrading which include road geometry improvisation and bitumen resurfacing (pavement) on the existing road can be done to avoid deterioration of LOS of the affected roads. The lanes of pavement structures should be design such that it should not fail before the total number of vehicles reaches its designed number of standard axle loads. The following road improvement programme should be adopted during construction stage to maintain roadway performance with presence of heavy trucks movements:

- Jalan Serkat (J111) road widening from 2 lane single carriageway to 4 lane single carriageway
- Federal route (FR95) road upgrading from 2 lane single carriageway to 4 lane single carriageway

The road section which need to be upgraded is shown in Figure 6.106.

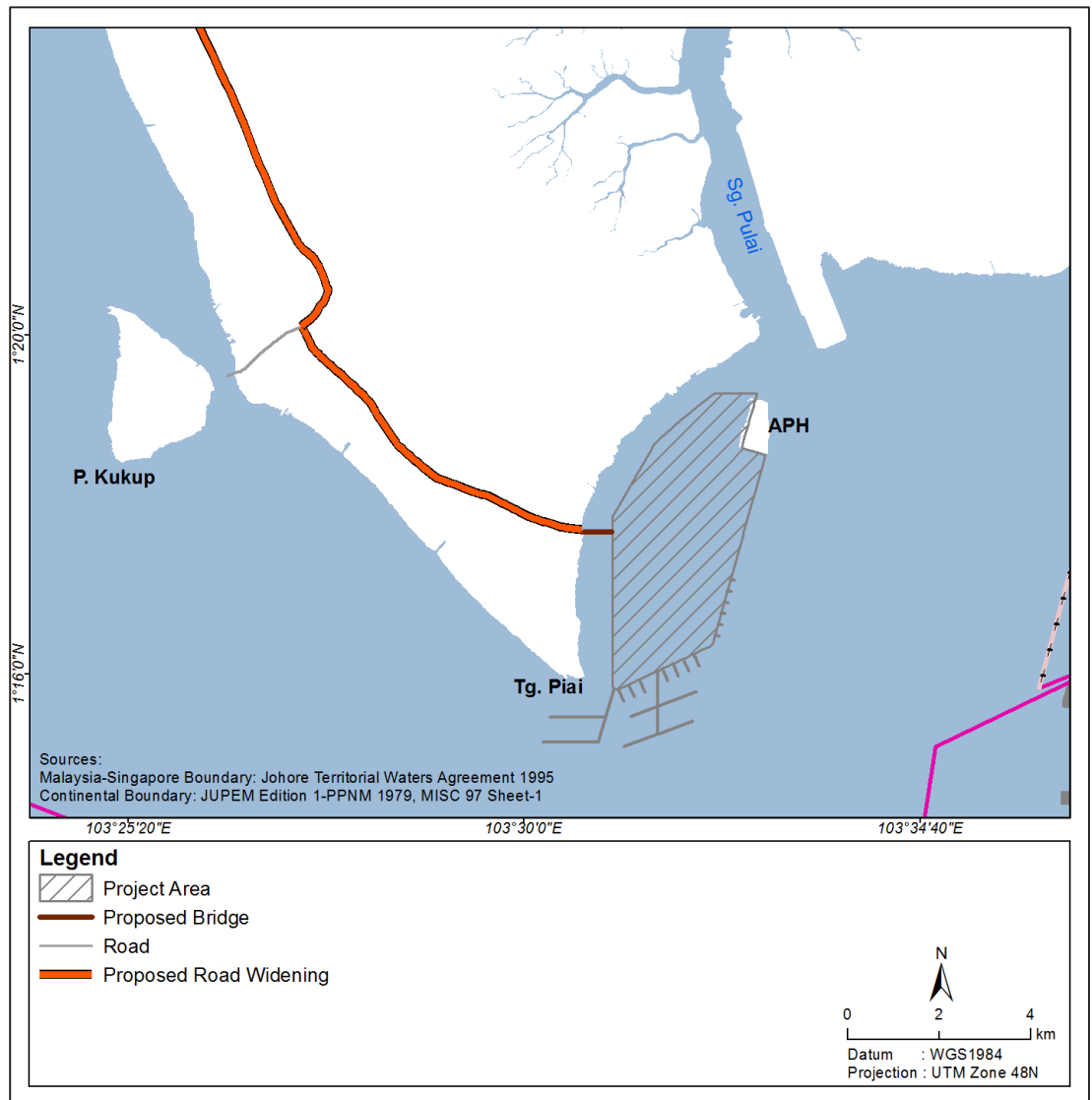


Figure 6.106 Proposed road widening during construction of phase 1, 2 and 3

Junction Performance

Traffic management and 'Flag Man' should be carried out at the junction turning off from the main road to the site access road to mitigate vehicle collision and safeguard road users during mining operation. In addition the existing junction should be upgraded to signalised junction as shown in Figure 6.107.

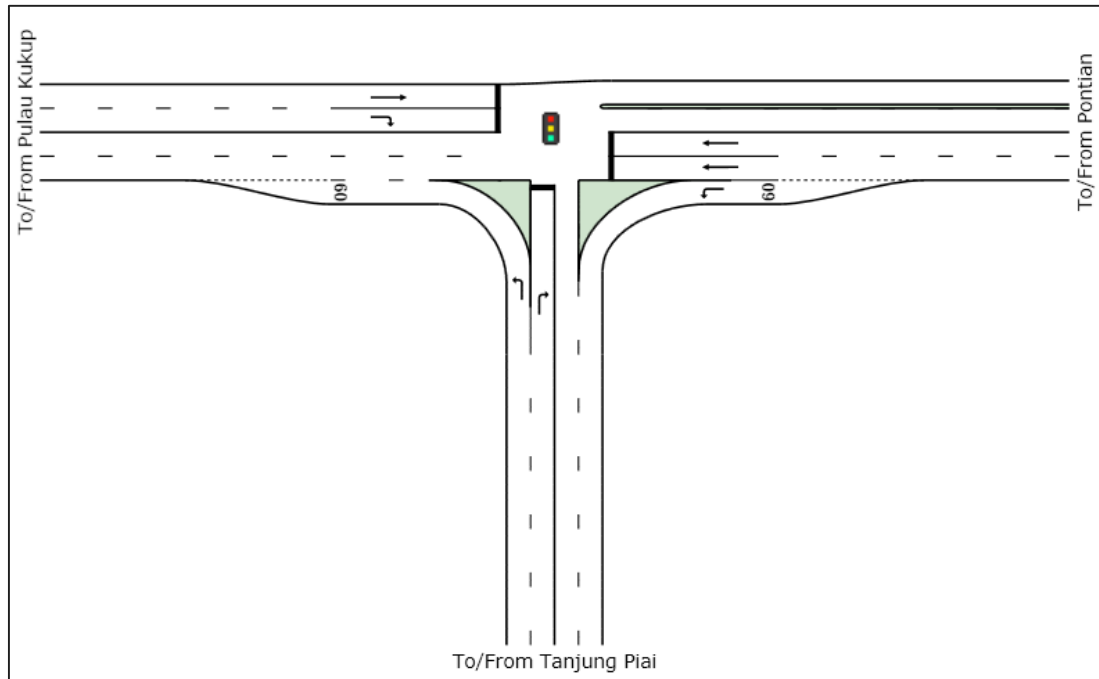


Figure 6.107 Proposed upgrading of junction 1 to signalise junction

6.21.4.4 Residual Impacts

No residual impacts expected during construction stage.

6.21.5 Operation

6.21.5.1 Predicted Impacts

Traffic generation

Traffic generation during operation stage was estimated based on expected employment during this stage as shown in Figure 6.108.

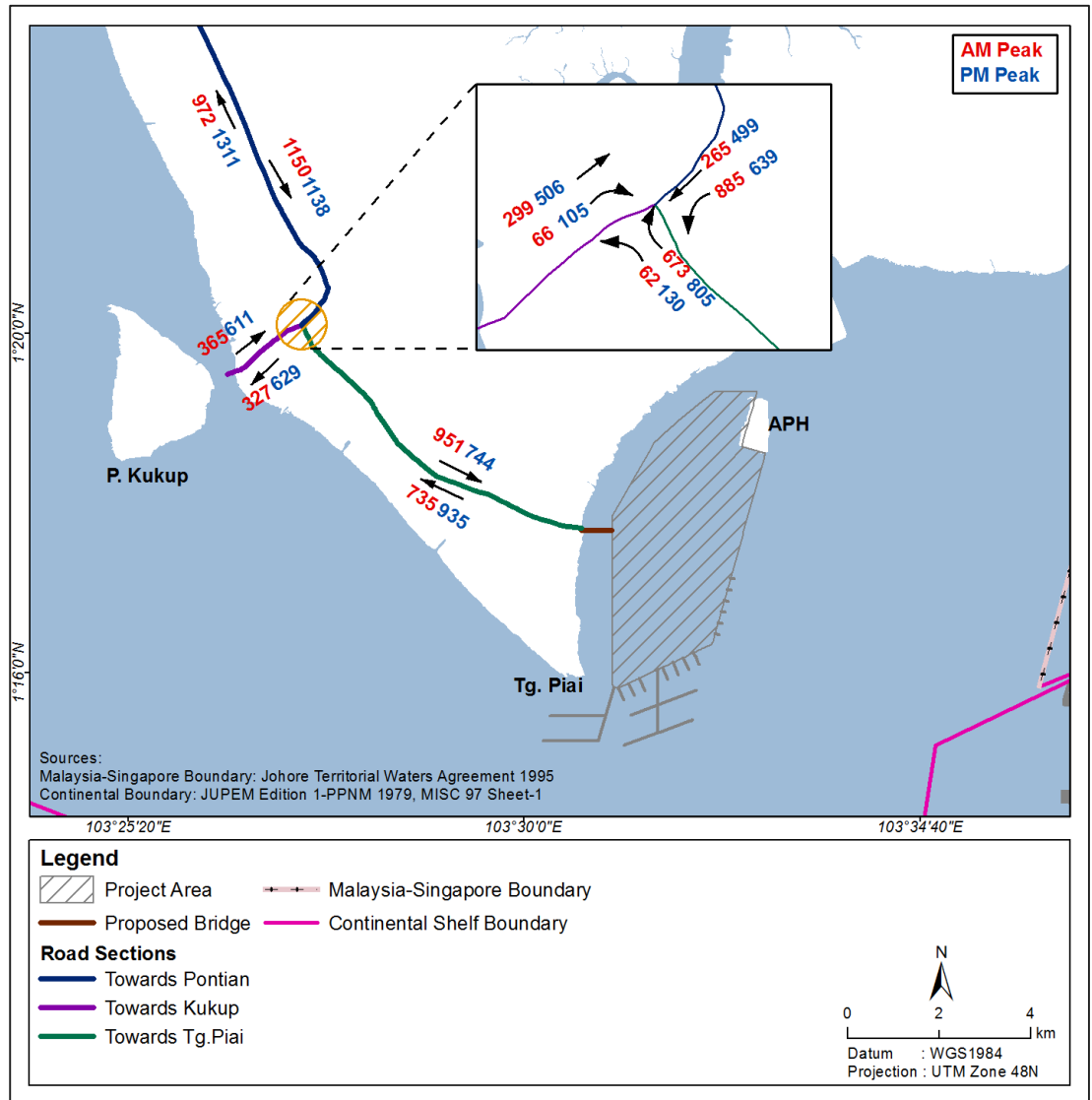


Figure 6.108 Estimated peak traffic flow (background + operation) in 2030

Roadway Performance

Analysis of future midblock capacity based on estimated traffic volume during operation stage indicates that the affected roads; FR 95 and J111 will operate within acceptable LOS of B and D during corresponding peak hours. Thus the existing road capacity would still be able to accommodate the future traffic demand during operation stage.

Junction Performance

Junction performance at this stage based on capacity analyses indicates that intersections and approaches were projected to operate with unacceptable LOS of C or better during morning or evening peak period. The greatest traffic performance was contributed by directional flow from Tg. Pi ai to Pontian/Johor Bharu where most this major movement has to stop at the traffic light.

Impact Evaluation

According to the RIAM, the impact is categorised as **No Change**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tanjung Piai, Sungai Pulai) and Johor Straits
Magnitude	0	No change
Permanence	1	No change
Reversibility	1	No change
Cumulativity	1	No change
Environmental Score	0	
Description	N	No change

6.21.5.2 Proposed Mitigation Measures

Traffic Generation

No mitigation measures required with the presence of roadway and junction upgrading.

Roadway Performance

No mitigation measures required.

Junction Performance

Signal control (traffic light) to be installed at the proposed stop junction from Tg. Piai to Pontian/ Johor Bahru in order to maintain acceptable level of service during operation stage as shown in Figure 6.109 and Figure 6.110. In addition signalised junction 1 with dedicated ramp should be upgraded connecting Tg.Piai to Pontian as shown in Figure 6.111.

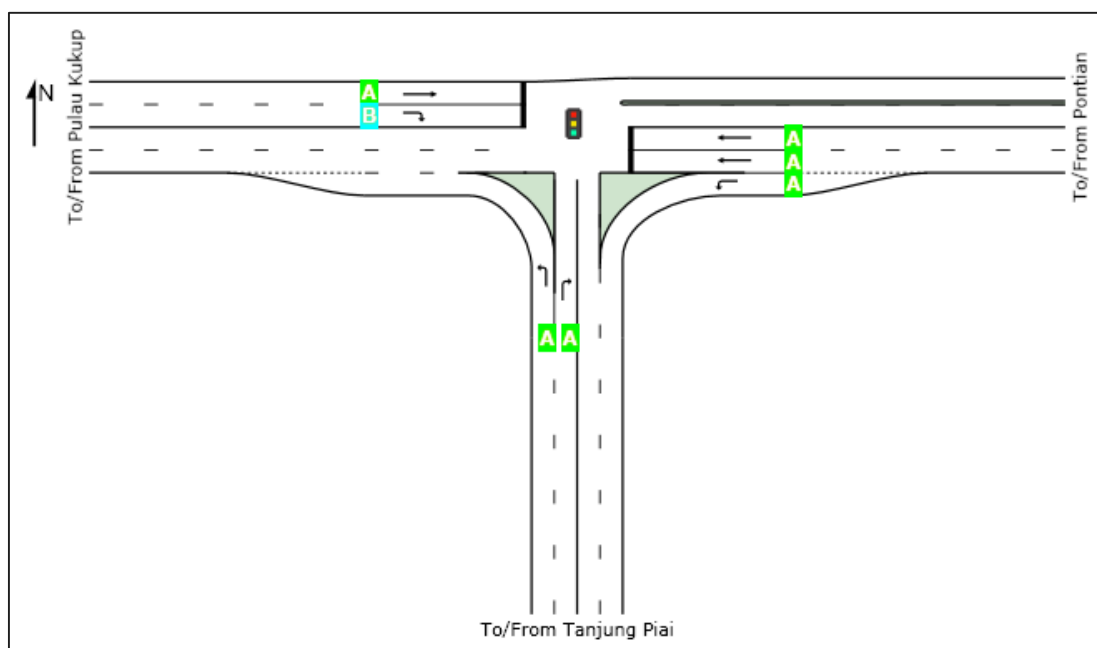


Figure 6.109 LOS of the junction during morning peak hour with the proposed traffic light

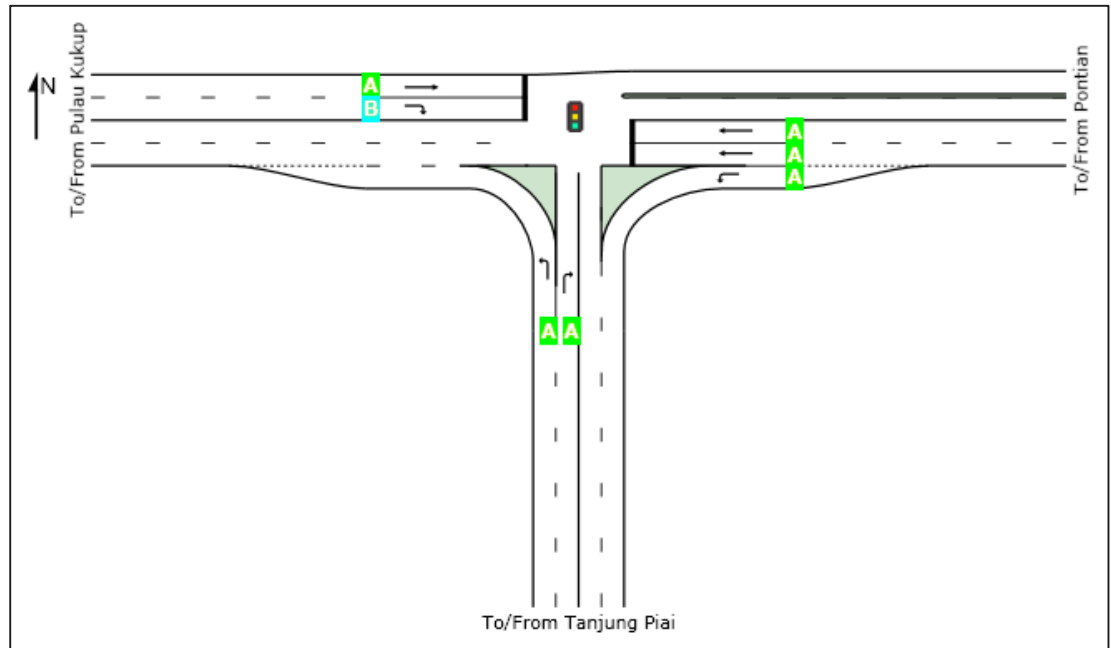


Figure 6.110 LOS of the junction during evening peak hour with the proposed traffic light

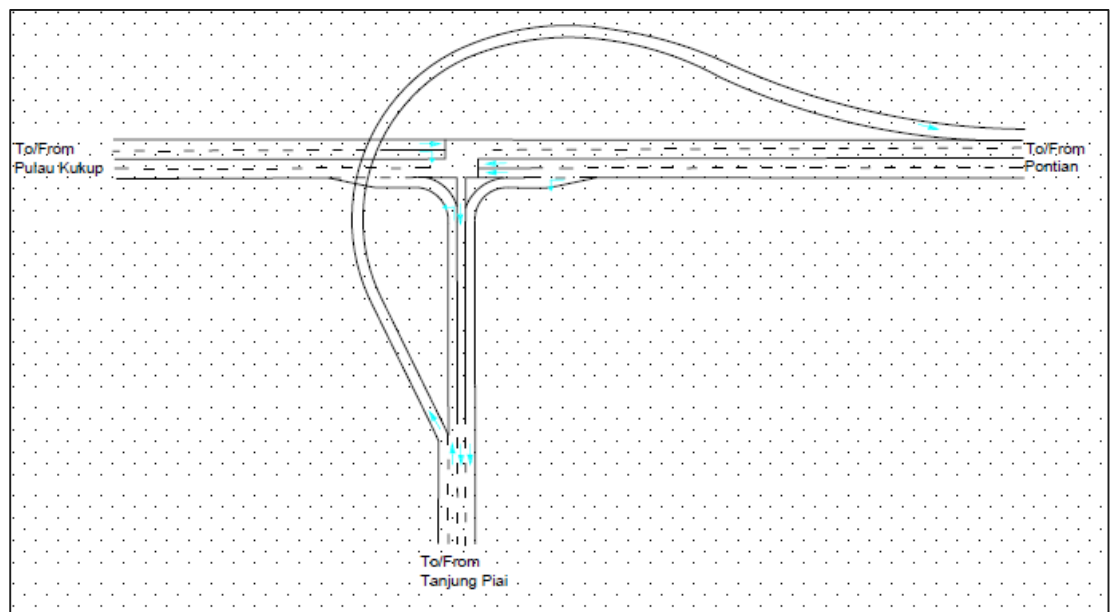


Figure 6.111 Proposed upgrading of Junction 1 with dedicated ramp from Tg. Piai to Pontian

6.21.5.3 Residual Impacts

The local people need to adapt with new road network system which considered to be able to enhance connectivity to the nearest town. Better road condition with dedicated ramp and traffic lights provides safer road condition for maneuvering.

Impact Evaluation

According to the RIAM, the impact is categorised as **Slight Positive**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai

Criteria	Score	Description
Magnitude	1	Positive change
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulativity	3	Cumulative
Environmental Score	9	
Description	A	Slight positive impact

6.22 Marine Traffic and Navigation

6.22.1 Evaluation Framework

The Project has the potential to impact the existing marine traffic and navigation due to the following:

- The presence of the reclamation and dredging will impact current flows in the area.
- The Project will generate additional shipping traffic during both the construction and operation phases of the project.

There are no set standards against which the impact of these can be assessed. An evaluation has therefore been made of the changes from the existing conditions and how these changes will impact existing navigation.

6.22.2 Scope

The scope of work for the Marine Traffic and Navigation studies is to:

- Assess the potential impacts of the project on adjacent navigation routes navigation to nearby marine facilities.
- Make an initial assessment of the safety of navigation to the proposed berthing facilities for the Project

A desktop assessment of the potential impacts of these issues of the adjacent marine facilities, and of the safety of navigation during construction and operation of the Project has been carried out. This is reported in Appendix I. Desktop navigation simulations have also been carried out to assess navigability to / from the proposed jetties. This is reported in Appendix J.

6.22.3 Sensitive Receptors

The existing marine facilities in the area and navigation routes are described in detail in Section 5.3.10. The key sensitive receptors in respect of navigation are listed below and shown in Figure 6.112.

- The navigation route between the Malacca Straits and South China Sea as defined by the IMO traffic separation scheme.
- The navigation channel to PTP, Tg Bin Power Station Jetty and the ATB Jetty
- The PTP container berths

- The Tg Bin Power Station Jetty
- The ATB Jetty
- The Ship to Ship transfer areas within the PTP port limits

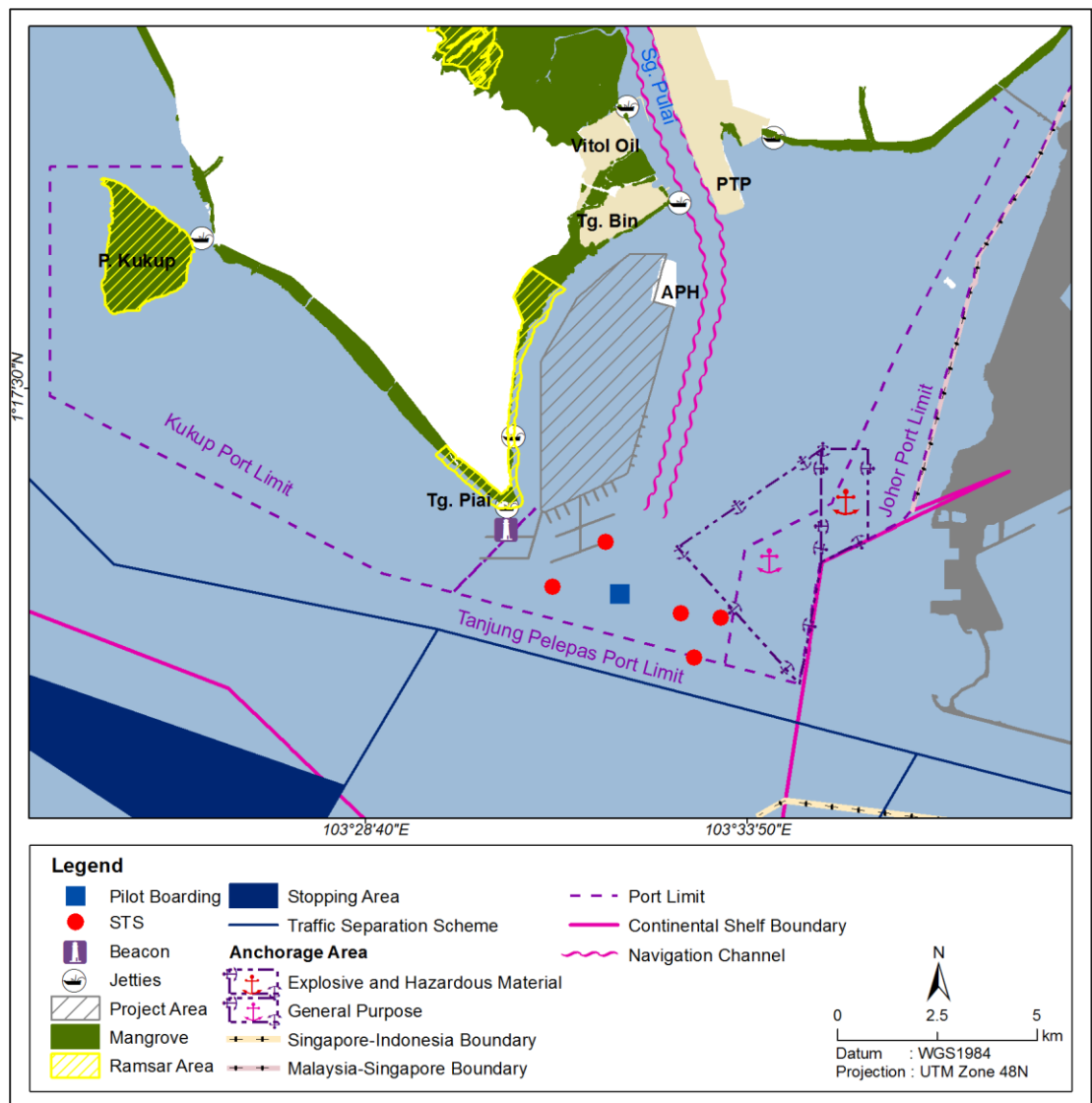


Figure 6.112 Sensitive Receptors for Navigation

6.22.4 Construction

6.22.4.1 Potential Impacts

Increase in Shipping Traffic

During the reclamation and dredging works there are expected to be 8 – 9 vessel movements per day of construction ships which will primarily be dredgers or sand transport barges. This equates to between 240 and 270 additional vessel movements per month.

The proposed project will have a direct impact on current ship-to-ship (STS) transfer operation at PTP. STS 1 is obstructing the approach while STS 2 location will be directly impacted by the Jetty 2 construction. The current pilot boarding ground will be used by the construction traffic which will increase congestion in this area.

With good coordination this is not expected to cause significant traffic congestion within the PTP port limits. However STS-2 will require relocation before the Jetty 2 construction commences.

The supply of sand requires the dredgers or sand supply barges to make a round trip to the sand source area located offshore of Muar, approximately 140 km (75 nautical miles) from the Project site. The dredged material is expected to be disposed of at a site on Long Bank approximately 75 km (40 nautical miles) from the Project site. The navigation routes for these vessel movements will require transit within the main shipping lanes in the Malacca Straits.

Impact Evaluation

According to the RIAM, the impact is categorised as **Slight Negative**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	1	No change
Environmental Score	-5	
Description	-A	Slight negative impact

Existing Navigation Aids

The new Jetty 1 will be constructed to the south of the Tg Piai light beacon and potentially obstructs the visibility of this light, particularly when large tankers are berthed at the jetty. The location of this light beacon and the proposed jetty is shown in Figure 5.106

The other navigation aids for PTP that are located in the vicinity of the project include the PTP approach channel lead-in light and navigation buoys will not be affected by the Project.

Impact Evaluation

According to the RIAM, the impact is categorised as **Significant Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tg. Piai, Sg. Pulai and Johor Straits)
Magnitude	-3	Major change
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulativity	2	Non-cumulative
Environmental Score	-48	

Criteria	Score	Description
Description	-D	Significant negative impact

6.22.4.2 Mitigation Measures

Increase in Shipping Traffic

The construction traffic including dredgers and sand supply vessels will require careful management to ensure that there is no impact on the safety of other shipping operating in the area. Every precaution needs to be taken to ensure that the construction of the proposed facility will not have any adverse effect on the safety and commercial efficiency of the shipping to other terminals within the PTP port limit as well as on the traditional fishing activities carried out in the area. In order to eliminate, or at least minimise potential impacts, the following mitigation measures should be effected:

- Closely following and fully adhering to all the Rules, Regulations, Guidelines and other requirements of the relevant Malaysian marine authorities, namely the Port Authority which is the Johor Port Authority, the Marine Department Malaysia, Southern Region, and all other relevant government agencies, and in addition, ensuring that when transiting international waters all vessels fully comply with the International Regulations, all other requirements and guidelines at all times.
- Set up and strictly enforce comprehensive Standard Operating Procedures (SOP), for both onshore and marine related activities.
- Utilise the services of the Licensed PTP pilots and tugboats as required by the Port Authority.
- Provide suitable marker buoys to mark the limits of the construction working areas.
- Regular dialogue sessions with local fishermen and their local fishermen associations be undertaken as identified in the EMP (Section 8), in order to educate the fishermen about the ongoing construction works and potential risks and to remind them of their own responsibilities. Regular feedback from both sides should be encouraged

Existing Navigation Aids

The Tg Piai light beacon be modified or relocated to ensure adequate visibility with the new jetty in place. It is recommended that the changes to this light beacon are considered during the Full Mission Ship Simulation that will be required prior to commissioning of the Jetty.

6.22.4.3 Residual Impacts

Increase in Shipping Traffic

The mitigation measures set out in Section 6.22.4.2 will minimise the risk of shipping incidents due to the increase in shipping traffic within the PTP port limits during construction of the Project. However the increase in shipping inevitably leads to an increase in the risk of an incident occurring due to there being more potentially conflicting shipping movements, in particular in the TSS precautionary zone and the approaches to the pilot boarding ground. The increased shipping traffic is therefore considered to have a Slight Negative Residual Impact.

Impact Evaluation

According to the RIAM, the impact is categorised as **Slight Negative**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai

Criteria	Score	Description
Magnitude	-1	Negative change
Permanence	2	Temporary
Reversibility	2	Reversible
Cumulativity	1	No change
Environmental Score	-5	
Description	-A	Slight negative impact

Existing Navigation Aids

Based on the assessment of modifications to the Tg Piai light as set out in Section 6.22.4.2 suitable upgrading of this light will be carried out to ensure that its function is maintained. There are therefore no residual impacts on the existing navigation aids in the vicinity of the Project.

Impact Evaluation

According to the RIAM, the impact is categorised as **Slight Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tg. Piai, Sg. Pulai and Johor Straits)
Magnitude	0	No change
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulativity	2	Non-cumulative
Environmental Score	0	
Description	N	No Change

6.22.5 Operation

6.22.5.1 Potential Impacts

Change in Current Patterns

The presence of the reclamation has the potential to change the current conditions in the existing PTP navigation channel and port areas. Numerical modelling for the DEIA has assessed the changes.

The maximum current speeds in the vicinity of the Project are shown in Figure 6.113, this plot shows the existing current conditions, conditions after the reclamation and dredging works for the Project are completed and the difference between these. These plots are for NE monsoon conditions, noting that similar conditions prevail during the SW monsoon and

inter monsoon periods. From this it will also be noted that the maximum current speeds in the PTP approach channel are between 1.5 and 2.0m/sec (3 to 4 knots). These are slightly increased by the reclamation with the maximum increase in the navigation channel being 0.1 m/sec (0.2 knots). There are no changes in current speeds at the PTP, Tg Bin Power Station and ATB berthing areas.

Figure 6.114 and Figure 6.115 show typical spring tide currents for peak flood and ebb conditions for the existing conditions and after completion of the proposed reclamation and dredging. From these it will be noted that there are no significant changes in the current directions in the PTP navigation channel and the berthing areas.

As there are no significant changes in either current speed or direction it is concluded that the development of the reclamation will:

- Not have any impact on the navigability of the existing PTP approach channel;
- Not have any impact on ships manoeuvring in the vicinity of the PTP, Tg. Bin Power Station and ATB berthing areas.

Impact Evaluation

According to the RIAM, the impact is categorised as **No Change**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	0	No change
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulativity	3	Cumulative
Environmental Score	0	
Description	N	No change

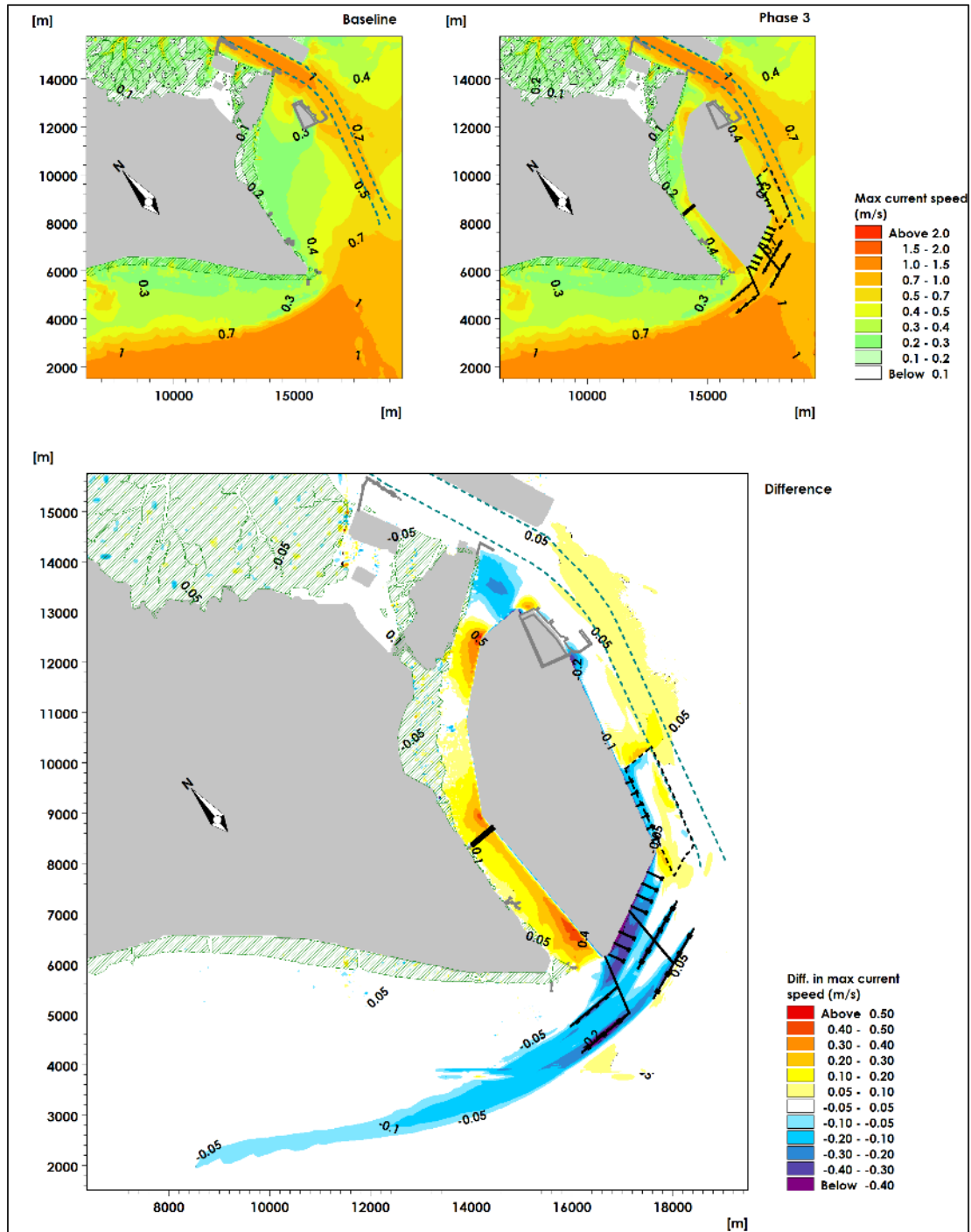


Figure 6.113 Change in Maximum Current Speeds during NE Monsoon

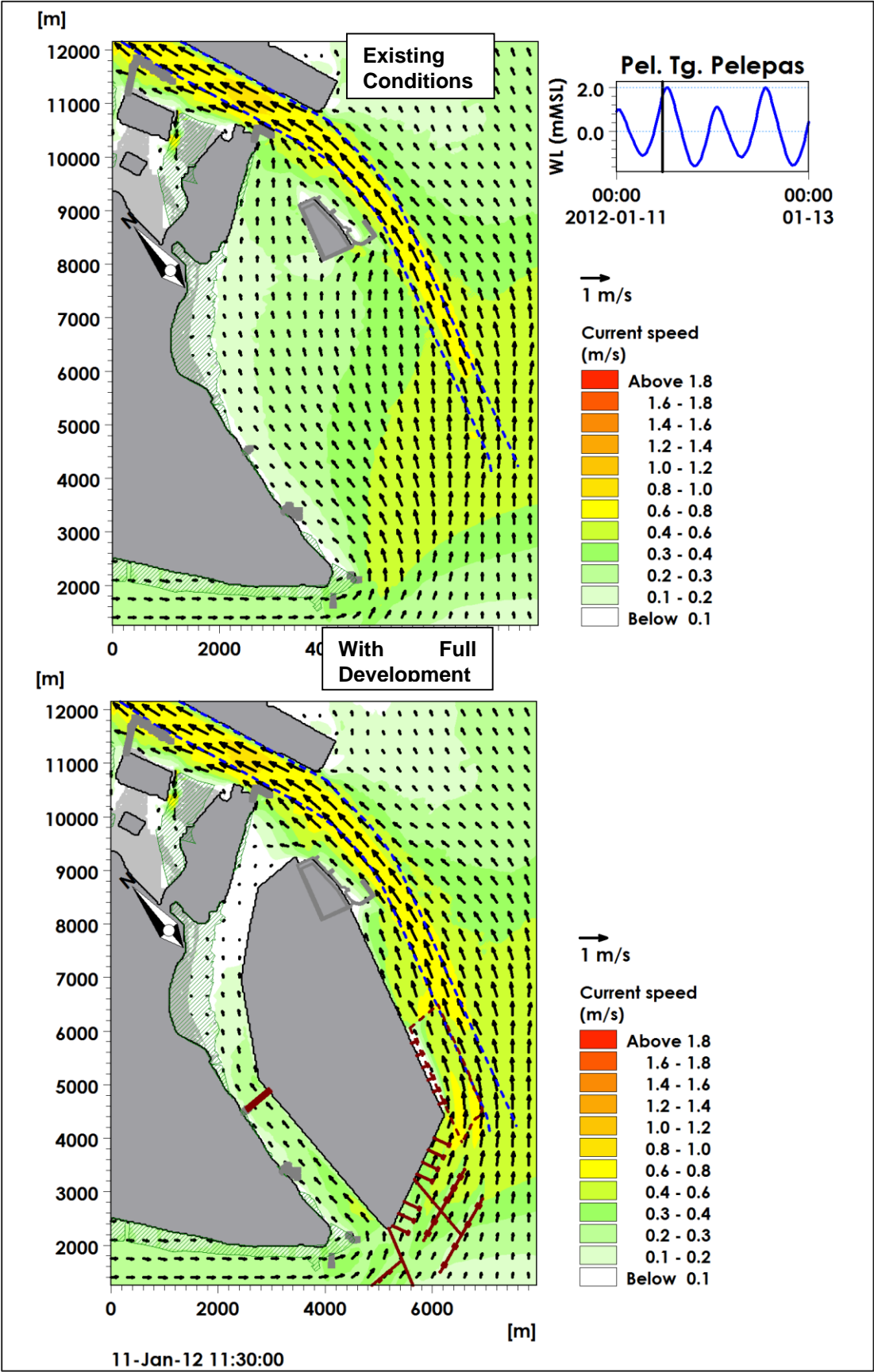


Figure 6.114 Typical flood tide currents during NE monsoon

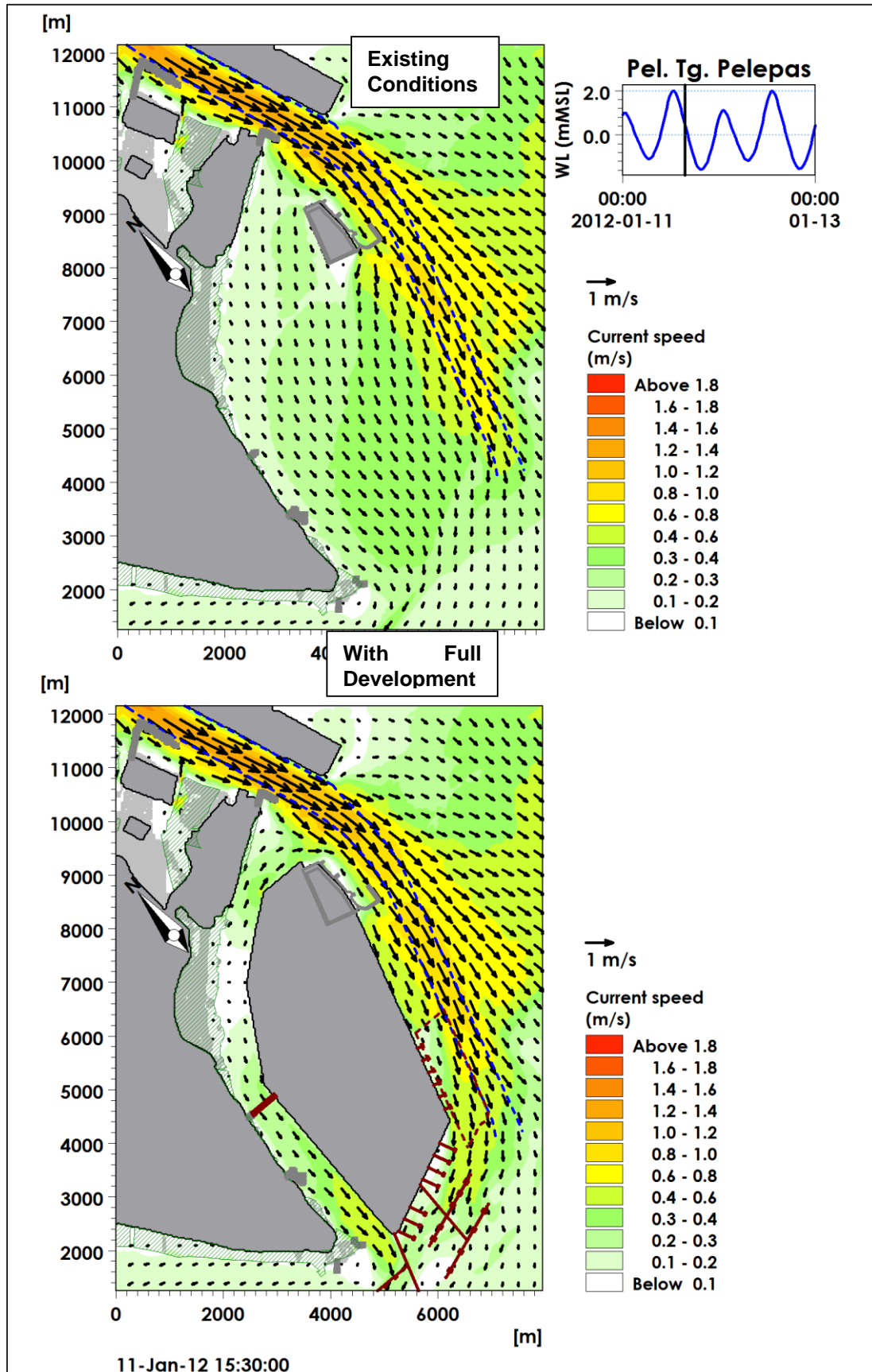


Figure 6.115 Typical ebb tide currents during NE monsoon

Increase in Shipping Traffic

Once the Project is fully operational it is expected that there will be additional traffic of about 916 vessel calls per month (an average of approximately 31 additional vessel calls per day). A breakdown of this shipping traffic is set out in Section 3.2.1. These additional vessel calls will increase the shipping traffic within the PTP port limits by approximately 160% from the 2013 figures.

Marine vessel movements to and from the Project Jetties will approach from the main traffic areas of the Traffic Separation Scheme (TSS) to the pilot boarding ground. This will lead to additional shipping traffic leaving the TSS in the precautionary area, and thus increase potentially conflicting vessel routes in this area. All ships approaching berthing facilities are required to pick up a pilot at the Pilot Boarding Ground, and the additional shipping traffic will increase congestion in this area.

After picking up the pilot shipping to the Project Jetties 1 and 2 and the shore connected berths along the south boundary of the reclamation will be from the south with no direct impact on shipping using the existing PTP approach channel. These ships pass through the area where the existing STS 1 and 2 are located. These STS operations will need to be relocated to an area clear of the new shipping routes before the new jetties commence operations.

Ships approaching new berths along the eastern side of the reclamation will approach either within the existing PTP approach channel or closely parallel to the channel and may therefore increase traffic in this channel. 6 of the proposed 41 Project berths are alongside the channel so this shipping will be approximately 15% of the total using the new berths (137 ship calls per month).

Impact Evaluation

According to the RIAM, the impact is categorised as **Minor Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tg. Piai, Sg. Piai and Johor Straits)
Magnitude	-1	Negative change
Permanence	3	Permanent
Reversibility	2	Reversible
Cumulativity	2	Non-cumulative
Environmental Score	-14	
Description	-A	Minor negative impact

Navigation Safety to Project Jetties

Desktop real time navigation simulations have been carried out to make an initial assessment of the safety of navigation to the Project jetties and assess whether any major changes are required to the jetty layout.

The majority of the navigation simulations were carried out for vessels manoeuvring under typical spring tide currents and regularly occurring wind conditions. The simulations have shown that the jetty layout is generally suitable for safe navigation and all the manoeuvres were successfully completed. However a number of issues were noted as follows:

- A few of the proposed berths were not fully aligned with the currents. This led to the berthing and unberthing operations being more difficult than for the berths fully aligned with the currents.
- Unberthing a laden tanker with strong following currents (i.e. current coming from astern) has greater risks to the ship manoeuvre than with currents from the ship bow as the vessel has less power and is less manoeuvrable when going astern.

A limited number of runs were also carried out where a Sumatra squall occurred part way through the shipping manoeuvre. In these runs the ships were controlled but had insufficient reserve power for the manoeuvre to be considered safe.

Impact Evaluation

According to the RIAM, the impact is categorised as **Slight Negative**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	-1	No change
Permanence	3	Permanent
Reversibility	3	Irreversible
Cumulativity	2	Non-cumulative
Environmental Score	-8	
Description	-A	Slight negative impact

6.22.5.2 Mitigation Measures

Change in Current Patterns

No impact therefore no mitigation measures required.

Increase in Shipping Traffic

The increase in marine traffic will necessitate enhanced control and coordination of vessel movements. Every precaution needs to be taken to ensure that the operation of the proposed facility will not have any adverse effect on the safety and commercial efficiency of the shipping to other terminals within the PTP port limit as well as on the traditional fishing activities carried out in the area. In order to attempt to eliminate, or at least minimise potential impacts, the following mitigation measures should be effected:

- Set up and strictly enforce comprehensive Standard Operating Procedures (SOP), for both onshore and marine related activities.
- Set up a central port traffic control system for the new jetties by using either the existing PTP Control Tower, or a yet to be established independent, efficient, professional and competent unified port control centre.
- Utilise the services of the Licensed PTP pilots and tugboats. It should be noted here that there would be a need to increase the number of pilots and tug boats over those presently available.
- Ensure that all vessels berthing at the Project jetties are thoroughly inspected prior to their initial call at the facility, and at regular intervals thereafter, to ascertain that they fully comply with all the international and local safety standards. Sub-standard vessels should be prohibited from using the Jetties.

- Carry out regular 'in-house' routine operational training and safety drills, and also participate in more comprehensive safety drills at both port and regional levels to train and re-train personnel in all emergency procedures.
- To consider locating an additional Pilot Boarding Area just south of the project site for vessels using the new Jetties 1 and 2 as this will reduce the congestion at the existing Pilot Boarding Area.
- STS operations in the area that is directly affected by the Project should be reviewed for termination.
- Regular dialogue sessions with local fishermen and their local fishermen associations should be undertaken, in order to educate the fishermen about potential risks and to remind them of their own responsibilities. Regular feedback from both sides should be encouraged.

Navigation Safety to Project Jetties

The following measures are recommended to ensure safe navigation to and from the proposed new berths:

- Full Mission Ship Simulations (FMSS) are carried out prior to commissioning of the new jetties to confirm the limiting current and wind conditions for vessel manoeuvring to be incorporated in the Standard Operation Procedures (SOP) for the terminal.
- These SOP should include restrictions on ships departing with strong following currents.
- The FMSS should also be used for pilot training prior to commencement of terminal operations.
- A squall warning system should be set up and ships should not commence arrival or departure manoeuvres if a squall is forecast to occur during the planned manoeuvring window.
- Real time monitoring of currents and winds should be carried out to provide data to the pilots during ship arrivals and departures.
- The final design of the jetty structures should as far as possible align the berths with the current directions.

6.22.5.3 Residual Impacts

Change in Current Patterns

No residual impacts.

Increase in Shipping Traffic

The mitigation measures set out in Section 6.22.5.2 will minimise the risk of shipping incidents due to the increase in shipping traffic within the PTP port limits due to the Project. However this significant increase in shipping inevitably leads to an increase in the risk of an incident occurring due to there being more potentially conflicting shipping movements, in particular in the TSS precautionary zone and the approaches to the pilot boarding ground. The increased shipping traffic is therefore considered to have a Minor Negative Residual Impact.

Impact Evaluation

According to the RIAM, the impact is categorised as **Minor Negative**.

Criteria	Score	Description
Importance	2	Important to South Western Johor (Tg. Piai, Sg. Pulai and Johor Straits)
Magnitude	-1	Negative change
Permanence	3	Permanent

Criteria	Score	Description
Reversibility	2	Reversible
Cumulativity	2	Non-cumulative
Environmental Score	-14	
Description	-B	Minor negative impact

Navigation Safety to Project Jetties

With the mitigation measures set out in Section 6.22.5.2 it is considered that ships can safely arrive at and depart from the proposed jetties.

Impact Evaluation

According to the RIAM, the impact is categorised as **No Change**.

Criteria	Score	Description
Importance	1	Important to Tg. Piai
Magnitude	0	No change
Permanence	3	Permanent
Reversibility	2	Reversible
Cumulativity	2	Non-cumulative
Environmental Score	0	
Description	N	No change

6.23 Summary of Impacts

The impact assessment presented in this section is the culmination of the quantitative assessment of the physical impacts and semi-quantitative and qualitative assessment of biological and socio-economic impacts documented in the preceding sections.

The impact assessment is directed towards the physical-chemical, biological-ecological and human aspects of the environment, where the issues have been identified on the basis of the scoping exercise, field surveys and numerical modelling and related sectoral impact assessments.

The RIAM analysis presented in this section summarises the impacts over the project life-cycle (i.e. including construction and operational stages) both without mitigation and with mitigation (residual impacts) and is used to document the overall impacts of the project over the multiple and dissimilar issues that have been presented above.

The overall impacts without mitigation are presented in Figure 6.116, while the residual impacts, i.e. those impacts anticipated to remain after all mitigation measures are implemented, are presented in Figure 6.117. The results show a significant number of

impacts can be reduced to “No change”, while the major negative impacts (-E and -D) have been addressed.

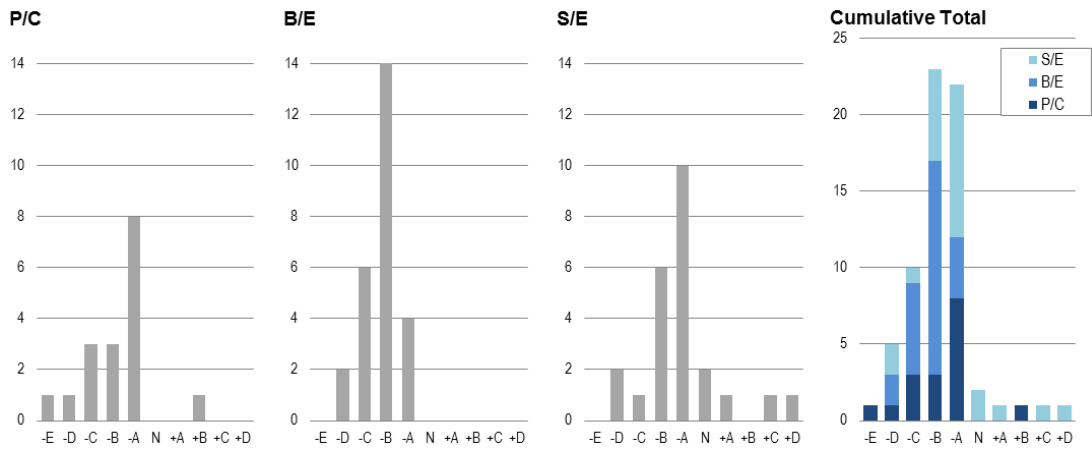


Figure 6.116 RIAM results for the overall project development – without mitigation.

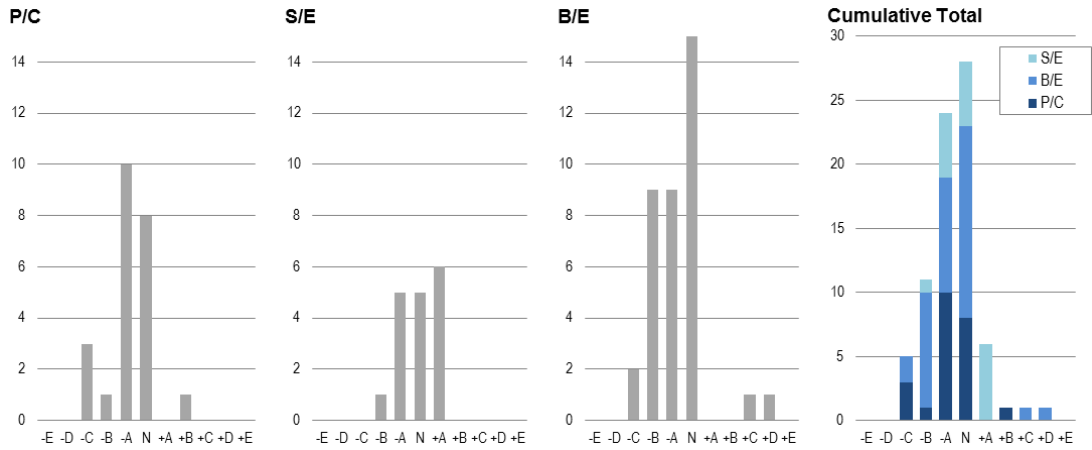


Figure 6.117 RIAM results for the overall project development – residual impacts (with mitigation).

