Summary

Table below shows the summary of the mangrove condition within the study area (Table 5.10).

Table 5.10 Summary of mangrove species and density within study area.

Location	Dominant Species	Average Density (trees/ha)	Other species	Observed human pressure
Tg. Piai National Park	*Rhyzophora apiculata, Bruguiera cylindrica*	4,013	BP, RM, CT, XG, AO	Erosion
Tg.Piai to Tg. Bin	*Rhizophora* spp.	1,498	AO, BC, BG, RA, RM, CT	
Tg. Piai to Kukup	*Avicennia alba, Rhizophora apiculata, Sonneratia* spp.	808	*Avicennia* spp., *Rhizophora* spp., *Sonneratia* spp., *Ceriops* spp., Bruguiera spp.	
Sg. Pulai	*Rhizophora* spp.	1,215	*Sonneratia* spp., *Avicennia* spp., AA, AO, RA, RM, BP, BC, CT.	Clearing
P. Kukup	*Rhizophora apiculata, Bruguiera cylindrica*	n/a	AA, SA, CT, BG, XG, LI	

BP: Bruguiera parviflora; RM: Rhizophora mucronata, CT: Ceriops tagal, XG: Xylocarpus granatum, AO: Avicennia officinalis, BC: Bruguiera cylindrical, BG: Bruguiera gymnorrhiza, RA: Rhizophora apiculata, AA: Avicennia alba, SA: Sonneratia alba, LI: Lumnitzera littorea.

5.2.4.2 Seagrass Habitat

In Malaysia, fifteen (15) species of seagrasses belonging to eight (8) genera and three (3) families have been reported /11/. The west coast of Peninsular Malaysia also contain several localities along the Straits of Malacca which support well-developed seagrass communities that constitute a large portion (40.0% - 85.7%) of all known seagrass species in Malaysia, whereby the central and southern regions of the Straits have a greater diversity of seagrass species compared to the northern reaches /12/.

Distribution, abundance & health

Seagrass beds can be found in the estuary of Sungai Pulai, Merambong Shoals and Tanjung Adang Shoals, as shown in Figure 5.44 and Table 5.11 /36/. These beds are of multi-species beds, as described below, with no distinct zonation.

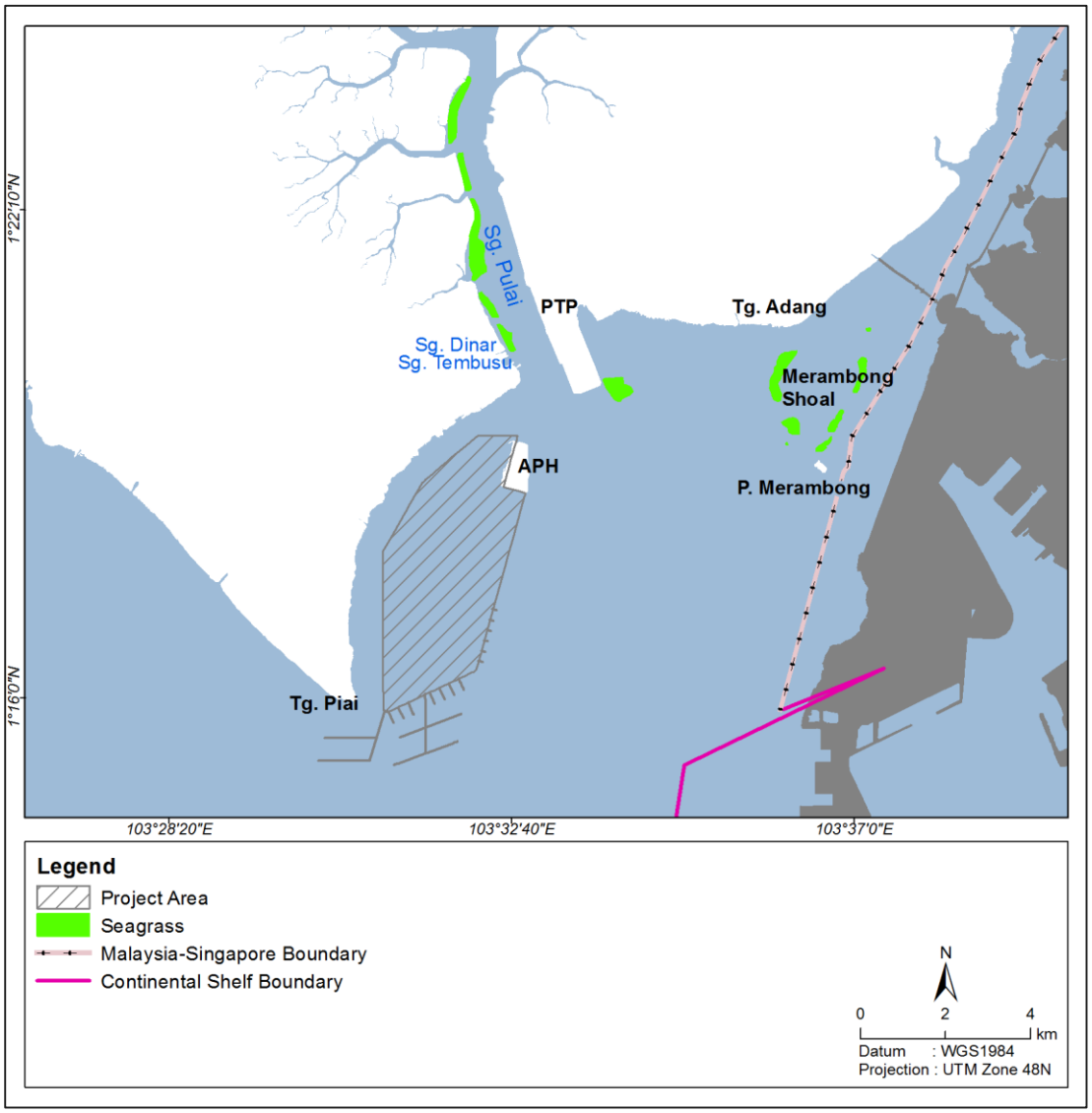


Figure 5.44 Location of seagrass beds within the study area.

Comparison between the three areas as shown in Table 5.11 indicates that Merambong Shoals contained the highest average percent seagrass cover (39%), followed by the Sungai Pulai estuary (Sg. Tembusu – Sg. Dinar, 36%), while the meadow off the Port of Tanjung Pelepas contained the least total average percent cover at around 33%.

The abundance and health status of seagrasses in this area are as follows:

Seagrass between Sg. Tembusu and Sg. Dinar was found beyond 100 – 170 m from the river bank with an estimated area of 2.3 ha. The most dominant species were *Enhalus acoroides* and *Halophila ovalis*. The sediment type for the seagrass beds along the Pulai river is muddy. In terms of the seagrass health, most of the quadrats show that the seagrass cover between Sg. Tembusu and Sg. Dinar are between 25 - 55%.

The most extensive seagrass area occurs off Pelepas Port, estimated at almost 12 ha. A previous study in around 2006/2007 /36/ also estimated the seagrass beds to be around 11.9 ha. During this study, seagrass cover ranged from 5 – 70% per quadrat with average percentage cover of 33%, while the most dominant species were *Enhalus acoroides* and *Halophila ovalis*.

At Merambong Shoals, the seagrass areas are estimated to total 60.7 ha. *Enhalus acoroides* and *Halophila ovalis* are the most dominant species. The *Enhalus acoroides* areas are much

denser at the edge of the seagrass beds fronting Singapore compared to the area fronting Tg. Kupang. This species is sparsely distributed in the centre of this seagrass area.

Table 5.11 Total average percent cover of seagrass found around Tanjung Piai – Sungai Pulai – Merambong Shoals.

Area	Average Percent Cover Seagrass	Number of species
Sg. Tembusu – Sg. Dinar	36	3
Port of Tanjung Pelepas	33	6
Merambong Shoals	39	10

Photo 5.26 Surveys being conducted on the extensive seagrass area off PTP.

Diversity

In total, ten (10) species have been recorded from the study areas, and they are: *Enhalus acoroides, Halophila ovalis, Halophila minor, Halophila spinulosa, Halodule uninervis, Halodule pinifolia, Cymodocea serrulata, Cymodocea rotundata, Thalassia hemprichii* and *Syringodium isoetifolium* (Table 5.12). The photos of the ten species are shown below (Photo 5.27 A - H).

Table 5.12 List of seagrass species found in the study area (Note: '+' = present, '-' = absent)

Species	Location		
	Between Sg. Tembusu and Sg. Dinar	Off Tg. Pelepas Port	Merambong Shoals
Enhalus acoroides	+	+	+
Halophila ovalis	+	+	+
Halophila minor	-	-	+
Halophila spinulosa	+	+	+
Halodule uninervis	-	+	+
Halodule pinifolia	-	-	+
Cymodocea serrulata	-	+	+
Cymodocea rotundata	-	-	+
Thalassia hemprichii	-	+	+
Syringodium isoetifolium	-	-	+

The highest diversity was recorded at Merambong shoals (10 species) compared to Sg. Pulai (between Sg. Tembusu and Sg. Dinar) (3 species) and off Tg. Pelepas Port (6 species).

Halophila ovalis, Halophila minor, Thalassia hemprichii, Cymodocea serrulata and *Enhalus acoroides* were the most abundant seagrass species within all the areas surveyed, but in only a few locations did they co-occur in similar abundance. Less frequently observed during the survey were *Halodule* sp. and *S. isoetifolium*.

Halophila spinulosa, also commonly known as fern grass, is grazed on by turtles and dugongs /35, 36/*. H. spinulosa* has been observed to be in abundance together with *E. acoroides* and *H. ovalis* off Merambong Shoals near the Tg. Adang mangrove shoreline.

Enhalus acoroides is a larger bodied monomorphic species with tough rhizomes creeping coarsely under sediments and shoot with leaves up to 150 cm growing in sandy loam substrates /13/ of littoral area off Merambong Shoals near Tg. Kupang.

All seagrass species found near the proposed project area are regarded in the IUCN Red List as *Least Concern* species /14/.

A - *Enhalus acoroides*

B - *Halophila spinulosa*

C - *Halophila ovalis*

D - *Halophila minor*

E - *Halodule uninervis*

F - *Halodule pinifolia*

G - *Cymodocea serrulata*

H - *Thalassia hemprichii*

Photo 5.27 Type of seagrasses found in the study area.

Associated Seagrass Flora and Fauna

During low tide, various flora and faunal habitats were exposed as shown in Photo 5.28. One of the abundant flora components frequently seen on these intertidal flats were seaweeds (marine algae). Seaweeds are marine macroscopic algae that do not possess true roots, stems or leaves. They are commonly found in shallow waters attached to the substratum such as rocks and reefs, attached on surfaces of plants and shellfish, as well as living on sand and mud attached to small shells and rocks. Malaysia has a total of 352 taxa of seaweeds, comprising 174 Rhodophyta (Red Algae), 93 Chlorophyta (Green Algae) and 85 Phaeophyta (Brown Algae) /15, 16/.

A total of 33 taxa of seaweed found within the seagrass meadows described above, where 17 taxa from Division Chlorophyta, 13 taxa from Rhodophyta and 3 taxa from Phaeophyta. The highest number of taxa was recorded in Merambong shoals with 32 taxa compared to 14 and 7 taxa recorded off Tg. Pelepas Port and between Sg. Tembusu and Sg. Dinar respectively. The major species found at Merambong shoals were *Ulva reticulata*, *Ulva lactuca*, *Amphiroa fragilissima*, *Amphiroa rigida* and *Gracilaria* species, while *Amphiroa fragilissima*, *Udotea flabellum* and *Gracilaria coronopifolia* dominated off Tg. Pelepas Port and between Sg. Tembusu and Sg. Dinar. Some photos of seaweed species found at the study area are shown in Photo 5.29.

Photo 5.28 Low tide at Pulau Merambong

A – *Caulerpa taxifolia*

B – *Caulerpa racemosa*

C – *Padina sp* adjacent to P. Merambong

D – *Ulva reticulata* adjacent to P. Merambong

E – *Enteromorpha tubulosa*

F – *Udotea flabellum*

G – *Amphiroa fragilissima*

H – *Gracilaria fisheri*

I – *Hypnea sp.*

J – *Halymenia sp.*

K – *Dictyota dichotoma*

L – *Enteromorpha sp.*

Photo 5.29 Seaweed species found around the study area.

The seagrass beds also have been known support substantial invertebrate populations /17, 18, 19/. During the current study, a total of sixty-four (64) invertebrate taxa were recorded, with thirty (30) taxa belonged to Mollusca (Photo 5.30), sixteen (16) taxa from Echinodermata (Photo 5.32), twelve (12) taxa from Arthropoda (Crustacea - Photo 5.35), four taxa from Cnidaria and one taxa each from Chordata and Annelida.

The highest number of invertebrates recorded was at Merambong shoals with 64 taxa, followed by off PTP with 47 taxa. The lowest number of taxa in the study area was recorded in Sg. Pulai between Sg. Dinar and Sg. Tembesu (14 taxa). Among the common invertebrate species found were *Protoreaster nodosus, Salmacis* sp*., Holothuria scabra, Stichodactyla* sp*., Nassarius* sp*.* and *Cymbiola nobilis*. The high abundance of invertebrate fauna recorded at the study area indicates that the seagrass beds provide a sufficient supply of detritus, grazing matter and faunal prey.

A – *Melo melo*

B – *Cymbiola nobilis*

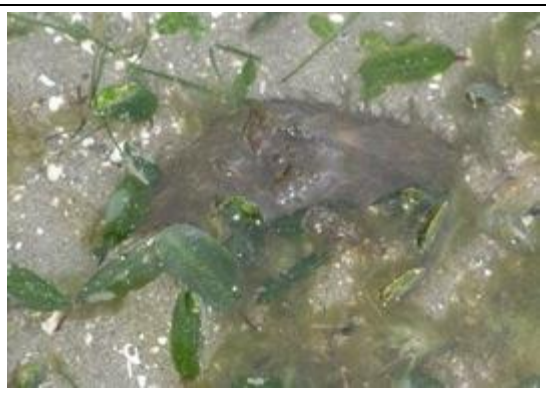
C – Syphonota geographica

D – Nassarius *sp.*

E – *Natica sp.*

F – *Cerithidea sp.*

G – *Notobryon sp.*



H – *Bursatella leachii*

Photo 5.30 Gastropods found at the study area.

A – *Pinna sp.*

B – *Placuna sp.*

C – *Polymesoda sp.*

D – *Circe scripta*

E – *Anadara granosa*

F – *Placamen calophylla*

G – *Solen sp.*

H – *Sepia sp.*

Photo 5.31 Bivalves and cephalopods found at the study area.

A – *Protoreaster nodosus*

B – *Astropecten sp.*

C – *Goniodiscaster scaber*

D – *Luidia maculata*

E – *Stellaster equestris*

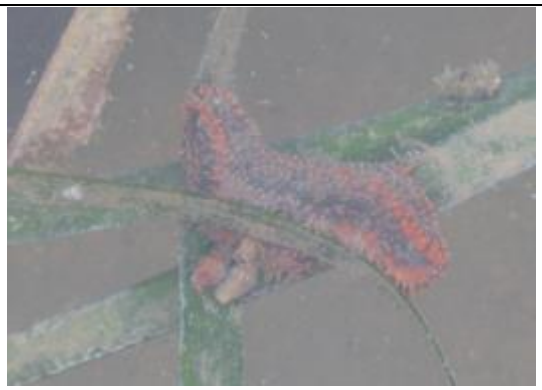
F – *Ophionereis sp.*

G – *Salmacis virgulata*

H – *Salmacis sphaeroides*

Photo 5.32 Echinoderms found at the study area.

A – *Holothuria scabra*



B – *Mensamaria intercedens*

C – *Holothuria sp.*

D – *Colochirus quadrangularis*

E – *Cercodemas anceps*

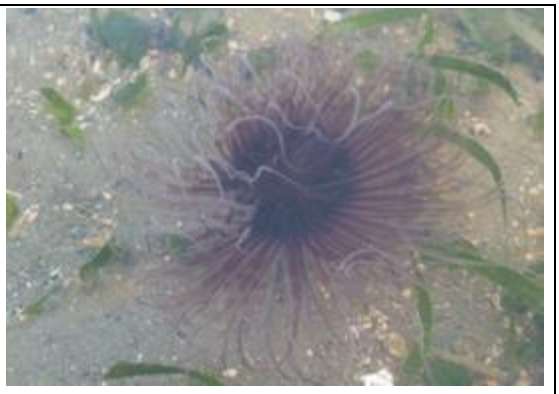
F – *Actinopyga sp.*

G – Stichopus *sp.*

H – Unidentified species

Photo 5.33 Holothuroideans found at the study area.

A – *Stichodactyla sp.*



B – *Cerianthus sp.*

C – *Boloceroides mcmurrichi*

D – *Cavernularia sp.*

E – *Polycarpa sp.*

F – *Oratosquilla sp.*

G – *Alpheus sp.*

H – *Alpheus sp.1*

Photo 5.34 Anemones and shrimps found at the study area.

A – *Clibanarius infraspinatus*

B – *Rhinolambrus* sp.

C – *Menaethius* sp.

D – *Dotilla* sp.

E – Unidentified Grapsid crab

F – *Portunus pelagicus*

G – Unidentified crab

H – Unidentified worm

Photo 5.35 Other invertebrates found at the study area

5.2.4.3 Coral

Coral reefs are one of the world's oldest, most diverse and productive ecosystems, usually existing in shallow coastal zones of warm tropical and subtropical oceans /20/. They are communities of soft-bodied invertebrates housed within a calcitic exoskeleton, living in a symbiotic relationship with unicellular algae. Coral reefs are important as a habitat for marine fish and invertebrate species and in protecting shorelines /21/.

The study area is more prominently known for its seagrass and mangrove habitats (Figure 5.45). Most of the current conservation efforts are focused on the said environments. However, the island of P. Merambong itself is an important ecosystem for both flora and fauna due the protection it provides in the open water. Pulau Merambong is located about 500 m from the border of Malaysia and Singapore, and is currently one of the main fishing grounds for the fishermen at Tanjung Kupang.

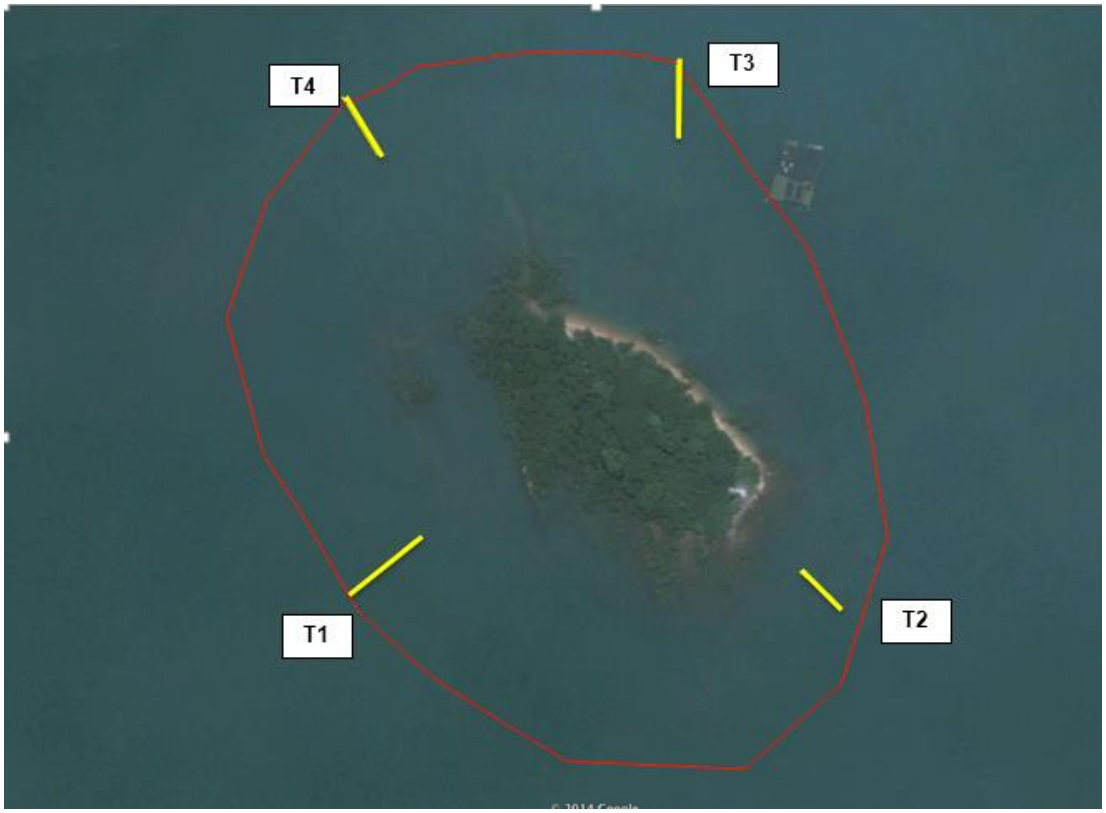


Figure 5.45 Location of coral reefs at the study area. Red line denotes the outer boundary of the reef.

Distribution, abundance & health

Four coral transects were surveyed around Pulau Merambong (T1 – T4; representing the southwest, southeast, northeast and northwest, respectively as shown in Figure 5.46. 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%. Table 5.13 summarizes the field observations, while Photo 5.37 to Photo 5.38 present snapshots of hard corals and soft corals recorded during the survey.

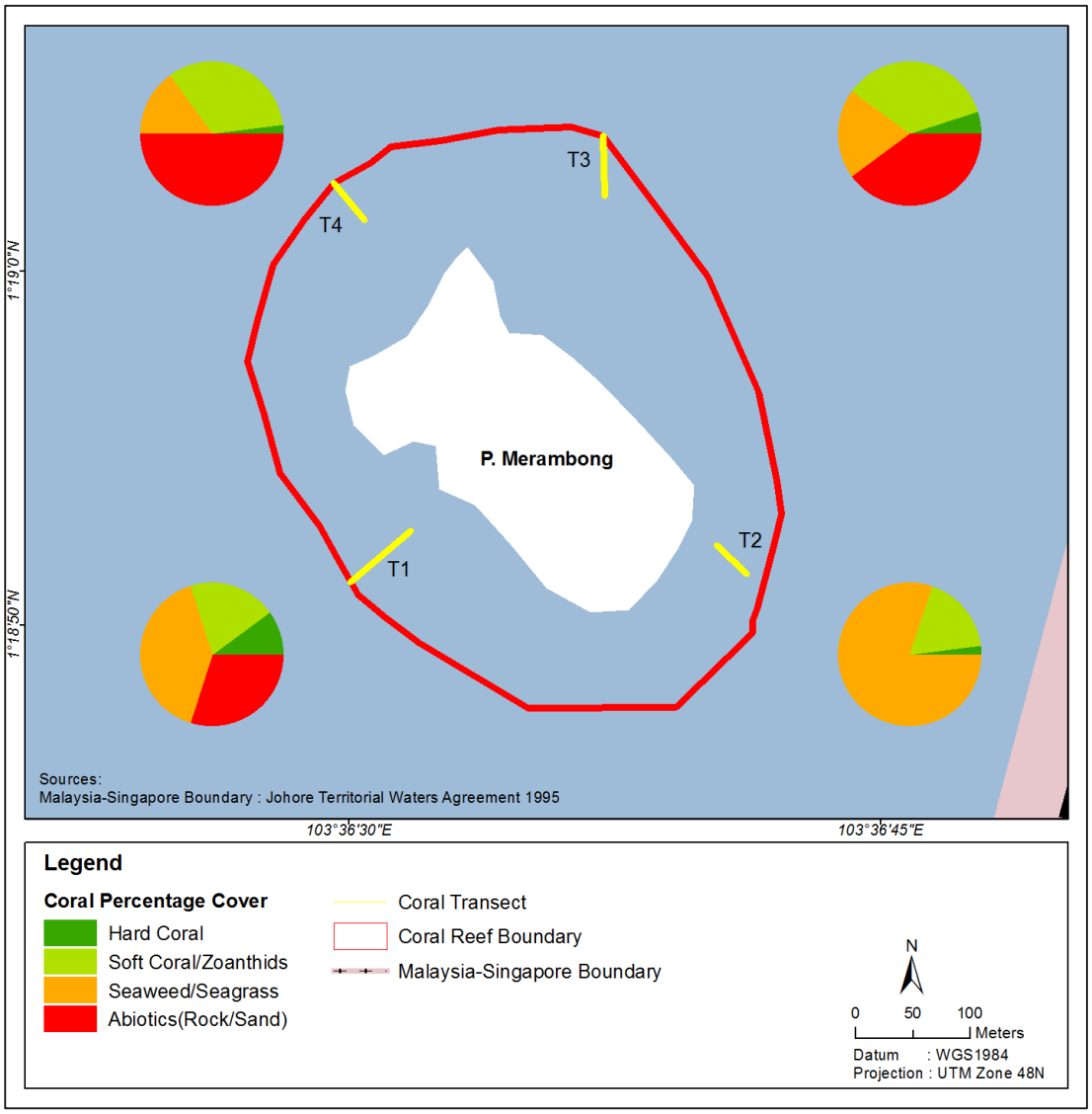


Figure 5.46 Coral percentage cover for each transect at P. Merambong.

Table 5.13 Percentage substrate cover of the reefs at Pulau Merambong.

Substrate Type	Percentage Cover			
	T1 – Southwest	T2 – Southeast	T3 – Northeast	T4 – Northwest
Hard Coral	10	2	5	2
Soft Coral/Zoanthids	20	18	35	33
Seaweed/Seagrass	40	80	20	15
Abiotics (Rock/Sand)	30	0	40	50

Overall, the southwest area of Pulau Merambong (T1) has the highest cover of hard coral, followed by the northeast (T3). The northeast and northwest (T4) transects have almost equal coverage of soft corals. Seaweed and seagrass were recorded in all areas (T1 – T4), and has the highest cover compared to other life forms. Soft corals and gorgonians were the second most frequent lifeforms throughout the area. The mean live coral cover in this area was only 5%, which indicates a very poor condition for the reefs here.

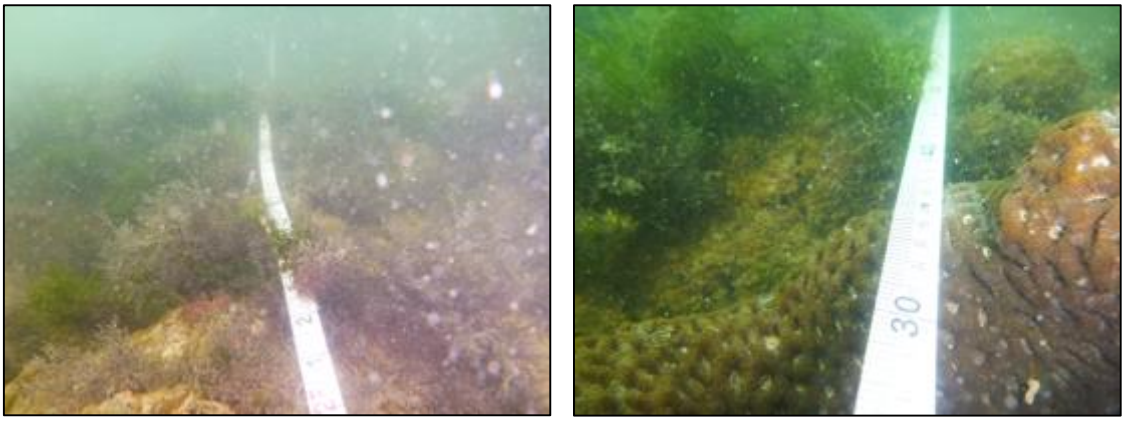
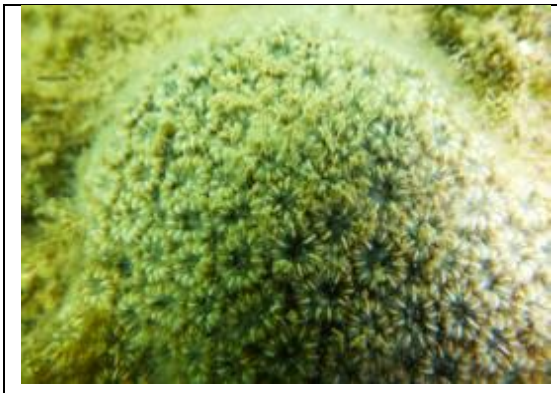


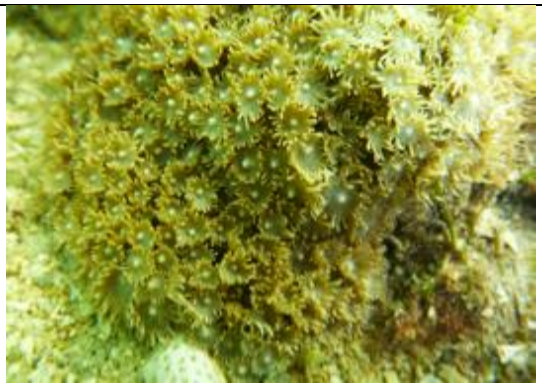
Photo 5.36 Reef conditions along the survey transects.

Diversity

A total of 10 taxa of hard corals, 10 taxa of soft corals and two (2) taxa of gorgonians were recorded (see details in Appendix G). The hard corals were mostly found at the reef edge, though the population was sparse. Most of corals found were small, with colony size below 20 cm in all dimensions (length, diameter, height). Some of the taxa found are shown in Photo 5.37 and Photo 5.38.



A – *Oulastrea crispata*



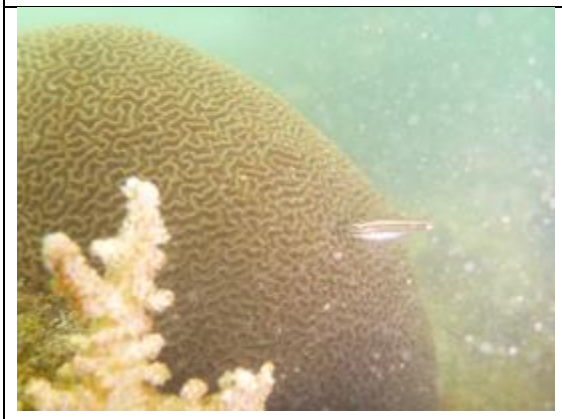
B – *Goniopora sp.*

C – *Turbinaria sp.*

D – *Favites sp.*

E – *Porites sp.*

F – *Porites sp.* with polyps extended



G – *Platygyra sp.*

H – *Echinophyllia sp.*

I – *Diploastrea heliopora*

J – *Favia sp.*

Photo 5.37 Hard corals found around P. Merambong

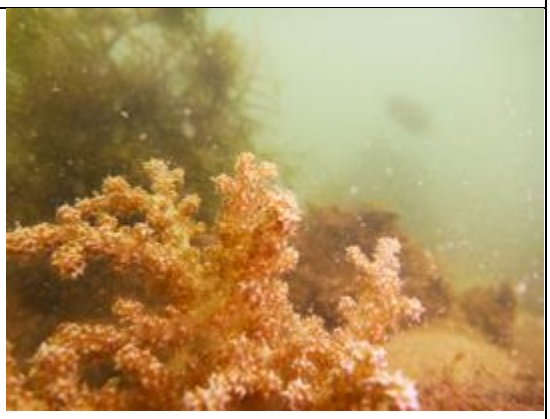
A – *Zoanthus sp*.

B – *Sinularia sp.*

C – *Phymanthus sp.*

D – *Pachycerianthus sp.*

E – *Dendronephthya sp.*



F – *Stereonephthya sp.*

G – *Dichotella sp.*

H – *Juncella sp.*

Photo 5.38 Soft corals and Gorgonians found around P. Merambong

Associated Reef Organisms

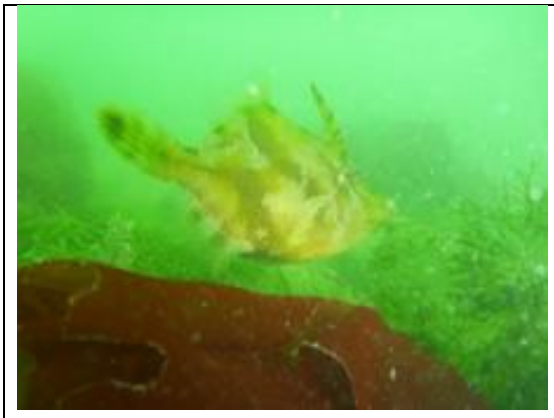
Coral reefs support a diverse range of fauna, both vertebrate as well as invertebrate. This is because apart from playing a major role in protecting shorelines from storms and waves, they also act as refuges, feeding and nursery grounds for the fish fauna /22, 23/.

Reef Fish

A total of 21 genera of fish belonging to 11 families were recorded during the survey. The highest diversity was recorded in T2 with 18 genera, followed by T3 and T1 with 15 genera each. Though there are no records of previous studies on the fish in Pulau Merambong, most of the fish genera found are common inhabitants of coral reefs throughout the country.

Several common fish recorded around the island were the Yellowtail Damsel (*Neopomacentrus azysron*), Damsel (*Pomacentrus sp.*), Black Damsel (*Neoglyphidodon melas*), Chromis (*Chromis sp.*), Copperband Butterflyfish (*Chelmon rostratus*), Wrasse (*Halichoeres sp.*), Fan Bellied Leatherjacket (*Monacanthus chinensis*), Cardinalfish (*Apogon sp.*) Rabbitfish (*Siganus sp.*) and Goatfish (*Upeneus sp.*) as shown in Photo 5.39. Most of these fishes are typically found in Malaysian waters.

There was a notable absence of algae-grazing fish such as parrotfish (Scaridae) and surgeonfish (Acanthuridae), which explains the abundance of seaweed in the area. The roles of these fish are critical in controlling the algal communities and influencing competitive interactions between corals and macroalgae /24/. Thus, the absence of the algae-grazing fish has influenced the distribution of the corals in this area.



A – *Monacanthus chinensis*

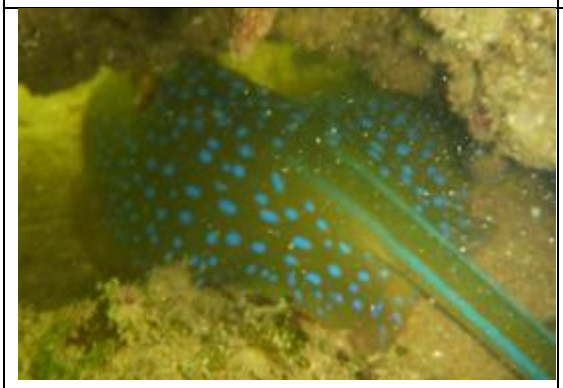
B – *Pentapodus paradiseus*

C – *Centrogenys vaigiensis*

D – *Echinogobius hayashii.*

E – *Apogon sp.*

F – *Amblygobius bynoensis*



G – *Taeniura lymna*

H – *Neoglyphidodon melas*

Photo 5.39 Associated reef fishes found around the reefs of P. Merambong.

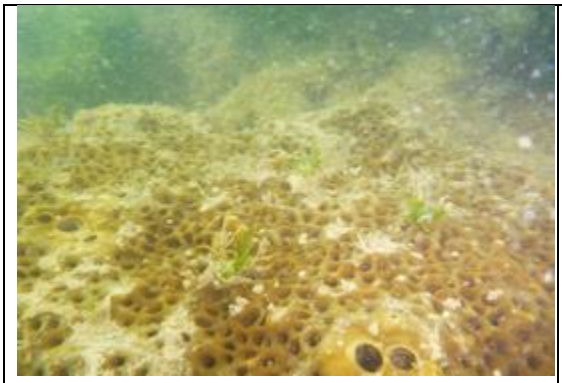
Macroinvertebrates

Seven (7) groups of invertebrates were recorded, which represent about 20 genera in the area. In details, there were five (5) genera of Sponges, seven (7) genera of Echinoderms, two (2) genera of each Molluscs, Ascidians, Polychaetes and Hydroid, and lastly a single genera of Arthropods. A full list of species is given in Appendix G.

The highest diversity was recorded in the southwest (T1), with 16 genera from six (6) groups. In this zone, the most dominant invertebrates were the Sponges, which may also support other inhabitants of this area by serving as substrate for growth of other organisms and as hiding places for both predator and prey /25, 26/. This in turn would lead to the proliferation of diverse inhabitants, typically fish and other invertebrates. In addition, there were also Hydroids, Molluscs, Ascidians, Polychaetes and Echinoderms recorded in this zone.

The invertebrates in the southeast (T2) and northeast (T3) were recorded with 14 and 15 genera, respectively. Both of these zones recorded lesser numbers of Sponges as compared to the T1 area. On the other hand, the lower diversity of macroinvertebrates was recorded at T4 on the northwest of Merambong Island with only Hydroids, Ascidians and Polychaetes, as well as two (2) genera of each Echinoderms and Sponges recorded.

Overall, the invertebrates found were generally common throughout the area. However, the current survey recorded low numbers or absence of algal-grazers such as seahares, snails, limpets, chitons and sea urchins, which are indicators for healthy coral reefs. Without these algal-grazers, the macro algae would proliferate and lead to a reduction of coral cover /27, 28/, which explains the study area.



A – *Spheciospongia sp.*

B – *Gelliodes fibulata*

C – *Synaptula sp.*

D – *Holothuria leucospilota.*

E – *Polycarpa sp.*

F – *Clavelina robusta*

G – *Sabellastarte sp.*

H – *Charybdis sp.*

Photo 5.40 Associated macroinvertebrates found around the reefs of P. Merambong.

Seaweed

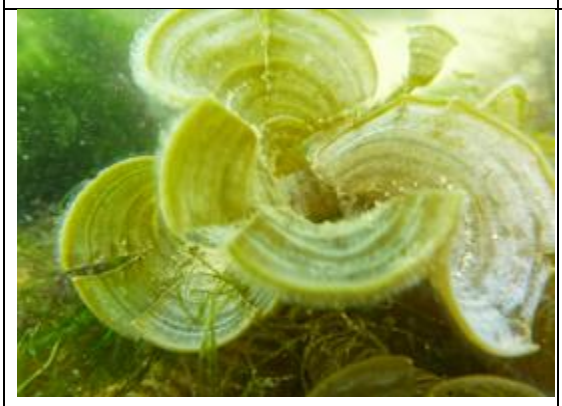
A total of thirteen (13) genera were recorded on the reefs around Pulau Merambong and they are distributed among twelve (12) families (Caulerpaceae, Ulvaceae, Bangiceae, Halymeniaceae, Hypneaceae, Solieriaceae, Siphonocladaceae, Florideophyceae, Phaeophyceae, Bryopsidaceae, Sargassaceae and Dictyotaceae) and the three main phyla (Chlorophyta, Rhodophyta and Phaeophyta – green, red and brown algae) (Photo 5.41). All of the identified seaweed were recorded in all of the areas in the study area.

Among the listed families, Caulerpaceae, Ulvaceae and Halymeniaceae represented the most number of species. Under the family Caulerpaceae, Sea Grapes (*Caulerpa racemosa*), Green Feather Algae (*Caulerpa sertularioides*) and Caulerpa Algae (*Caulerpa taxifolia*) was recorded. Genera under Ulvaceae includes Sea Lettuce (*Ulva lactuca*) and Ribbon Sea Lettuce (*Ulva reticulata*), while under family Halymeniaceae, Ruffled Red Seaweed (*Halymenia dilatata*) and Red Seaweed (*Halymenia sp.*) were recorded.

The proliferation of seaweed in this area may be a product of the high nutrients as seen in the waters of the area (Section 5.1.9), particulary such species as the sea lettuce (*Ulva lactuca)*. Such impacts are a concern as it could affect other inhabitants of Merambong island i.e. corals, seagrass, fish and invertebrates /29, 30, 31/.

A – *Ulva reticulata*

B – *Caulerpa racemosa & C. sertularoides*



C – *Padina sp.*

D – *Sargassum sp.*

E – *Halymenia dilatata*

F – *Gracilaria sp.*

Photo 5.41 Photos of some seaweeds found around the reefs of Pulau Merambong

Seagrass

Four (4) species of seagrass were recorded around Pulau Merambong, which are *Enhalus acoroides*, *Halophila ovalis*, *Thalassia hemprichii* and *Halodule sp.* from two (2) families namely Hydrocharitaceae and Cymodoceaceae. The distribution of the seagrass was very sparse, and was only found in between seaweeds, sponges, gorgonians and hard corals.

The highest diversity of seagrass was recorded in the southeast (T2), with a total of three taxa recorded. Two taxa was recorded in the southwest (T1), while both the northeast (T3) and northwest (T4) recorded a single taxa each.

5.2.4.4 Marine Megafauna

Marine mega fauna consists of large animals commonly found within a marine area. These animals are mostly mammals and reptiles, which either inhabit the marine area or just pass through during migration. The Malaysian water-bodies (i.e. Straits of Malacca, South China Sea and Sulu-Sulawesi Seas) are marine areas where mega fauna have been recorded in the past few years although the knowledge on the distribution of marine mammals throughout most parts of Malaysia remains basic and poorly documented /32/. The project area is located within the Straits of Malacca, being one of the largest estuarine environments in the Southeast Asia regions, characterised by soft-bottom habitats, fringing coral reefs, seagrass beds and mangroves lining the coastlines /33/. Secondary data from existing literature has been used to document this section. Focus is given to literature documenting the marine mega fauna and other species of conservation significance of the Straits of Malacca, specifically, those nearby the proposed project area. For the purpose of this report, this section is categorised into two sub-sections, namely marine mammals and other species of conservation significance.

Tanjung Piai is home to the endangered dugong (*Dugong dugon*), Green Turtle (*Chelonia mydas*) and Spotted Seahorse (*Hippocampus kuda*) /34/, while Choo, C.K. (2007 /36/) reported that Pulai River Estuary is the only place in Malaysia to find significant Spotted Seahorse (*Hippocampus kuda*) population, aside from Sungai Johor estuary /35/. It has the most extensive seagrass bed in the country, large tracts of pristine mangrove forest and some coral reef. Other endangered marine creatures like the dugongs, sea turtles, saltwater crocodiles, pipefishes, and dolphins are also present /36/.

Marine Mammals

Reported Species and Distribution

A total of 27 species of marine mammals from 21 genera and seven (7) families has been recorded to reside or pass through Malaysian waters /32/. Most literature reports findings of megafauna via beach strandings or live sightings. Figure 5.47 shows the location of sightings/findings of these fauna along the coast of Peninsular Malaysia. Table 5.14 list the locations of sightings of mega fauna around Peninsular Malaysia, while Table 5.15 below lists recorded megafauna around Johor waters and the proposed project area.

Figure 5.47 Map showing locations of life sightings and stranding of various cetacean species in Peninsular Malaysia. The letters indicate species observed as per Table 5.15 and locations are listed in Table 5.14 (Source: Ponampalam, L., 2012 /32/).

Table 5.14 List of marine mammal species recorded in Peninsular Malaysia according to location of sightings and their conservation status. (Source: Ponampalan, L. 2012 /32/; Jaaman, S. A. 2004 /38/; Utusan Online 1999 /39/; Bernama Online 2006 /40/; The Star Online 2012 /41/; Choo et al. 2007 /36/ and Jaaman, S. A. 2002 /37/; unless indicated otherwise)

Species	Occurence	Conservation Status (IUCN Red List)
Family Dugongidae Dugong (*Dugong dugon*)	Johor (Pasir Gudang, Sg. Rengit, Tg. Pengelih), Singapore, Langkawi	Vulnerable
Family Phocoenidae Finless Porpoise (*Neophocaena phocaenoides*)	Straits of Malacca, Matang, Pulau Indah (DHI pers. Ob.), Langkawi, Perak, Pahang, Johor estuary, between P. Ubin – Johor, Singapore	Vulnerable
Family Delphiniidae Irrawaddy Dolphin (*Orcaella brevirostris*)	Pantai Merdeka (Penang), Mersing, Straits of Malacca, Matang (Perak), Singapore, Kuala Rompin (Pahang), Sg. Bernam (Selangor)	Vulnerable
Short-finned Pilot Whale (*Globicephala macrorhyncus*)	Jeram (Selangor), Straits of Malacca,	Data Deficient
False Killer Whale (*Pseudorca crassidens*)	P. Redang (Terengganu), Langkawi	Data Deficient
Melon-headed whale (*Peponocephala electra*)	Kg. Kuala Tunjang (Kedah), Sg. Tiang (Perak)	Least Concern
Common Dolphin (*Delphinus sp.*)	Kuala Gula (Perak), Straits of Malacca, P. Tioman (Pahang), P. Pemanggil (Johor), Langkawi, P. Sembilan (Perak), P. Redang & P. Kapas (Terengganu), Singapore.	Least Concern
Spinner Dolphin (*Stenella longirostris*)	P. Tioman (Pahang)	Data Deficient
Indo-Pacific Bottlenose Dolphin (*Tursiops aduncus*)	P. Redang (Terengganu), Langkawi, Singapore, Straits of Malacca,	Data Deficient
Indo-Pacific Humpbacked Dolphin (*Sousa chinensis*)	Straits of Malacca, Perak, Penang, P. Kapas (Terengganu), Malacca, Langkawi, Sg. Pulai (Johor), Singapore.	Near Threatened
Family Physeteridae Sperm Whale (*Physeter macrocephalus*)	South China Sea, Straits of Malacca	Vulnerable
Family Balaenoptera Blue Whale (*Balaenoptera musculus*)	Straits of Malacca	Endangered
Sei Whale (*Balaenoptera borealis*)	Kuala Kedah (Kedah) – DHI pers. Comm.	Endangered

As seen in Table 5.14, thirteen (13) species of marine mammals have been recorded within the waters of Peninsular Malaysia. These species came from thirteen (13) genera and five (5) families. The live sightings (LS) and strandings (ST) that were marked on Table 5.15 are indicted by two (2) letters species' code.

On the other hand, Table 5.15 shows ten (10) species of marine mammals which have been recorded within Johor waters and the proposed project area. The ten species of mega fauna reported here came from ten (10) genera and four (4) families (Table 5.15).

Table 5.15 List of marine mammal species recorded in Johor waters and the proposed project area. (Source: Ponampalam, L., 2012 /32/)

Species	**Occurrence (LS – live sighting; ST – stranding)**
Family Dugongidaae	
Dugong (*Dugong dugon)* – Dd	LS, ST
Family Delphinidae	
Long-beaked Common Dolphin (*Delphinus capensis*) – Dc	LS, ST
Pygmy Killer Whale (*Feresa attenuata*) – Fa	ST
Irrawaddy Dolphin (*Orcaella brevirostris*) – Ob	LS, ST
False Killer Whale (*Pseudorca crassidens*) – Pc	LS, ST
Indo-Pacific Humpbacked Dolphin (*Sousa chinensis*) – Sch	LS, ST
Spinner Dolphin (*Stenella longirostris*) – Sl	LS
Indo-Pacific Bottlenose Dolphin (*Tursiops aduncus*) – Ta	LS, ST
Family Phocoenidae	
Indo-Pacific Finless Porpoise (*Neophocaena phocaenoides*) – Np	LS, ST
Family Ziphiidae	
Ginkgo-toothed Whale (*Mesoplodon novaeangliae*) – Mg	ST

Three species were reported to ply the waters of the southern coast of Johor /32, 36, 37, 38, 39, 40, 41/ and they are:

1. Indo-Pacific Finless Porpoise (*Neophocaena phocaenoides*)
2. Indo-Pacific Humpbacked Dolphin (*Sousa chinensis*)
3. Dugong (*Dugong dugon*)

All these species prefer to inhabit coastal waters close to shore /37, 38, 42/, which is the characteristics of the south coast of Johor, where numerous reports documented the presence of beds of seagrasses with dominant seagrass (from *Halophila sp.* and *Halodule sp.*) /36, 37, 38/, large tracts of pristine mangrove forest and some coral reef /36/.

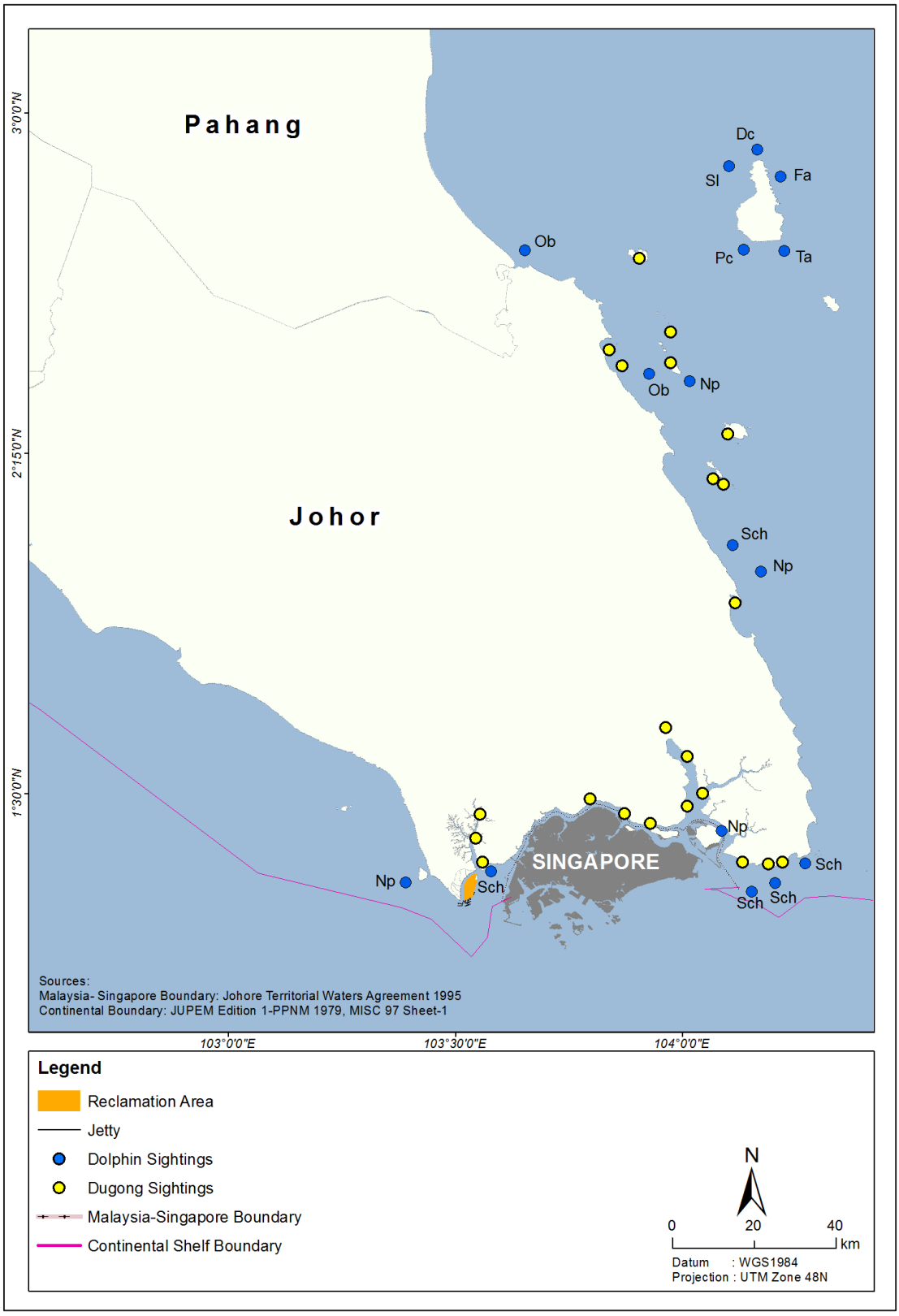


Figure 5.48 List of megafauna recorded around Johor waters and the proposed project area. (The yellow dots indicates dugong sightings while 2-letters in blue indicates other megafauna sightings, as per Table 5.15)

Eighteen (18) observations of mega fauna were made between December 2011 to October 2013 in the southeastern coast of Johor /41, 43/. Fifteen (15) of which were of dolphins, two (2) of dugongs and a single observation of a Green Turtle (*Chelonia mydas*). Two of these

dolphin observations were confirmed sightings of Indo-Pacific Humpbacked Dolphins (*Sousa chinensis*), while thirteen (13) other observations were of undetermined species. A more recent detailed opportunistic observations of mega faunas, specifically dolphins and dugongs were also reported by DHI in the RAPID MOLF EIA report /41, 43/. It is also clear that dolphins sighted ply their route along the southern coastline of east and west Johor /43/, where two species (*S. chinensis* and *N. phocaenoides*) were seen around the waters around Tanjung Piai. Smaller groups of *S. chinensis* (less than 6 dolphins) remain in fairly close, although varied, proximity to each other (roughly 1–20 m) and kept moving up and down along several hundred meters of coastline approximately 200–300 m offshore /44/.

Dugong

The Dugong (*Dugong dugon*) is the most significant marine mammal in Johor waters in terms of conservation /45/. They are the only live member of Sirenia (Dugongidae) that lives in the coastal habitat, which is predominantly determined by their diet which significantly depends on seagrass, especially *Halophila sp.* and *Halodule sp.* /37, 38, 42, 45/.

According to Marsh et al. 2002 /42/, the dugong has a large range that spans at least 37 countries and territories and includes tropical and subtropical coastal and island waters from east Africa to Vanuatu. It is generally believed that throughout much of its range, the dugong is represented by relict populations separated by large areas where its numbers have been greatly reduced or it is already extirpated. But most importantly, the East and Southeast Asia are among the main habitat areas. Globally it is considered to be Vulnerable (to extinction) by IUCN throughout most of its range.

The dugong's historical population status and information in Malaysia are limited except for observational sighting and stranding reports. They have been reported to inhabit waters off Johor, Penang, Sabah (Pulau Banggi) and Sarawak (Lawas). Mansor *et al.* (2000), Jaaman, S. A. (2004) and Ponnampalam *et al.* (2014) summarized recent dugong distribution and abundance in Peninsular Malaysia. They suggested that a small population of dugongs is probably resident in waters around the islands off the eastern coast of Johor where beds of seagrasses such as *Halophila spp.* and *Halodule spp.* were found dominant.

However, Ponnampalam et al. 2014 /45/ reported that besides the eastern coast islands of Johor, the estuaries of Sungai Johor and Sungai Pulai are also the main habitat for dugong population in Peninsular Malaysia, although at a much reduced population size, which may in part be due to major developments nearby. They also reported that grazing trails at these two estuaries were mainly found in areas with high seagrass biomass. This report supports what Choo *et al.* (2007) reported, with photographic evidence of dugong feeding trails which were occasionally seen when the seagrass beds was exposed /36/.

Table 5.16 lists recorded dugong sightings in Johor waters from 1994 to 2012 /41, 43/ and also their approximate distances to the proposed project site. Based on the sightings and stranded reports published earlier, it is believed that areas in the east coast of Johor and Johor Straits are likely to have a high abundance of dugongs due to the existence of scattered seagrass beds. The southwest area of Pulau Sibu was identified as a hotspot for dugongs where daily mean encounter rate was 15.4 dugongs per day or 7.04 dugongs per hour /45/.

While these data give a regional context they do not allow a finite assessment of the project area. Having said that, the lack of extensive segrass beds would imply that any dugong sighted in the proximity of the western mouth of the Johor Straits is most likely to be in transit. Some dugong are known to travel distances of 100s' of kilometres, although the reasons for these passages are not understood. Dugong are sensitive to boat traffic and other disturbances but the effect of such disturbances on movement patterns is not understood.

Table 5.16 Appearance of Dugong in Johor waters (with approximate distance to project site) (Source: DHI, 2014, Ponnampalam *et al.*, 2014)

No	Date	Total	Gender	Areas	Distance to project site
1	1994	2	Female and baby	Pulau Sibu	114 km
2	1995	5	Unidentifiable	Sekakap, Mersing	131 km
3	1996	1	Unidentifiable	Pulau Sibu	114 km
4	1998	1	Unidentifiable	Tanjung Sedili	93 km
5	10.03.1999	1	Male (Juvenile)	Pasir Putih	45 km
6	14.03.1999	1	Female (Adult)	Selat Tebrau	46 km
7	18.03.1999	1	Male (Adult)	Selat Tebrau	46 km
8	23.03.1999	1	Male (Adult)	Pasir Gogok	60 km
9	18.05.1999	1	Male (Adult)	Kampung Jawa	66 km
10	01.06.1999	1	Male (Juvenile)	Tanjung Langsat	55 km
11	23.06.1999	1	Female (Adult)	Pasir Gogok	60 km
12	14.07.1999	1	Male (Adult)	Tanjung Pelepas	2 km
13	16.08.1999	1	Female (Adult)	Johor Lama	60 km
14	28.08.1999	1	Male (Juvenile)	Tebing Runtuh	16 km
15	01.10.1999	1	Male (Adult)	Tanjung Langsat	55 km
16	05.05.2001	1	(Juvenile)	Pasir Gudang	40 km
17	04.07.2001	1	(Adult)	Teluk Kabung	Unknown
18	30.10.2001	1	Female (Adult)	Tanjung Buai	60 km
19	31.10.2001	1	Male (Juvenile)	Tanjung Buai	60 km
20	14.05.2003	1	(Adult)	Tanjung Pelepas	2 km
21	12.04.2006	1	(Juvenile)	Simpang Arang	10 km
22	16.02.2008	1	Female (Adult)	Tanjung Langsat	55 km
23	30.04.2010	1	(Adult)	Tanjung Dato	69 km
24	02.09.2012	1	(Adult)	Sungai Rengit	75 km
25	08.07.2010	66	(Adult & Juvenile)	Pulau Sibu	114 km
26	08.07.2010	15	(Adult & Juvenile)	Pulau Tinggi	126 km
27	08.07.2010	2	(Adult)	Pulau Setindan	134 km
28	08.07.2010	6	(Adult)	Pulau Besar	134 km
29	08.07.2010	1	(Adult)	Pulau Rawa	143 km
30	08.07.2010	3	(Adult & Juvenile)	Pulau Seri Buat	158 km

Conservation Status

The conservation status of these marine mammal species is listed in Table 5.17. Classification is based on the IUCN Red List of Threatened Species (http://www.iucnredlist.org) and the Protection of Wildlife Act 1972 – Act 76, amendment 2006.

Three (3) species are classified as 'vulnerable' under the IUCN Red List, while one (1) species is considered 'Near Threatened', one species listed as 'Least Concern', while the rest are listed as 'Data Deficient'. Under the Protection of Wildlife Act 1972, four (4) species are 'Totally Protected' while the remaining species are classified as 'Protected', while one is not listed.

Two species has been sighted close to the project site: both the Indo-Pacific Finless Porpoise (*Neophocaena phocaenoides*) and the Dugong (*Dugong dugon*) are Vulnerable and are Totally Protected.

Table 5.17 Status of marine mammal species

Species	**Status**	
	IUCN Red Book	**Protection of Wildlife Act 1972**
Family Dugongidaae		
Dugong (*Dugong dugon)* – Dd	Vulnerable	Totally Protected
Family Balaenopteridae		
Bryde's Whale (*Balaenoptera edeni*) – Be	Data Deficient	Totally Protected
Family Delphinidae		
Long-beaked Common Dolphin (*Delphinus capensis*) – Dc	Data Deficient	Not Listed
Pygmy Killer Whale (*Feresa attenuata*) – Fa	Data Deficient	Protected
Short-finned Pilot Whale (*Globicephala macrorhynchus*) – Gm	Data Deficient	Protected
Irrawaddy Dolphin (*Orcaella brevirostris*) – Ob	Vulnerable	Protected
Melon-headed Whale (*Peponocephala electra*) – Pe	Least Concern	Protected
False Killer Whale (*Pseudorca crassidens*) – Pc	Data Deficient	Protected
Indo-Pacific Humpbacked Dolphin (*Sousa chinensis*) – Sch	Near Threatened	Totally Protected
Spinner Dolphin (*Stenella longirostris*) – Sl	Data Deficient	Protected
Indo-Pacific Bottlenose Dolphin (*Tursiops aduncus*) – Ta	Data Deficient	Protected
Family Phocoenidae		
Indo-Pacific Finless Porpoise (*Neophocaena phocaenoides*) – Np	Vulnerable	Totally Protected
Family Ziphiidae		
Ginkgo-toothed Whale (*Mesoplodon novaeangliae*) – Mg	None	Protected

Other Species of Conservation Significance

Seahorse

According to Lourie *et al.* 2004 /46/, seahorses are grouped with pipefishes, pipehorses and seadragons as members of the family Syngnathidae. Thirty-three (33) species of seahorse (genus Hippocampus) are described globally, but it is likely that more species will emerge from further taxonomic research. Most seahorse species have not been studied in the wild.

Seahorses occupy both temperate and tropical coastal waters, with a distribution from about 50 degrees north to 50 degrees south. They may usually be found among corals, macro algae, mangrove roots and seagrasses, but some live on open sandy or muddy bottoms. Certain species may be found in estuaries or lagoons /46/. All the seahorse habitats mentioned can be found in/around Tanjung Piai – Sungai Pulai – Pulau Merambong triangle.

Seahorses tend to be patchily distributed at low densities. They are particularly susceptible to habitat degradation from human activities. Most seahorse species studied exhibit high site-fidelity and small home range sizes, at least during the breeding season. The young of some species are planktonic, entering the water column immediately after birth. The extent of juvenile dispersal by passive means is unknown, but may provide some gene flow among populations /46/.

Seahorse species distribution and abundance around Peninsular Malaysia was studied by Choo & Liew in 2003 /35/, and their spatial distribution is shown in Figure 5.49. Four (4) species of seahorses inhabit the waters around Peninsular Malaysia: *Hippocampus kuda*, *Hippocampus kelloggi, Hippocampus spinosissimus* and *Hippocampus trimaculatus* /35/. However, another species, the Japanese Seahorse (*Hippocampus mohnikei*) was also reported in the northeastern part of Singapore waters (Changi Beach) / Sungai Johor estuary, possibly introduced via ballast waters. There was also an unconfirmed sightings of Hippocampus comes in Pulau Aur (east coast of Johor) reported /47/. This brings the total number of species for seahorses in Peninsular Malaysia waters to six (6) species.

Sungai Pulai is the only place in Malaysia with a substantial population of H. kuda /35, 36/ which can be found inhabiting both the eastern and western parts of Johor Straits, and their distribution extends southwards into Singapore waters /59/, but neither eastwards nor westwards. *H. kuda* is not the only species of seahorse found around Johor waters. *H. trimaculatus*, which is a universal species that can be found throughout the coastal waters of Peninsular Malaysia /35/, was also spotted around the coastal waters of Johor, along with another species, *H. spinossimus*. *H. mohnikei* was only seen near Sungai Johor estuary but nowhere else /48/. Besides seahorses, Alligator pipefish (*Syngnathoides biaculeatus*) is also another Syngnathoid found to inhabit the Merambong Shoal /36/.

It is reported that seahorses used to be aplenty around Tanjung Piai – Sungai Pulai – Merambong Shoal area, where they were harvested and sold to Singaporean middlemen for RM0.50 per individual, but their numbers are dwindling /34/.

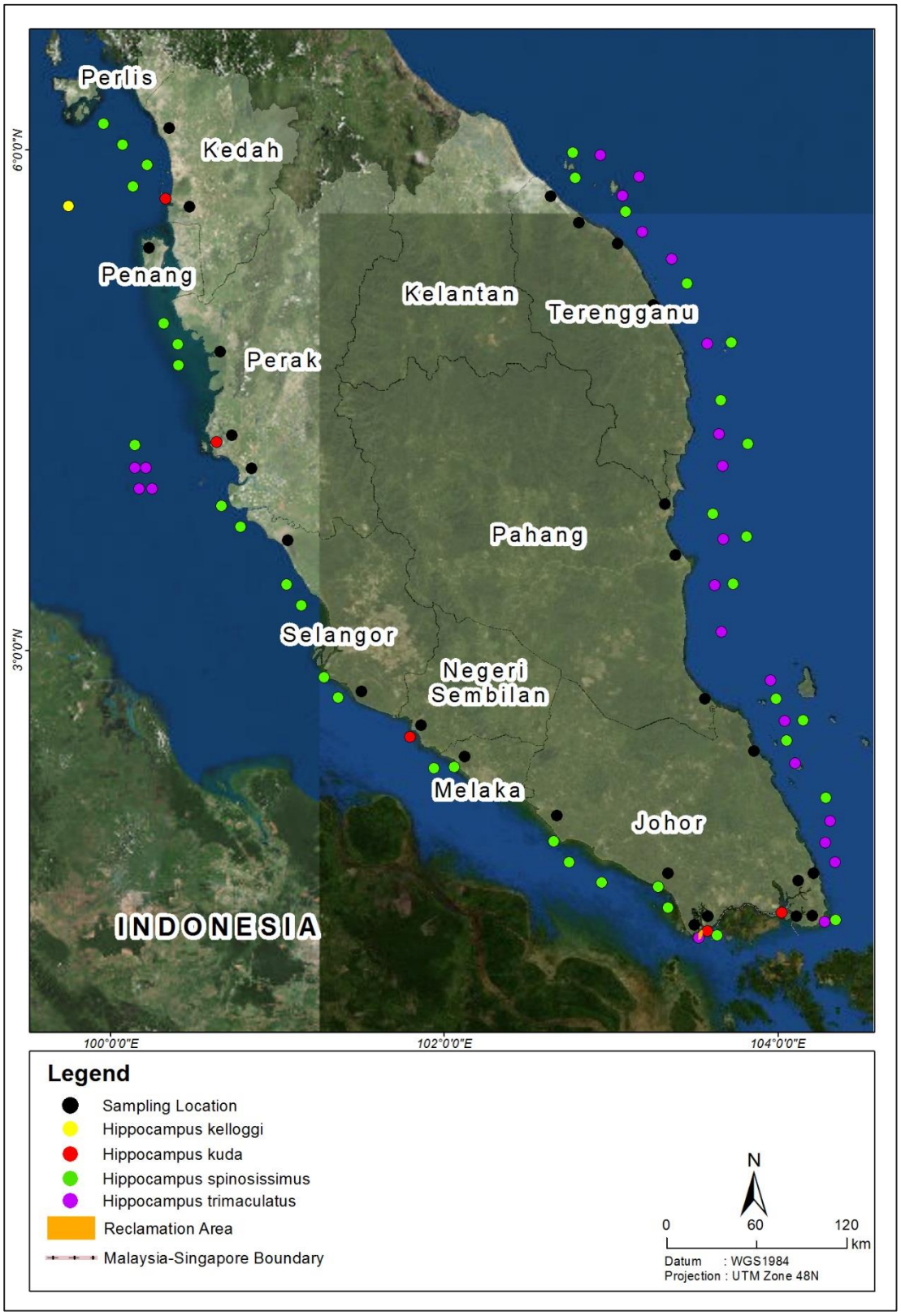


Figure 5.49 Spatial distribution of seahorse species around Peninsular Malaysia. (Source: Choo & Liew, 2003 /35/)

Sea turtle

Marine turtles are considered globally important species /49/. For thousands of years, marine turtles have been a source of food and sustenance for coastal communities in tropical and subtropical regions. /50/. Marine turtles are migratory and represent an open-access resource /50/. They are known to inhabit a range of oceanic and neritic environments throughout their lifecycle /51/, but are also known to occur predominantly in developing countries. These countries stand to lose most from continued decline and have most to gain from reversing negative population trends /50/. The Southeast Asian region has one of the biggest sea turtles nesting populations in the world. There are seven (7) species of marine turtles in the world and six out of these seven species are confirmed to nest in or inhabit Southeast Asian waters /56 /.

Four (4) out of these seven species are found in Malaysia; namely Green Turtles (*Chelonia mydas*), Hawksbill Turtles (Eretmochelys imbricata), Olive Ridleys Turtles (*Lepidochelys olivacea*), and Leatherback Turtles (*Dermochelys coriacea*) /49/. The Green turtle is the most dominant species in Southeast Asia /56/ and in Peninsular Malaysia, Green Turtle (*Chelonia mydas*) are the most widely distributed species, with regionally important populations with about 2,000 – 3,000 nests per year from Peninsular Malaysia alone, while Hawksbill Turtle (*Eretmochelys imbricata*) produced about 200 – 400 nests per year /52, 53/. The nesting beaches in Melaka is one of two most important national rookeries for this species /54/. A few nests are also recorded in the islands of West Johor, although no exact locations were mentioned /56/, but could most probably be Pulau Pisang group of islands off Pontian. However, nesting sites were reported on the islands off the east coast of Johor /55/.

Adult turtles spend the majority of their lives in neritic foraging habitats, such as coastal seagrass beds and reefs /51/, that can be found in Tanjung Piai area. Sexually mature *C. mydas* migrate seasonally to breeding grounds, which are in their natal areas. During their reproductive years, *C. mydas* adults show strong fidelity to these foraging and breeding sites, which can be up to thousands of kilometres apart. Home ranges of foraging *C. mydas* adults are thought to be associated with small abundant patches of macroalgae and seagrass food resources, and that foraging areas could be influenced by the quality of seagrass habitats in these areas (van de Merwe et al. 2009, /51/).

Studies in 2005 identified two species of turtles, Green Turtle (*Chelonia mydas*) and Hawksbill Turtle (*Eretmochelys imbricata*) occurring at Tanjung Piai, however the area represents a minor foraging habitat for them /56/. Within the seagrass areas, no evidence of sea turtles was observed during the surveys nor did the seagrass show any signs of sea turtle grazing. Nevertheless, the probability of Hawksbill Turtles foraging within the Tanjung Piai seagrass beds and Pulau Merambong coral reef is high with the increase in number of nestings recorded in Melaka, as shown in Figure 5.50 /57/. However, the nearest nesting site (Pulau Upeh) is 177 km from the proposed project site, and if the speculated Pulau Pisang group of islands as nesting grounds are true, then this brings the location nearer to 34 km, while on the east coast, the nearest nesting sites would be Pulau Sibu, about 115 km from Tg. Piai.

Salt Water Crocodile

Within Peninsular Malaysia the saltwater crocodile (*Crocodylus porosus*) is not common but can still be found within certain locations (Webb *et al.* 2010). Historically the species appears to have been widespread and attacks on humans were very frequent along the coast during the first half of the 20th Century. While information is limited it has been suggested that the species is breeding within the Nipah swamps of the Pulai River along the Johor strait (Ramsar 2008). In 2013 it was reported in the media that up to 10 specimens have been sighted in the Singapore Sungei Buloh Wetland reserve northeast of the project area in the Johor Straits (http://www.straitstimes.com/the-big-story/case-you-missed-it/story/catch-crocs-sungei-buloh-20130605).

The conservation status of the species in the 2009 IUCN Red List: is LRlc (Lower Risk, least concern). It is an Appendix I listed species under CITES.

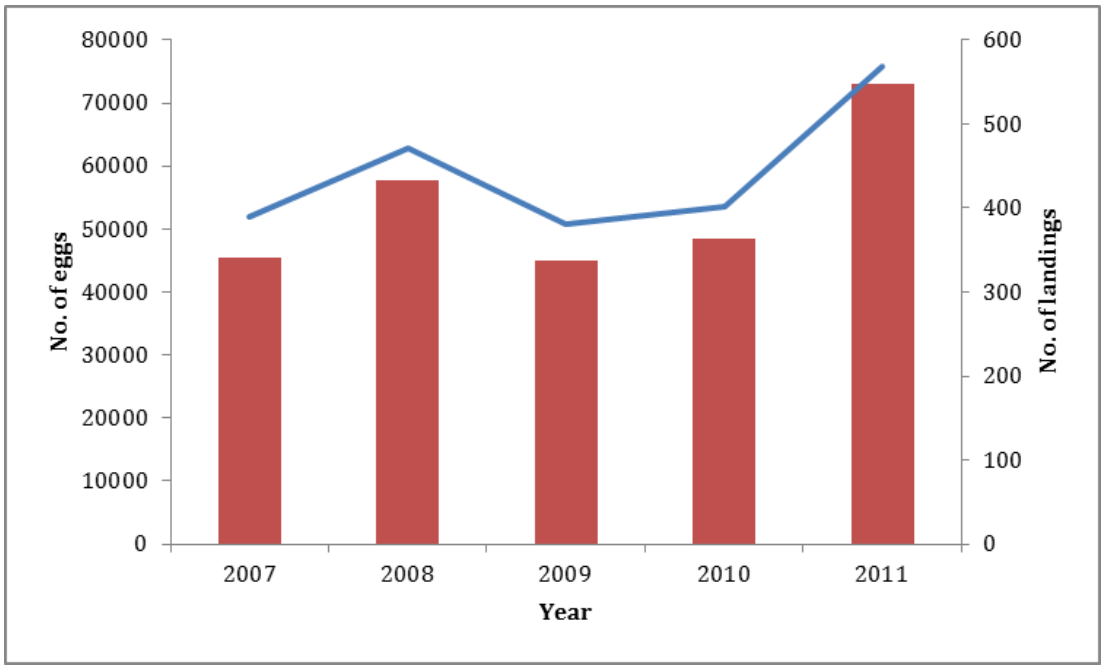


Figure 5.50 Graph showing number of turtle landings versus number of eggs laid in Melaka. (Source: Pontian Sand Source EIA, 2012).

Conservation Status

Seahorses are among the first marine fish species of commercial importance to be listed on CITES, with basking and whale sharks. These fishes are also part of among the largest wildlife trade issues under CITES, in terms of number of animals traded per annum /46/. This fact is further supported by Vincent *et al.* (2011) who reported that most traded seahorses come from trawl by-catch, although the seahorses themselves are specifically targeted /58/; and in the local context, the same finding is reported by Choo & Liew (2005) /59/.

All the species reported to occur in the Johor Straits are listed as vulnerable in the IUCN Red List of Threatened Species, except *H. mohnikei* which is listed as data deficient /14/. However, no legislative protection is accorded to seahorses of any species at the national level.

It is known that there is a direct correlation between the condition of the seabed and the number of seahorse species /35/. The impact that trawling has had on density and distribution of seahorses is undeniable, and it reasonable to assume that the removal of holdfasts and the drastic altering of the habit was a driving force behind seahorse declines.

In Malaysia, marine turtles are within the jurisdiction of the State Government as per Item 12 of List II of the Ninth Schedule of the Federal Constitution. However, according to the Fisheries Act 1985 /60/, the management (although limited) of turtles in waters outside the jurisdiction of any State in Malaysia is within the purview of the Federal Government.

5.2.4.5 Fish Fauna

Fish are a major source of high-quality protein, providing about 16% of animal protein for human consumption around the world /61/. Fish are either caught in the wild or raised through fish farming or aquaculture. In Johor, Tanjung Piai is one of the main fisheries areas for many of the fishermen there. Fishermen coming from Sg. Pulai (Sg. Dinar, Sg. Boh, Sg. Karang) catch the fish mostly by using drift nets. The catch is either consumed or sold to the

market. It is thought that one of the main factors for the high abundance of fish in the area is the use of the intertidal and subtidal mud flats as a feeding ground and the mangrove forest and seagrass beds as nurseries for juvenile fish /62, 63, 64/.

Fish sampling using local fishing methods was carried out at ten stations as shown in Figure 5.51. Sampling was carried out over three separate seasons; the northeast monsoon, the southwest monsoon and during the intermonsoon period.

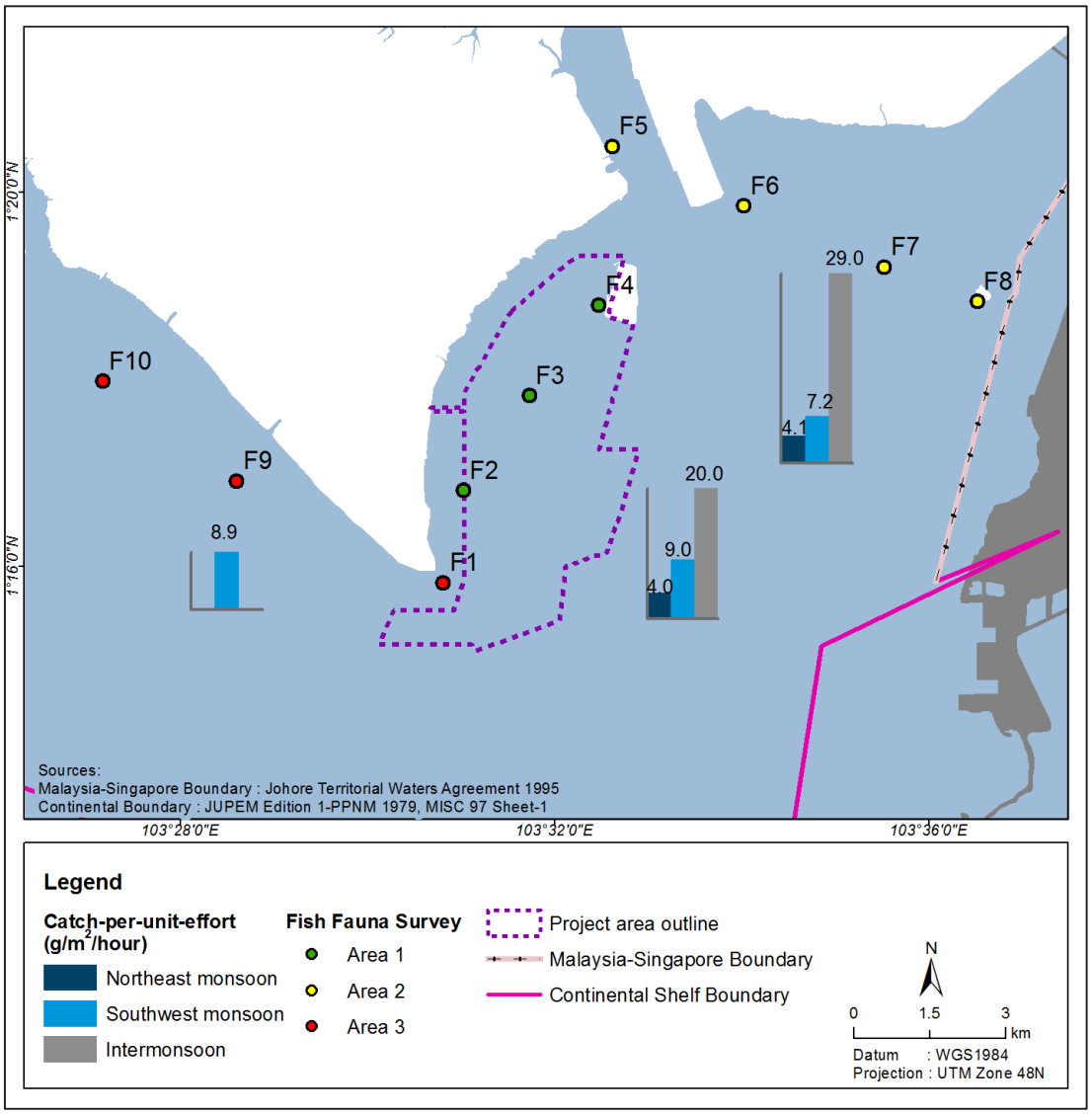


Figure 5.51 Locations of fisheries sampling stations within and around the proposed project area. The pie chart indicates the catch-per-unit-effort (in g/m^2/hr), in blue: western Tg. Piai stations (F9 & F10), red: eastern Tg. Piai stations (F1, F2, F3, F4), and green: Sg. Pulai stations (F5, F6, F7 & F8).

Fish Diversity & Abundance

A total of 333 individuals of fish, 65 individuals of crustaceans (44 individuals of shrimps, 17 individuals of crabs, 3 individuals of mantis shrimp and a single individual of lobster), two (2) individuals of cuttlefish and two (2) individuals of horseshoe crab were caught during three (3) monsoon periods. The fish caught belonged to 24 families and consisted of 52 species, while crustaceans (shrimps, crabs, mantis shrimp and lobster), cuttlefish and horseshoe crab, each belonged to one (1) Family and comprised of seven (7) species.

The data from the current study recorded the highest number of fish and fish species during the southwest monsoon (Figure 5.52), with a total of 148 individuals and 33 species, followed by inter monsoon (145 individuals; 21 species), while the lowest count was during the northeast monsoon (40 individuals; 11 species).

In terms of biomass, the highest biomass value was recorded at the sensitive habitats (Sg. Pulai estuary and Pulau Merambong) during the inter monsoon (28.967 g/m^2/hour), followed by the area within the reclamation footprint also during the inter monsoon (20.033 g/m^2/hour) and the area within the reclamation footprint during southwest monsoon (9.053 g/m^2/hour). High biomass were recorded particularly at the sensitive habitats (Sg. Pulai estuary and Pulau Merambong) and within the reclamation footprint both during the inter monsoon indicates that adult fish are high in seagrass and mangrove habitats reflecting the role of both habitats as breeding, spawning and foraging ground /65, 66/. The lowest value was recorded within the reclamation footprint during the northeast monsoon (4.033 g/m^2/hour).

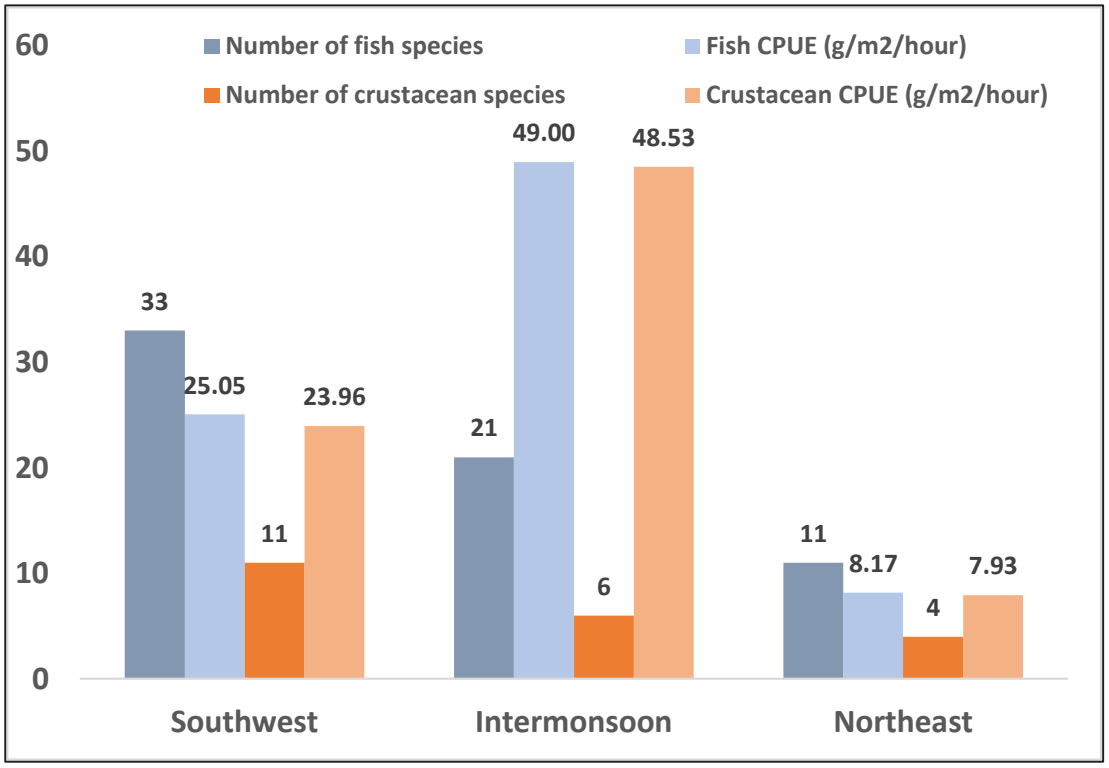


Figure 5.52 Seasonal trend for overall species count and Catch-per-unit-effort for fish fauna and crustaceans from all stations.

Crustaceans Diversity & Abundance

The area between Tg. Piai and Kukup during the southwest monsoon recorded the highest number of crustaceans (34 individuals; CPUE: 0.227/m^2/hour), followed by the area within the reclamation footprint during the inter monsoon (11 individuals; CPUE: 0.073/m^2/hour) and lastly at the sensitive habitats (Sg. Pulai estuary and Pulau Merambong) during the inter monsoon (9 individuals; CPUE: 0.060/m^2/hour). In terms of species, a total of 15 species of crustaceans were recorded at the study area during the northeast, southwest and intermonsoon periods. The highest number of species were recorded within the reclamation footprint (southwest monsoon), followed by at the sensitive habitats (Sg. Pulai estuary and Pulau Merambong) and between Tg. Piai and Kukup both during the inter monsoon with four (4) species for each area.

The area between Tg. Piai and Kukup recorded the highest number of crustacean in terms of number of individuals and species during the southwest monsoon. Crabs were found within the reclamation footprint (stations F1 – F4) during southwest and inter monsoon periods. At

the sensitive habitats (from Sg. Pulai estuary to Pulau Merambong; stations F5 – F8) crabs were present during all seasons (northeast, southwest and intermonsoon). The most dominant was Ketam renjong (*Portunus armatus*).

The highest biomass value was recorded at the sensitive habitats (Sg. Pulai estuary and Pulau Merambong) during the inter monsoon (7.033 g/m^2/hour), followed by the area within the reclamation footprint also during the inter monsoon (1.900 g/m^2/hour) and again at the sensitive habitats (Sg. Pulai estuary and Pulau Merambong) during the southwest monsoon (1.733 g/m^2/hour). The lowest value was recorded within the reclamation footprint during the southwest monsoon (0.733 g/m^2/hour) (Figure 5.52).

The data collected during the course of this study indicates that the highest number of crustaceans and species were recorded during the southwest monsoon, with a total of 43 individuals and 6 species, followed by the inter monsoon (20 individuals; 7 species) and the lowest during the northeast monsoon (2 individuals; 2 species).

5.2.4.6 Plankton Communities

Three (3) major phyla of phytoplankton were recorded in the study area during all three monsoons (Northeast monsoon, Southwest monsoon and Intermonsoon), i.e., Bacillariophyta, Dinoflagellata and Cyanophyta. The study area was divided into 5 main areas (Figure 5.53);

- Area 1: area within the 0 high water line
- Area 2: area within the reclamation footprint
- Area 3: area outside reclamation footprint (more than 3 km)
- Area 4: area at sensitive habitats at Sg. Pulai estuary and Pulau Merambong
- Area 5: area between Tg. Piai and Kukup

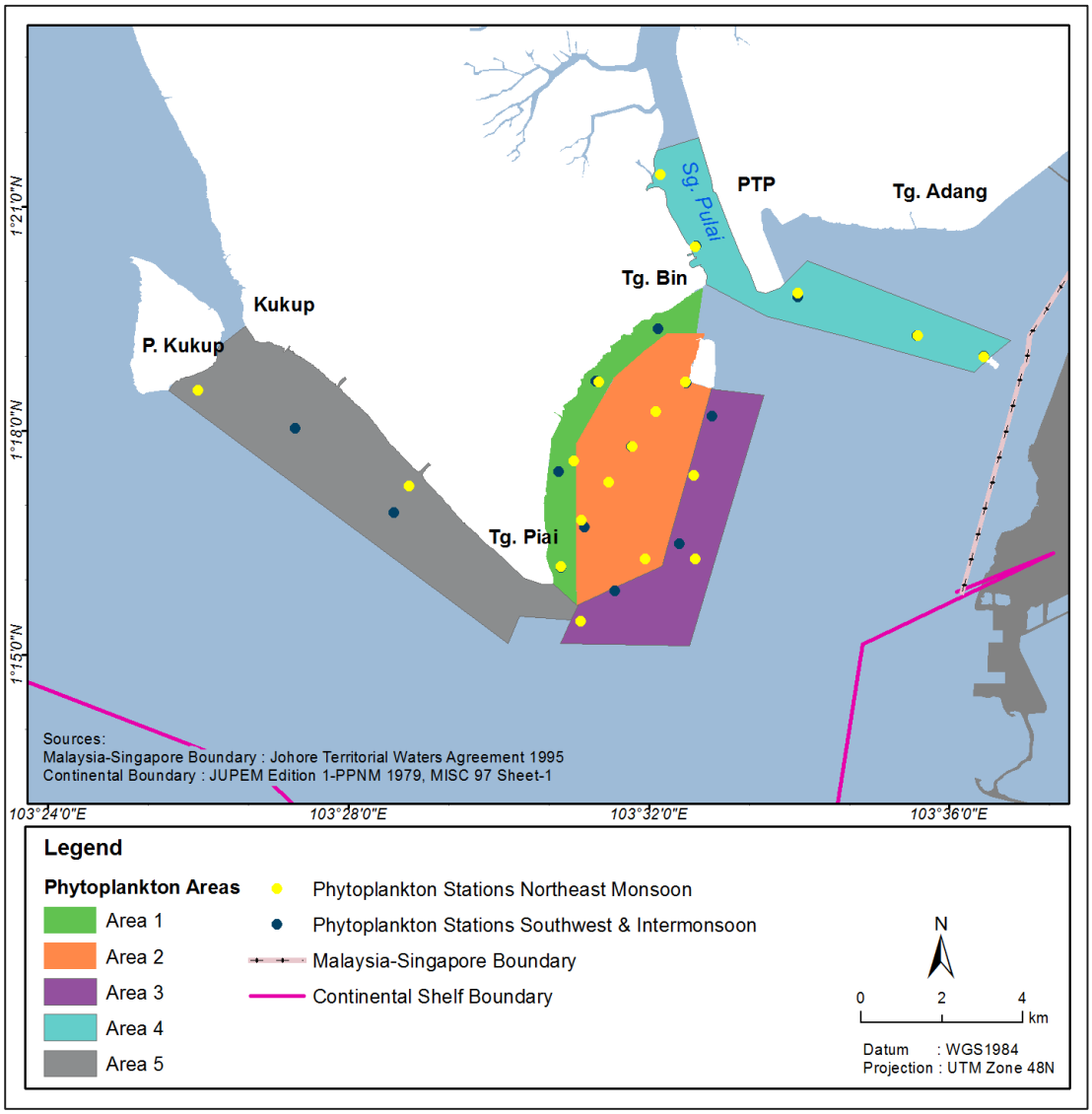


Figure 5.53 Phytoplankton study areas and stations.

The most dominant phylum was Bacillariophyta, which constituted more than 98% of the total phytoplankton density, while Dinoflagellata and Cyanophyta contributed less than 2%. According to Casea et al., (2008) /67/, Bacillariophytes normally form more than 80% of the total phytoplankton biomass in marine tropical waters. In term of density, it ranged from 11.59 cells/ml to 186.34 cells/ml or averaged at 66.86 cells/ml. As for species diversity, the Shannon-Weiner diversity index ranged from 0.65 - 2.56, where most of the stations were found to be moderately diverse.

A total of 29 taxa of Bacillariophyta were recorded at the study area, where the highest number of taxa recorded within the reclamation footprint during northeast monsoon (24 taxa), while the lowest recorded between Tg. Piai and Kukup during southwest monsoon (7 taxa). Most of the taxa found in the study area are common species and also had been reported in other studies in Pulai waters (Refer Appendix G).

In term of speciation, all surveys showed *Nitzschia* as a common taxa encountered at most of the sampling areas, excluding sensitive habitats at Sg. Pulai estuary and Pulau Merambong during intermonsoon, where *Thalassiosira* was more dominant. The mean density of *Nitzschia* ranged from 1.49±1.05 (0.61 – 2.66) cells/ml – 489.55±461.59 (93.61 – 996.54) cells/ml.

As for densities, on the whole, the highest mean density of bacillariophytes recorded within the reclamation footprint during southwest monsoon recorded at 546±479 (123 – 1,066) cells/ml, followed by the outside area of the reclamation footprint (more than 3km) during southwest monsoon (159±136 (32 – 303) cells/mL) and between Tg. Piai and Kukup during northeast monsoon (128 ±79 (74 – 184) cells/ml), while the lowest mean density recorded at the outside area of the reclamation footprint (more than 3km) during intermonsoon (8±4 (4 – 12) cells/ml) (Figure 5.54).

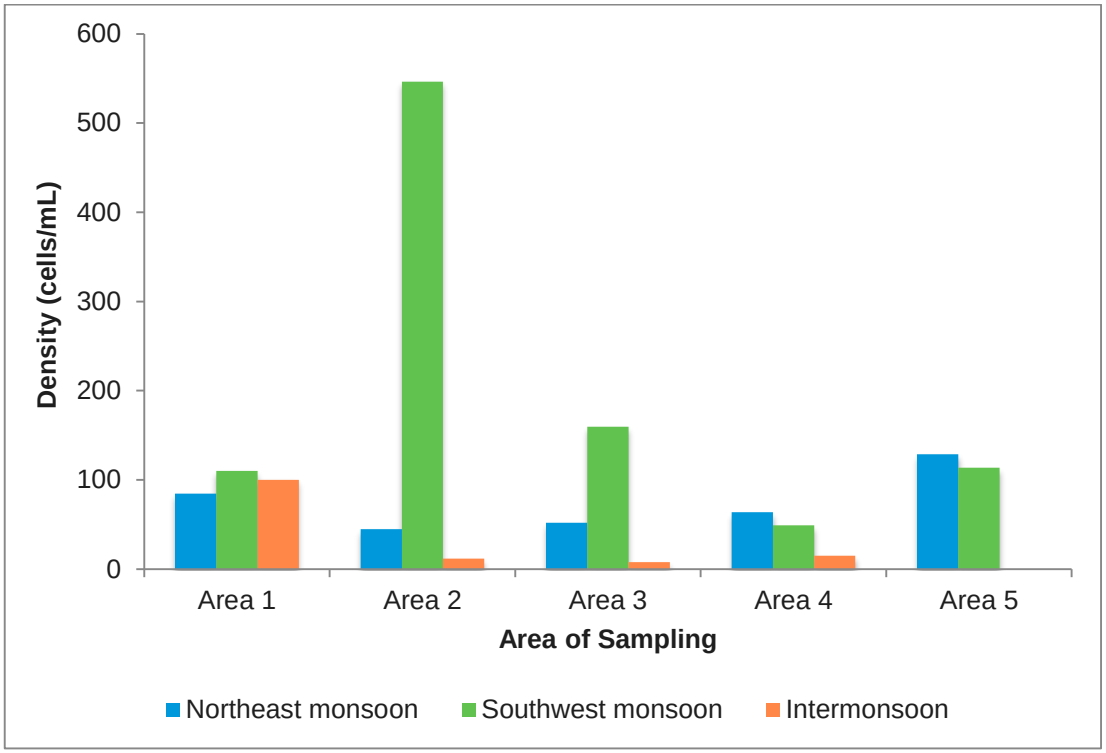


Figure 5.54 Mean density (cells/mL) of Phylum Bacillariophyta at the study area.

On the whole, area between Tg. Piai and Kukup during southwest monsoon recorded highest mean density of dinoflagellate, with value of 8 ±8 (2 – 14) cells/ml, followed by the area within the 0 high water line during intermonsoon (7±12 (0.00 – 24) cells/ml) and the area within the 0 high water line during southwest monsoon (3±1 (2 – 5) cells/ml) (Figure 5.55).

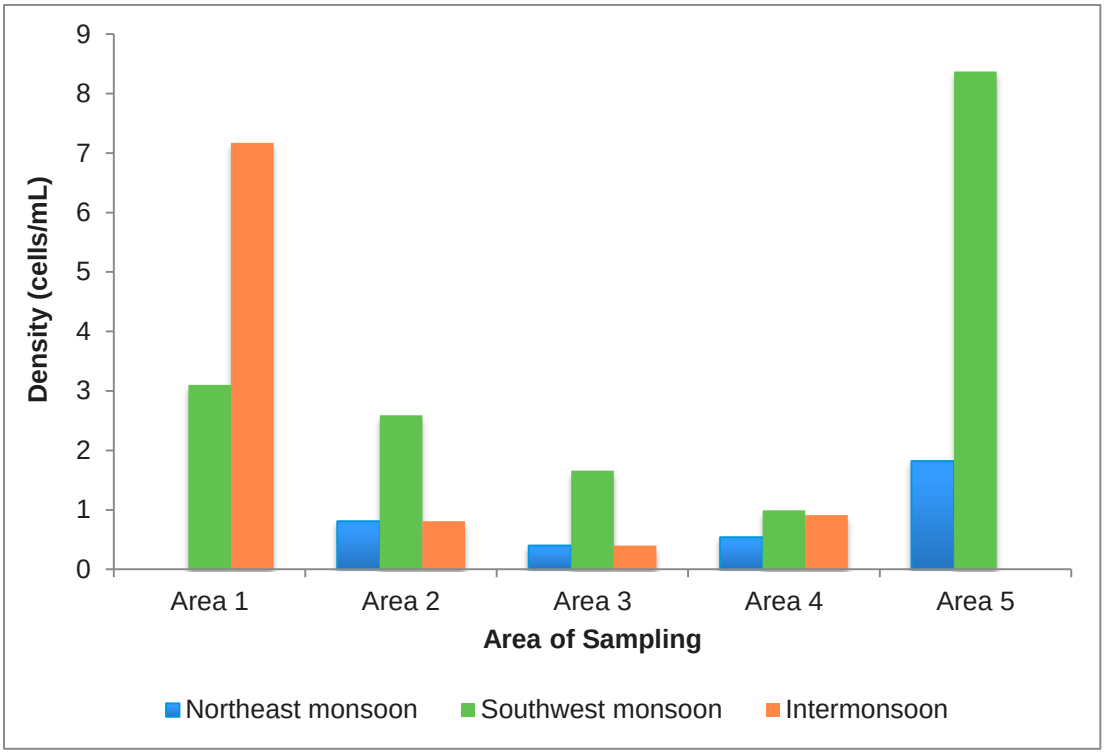


Figure 5.55 Mean density (cells/mL) of Phylum Dinoflagellata at the study area.

It is important to note that, some dinoflagellates are also known to cause harmful algal blooms (HAB). The three dinoflagellates identified within the field survey (*Peridinium spp*., *Protoperodinium spp*. and *Ceratium spp.*) are all known as potential HAB species. HAB (example, *Peridinium spp.)* normally have an abundance range from 3000-7000 cells/mL /68/. During the recent studies in Tg. Piai covering the three monsoons, the maximum density of *Peridinium spp*. (24.22 cells/ml), maximum density of *Protoperodinium spp.* (3.63 cells/ml) and *Ceratium spp.* (0.81 cells/ml); these low values indicate no presence of HAB at the study area.

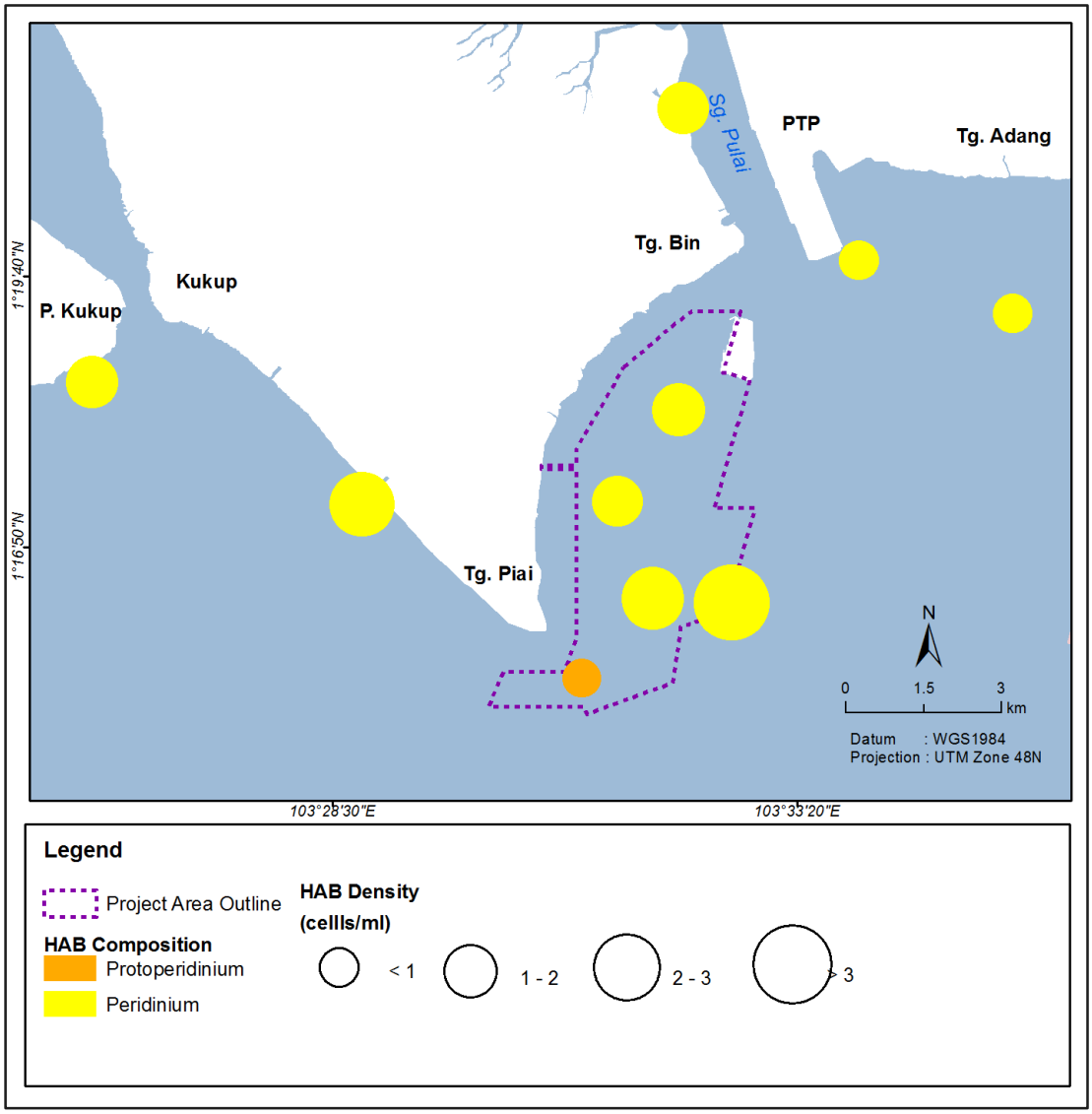


Figure 5.56 Relative density of HAB species found during the Northeast monsoon.

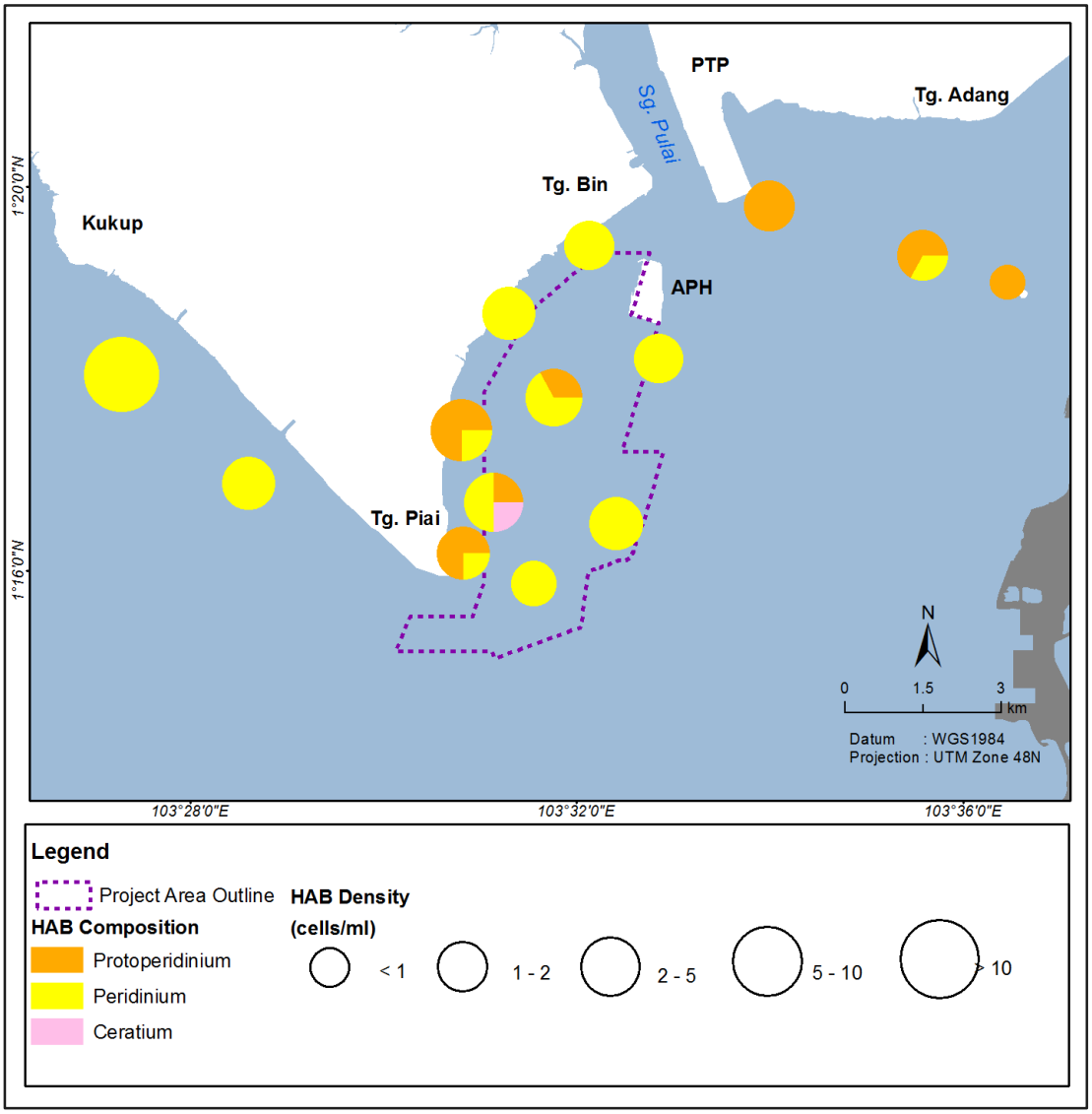


Figure 5.57 Relative density of HAB species found during the Southwest monsoon.

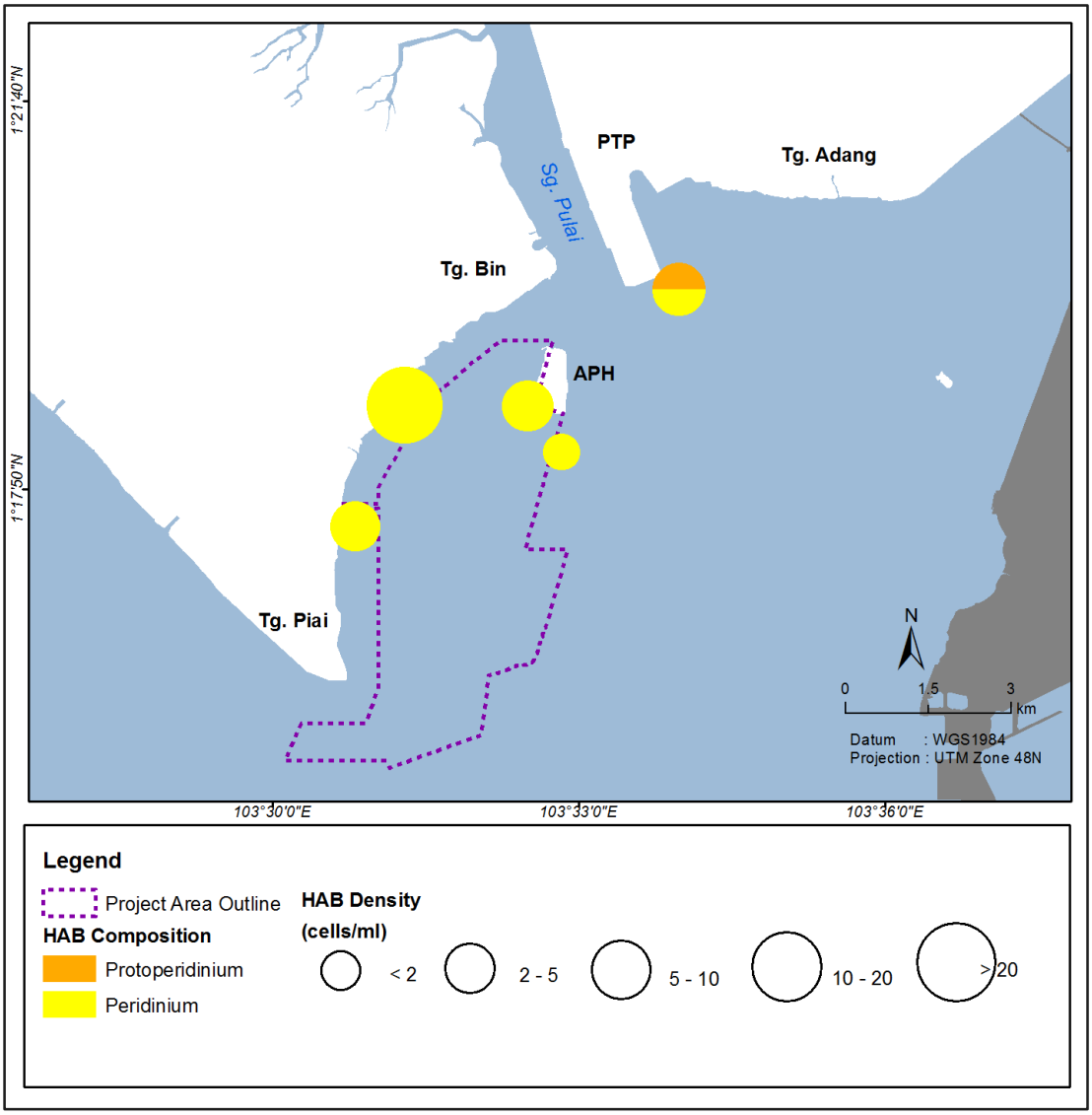


Figure 5.58 Relative density of HAB species found during intermonsoon.

Cyanophyta, as the least abundant group was represented by single taxa i.e. *Trichodesmium*. They only found at the outside area of the reclamation footprint (more than 3 km) and sensitive habitats at Sg. Pulai estuary and Pulau Merambong, with relatively low mean density. The mean densities at sensitive habitats were 0.12±0.77 (0.00 – 1.33) cells/mL (northeast monsoon), 5.10±6.07 (0.00 – 12.00) cells/ml (southwest monsoon) and 0.15±0.77 (0.00 – 1.33) cells/ml (intermonsoon). The outside area of the reclamation footprint recorded mean density of 0.20±0.35 (0.00 – 0.61) cells/ml (southwest monsoon) and 0.44±0.77 (0.00 – 1.33) cells/ml (intermonsoon) (Figure 5.59).

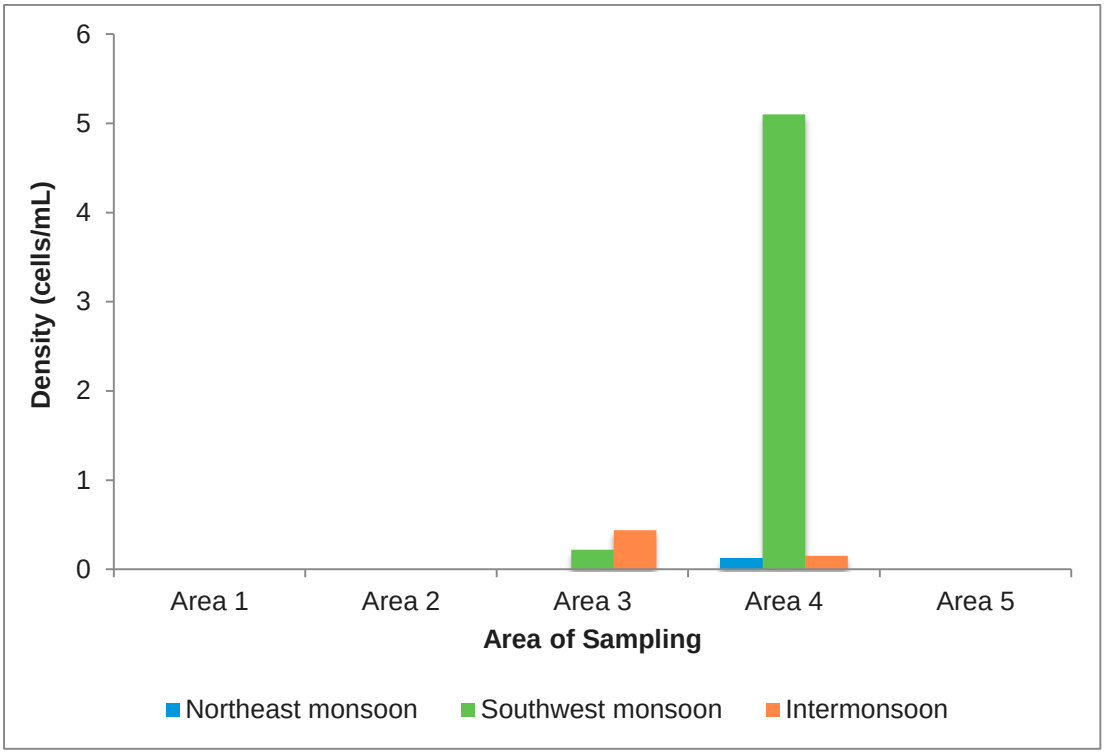


Figure 5.59 Mean density (cells/mL) of Phylum Cyanophyta at study area.

In conclusion, the mean phytoplankton density recorded at 108.75±135.25 (8.76 – 549.04) cells/ml (Figure 5.60). Other studies undertaken at Tg. Bin and Sg. Pulai area indicated low mean density compared to the current study /69, 70, 71/.

In term of season (Figure 5.60), the highest mean density was recorded during the southwest monsoon, recorded at 200.15±198.68 (55.30– 549.04) cells/ml, followed by the northeast monsoon with 75.51±34.25 (45.38– 130.67) cells/ml, while the lowest during was the intermonsoon (36.04±47.48 (8.76– 107.12) cells/ml) (Figure 5.60). High mean density recorded during the southwest monsoon was unclear. However, according to Huang et al. (2004) /72/, growth and blooming of phytoplankton generally caused by the effect of the coastal current and mixing action between offshore seawater and dilution of rivers. On the other hand, significant low mean density during the intermonsoon could be related to vertical stratification, should it occur. According to Mohd Fadzil et al., (2014) /73/, current movement during the intermonsoon period are relatively slow, and therefore, the development of stratification may have happened, although the salinity data do not indicate this.

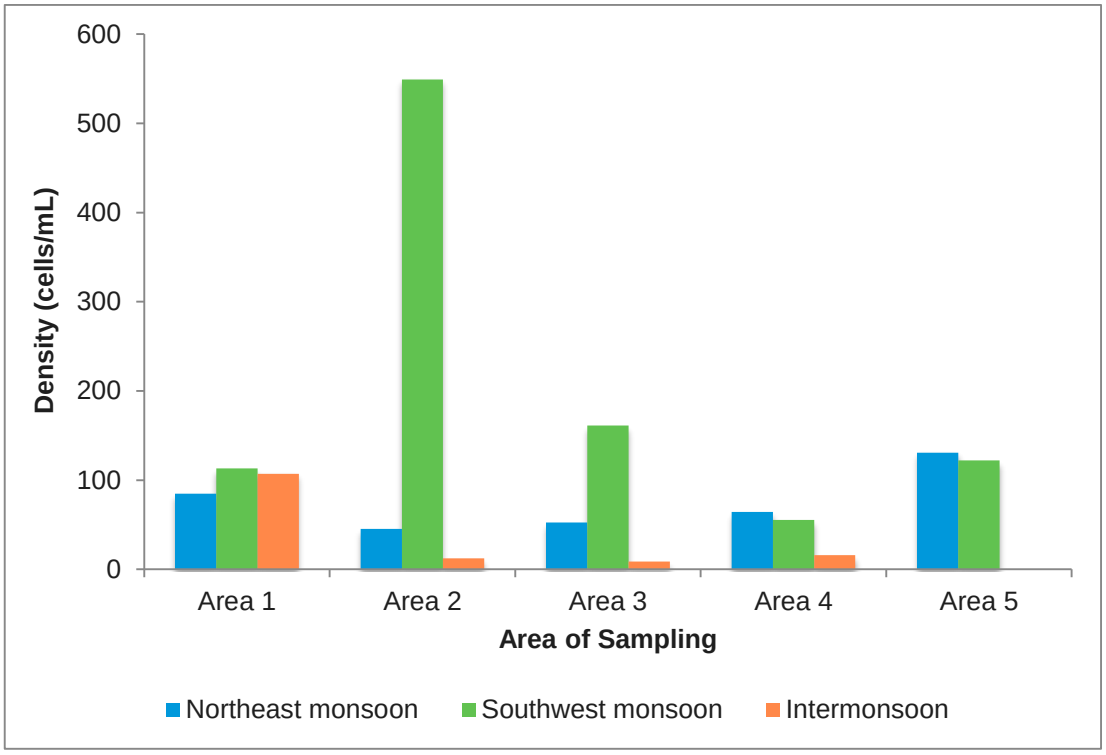


Figure 5.60 Total mean density (cells/ml) of phytoplankton at the study area.

With respect to the recent study, the mean diversity index recorded at 1.46±0.38 (0.73 – 2.22), showed a moderate diversity pattern. Both the highest and lowest values were recorded within the reclamation footprint.

The highest and lowest values recorded during northeast (2.22±0.28 (1.84 – 2.56)) and southwest (0.73±0.36 (0.37 – 1.09)) monsoon respectively (Figure 5.61).

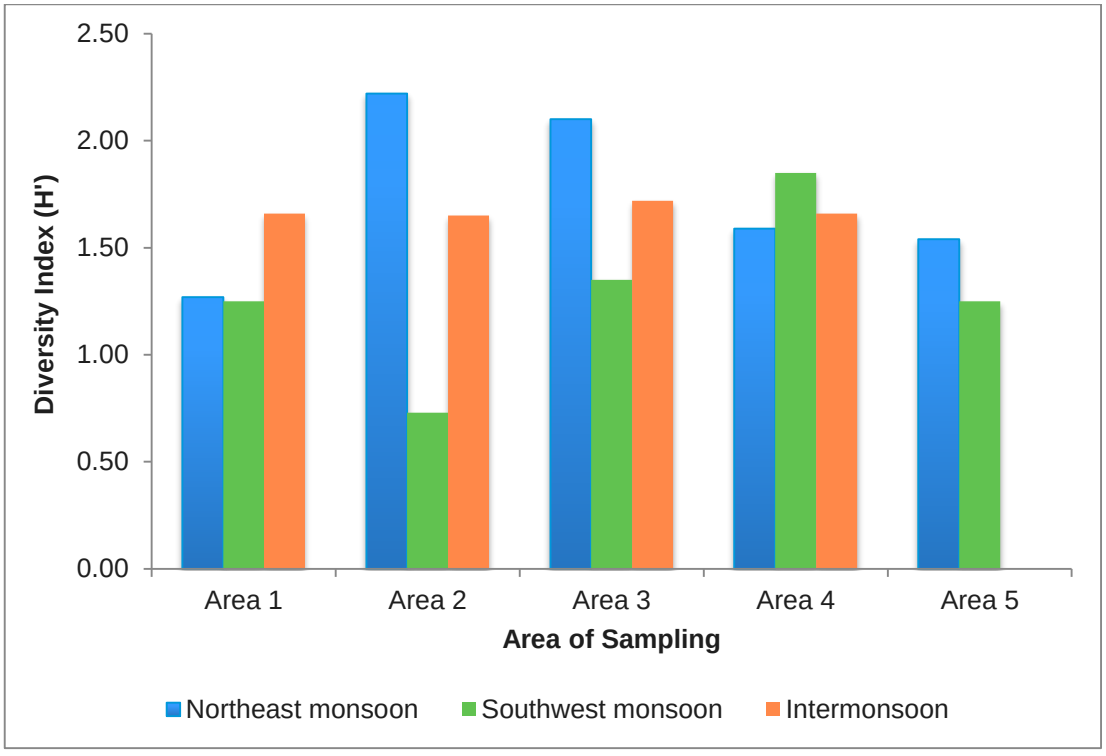


Figure 5.61 Mean diversity Index (H') of Phytoplankton at study area.

Eight (8) phyla of zooplankton were recorded, i.e., Arthropoda (Crustacea), Mollusca, Annelida, Chordata, Chaetognatha, Ciliophora, Cnidaria and Echinodermata. The most dominant phylum was Arthropoda, which contributed 94.84% of the total zooplankton density, followed by Mollusca (1.64%) and Annelida (1.55%), while other phyla recorded less than 1.25% (Figure 5.62). The domination of the Arthropods in the study area was also reported by several other studies in Tg. Bin and Pulai areas. Densities ranged from 1.60 ind./l to 91.25 ind./l or averaged at 20.58 ind./l. As for species diversity, the Shannon-Weiner diversity index ranged from 0.63 - 2.07, where most of the stations were found to be moderately diverse.

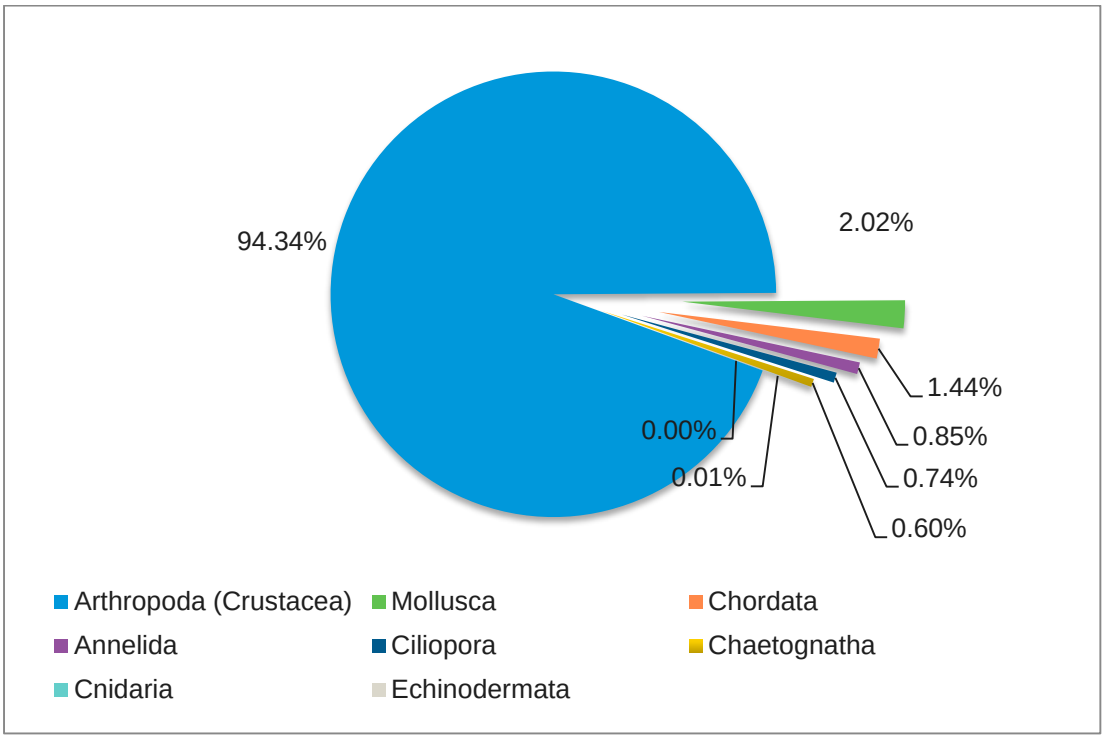


Figure 5.62 Mean composition of the zooplankton at the study area.

Overall, in terms of densities, throughout the three (3) monsoon periods i.e. northeast monsoon, southwest monsoon and inter-monsoon, the mean density was recorded at 34.18±34.92 (5.32 – 142.35) ind./L. The highest mean density was recorded during the southwest monsoon (57.98±49.81 (19.98 – 142.35) ind./L) followed by inter-monsoon (24.12±16.79 (11.63 – 48.06) ind./L), while the lowest during the northeast monsoon (18.42±12.32 (5.32 – 37.23) ind./L) (Figure 5.63).

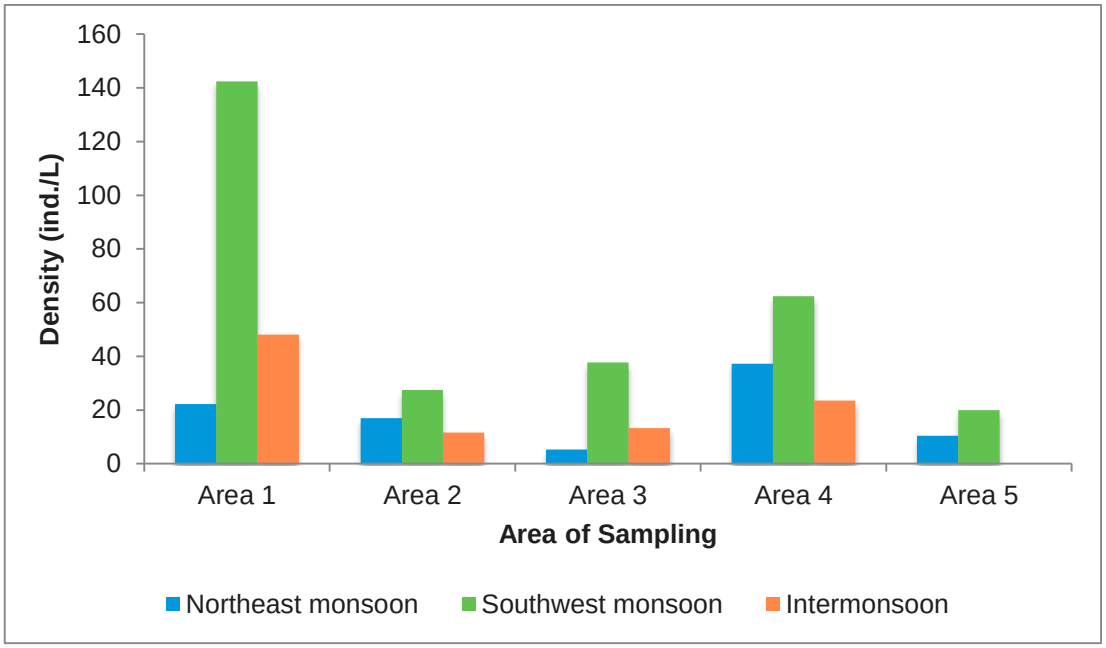


Figure 5.63 Total mean density (cells/ml) of zooplankton at the study area.

With respect to the current study, the mean diversity index recorded at 1.75±0.16 1.47 – 2.00), showed a moderate diversity pattern.

The highest value recorded at sensitive habitats at Sg. Pulai estuary and Pulau Merambong during southwest monsoon, with value of 2.00±0.21 (1.78 – 2.27), while the lowest was at outside area of the reclamation footprint (more than 3km) during intermonsoon (1.47±0.03 (1.45 – 1.50))

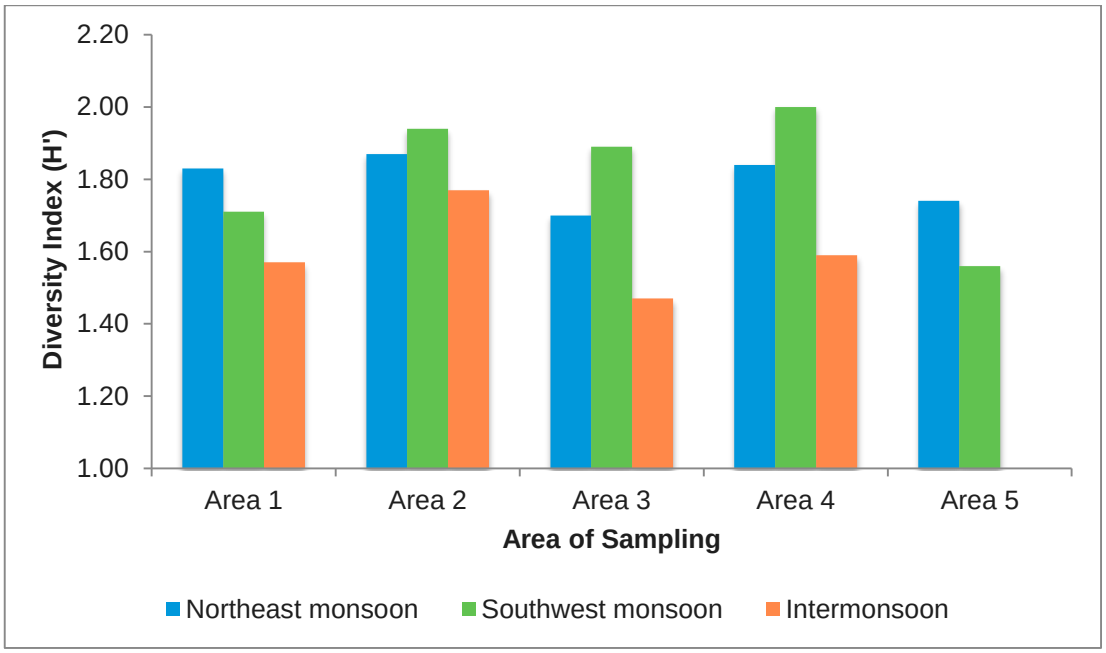


Figure 5.64 Mean diversity (H') of zooplankton at the study area.

5.2.4.7 Benthic Communities

Composition and Diversity

There were eight (8) different phyla recorded in the study area, with Annelida, Arthropoda (Crustacea), Mollusca, Echinodermata, Chordata and Sipuncula being found during northeast, southwest and intermonsoon, while Platyhelminthes was only recorded during northeast monsoon and Cnidaria only during the intermonsoon. The most dominant phylum was Annelida, which accounted 60 % of the total macrobenthic population, followed by Mollusca (20%) and Arthropoda (Crustacea) (18 %). Minor phyla i.e. Echinodermata, Chordata, Sipunculida, Cnidaria and Platyhelminthes only contributed less than 2%. The domination of the annelids in the marine water was also similarly reported by several studies in Tg. Bin and Pulai area.

The greatest abundance of the macrobenthos was recorded during the northeast monsoon with mean density of 320±114 (range: 126-535) ind./m^2, followed by inter monsoon with 314±266 (63-1,840) ind./m^2 and the lowest during the southwest monsoon with 267±247 (56-1,343) ind./m^2. The mean density of macrobenthos in the study area are shown in Figure 5.65. The higher density of macrobenthos during the northeast monsoon is most probably due to less demersal fish recorded at the study area as compared to the southwest monsoon. Most demersal fish consume largely benthos as their main diet /74, 75/. However, environmental conditions like salinity, oxygen, temperature and nutrients are also known to influence the composition and distribution of macrobenthos /76, 77/. In terms of species diversity, the mean Shannon Weiner Diversity Index values were recorded at 2.69±0.60 (0.34 – 3.65).

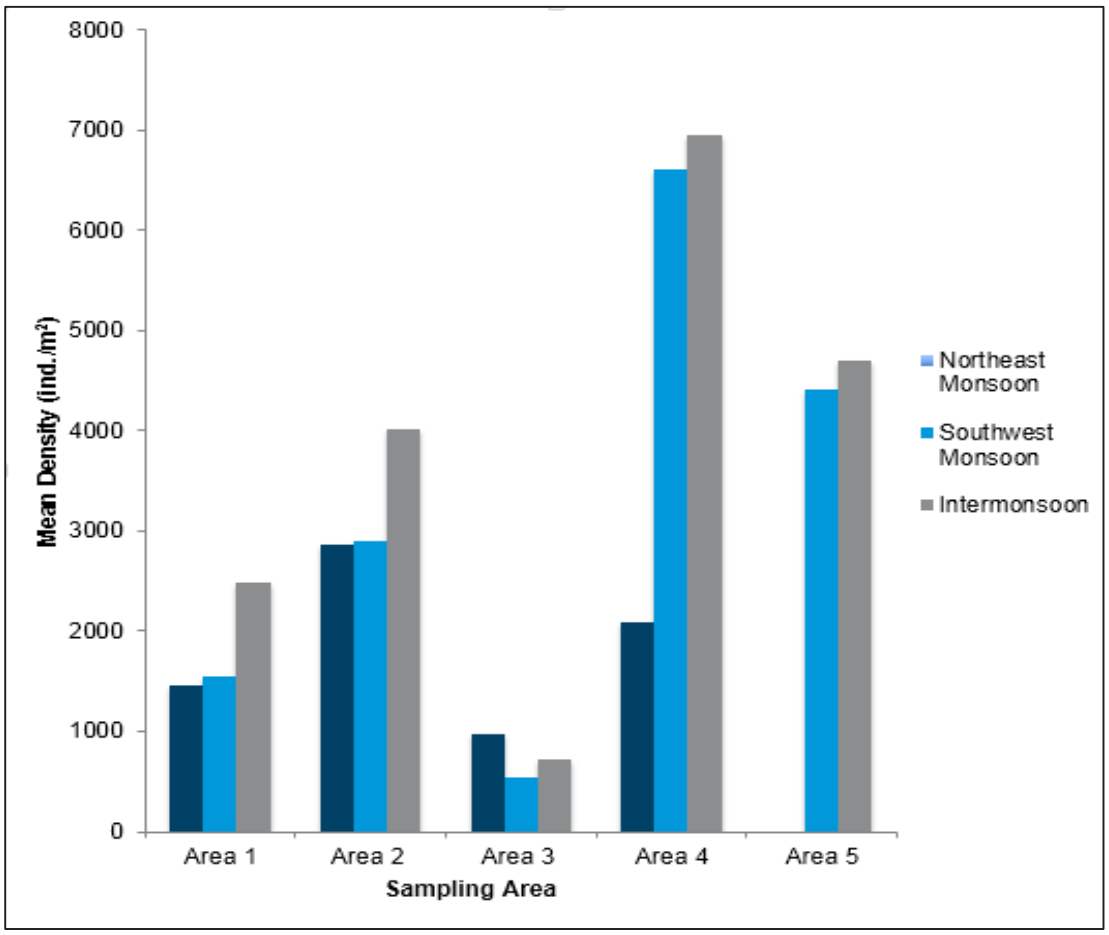


Figure 5.65 Mean density (ind./m^2) of macrobenthos at study area.

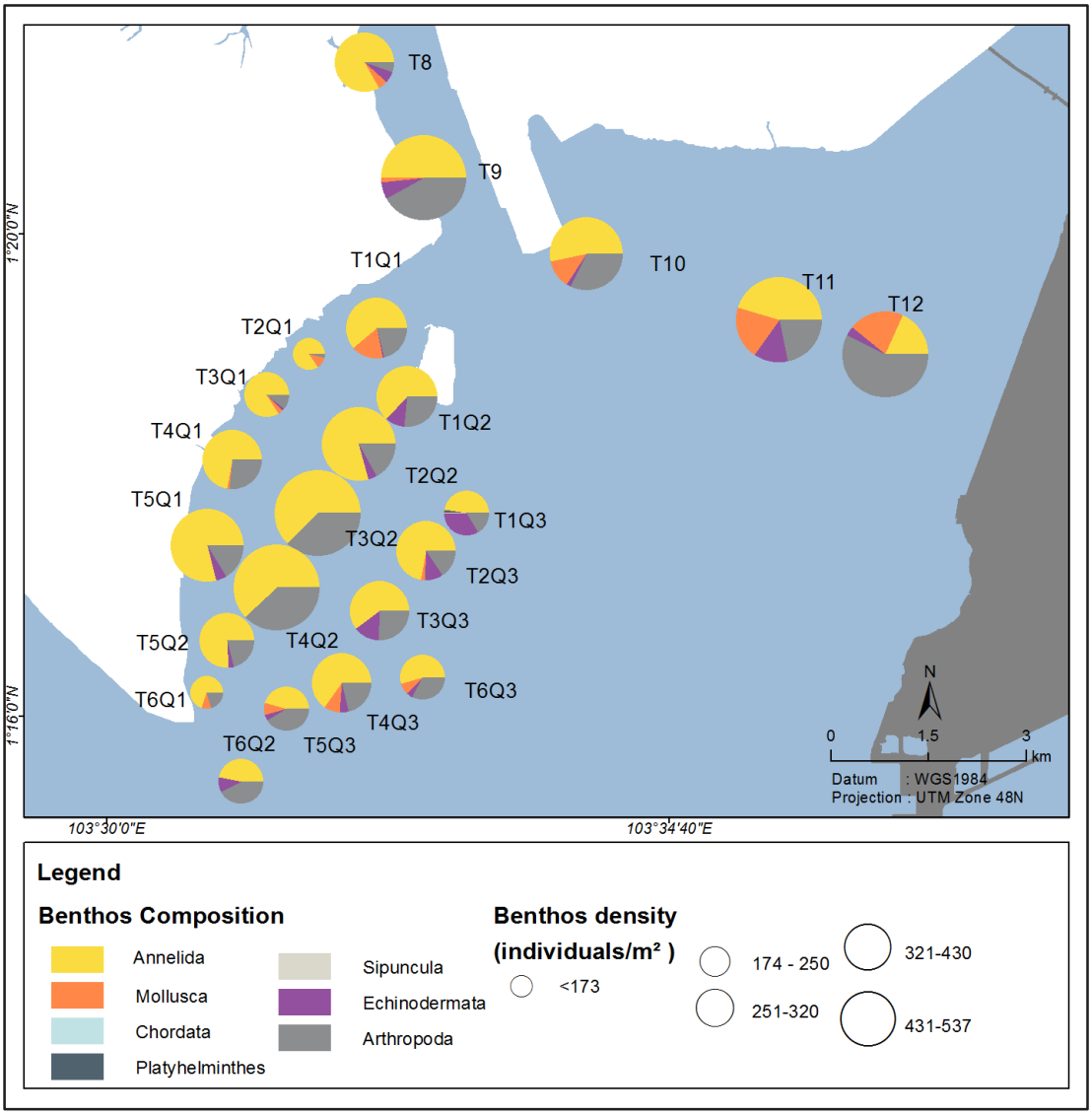


Figure 5.66 Benthos composition and density within the project area during Northeast monsoon.

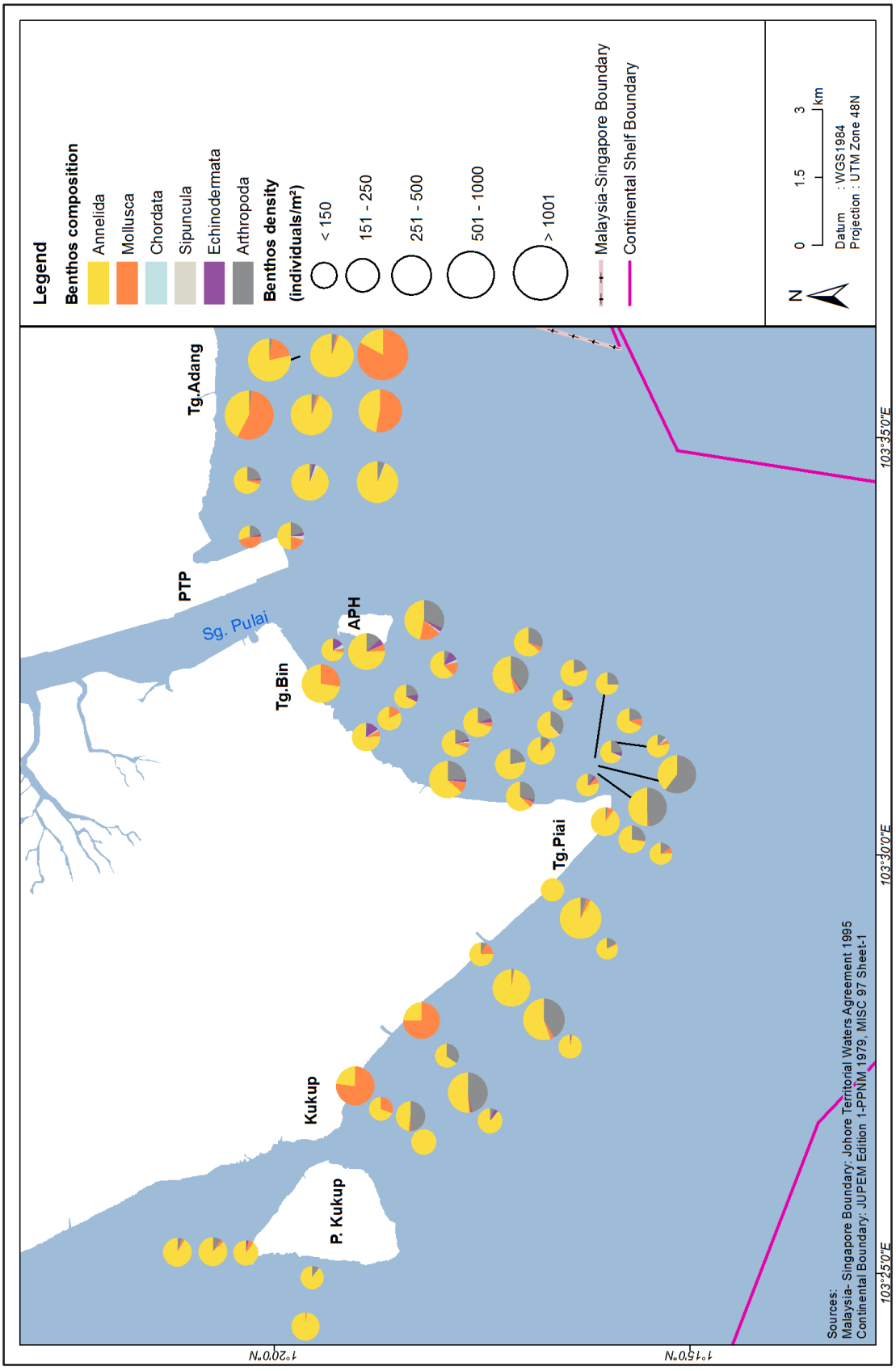


Figure 5.67 Benthos composition and density within the project area during Southwest monsoon.

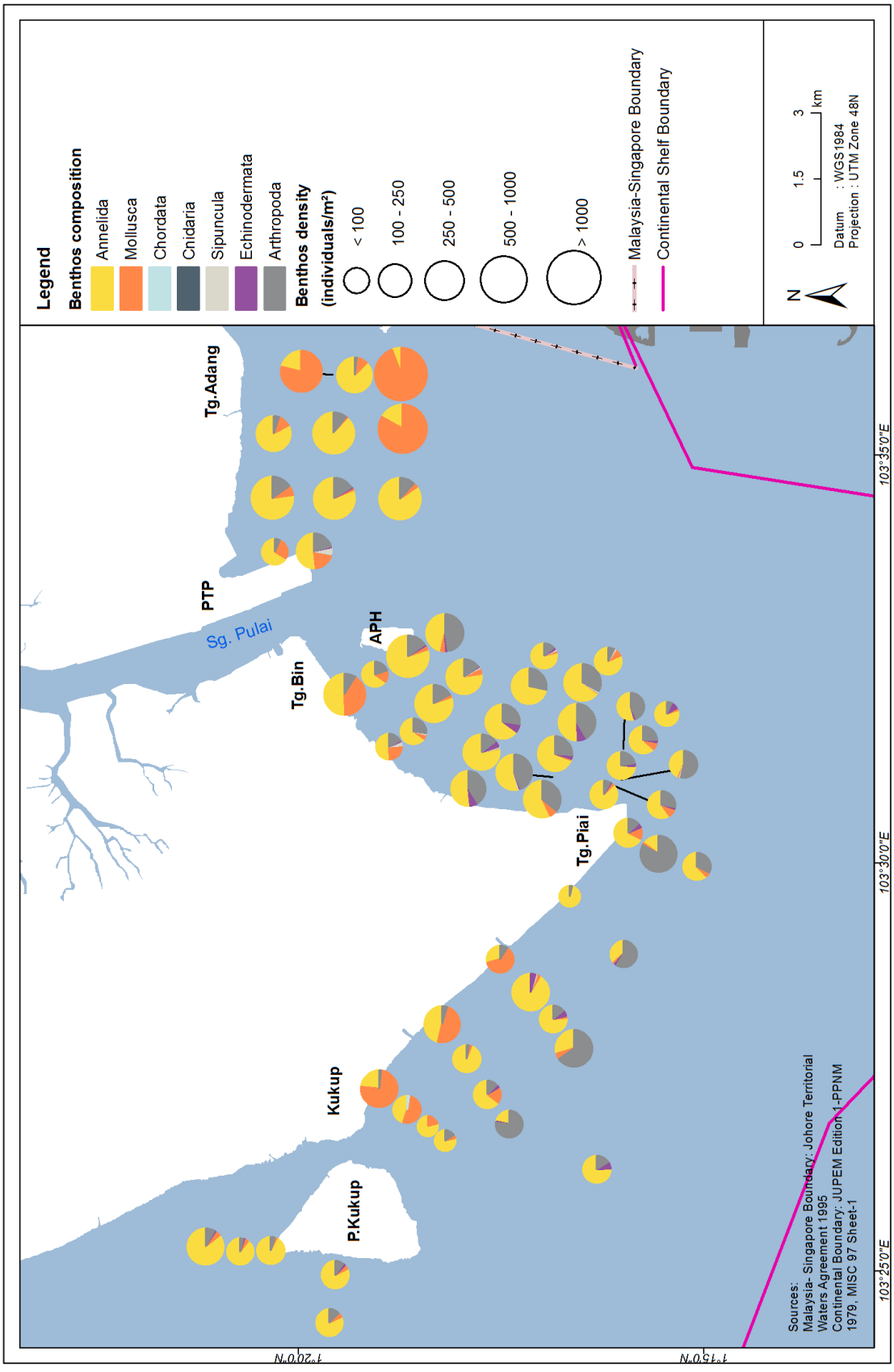


Figure 5.68 Benthos composition and density within the project area during intermonsoon.

Biomass

Benthic biomass surveys revealed gradients of biomass. Mean total biomass was highest in the northeastern part of the study area, while lowest on the western coast of Johor (Figure 5.69 to Figure 5.71).

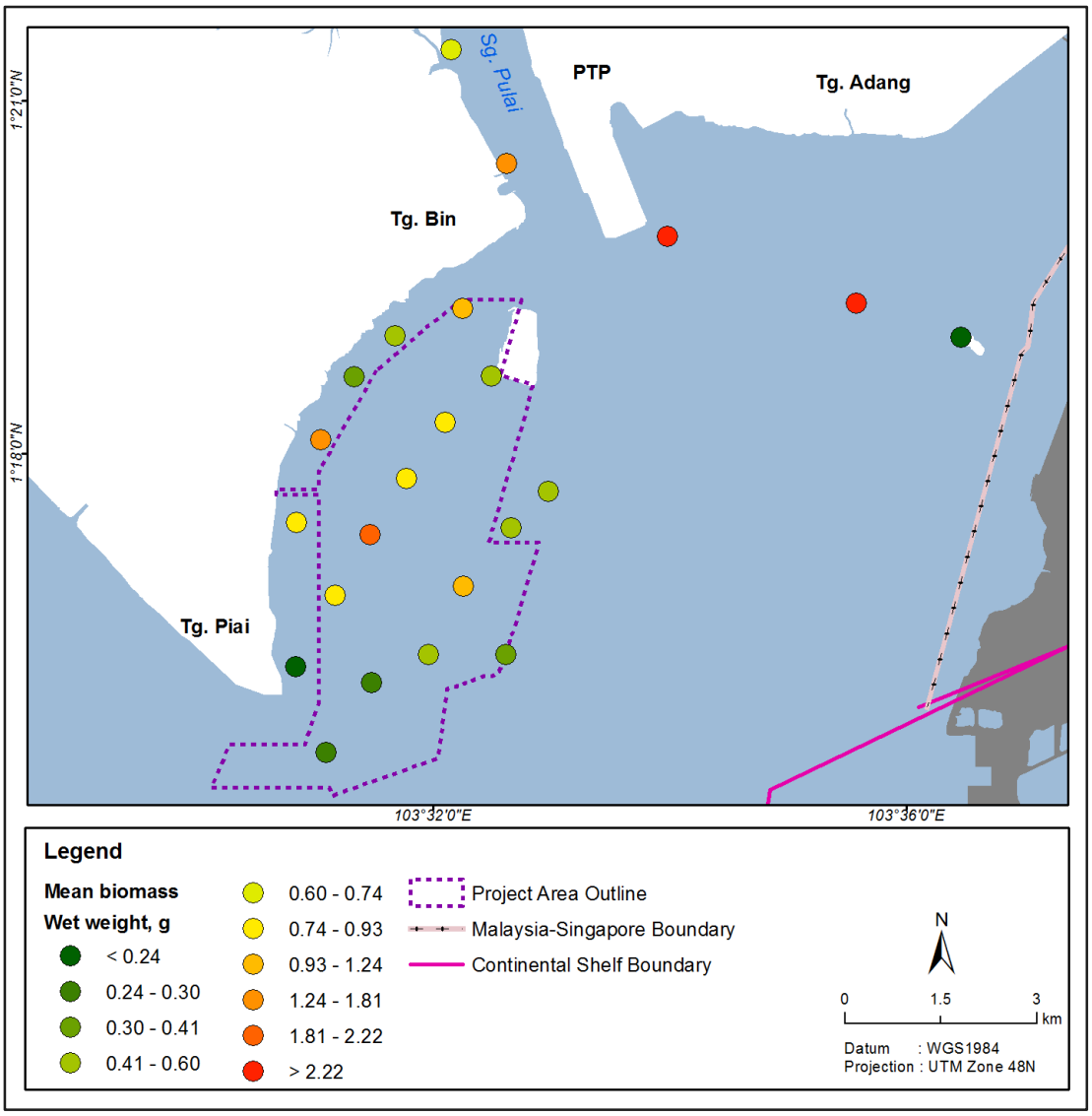


Figure 5.69 Mean zoobenthos biomass during northeast monsoon.

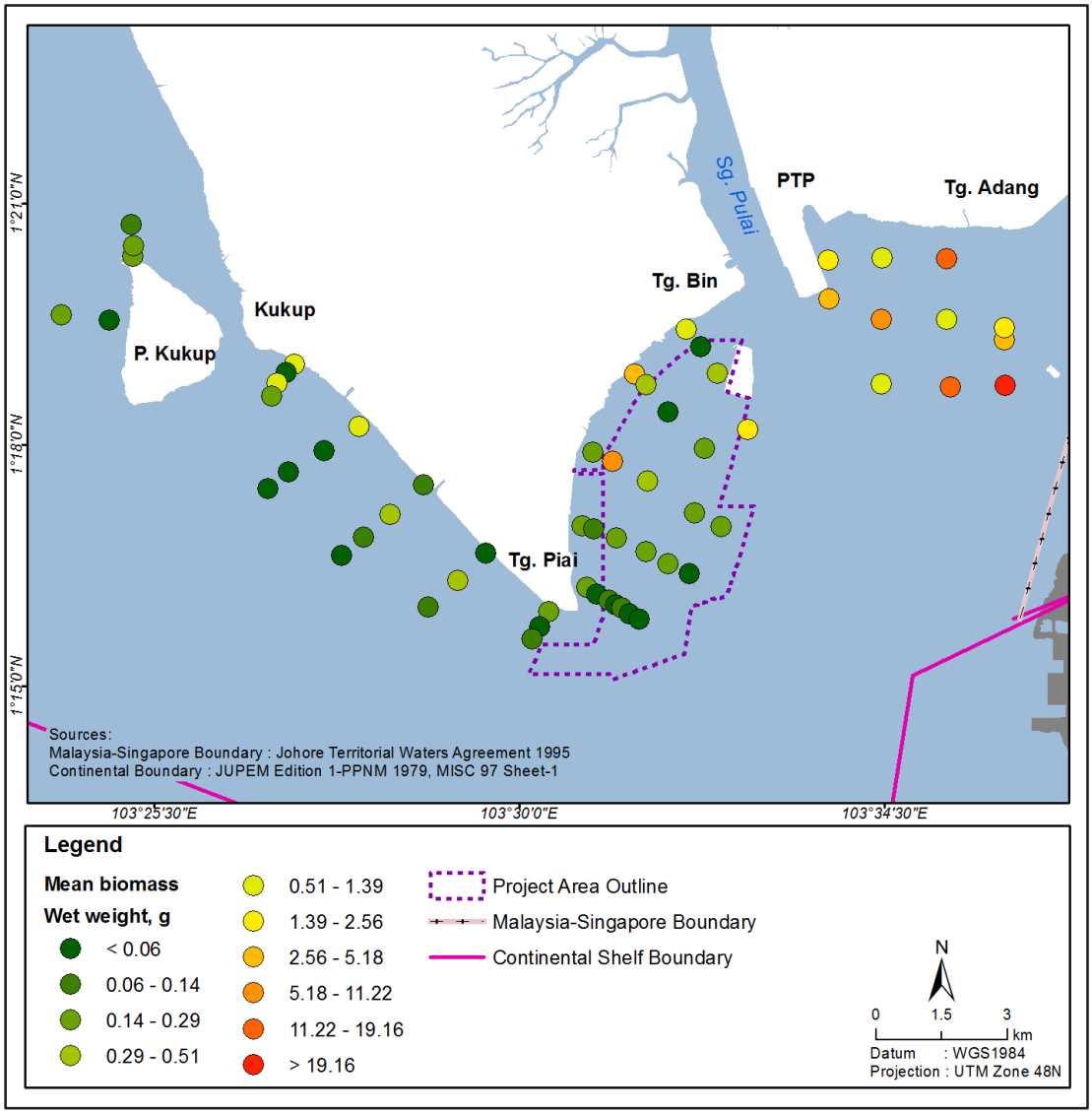


Figure 5.70 Mean zoobenthos biomass during southwest monsoon.

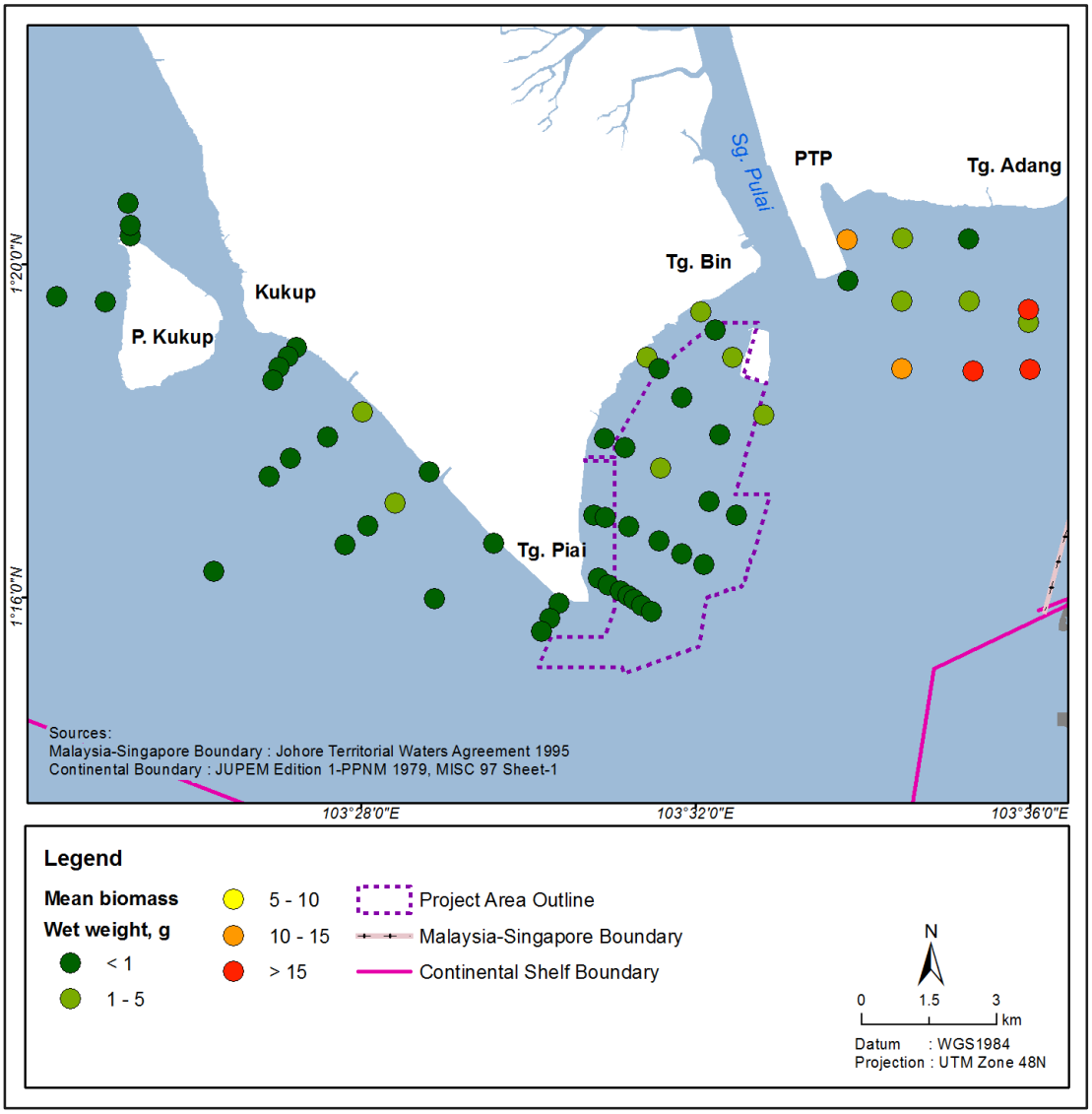


Figure 5.71 Mean zoobenthos biomass during intermonsoon.

Habitat Modelling

Regional distributions of individuals, populations and species in a coastal or estuarine environment are largely determined by primary level processes associated with climatic and environmental factors coupled to the tidal dynamics, whereas biotic and anthropogenic interactions are secondary processes that may alter the patterns. Hence, it would be unwise to consider the current distribution of habitats and species in the study area from a static point-of-view and disregard current influences of human activities when evaluating the present status or the potential impact from this project.

Although the sampling effort for most biological components as outlined above has been relatively high compared to many similar EIA studies in the country, there are still limitations in the scope especially to capture larger scale patterns and temporal cycles. In order to address these constraints, habitat models have been developed for the benthic communities as a key potential receptor to this project as per the approved TOR. An initial attempt to model the avifauna has not been successfully undertaken as a result of data limitations and will not be describe here. Work is ongoing to see if an avifauna model can be developed.

The habitat modelling employs predictive statistical modelling which describes the spatial distribution of a species or species groups as a function of environmental predictors such as sediments, disturbance, food resource availability, water depths, currents, and so forth. In

such a way the spatial distribution of the species or communities in question (and their responses to change) can be predicted without having to establish data-heavy local mechanistic models which describe all possible interactions between species and biotic and abiotic factors.

The models are based entirely on empirical local data for the response variables (species) and on empirical and modelled predictor variables (i.e. hydrodynamic models). The baseline sampling was aligned with the design of the hydrodynamic models in order for the habitat models to provide comparable, coherent, if not complete, descriptions of the existing patterns of priority species and habitats for the entire region in question (i.e. providing estimates for areas not sampled).

A combination of dynamic and static environmental variables were evaluated for their capacity to predict macrobenthos (Figure 5.72). Dynamic variables were computed for the three monsoon seasons. For the macrobenthos, dynamic variables were integrated based on position, and averaged over the survey period. Further, the static variables of bottom slope, sediments type, exposure to pollution sources and shipping intensity were also further included.

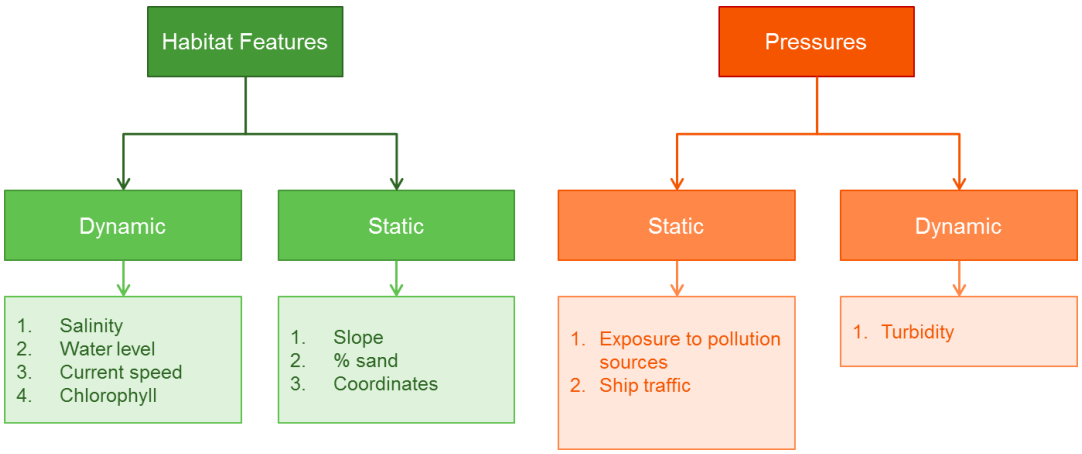


Figure 5.72 Overview of habitat and pressure variables used as predictors for modelling the abundance of macrobenthos.

The habitat models (also called species distribution models) were developed using generalised additive model (GAM) semi-parametric algorithms /78/. GAMs are able of fit other family distributions than the normal distribution (Gaussian), for example binomial, Poisson, gamma distributions, which are more appropriate for biological data. GAMs further fit semi-parametric smoothing functions to each predictor variable and additively calculate the component response, and are therefore capable of fitting nonlinear responses which are so common in nature. Further details of the model are given in Appendix H.

Results of Modelling

Statistical GAMM models (see Appendix H) have indicated that the drivers with the best explanatory power for benthic biomass are percent sand and current speed. The next most parsimonious model included these predictors as well as the distance to pollution source. Benthic biomass increased with percentage sand, but decreased with current speed.

There were no seasonal differences in the importance of predictors, as evidenced by the insignificant relationship to monsoon season from the statistics modelling. The resulting predicted **zoobenthos biomass** in the study area for the SW monsoon is shown in Figure 5.73 illustrates the results.

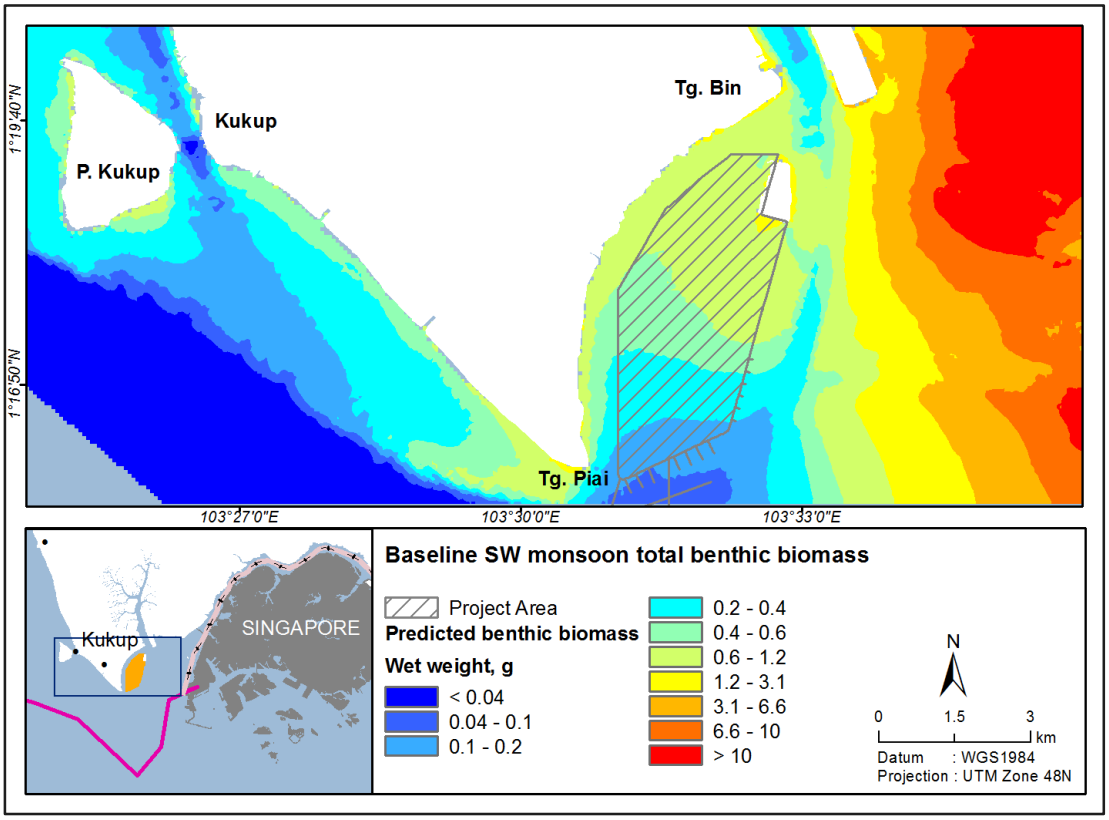


Figure 5.73 Predicted zoobenthos biomass.

Similar gradients were observed for the **density of bivalves** as for total biomass, with the highest densities found south of Tanjung Adang, and the lowest on the western coast of Johor (Figure 5.74). Like the benthic biomass, the density of bivalves increased with percentage sand, but decreased with current speed.

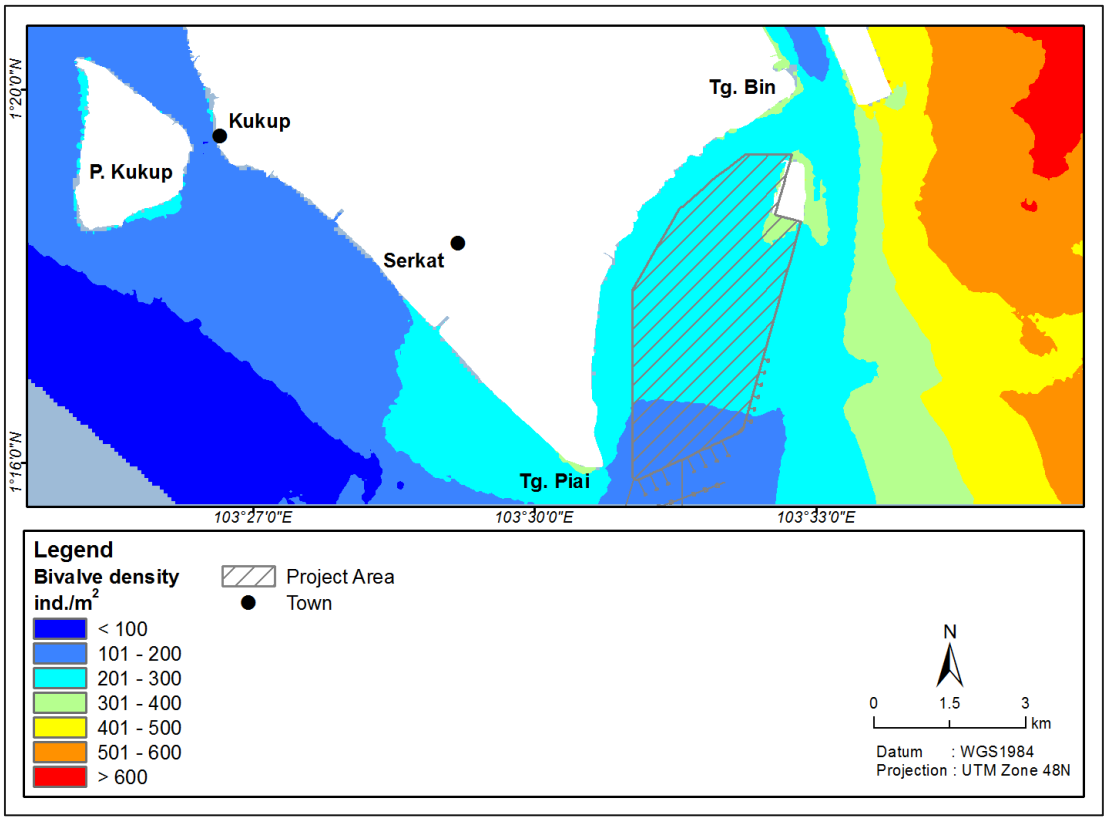


Figure 5.74 Baseline Southwest monsoon bivalve density.

5.3 Human Environment

The project is located within the coastal areas of Mukim Serkat in the District of Pontian. Mukim Serkat has a rural-based economy, mainly based on agricultural and fishing activities. Both activities involve about 50% of the employed population. It also has tourism products and services, such as homestays that have been promoted and ongoing for several years. Currently there are several major industrial facilities that are located around the area, which is the Port of Tg. Pelepas and Tg. Bin at the downstream of Sg Pulai. The Mukim Serkat may also be influenced by the spillover from the Iskandar economic region in the near future as the area is adjacent to the Zone C (Western Gate Development) which comprises of the Tg Pelepas Port, Free Trade Zone and the Ramsar World Heritage Park.

Fishermen still constitute a significant proportion of the population in Mukim Serkat (approximately 31.5% based on sampled population), in particular along the coastline. Therefore, impacts to the fishermen are one of the key issues related to this Project. This section provides an overview of the population, economic activities and land and sea-uses pertinent to the study area to provide the social context for evaluating the impacts of the Project on the human environment. This is based on existing data and studies, supplemented by a detailed socioeconomic survey carried out in the study area which is outlined in the following section and described in further detail in Appendix D.

5.3.1 Data Collection and Sources

As described in Chapter 1, the DEIA study boundary for the human environment component is 5 km radius from the project boundary. Information concerning the study area was sought from published and unpublished reports on the human environment in the study area (Population and Housing Survey 2010, Statistics Department of Malaysia 2011) and from primary data collected from social surveys. The socioeconomic surveys were carried out in

September 2013 and March 2014 and are described further in the below subsection. Land traffic surveys on the other hand were carried out in February 2013 (see Appendix N).

The assessment of the human environment in this section is divided into the following components:

- Settlements
- Land use
- Socioeconomic profile
- Fisheries and aquaculture
- Tourism
- Public health status
- Public perception of the Project
- Land use
- Land traffic
- Marine traffic, navigation and uses.

5.3.1.1 Socio-economic Survey Methodology

A brief summary of the socio-economic survey approach is provided here in order to provide background to the results presented in the subsequent sections. For further detail, refer to Appendix D.

The survey was conducted using structured interviews (questionnaire) for most of the respondents, while focus group meetings were conducted for the remainder. Purposive convenience sampling[3] was utilised in the selection of respondents. The public questionnaire covered 12 villages and one town within 5km radius area which includes Kampung Sungai Boh, Kampung Sungai Dinar, Kampung Sungai Sam, Kampung Sungai Cengkih, Kampung Sungai Chokoh, Kampung Sungai Belukang, Kampung Serkat Barat, Kampung Serkat Laut, Kampung Serkat, Kampung Perpat Pasir, Kampung Perpat Darat, Kampung Serong Darat and Pekan Serkat (town).

[3] Purposive sampling, also known as judgmental, selective or subjective sampling, is a type of non-probability sampling technique where the units that are investigated are based on the judgement of the researcher.

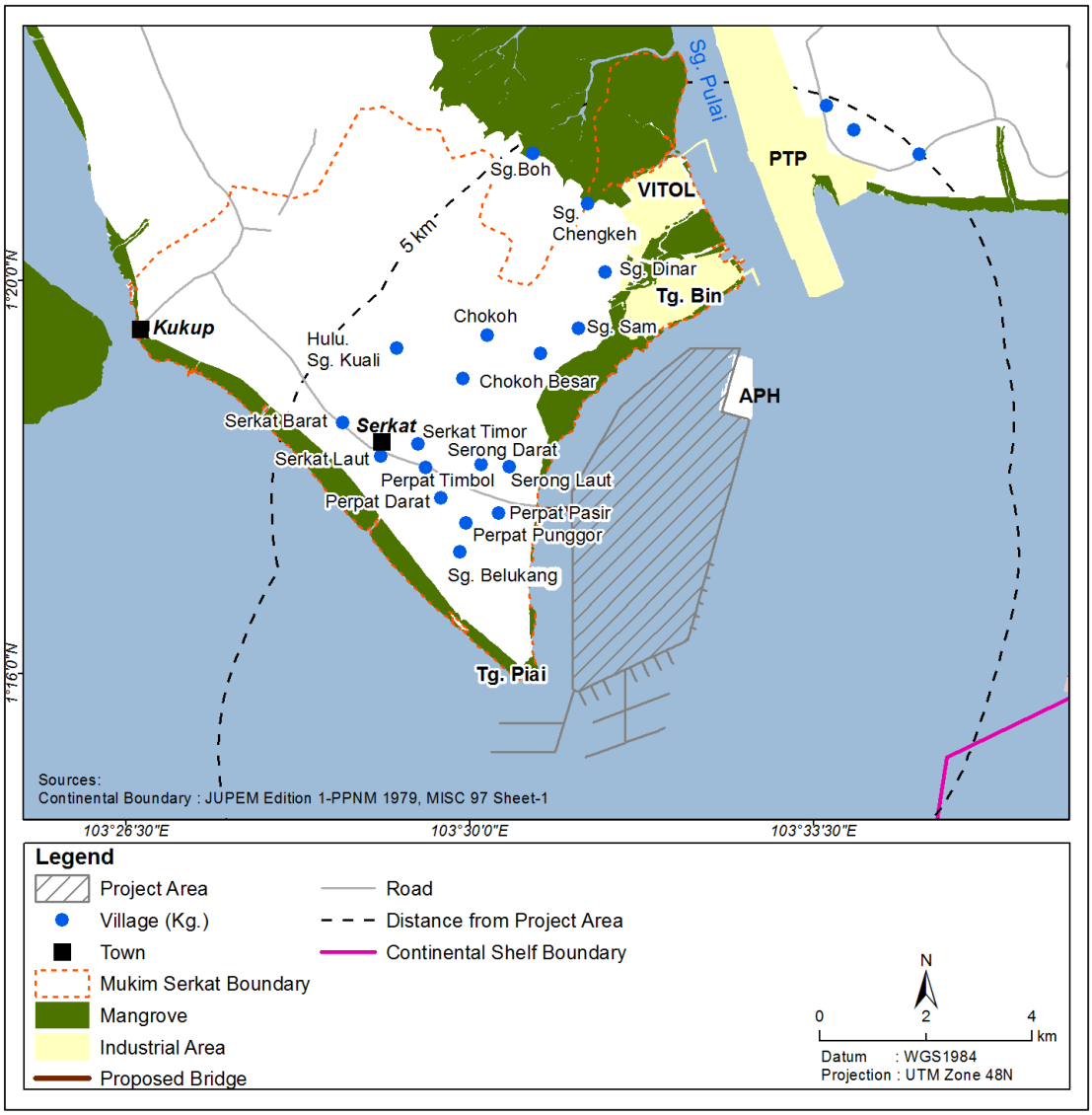


Figure 5.75 Location of villages within 5km of the project site.

5.3.2 Settlements

There are 19 settlements within 5 km radius from the project area as shown in Figure 5.75 above. Most of these settlements are traditional villages except for Pekan Serkat. While all villages have basic amenities and facilities, Serkat has a mosque, surau, kindergarten, school, clinic, community hall and sundry shops. Electricity supply is provided by Tenaga Nasional Berhad (TNB) and water supply is provided by Syarikat Air Johor (SAJ).

During the survey there were several Orang Asli from the Seletar community staying in Kampung Simpang Arang in order to fish in the Pulai estuary. Orang Asli Seletar are a small community with 679 people (JAKOA, 2009) living in Gelang Patah. Ramsar Sungai Pulai is their “kawasan wilayah adat”. They depend on Sungai Pulai for their livelihood and needs with mangrove wood for charcoal productions being one of their source of income.

5.3.3 Land Use

The proposed project is located within the waterbody of the Johor Straits at the southeast coast of Pontian district. The existing land use within 5 km radius from the proposed project area was assessed to develop understanding on the surrounding landuse which will be affected by the proposed project. In addition approved developments within this area were also integrated to predict the future land use within this area. Description of the existing and future landuse was made based on several documents as the following listed items:

- Iskandar Regional Development Comprehensive Development Plan
- Integrated Land Use Blueprint for Iskandar Malaysia
- Draft Plan of Pontian Local Plan 2002 -2015
- Draft Plan of Johor Bahru and Kulaijaya Local Plan (Amendments)
- National Coastal Zone Physical Plan
- Integrated Shoreline Management Plan (ISMP) 2012

5.3.3.1 Existing Land Use Zoning

The existing land use of the proposed project area is an undisturbed water body. Based on the Draft Local Plan of Pontian District 2002 -2015 and Draft Local Plan of Johor Bahru and Kulaijaya District (Amended), there are no planned future developments within the project site. The study area falls within planning blocks as listed in Table 5.18.

Table 5.18 Related planning blocks associated with the proposed project

Planning block (BP)	Small Planning block (BPK)
BP 3: Permas Kechil (Pontian)	BPK 3.5: Tanjung Piai
	BPK 3.6: Chokoh
BP 7: Sungai Karang	BPK 7.1: Tanjung Bin
BP 8: Tanjung Pelepas (Johor Bahru)	BPK 8.2: Persin Port, Tanjung Pelepas

Source: Draft Local Plan of Pontian District 2002 -2015 and Draft Local Plan of Johor Bahru and Kulaijaya District (Amended)

In general the existing landuse within the 5 km radius comprises agricultural, industrial land use, environmentally sensitive areas (ESA), human settlement area and public facilities including schools, clinics and mosques. Figure 5.76 shows the existing land use types and features while Table 5.19 and Table 5.20 show the details of these areas. The ESA areas found within study area are categorised as Rank 1 which refers to core conservation areas as specified under framework ESAs of Iskandar Malaysia. Core conservation areas could be further described as areas with high biodiversity value and / or perform critical ecosystem functions.

Table 5.19 Land use within 5 km radius from the project

Land Use Type	Area	
	Acres (ac)	Percentage cover (%)
Industry	2206	17.16
Mangrove	2353	18.31
Planned Housing	27	0.21
Rizab Rintis Electric	21	0.16
Empty Land	20	0.16
Water Body	90	0.70
Agriculture		

Land Use Type	Area	
	Acres (ac)	Percentage cover (%)
Palm Tree Plantation	1877	14.60
Rubber Tree Plantation	1426	11.10
Other Plantation	861	6.70
Undefined	574	4.47
Livestock	3397	26.43
Total	12,852	100.00

Table 5.20 Details on land use features found within 5 km radius from the project.

Land use Features	Description
Villages	Kg. Sinar Dinar
	Kg. Sg. Chengkeh
	Kg. Sg. Siam
	Kg. Chokoh Kechil
	Kg. Sg. Belukang
	Kg. Chokoh Besar
	Kg. Chokoh
	Kg. Hulu Sg. Kuali
	Kg. Serkat Barat
	Kg. Serkat Laut
	Kg. Serong Laut
	Kg. Perpat Darat
	Kg. Perpat Punggor
	Kg. Perpat Pasir
	Kg. Serkat Timor
	Kg. Serong Darat
	Kg. Perpat Timbul
	Kg. Sg. Boh
	Kg. Tg. Adang
	Kg. Pekajang Lurus
	Kg. Pok Kechil Laut
Schools	SJK (C) Pei Chiao
	Sekolah Kebangsaan Serkat
	SK Seri Sinaran Chokoh
	SK Andek Mori
	SJK (C) Ken Boon
	SK Seri Perpat
	SK Sg. Boh
	Sekolah Agama Serkat
Mosques	Masjid Jamik Dato' Nooh Gadot
	Masjid Jamik Kg. Chokoh
	Masjid Parit Perpat

Land use Features	Description
	Masjid Jamik Perpat Timbul
	Masjid Jamik Sg Boh
	Masjid Jamek Dato' Haji Noh Gadut
	Masjid Jamek Serkat Pontian
Clinics	Klinik Desa Sg. Boh
	Klinik Pergigian Serkat
	Klinik Kesihatan Serkat
	Klinik Desa Perpat Serkat

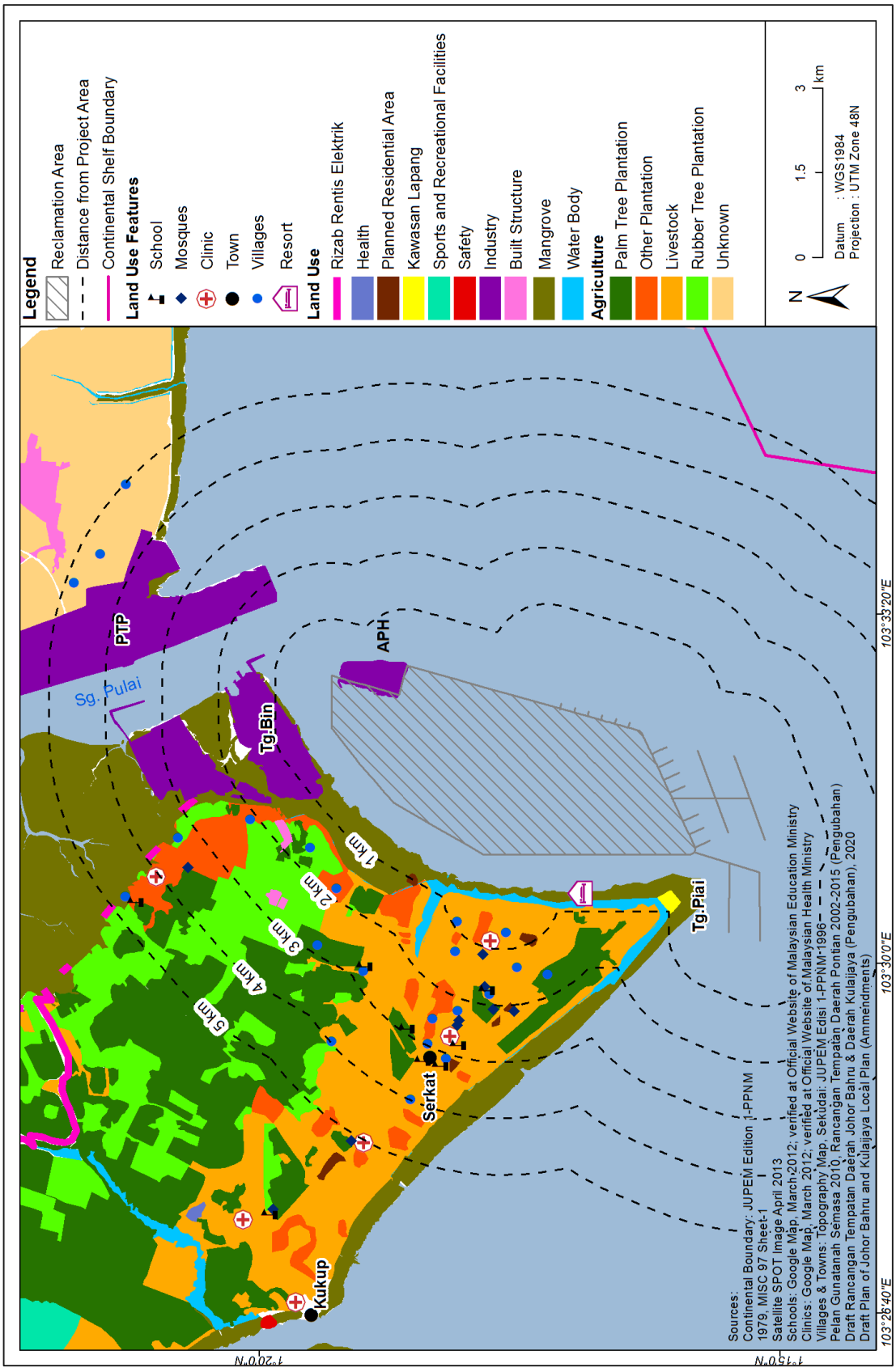


Figure 5.76 Existing land use as per Pontian Local Plan within 5 km from the project modified to include major projects (see Drawings for A3 size figure).

5.3.4 Socio Economic Profile

The socio-economic profile description extends up to the 5 km radius from the boundary of the project site which mainly consists of the population within Mukim Serkat. The profile includes information on the demographic characteristics, occupation and livelihood and settlements. The information presented were derived from the Department of Statistics and also from socioeconomic survey conducted specifically for this project within 5km radius from project boundary. The public questionnaire covered 12 villages and one town within 5km radius area which includes Kampung Sungai Boh, Kampung Sungai Dinar, Kampung Sungai Sam, Kampung Sungai Cengkih, Kampung Sungai Chokoh, Kampung Sungai Belukang, Kampung Serkat Barat, Kampung Serkat Laut, Kampung Serkat, Kampung Perpat Pasir, Kampung Perpat Darat, Kampung Serong Darat and Pekan Serkat (town).

5.3.4.1 Demography of Population in the Study Area

Population

The total population in Pontian District in 2010 was 149,938 people (Population Distribution and Basic Demographic Characteristics, Department of Statistics 2011). Mukim Serkat is located within the study area (i.e. within 5 km radius of proposed project area), which in 2010 had a population of 7,994 - contributing about 5% out of the total population in the District of Pontian (Figure 5.77).

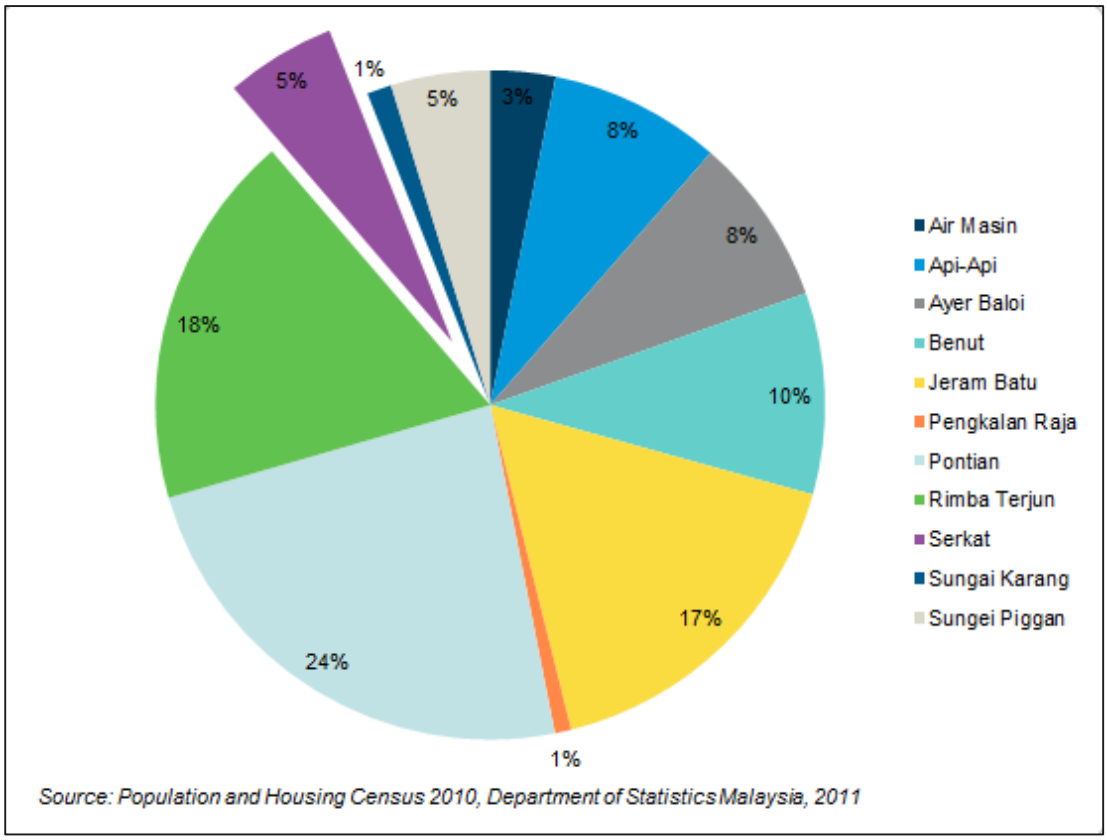


Figure 5.77 Population composition in Pontian District based on Mukim (Source: Population Distribution and Basic Demographic Characteristics, Statistics Department 2011).

In terms of households, the whole of Mukim Serkat has approximately 1,745 families and 1,976 units of living quarters as of 2010. As Mukim Serkat extends beyond the 5 km radius of impact area, it is estimated that the population within the study area (5km radius) comprises 60% of the total Mukim Serkat which makes up 4,796 people from an estimated 1,047 households.

Table 5.21 Population Distribution in Pontian District and Mukim Serkat in 2010

Area	Population	Households	Living Quarters
District Pontian	149,938	34,339	39,306
Mukim Serkat	7,994	1,745	1,976

Source: Population and Housing Census 2010, Department of Statistics Malaysia, 2011

Age Structure

Within the total population living in Mukim Serkat, approximately 26.9% consists of persons within the age of 0-14 years old, while those of working age (15-64 years old) comprise the majority at about 64.6%. The rest of the population (8.4%) are over 65 years old (Table 5.22). Figure 5.78 shows the population distribution based on estimated working age categories from 15 years old to 64 years old. It is clearly shown that the population distribution decreases according to increase of age.

Table 5.22 Age distribution of Pontian District and Serkat Mukimin 2010

Age Cohort (years old)	0-14	15-64	>65	Total (Population)
District Pontian	42,413	54,721	12,308	149,938
Mukim Serkat	2,154	5,167	673	7,994

Source: Population and Housing Census 2010, Department of Statistics Malaysia 2011

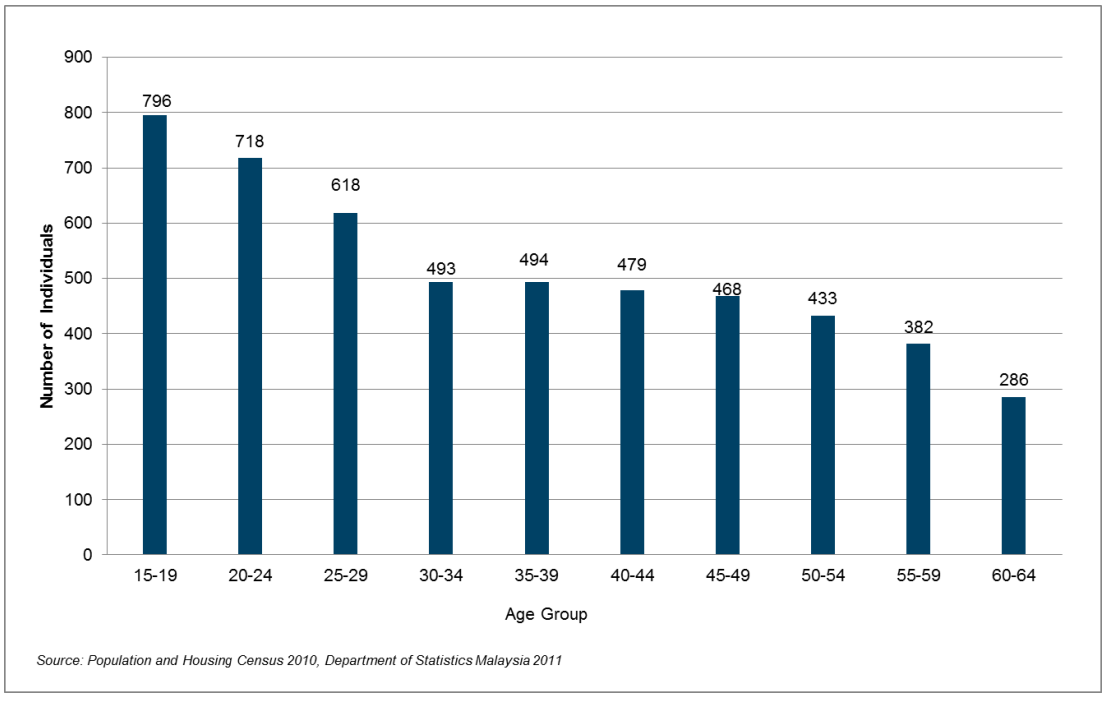


Figure 5.78 Working Age Population in Mukim Serkat in 2010 by age groups

Ethnic Composition

The ethnic composition in Mukim Serkat is mainly made up of Malays, who represent about 76.2%, while the Chinese and Indian community makes up about 17.1% and 0.3% respectively (Figure 5.79). At the same time, there is a sizeable amount of non-Malaysians making up about 7.9% of the population in the Mukim. The ethnic composition in Mukim Serkat roughly mirrors the general ethnic composition in the Pontian District (Table 5.23).

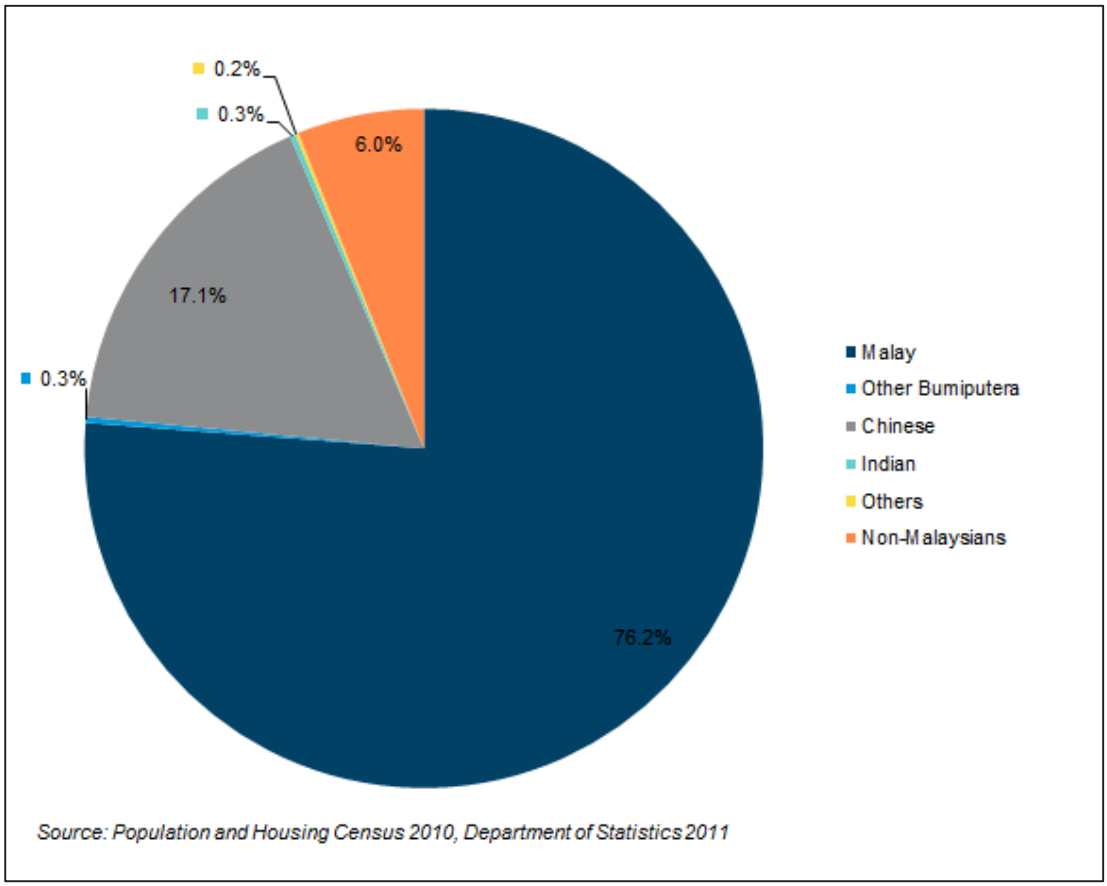


Figure 5.79 Ethnic Composition of Mukim Serkat in 2010

Table 5.23 Ethnic Composition of the Pontian District and Mukim Serkat in 2010

Area	Malaysian Citizens					Non-Malaysian Citizens
	Bumiputera		Chinese	Indian	Others	
	Malay	Others				
District Pontian (n)	95,732	1,202	40,188	1,481	399	10,936
District Pontian (%)	63.8	0.8	26.8	1.0	0.3	7.3
Mukim Serkat	6,092	22	1,364	21	13	482
Mukim Serkat (%)	76.2	0.3	17.1	0.3	0.2	6.0

Source: Population and Housing Census 2010, Department of Statistics 2011

5.3.4.2 Background of Respondents

Age Distribution

Among the 230 respondents, individuals that fall within working age group (18 to 60 years old) makes up about 93.0%. The older group > 40 years old comprised 59.0% (Table 5.24).

Table 5.24 Age structure of respondents in the study area

Age Class (Years)	Percentage (%)
>17	1.5
18 - 25	6.0
26 – 40	33.5
40- 60	53.5
>60	5.5

Education Level

Based on the social survey conducted in September 2013, approximately 80.5% of the respondents had completed their primary education and secondary education. However, only 17.0 % furthered their study after SPM (Figure 5.80).

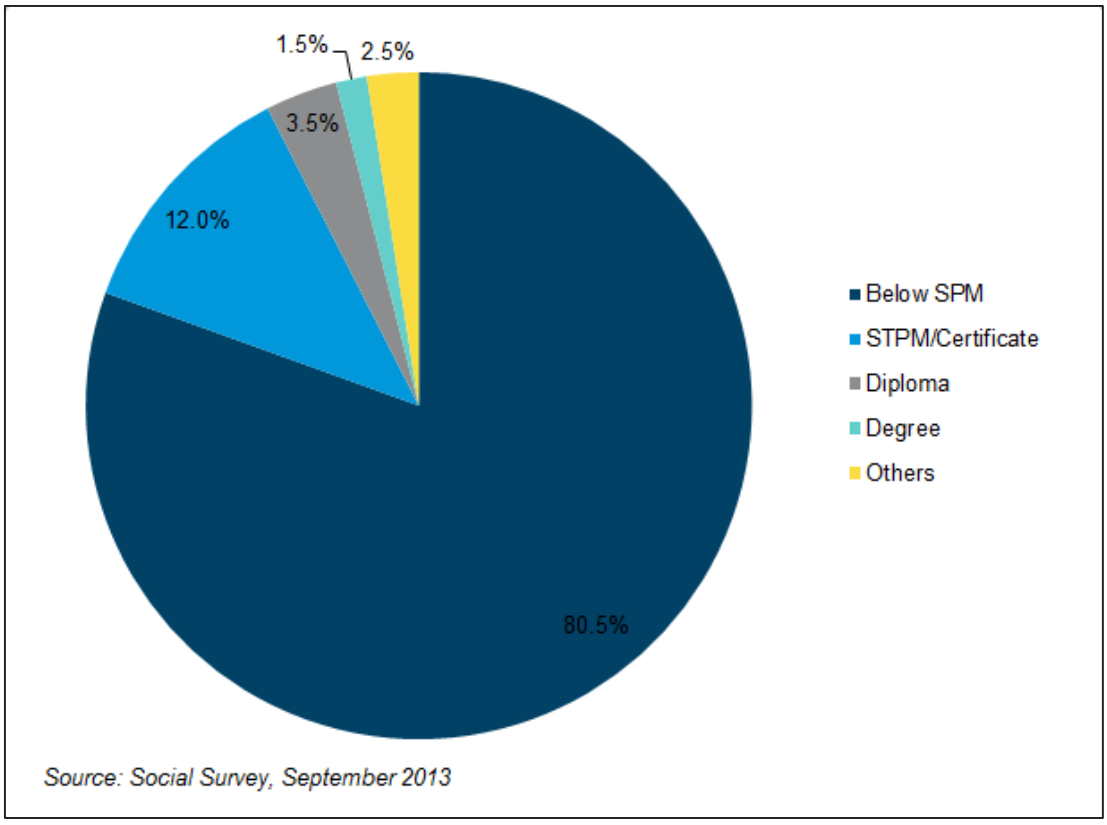


Figure 5.80 Educational level in the study area.

Family Size

In general, the size of an average family is 4-6 persons per family (Table 5.25). However, there is a trend where the younger population migrate to other places for better job opportunities and also to pursue higher education.

Table 5.25 Family size in the study area

Family Size	Percentage (%)
1-3 persons	38.5
4-6 persons	48.0
7-9 persons	10.0
10-12 persons	3.5

Source: Social Survey, September 2013

Employment

As shown in Figure 5.81, the source of livelihood for 31.5% of the respondents came from the local fishery and aquaculture industry. Approximately 21.5% of the respondents were self-employed, either through farming, small-time traders, odd job workers or managing small businesses and enterprises. Those who worked in the private sector (e.g. estates, restaurants, factories, shops and others) consist of 16.0% of the total respondents. Only 9.0% were employed in the government sector as teachers, officers of departments and agencies. A small fraction of respondents who are not working (5.0%) mainly consists of students, retirees and housewives.

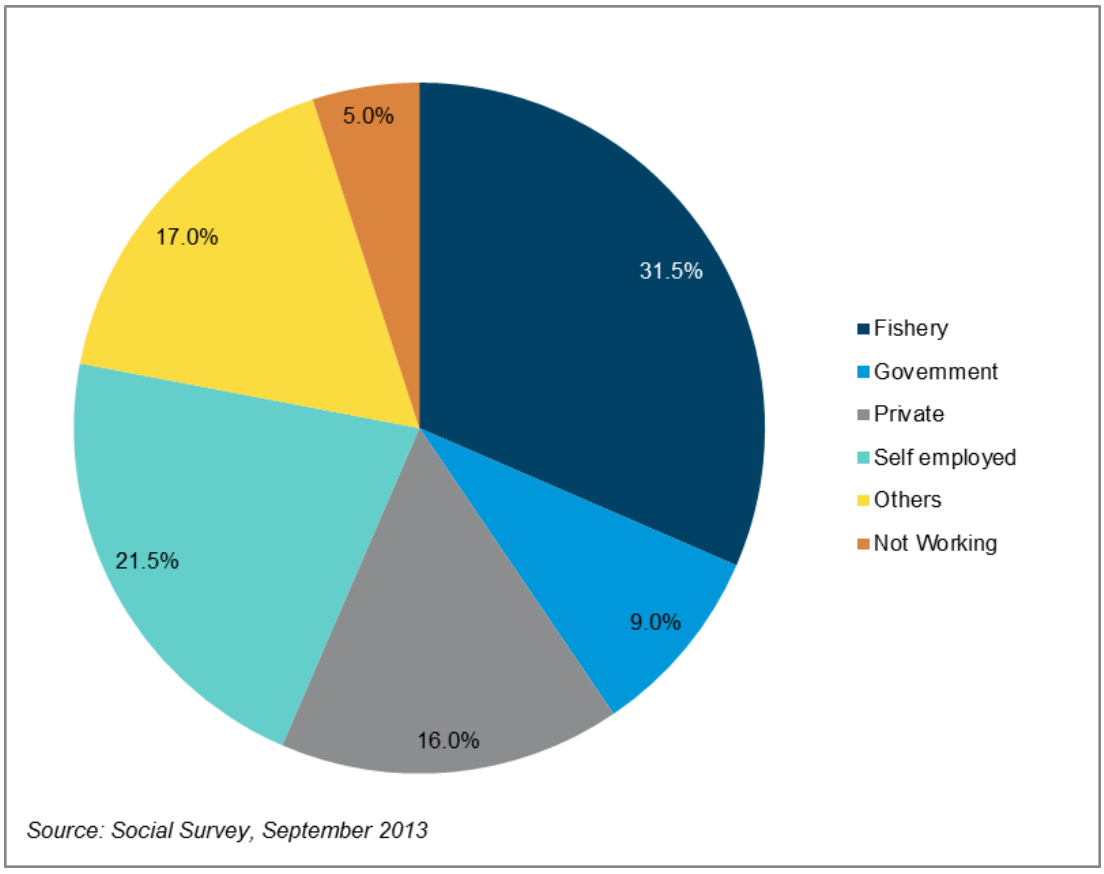


Figure 5.81 Employment categories of the respondents in Mukim Serkat within 5km radius of impact area

Household Income

Based on the Poverty Line Income (PLI) of Malaysia[4], a household in Peninsular Malaysia is considered 'poor' if its income is less than RM 790 per month /79/.

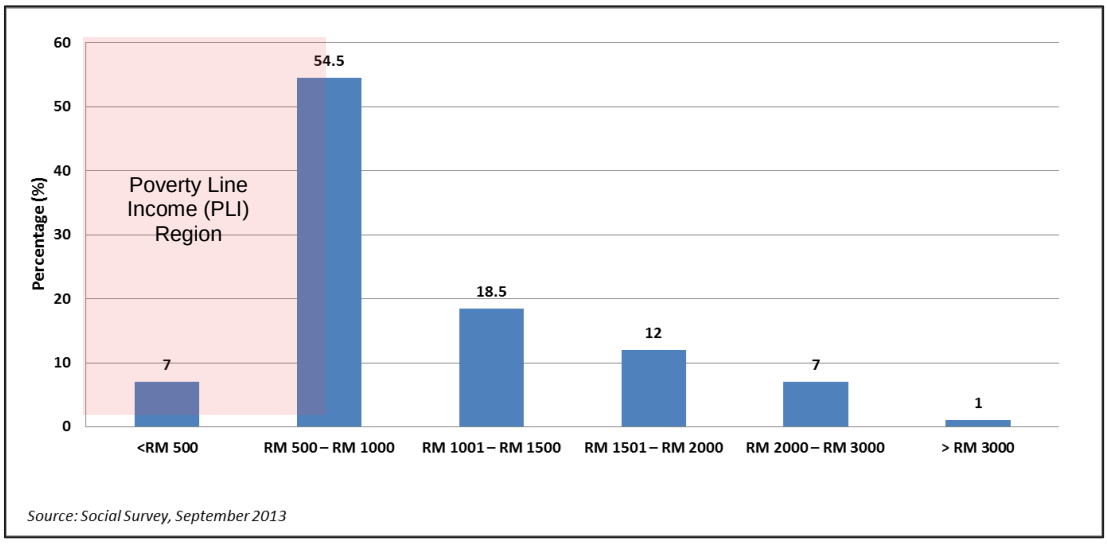


Figure 5.82 Household income per month of respondents in Mukim Serkat

Based on the survey results, more than half (54.5%) of the respondents' household income in the study area is within RM500- RM1,000 per household per month (Figure 5.82). It is to be noted that within the 54.5% of respondents, there are some which are possibly living below the PLI (household income below RM790) within the RM 500-RM 1,000 category.

In general, 30.5% of the respondents have a household income of more than RM1,000 per month and only 8% have income of more than RM2,000 per month. Seven percent of the respondents (income below RM500) are definitely living below the PLI (RM790) which can be classified as hardcore poor. Assuming a uniform distribution of income from RM500 to RM 1000 in the second category a minimum of an additional 31% can be considered to below the PLI. The implication is that an estimated 38% have household incomes below the PLI.

While all villages have basic amenities and facilities, the small towns have a mosque, surau, kindergarten, school, clinic, community hall and sundry shops. Electric supply is provided by Tenaga Nasional Berhad (TNB) and water supply is provided by Syarikat Air Johor (SAJ).

5.3.5 Fisheries and Aquaculture

This section discuss the background of the fishery and aquaculture community in the study area. It is estimated that a total of 473 fishermen from Mukim Serkat are registered with the Department of Fisheries, with 282 of them found within the 5 km radius study area. The Table 5.26 below shows the villages and the jetties, together with their distances from the proposed project which would be affected by the project within 5km radius.

[4] Poverty Line Income (PLI) is defined as "an income that is necessary to buy a group of foods that would meet the nutritional needs of the members of a household. The income is also to meet other basic necessities such as clothing, rent, fuel and utilities, transport and communications, medical expenses, education and recreation."

Table 5.26 Fishing Villages and the Jetties that would be affected within 5 km radius

Village & fishing village	Jetty	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 metre	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

The following information were gathered from a social survey of 84 fishermen respondents in September 2013. They are registered with the Department of Fisheries as eligible recipients of the fuel subsidy programme. Approximately 83% of the respondents in the social survey are coastal fishermen, followed by deep sea fishers (13.6%) and aquaculturists (3.4%) (Figure 5.83). The information in this section is also complemented by information gathered from fisheries and aquaculture assessment conducted in February 2013 at the study area (Appendix G).

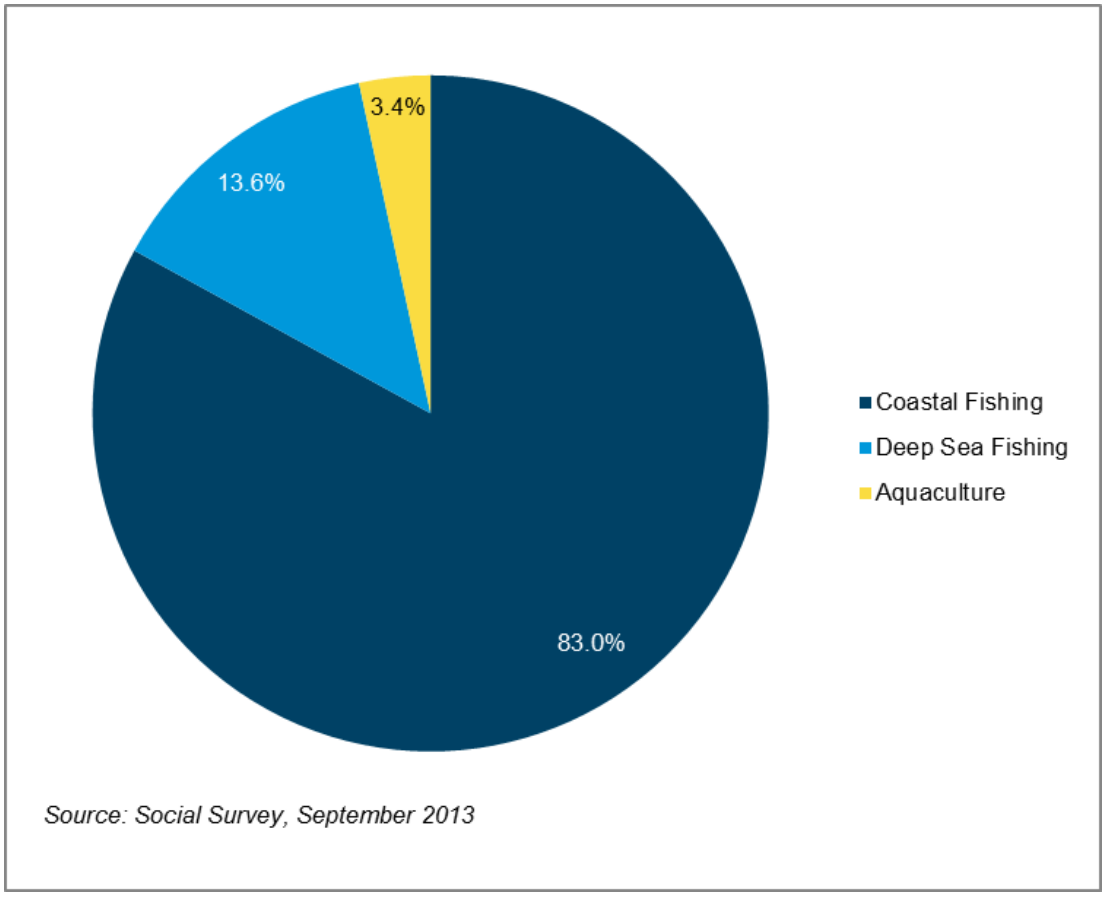


Figure 5.83 Types of activities carried out by the respondents in the fishery industry

Fishing Grounds

Most of the fishing activities are conducted from the swampy mangrove areas along Sg. Pulai, Tg. Piai to Pulau Kukup as well as up to the International border (separating the west and south Johor from Indonesia and Singapore). In addition, fishermen from Parit Penghulu (Serkat) reported travelling as far as Pulau Pisang (off Pontian Besar) for fishing, see Figure 5.84. The indicative main fishing grounds for artisanal fishermen within the study area is shown in Figure 5.84. This has been delineated is based on the nearshore areas available outside of the vessel anchorage areas and the Traffic Separation Scheme.

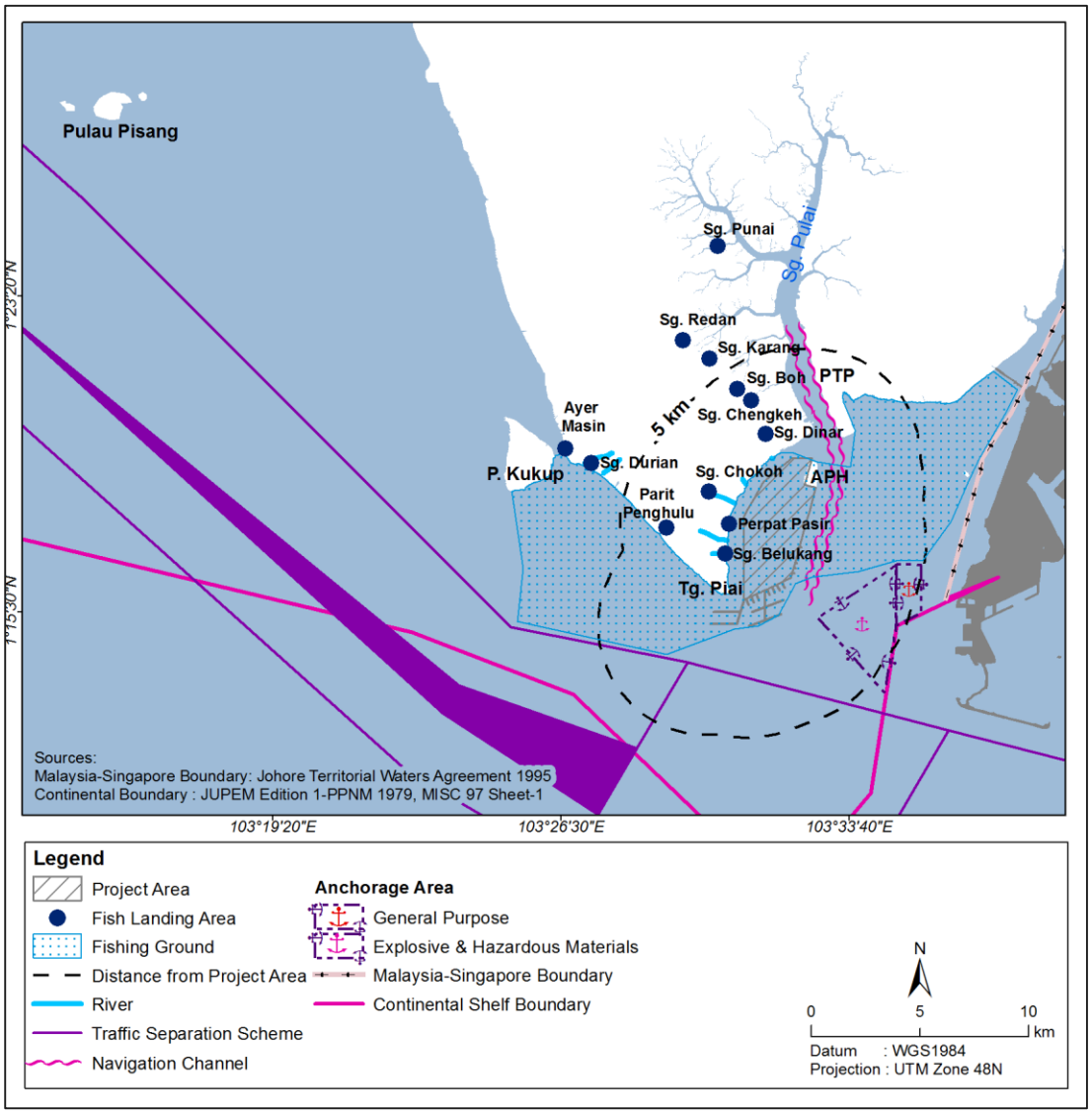


Figure 5.84 Fishing grounds frequented by fishermen of the study area which includes Sg Pulai, Pulau Kukup and Pulau Pisang. Indicative fishing ground is based on nearshore areas excluding the marine traffic separation scheme and anchorage areas.

Landing Areas

Based on the fisheries and aquaculture assessment conducted in February 2013, there are a total of 11 fish landing areas along the coast of Serkat as shown in Figure 5.85. Out of these, seven (7) landing areas are within 5 km radius of the Project site which includes Sungai Chokoh, Parit Penghulu, Perpat Pasir, Sungai Belukang, Sungai Dinar, Sungai Cengkeh and Sungai Boh.

Although there are only seven landing areas that fall within 5 km radius of the project, the fishermen that live within the 5 km radius of project area also land their fishes at areas outside of the 5 km radius. Out of 84 respondents in the social survey, 34.5% said that they land at Parit Penghulu jetty (see Figure 5.85). The rest of the fish landing areas are frequented by a small amount of fishermen, between 1.2% (Sg. Redan) and 19.0% (Sg Chokoh) (Figure 5.86).

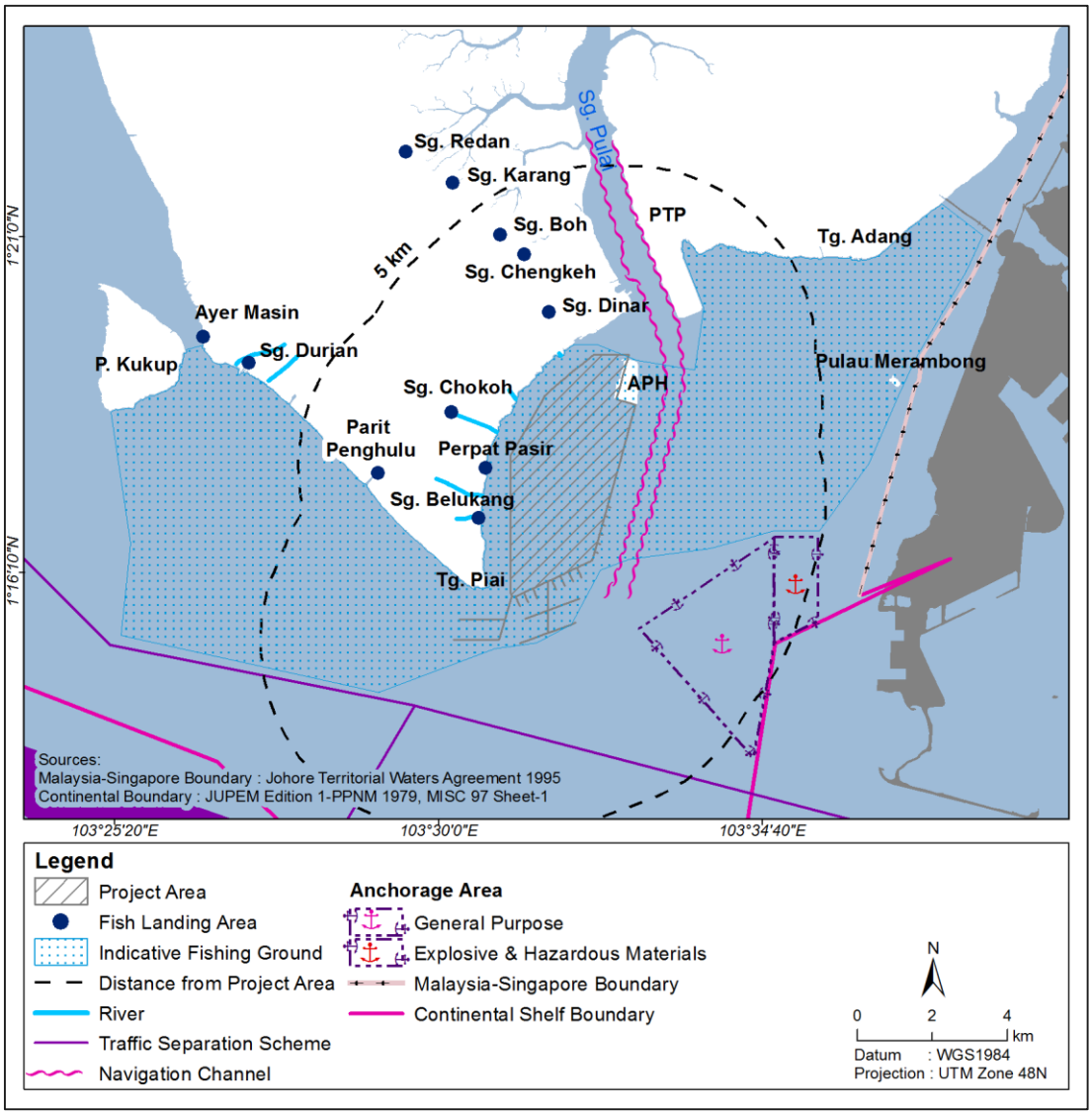


Figure 5.85 Location of fish landing areas at various sites around Mukim Serkat.

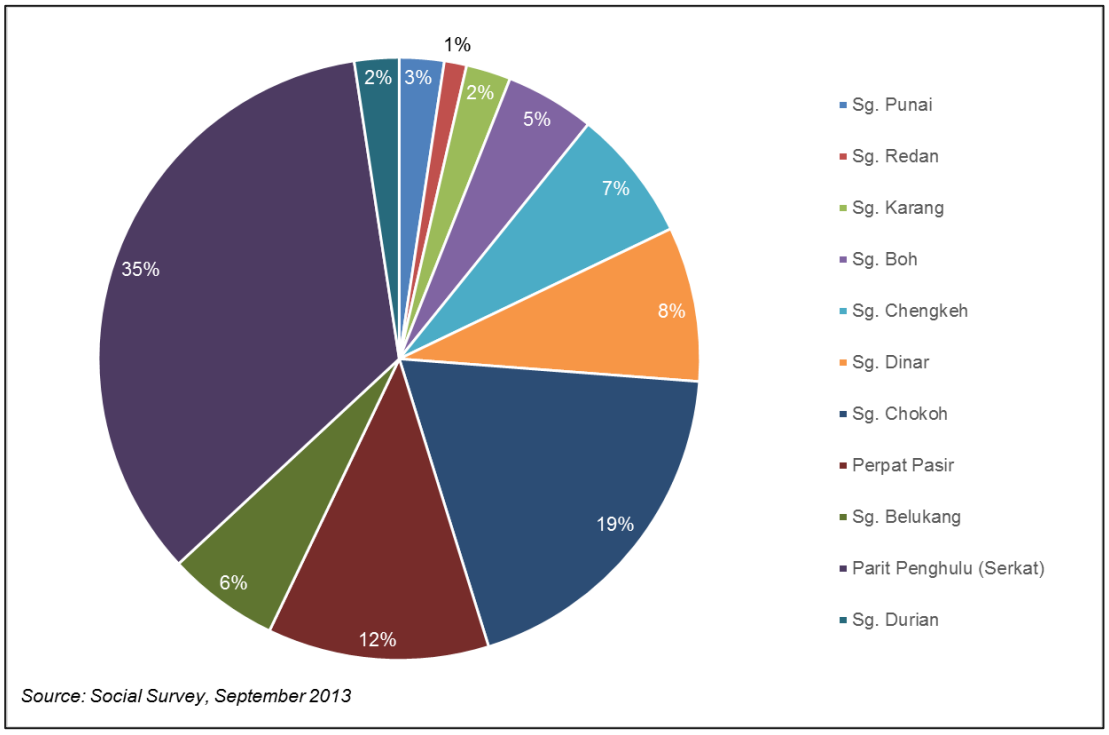


Figure 5.86 Number of Fishermen Operated at Study Area according to the Social Survey

Beyond the 84 fishermen in the social survey, a total of 423 fishermen and 367 fishing boats operated in the 11 landing areas mentioned above. Based on the fisheries and aquaculture assessment (Appendix G), more than 98% operated of them are using outboard powered boats. Most of the fishermen operated 1 person/boat. However, there were also three boats from Sg. Punai and Sg. Dinar as well as 50 boats from Parit Penghulu (Serkat) which is operated by 2 persons/boat (Figure 5.87).

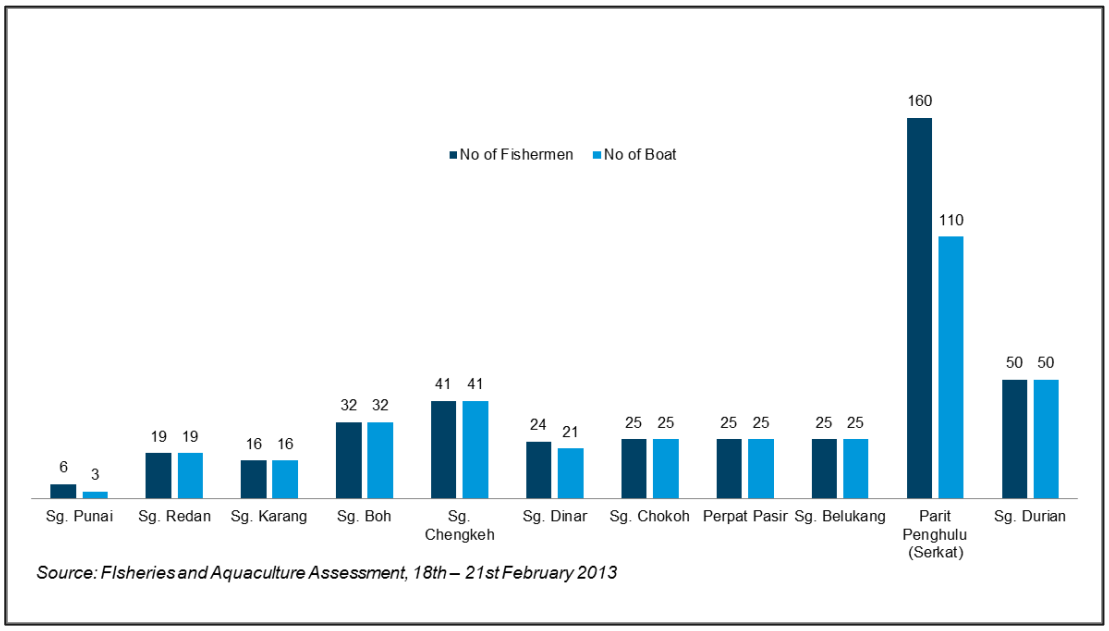


Figure 5.87 Number of Fishermen and Fishing Boat Operated around and within Study Area Capture Fishery

Fishing Gear

The fishing gear used by the local fishermen respondents are influenced by the type of fishery that they are engaged in. Since the majority of the fishermen within the assessment

area are coastal fishermen at a moderately sheltered shoreline, the gears most widely used are gill nets (65.4%) followed by hook and line (69.3%) (Figure 5.88).

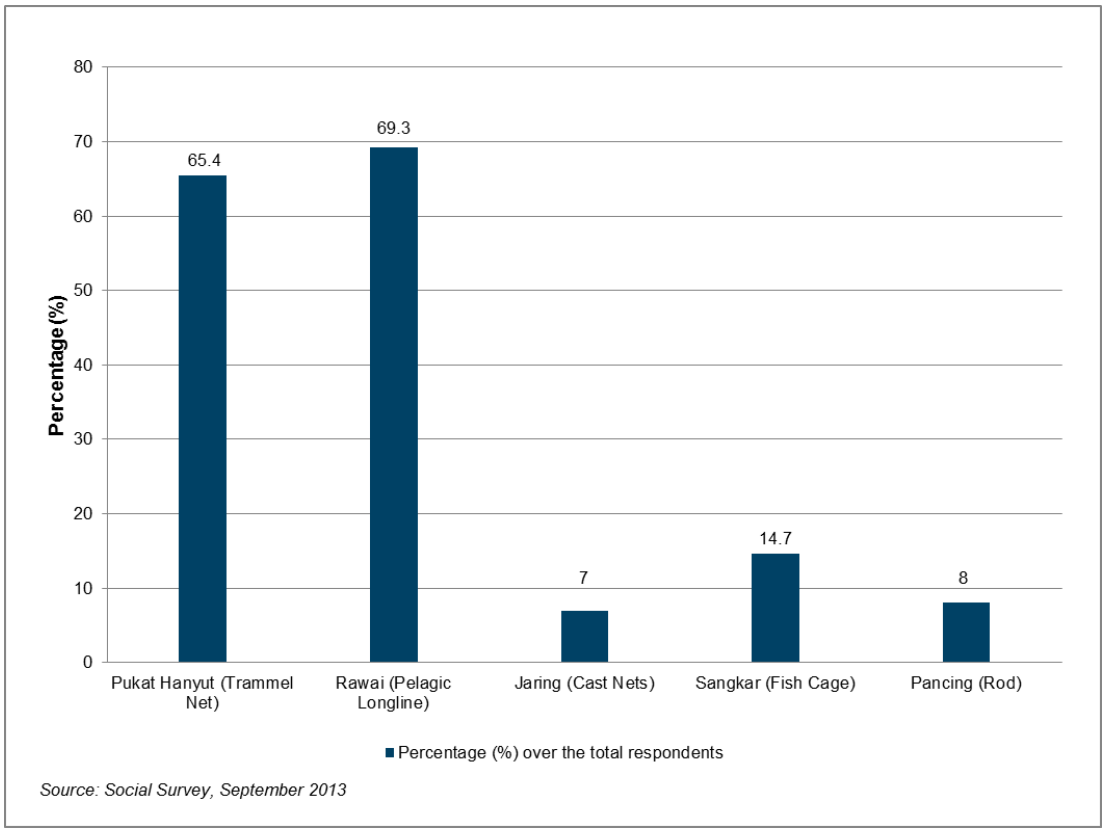


Figure 5.88 Types of fishing gear used by respondents

Types of Catch

In terms of catch (Figure 5.89), fin fishes (grouper, red snapper, mackerel, catfish and gelama) are caught throughout the year with intermittent shrimp fishing depending on seasons. Between April and June, squids are fished, while cockles are harvested from the mudflats at the western coast of Serkat.

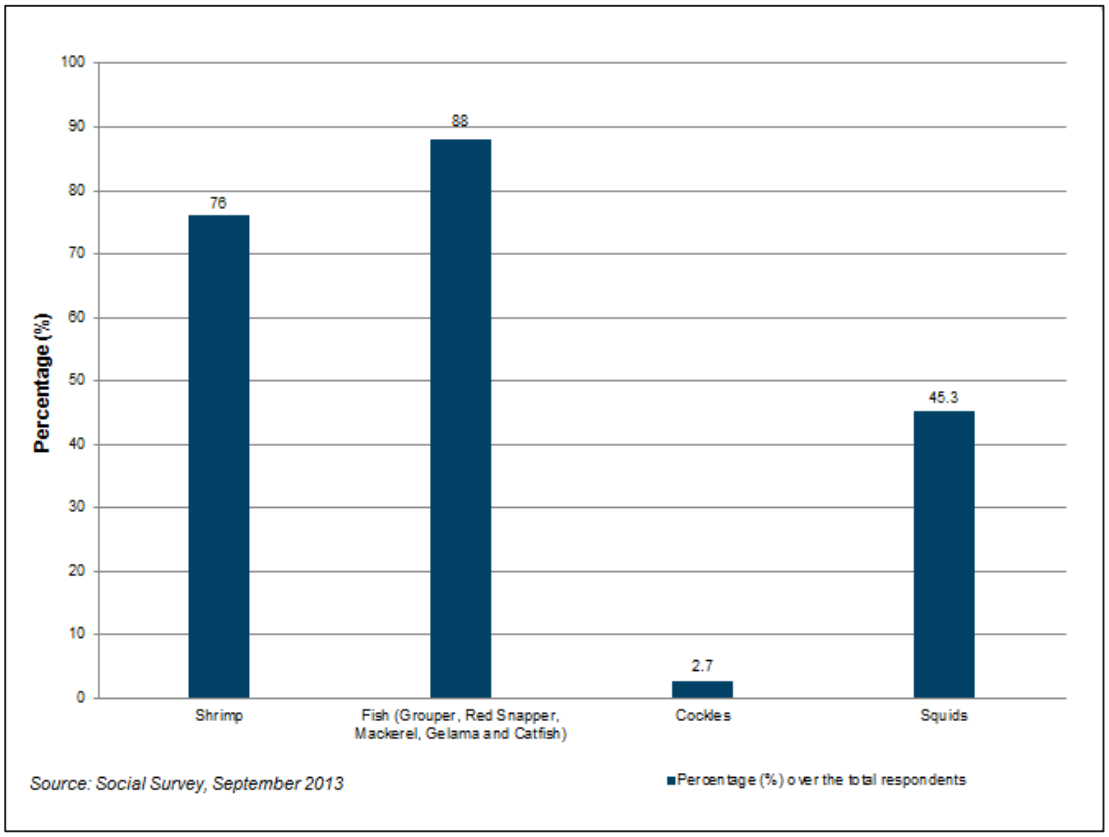


Figure 5.89 Type of fish catch as reported by respondents

Fishery Catch

For 51.2% of the fishermen, the amount of fish caught ranges between 50 and 100 kg per fishing trip. However, there are also about 27.4% of the fishermen that catch less than 100 kg per trip to the sea (Figure 5.90).

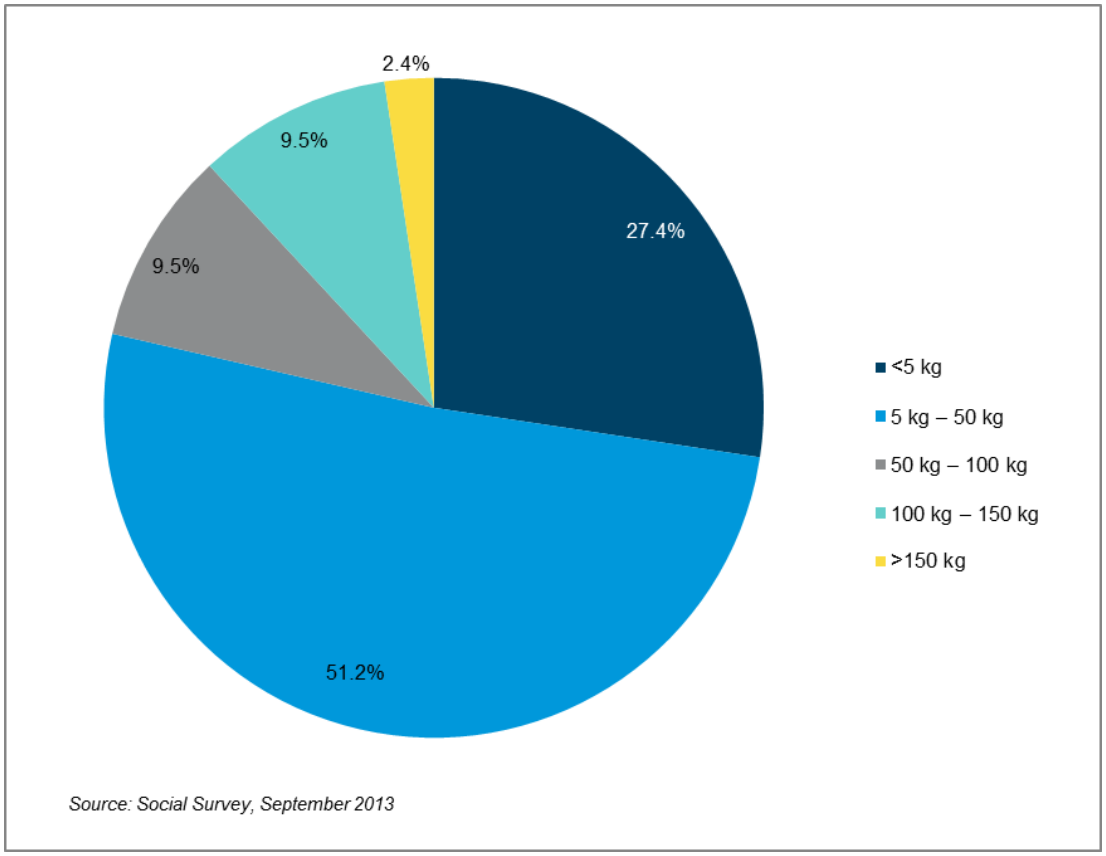


Figure 5.90 The fish catch per trip (weight in kilogrammes) based on the number of fishermen respondents

Synopsis

In summary, the community within the 5 km radius of the study area are predominantly those who are in the fishery industry (31%), mainly coastal fishermen. They represent almost 60% of all registered fishermen living in Mukim Serkat. Considering that 54.5% of the general population within the 5 km radius are living with household income of RM500- RM1,000 per month (based on the social survey in September 2013), it is likely that most of the fishermen will fall under this household income range. Using mainly trammel nets and long lines, their main fishery catch are commercially valuable fishes such as groupers, red snappers and mackerel; to name a few. The busiest landing point according to the fishermen respondents is at Parit Penghulu at the west coastline of Mukim Serkat. It is located within the 5 km radius of the study area (approximately 4.3km from Tg Piai and 5.5km from Pulau Kukup) and is frequented also by fishermen living outside the 5km radius area.

5.3.5.1 Aquaculture

Aquaculture activities are also undertaken close to the study area i.e. at Pulau Kukup, which is located approximately 10 km from the proposed project area. The major system practiced is brackish water cage culture. The majority of the species reared include Siakap (*Later calcarifer)*, Merah (*Lutjanus spp*.), Unga Tanda (*Lutjanus spp*.), Kerapu Rimau (*Epinephelus fuscoguttatus*), Kerapu (*Epinephelus spp*.), Kerapu Kertang (*Epinephelus lanceolatus*), Monang (*Gnathodon speciosus*), Bawal Emas (*Parastomateus sp*.) and Siakap Merah (*Lutjanus argentimaculatus*). Most of the grade A fish are exported to Singapore, while low quality fish are sold to recreational ponds in Johor. In term of fish production, fish are harvested once every two months, depending on the demand, and involves 700 -800 kg/ harvest).

5.3.5.2 Past and Present State of Fishery

In the survey questionnaire, the fishermen were asked how the current existence of Tanjung Bin Power Plant and Tanjung Pelepas project had affected their fishery activities. Only about 3.6% of respondents claimed that their catches have increased, while 89.3% reported a decrease in their catch yield (Figure 5.91) ever since these two major industrial projects came into place.

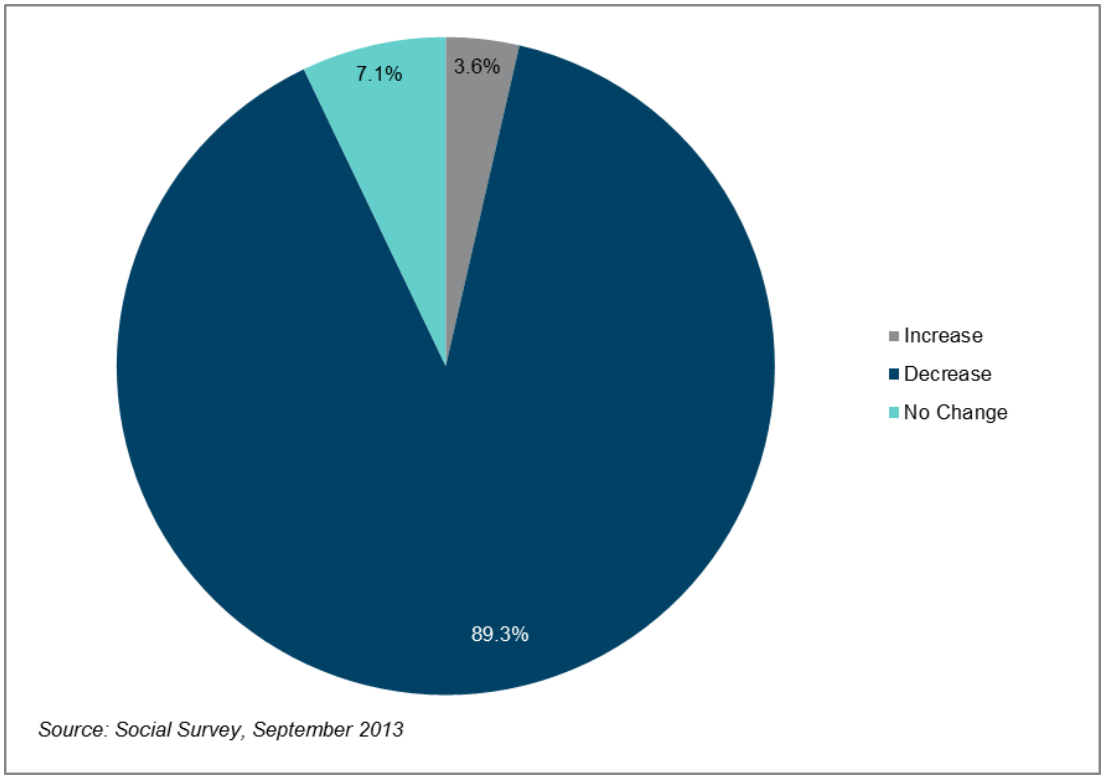


Figure 5.91 Changes in fishery status before and after the existence of Tg Bin Power Plant and Tg Pelepas Port as reported by respondents

5.3.5.3 Perception on Proposed Project

Due to the present fluctuations of the fishery catches, the respondents from the local fishery industry (84 individuals) claimed that the proposed project may affect fish catch and income further (Figure 5.92).

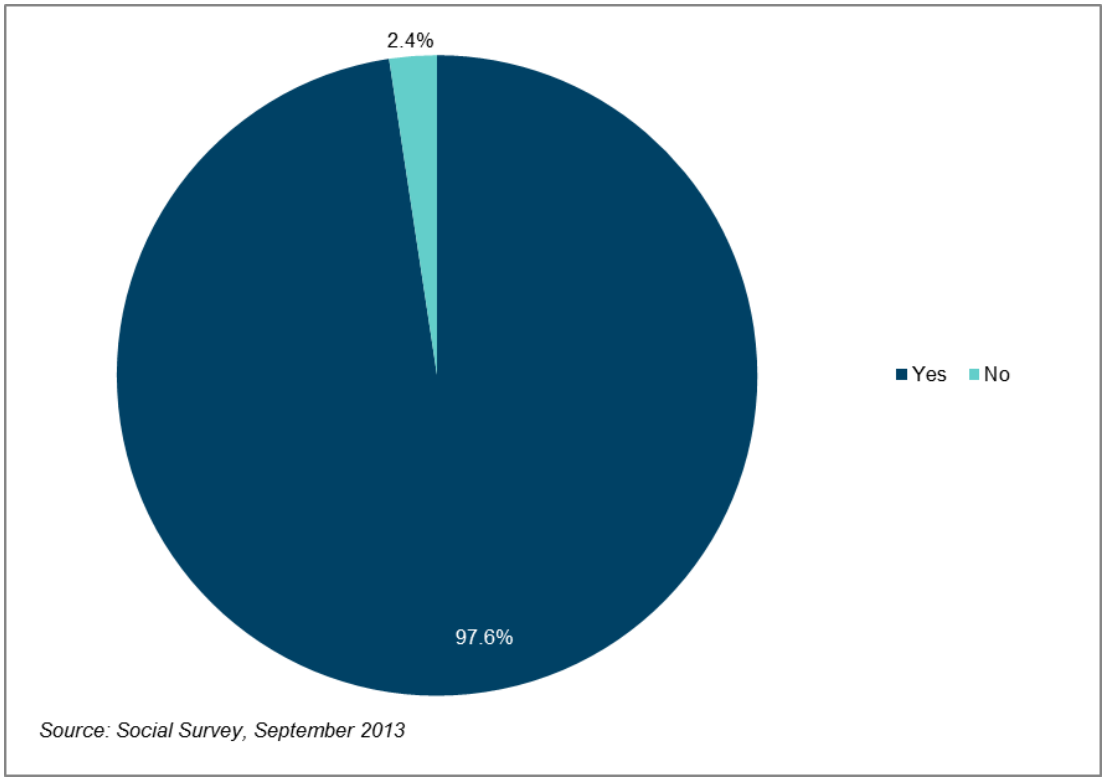


Figure 5.92 Respondents' perception on project potential impacts on their catch and income

Only 17.9% of the 84 fishermen respondents are supportive of the project while the majority of the fishermen (65.5%) voiced their objections. The remaining 16.6% reserved their comments about the impact it would bring to their livelihood (Figure 5.93).

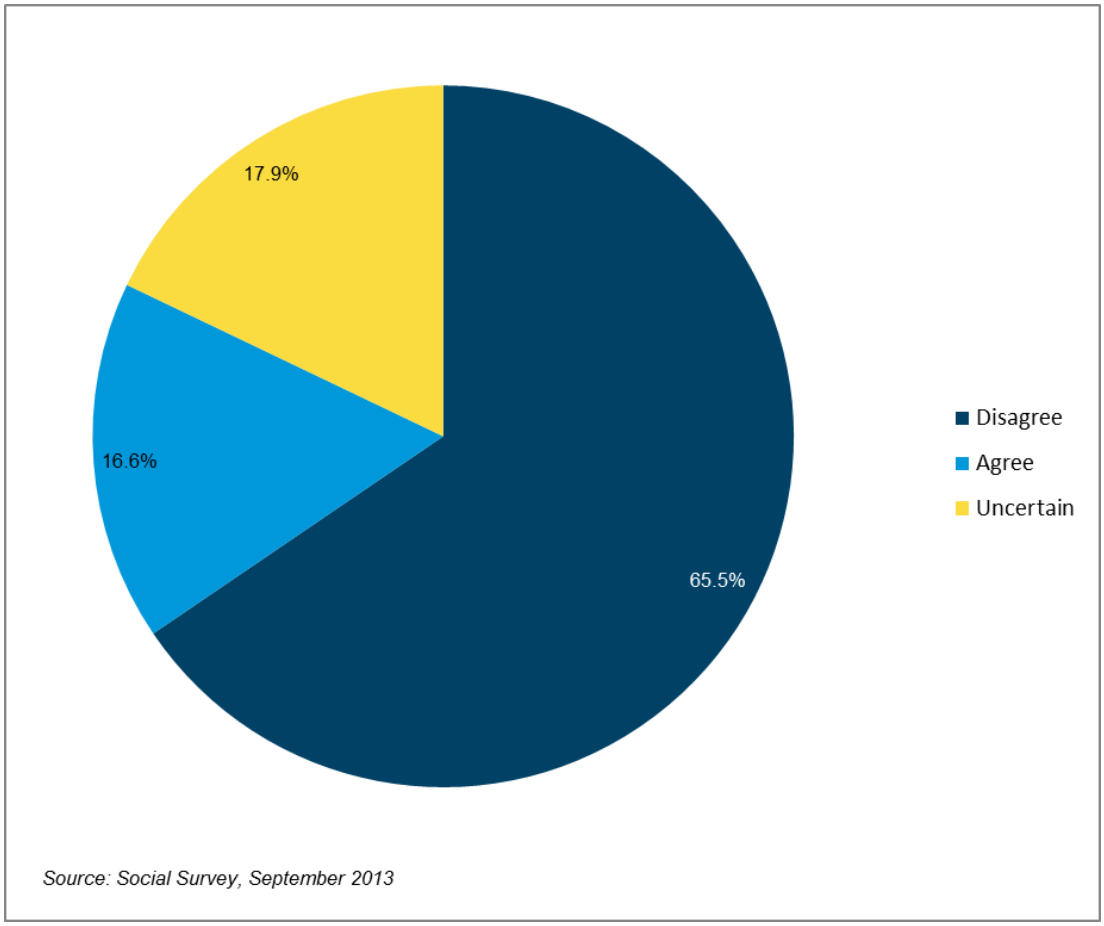


Figure 5.93 Acceptance of the project based on the fishermen respondents

Reasons to which the majority of the fishermen respondents are objecting to the project are shown in Table 5.27, noting that the respondents are given more than one choice for stating their reasons. The reclamation from the project is perceived to reduce the fishing ground for both shrimp and fishes. This would exacerbate the current scarcity of suitable fishing grounds as a result of the Pulai estuary and the coast of western Serkat already being off limits due to the ship navigation channel near Tg. Pelepas Port and for the mooring of large vessels along the deep water off western Serkat.

Table 5.27 Reasons for objecting

Reasons	Percentage (%) out of Total Fishermen Respondents
Reduce or Loss the catchment areas	43.0
Reduce the amount of catch & income	33.4
Permanent loss of Marine Habitat within the reclamation site	77.3

5.3.5.4 Willingness to Change Occupation

There is an almost equal distribution of fishermen who are willing and those who are unwilling to change their occupation (51.2% and 48.8% respectively) (Figure 5.94). The fishermen respondents in the survey not willing to change their present activities/occupation offered the following reasons:

- Old age prevents them from securing a new job
- A new job requires new training and acquiring of new skillsets which they may not be able to cope well with

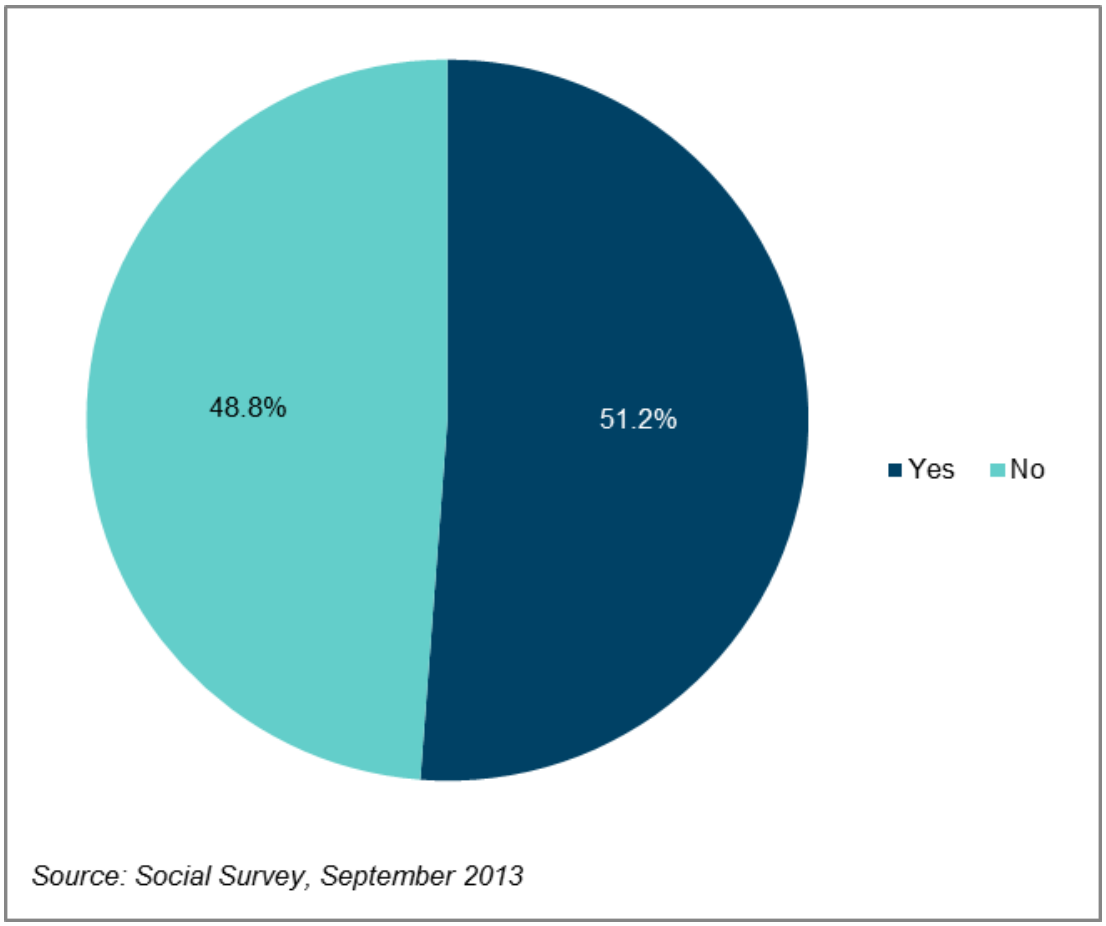


Figure 5.94 Willingness to change occupation.

In a more detailed analysis as shown on Table 5.28 revealed that 50% of the total surveyed fishermen who are willing to change job are in the 40-60 years old bracket. The second majority (31%) which are not willing to change job are also in the same age bracket. It is important to note that this age bracket (40-60 years old) represents 81% of the total surveyed fishermen. Meanwhile, it is understandably that fishermen who are 60 years and above are more unwilling to change occupation (4.8% unwilling vs 1.2% willing). However, regardless of their willingness to change occupation, 96.5% of them agreed that this proposed project will have negative implications on their livelihood.

Table 5.28 Fishermen age profile and their opinions regarding changing occupations and impact of proposed project

Age	Fishermen (%)	Willingness To Change Job		What is the impact of the proposed project in your opinion?	
		Yes (%)	No (%)	Positive (%)	Negative (%)
>17	1.2	0.0	1.2	1.1	0
18-25	1.2	0.0	1.2	0.0	1.2
26-40	10.7	6.0	4.8	0.0	10.7

Age	Fishermen (%)	Willingness To Change Job		What is the impact of the proposed project in your opinion?	
		Yes (%)	No (%)	Positive (%)	Negative (%)
40-60	81.0	50.0	31.0	2.4	78.6
60 above	6.0	1.2	4.8	0.0	6.0
Total	100	57.2	43.0	3.5	96.5

5.3.6 Tourism

The Tg Piai National Park, consisting of coastal mangrove and intertidal mudflats of about 926 hectares is a famous as a hotspot for bird watchers during migratory season (September to March annually). Coined also as the Southernmost Tip of Mainland Asia, this national park has attracted about 65,000 visitors (Suhairi Hashim, JNPC, 2012, personal communication) in 2011 – which generated about RM390,000 of revenue through the entrance fees that visitors paid.

Photo 5.42 Tanjung Piai National Park

Another prominent tourism activity would be at the Tg Piai Resort which is located on the east coast of Tg Piai, next to Sungai Belukang. It is a tourist attraction especially during the weekends (104 days annually), public and school holidays (average of 71 days/year). The total room occupancy during off-peak season (19 days) is about 10%. Based on the number of stayovers and average room rates (RM124/person /night), the annual revenue of the resort is estimated between RM2.5 million and RM3million. The resort has a small team of staff (20 people) running the resort, which includes the receptionists, managers, waiters, housekeepers, cooks and errand boys.

Photo 5.43 *Tanjung Piai Resort*

5.3.7 Public Health

The existing health status of this population was evaluated to include the assessment of physical, mental and social well being as defined by World Health Organisation (WHO, 1946). Information on the existing health status of the people at this area was deduced from health indicator data sourced from the socioeconomic survey described above. In addition, the findings of the existing air quality and noise surveys (see Section 5.1.10 and Section 5.1.11) were integrated to determine all the potential secondary health impacts.

These were supplemented by secondary data from Census and Reports by Government agencies as listed below:

- Johor Weekly Epidemiological Report (2013)
- Department of Statistics, Malaysia (2013 and 2014)
- Ministry of Health Malaysia (2013 and 2014)

For the purpose of baseline health status description, both health indicator data and common health issues related to development will be elaborated based on data of Pontian district in relation to Johor state. The health indicator data which will be stressed in this section includes source of water supply, availability of electrical supply, types of toilets, and presence of garbage collection facilities. On the other hand, the main health issues includes air aerosol, vector borne, food or water borne type, sexually transmitted diseases (STD) and other related diseases.

5.3.7.1 Health Indicator Data

The health indicator data refers to general investigation on the presence of basic necessities which if not present or present in poor condition may result in negative effects on people's health. This especially could lead to development of various diseases as described under Section 5.3.7.2.

Source of Drinking Water Supply

Source of safe drinking water supply is crucial to prevent waterborne diseases such as food poisoning, cholera, typhoid and dysentery. The majority of people in Johor (99.7%) are supplied with piped water in their homes while a minority receive water from other water supplies (0.2%) and from public water stand pipe (0.1%). Pontian district has 97.2% of safe drinking water supply while 98.3% of the survey respondents received safe drinking water source. However, a minority of the respondents (4; 1.7%) still consume water from tube wells.

Availability of Electricity Supply

Electric power supply is very significant for food safety and preservation in preventing microbe's growth. The whole of Pontian district (100%) has electricity supply which secures food preservation and prevents potential food borne diseases.

Types of Toilet

There are three types of toilets present within Johor which includes flush toilet, pour toilet and other types. In general, Johor has good coverage of aseptic latrines. The majority of the respondents (95.2%) have their own in-house latrine either as pouring or flushing toilet while a minority (4.8%) claimed to use nearest irrigation or river as their option.

Presence of Garbage Collection Facilities

Availability of proper garbage collection facilities is crucial in managing solid waste. Absence of this facility will lead to inappropriate dumping or burning of this solid wastes which results in contamination of surface soil and water, deterioration of air quality and vector borne outbreak. Majority houses in Johor (83.4%) do not have options for their solid waste disposal. Most of the respondents (61.8%) within the study area disposed of their domestic waste by burying it under soil, followed by municipal collection system (26.5%), open burning (7.4%) and open space dumping (4.3%). Based on this, the risk of surface soil and water contamination within this area is assumed to be high.

5.3.7.2 Health Issues

In general Pontian district is free from excessive burden of diseases except for waterborne disease and STDs.

Airborne Diseases

Airborne diseases are caused by pathogens which are transmitted through air. Among the reported airborne diseases at Pontian are Influenza-like-illness (ILI) and tuberculosis in which the former is common (22.6%) compared to tuberculosis (5.1%) in Pontian in 2012. The ILI might be a common cold which normally occurs during monsoon or drought season in Malaysia.

Vector- borne Diseases

Most of the communicable diseases in Malaysia are classified as vector-borne diseases which includes dengue fever (including dengue haemorrhagic fever) and malaria which occur in Pontian district. The number of dengue and dengue haemorrhagic fever cases had increased to 3.7% and 2.0% respectively in 2012 compared to 2011 at Pontian. This explains the number of patients with dengue cases diagnosed by a medical doctor within study area was the highest (4.8%) compared to other diseases. In addition common health discomfort complaints such as vomiting (4.3%) and headache (10%) were considered to manifest the symptoms of dengue fever. Malaria is another disease that usually associated with the influx of foreign migrants which might be of concern due to proposed project which however had decreased to 1.1% in 2012 at Pontian.

Food Waterborne Diseases

Food and waterborne diseases generally caused by pathogenic microorganisms which are most commonly transmitted through contaminated fresh water and food. Among the related

diseases recorded at Pontian includes food poisoning, dysentery, typhoid, hepatitis A and acute gastroenteritis in which food poisoning was recorded to be the highest percentage (3.2%) of cases recorded in year 2012. Among the health problems experienced by respondents within study area which could be linked to the food and waterborne disease includes headache (10%) and vomiting or diarrhoea (4.3%).

Sexually Transmitted Diseases (STDs)

Human Immunodeficiency virus (HIV) infection, gonorrhoea, syphilis and hepatitis C are among important sexually transmitted illnesses (STI) that have been reported within Pontian district. Among them, Hepatitis C was recorded to be the highest (3.9%) at Pontian in 2012.

Other Communicable Diseases

Some communicable diseases are caused by unhygienic conditions and direct contacts like leprosy, leptospirosis, measles and viral encephalitis. Within Pontian district, there were two diseases that showed an incremental progress from year 2010 to 2012 which include leptospirosis (3.1%) and measles (16.3%) in 2012. Both diseases occur due to exposure through direct skin contact, the first with polluted water or soil by rat's urine (leptospirosis) and the second with infectious patients (measles).

Other diseases which were recorded among the respondents from the study area include anemia (0.4%), asthma (2.2%), chest infection (0.9%), diabetes mellitus (0.4%), eczema (1.7%), heart problems (3%), hypertension (3.5%) and malnutrition (0.9%). Based on these reported diseases, heart related diseases were observed to dominate. In addition 1.3% of the respondents with heart problem had been hospitalised within last six month from the date of survey.

5.3.7.3 Social Well-being

Health Care Facilities

More than half of the Johor citizens have good accessibility to health care centres located less than 5 km away from their house. Presence of health care centres in an area is a clear indicator of the awareness level of the people towards importance of health.

Serkat Health Clinic

Serkat Health Clinic is located approximately 2.5 km away from the Project area connected by state road J111 from Tg. Piai to Serkat town. This health clinic is administered by the District Health Office of Pontian which serves to provide multiple health care services and disease prevention programmes to the surrounding local communities. There are fourteen (14) villages located within 2 km radius from this clinic which reflects its service boundary.

Pontian District Hospital

Pontian district hospital is located approximately 25 km away from the Project area connected through state road (J111) and federal route (FR95) from Tg. Piai. It is a non-specialist hospital with 120 beds and complete range of medical and surgical care facilities. At present, there are nine doctors and fourteen staff nurses handling four main wards including gynaecology ward, obstetric ward, paediatric ward and multidisciplinary ward. The average number of admissions is 33 cases per day with bed occupancy rate of 57.2% and average stay of 2.2 days per patient. The entire number of in-patients was about 12,000 patient per-year. Most admission cases were due to pregnancy and deliveries, respiratory problems and cardiovascular diseases whereby the later two cases along with infections case were the main cause of mortality at this hospital. There are approximately 19 villages within 5 km radius from the proposed project area which need to be catered by this hospital.

Education Centres

Presence of education centres within accessible distance from the house creates better education opportunities for the younger generation. In view of health, education on self-hygiene practices, physical education and balanced selection of food to enhance nutrition

status would develop better health status among people. There are six schools located distributed within accessible limit within study area.

5.3.8 Public Perception

As mentioned in Section 5.3.1, information regarding the public perception of the Project was gathered from a total of 230 respondents from within the study area over five days of social survey campaign carried out in September 2013. The background of the respondents are presented in Section 5.3.4.2. The sections below presents the findings from the survey.

5.3.8.1 Awareness and Acceptability

While the respondents are aware of the proposed reclamation project at Tg. Piai, they are not aware of the nature of project that would be implemented (i.e. development of integrated petroleum hub and maritime industrial park). Those who disagreed with the proposal (42.2%) (Figure 5.95) reasoned their disagreement through their past experience of the negative impacts from previous development projects, such as Tg. Bin Power Plant and Tg. Pelepas Port.

Among the negative impacts that the respondents anticipated include water pollution (river and marine), loss of marine biodiversity and the impact on local tourism industry. Other impacts are also included, such as severe air pollution, noise level increase and threat to local safety. However, a small percentage of 8.7% of the respondents were unsure or do not have any comments as they have no prior experience of the impacts caused by the project.

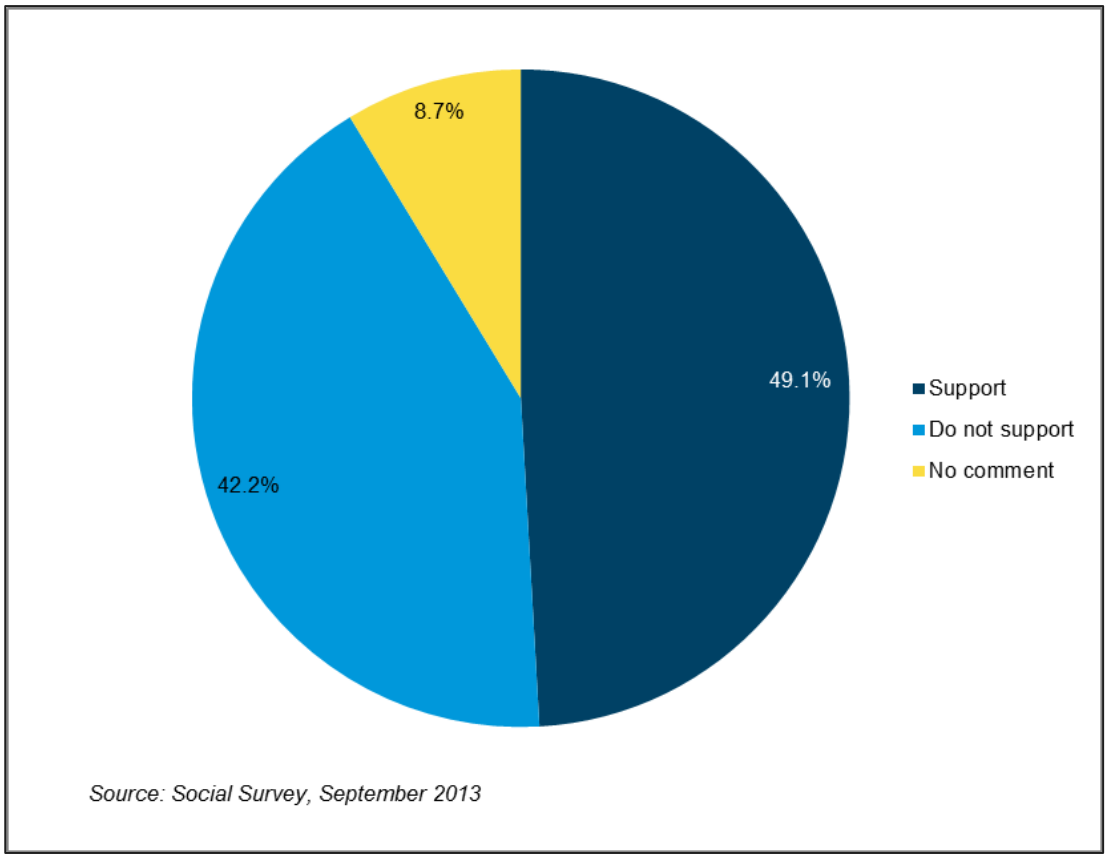


Figure 5.95 Perception of the respondents on the proposed project

In contrast, the percentage of respondents who support the Project comprised 49.1% which is the highest among the total respondents. This is due to the potential creation of job opportunities both during construction and operational phases, improvement of facilities and

infrastructure development – those of which that may enhance economic growth in their respective villages.

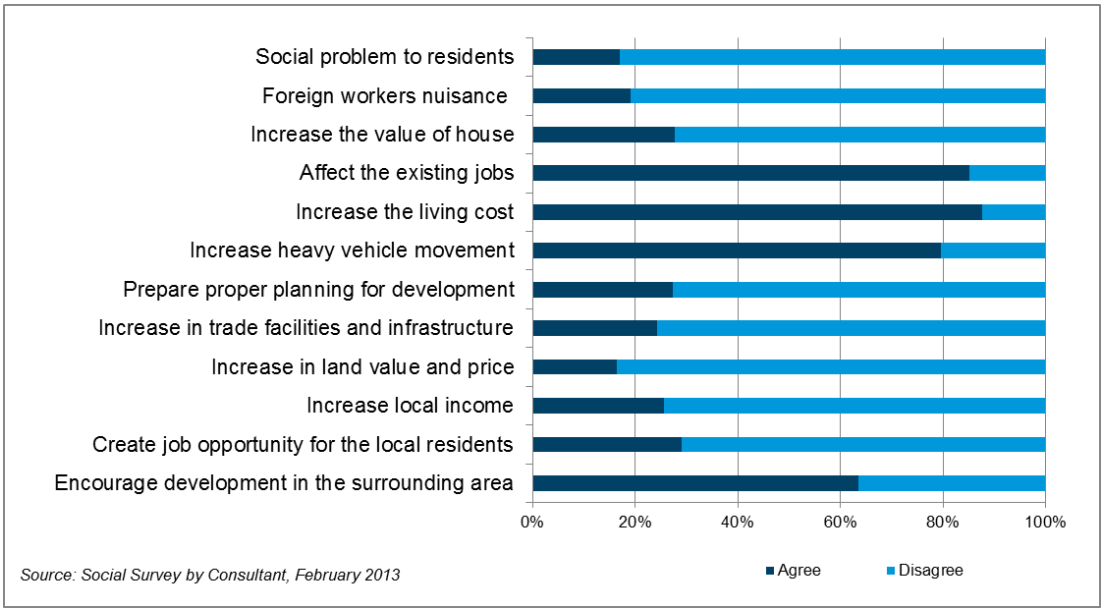


Figure 5.96 Public perception of the potential impacts from the proposed project

5.3.8.2 Findings

Two public engagements were carried out with AJK Persatuan Nelayan Kawasan Selatan Johor and communities Mukim Serkat (Table 5.29) with the aim of better understanding the issues from the audience perceptions, needs, problems, belief, reason and opinions.

Table 5.29 Information on the public consultation

Date	Location	Participants
13 March 2014	Pejabat Persatuan Nelayan Kawasan Selatan Johor	The participants consisted of representatives who are Ahli Jawatankuasa Persatuan Nelayan Kawasan Selatan Johor.
16 March 2014	Kompleks Penghulu Mukim Serkat	The participants consisted of Penghulu Mukim Serkat, JKKK Mukim Serkat, fishermen and villages in Mukim Serkat.

The key findings from the public consultations are as below:

Concerns

- Loss of fishing ground within coastal waters off Kukup and Mukim Serkat
- Reduction of catch triggering a string of impacts from loss of income, jobs, affecting the fishing industry and its related industries (e.g. shrimp paste production)
- Pollution and siltation that deteriorates water quality affecting the aquaculture farms (at Sungai Pulai based on their experience with the existing projects, e.g. Tg Bin and Tg Pelepas)
- Extra operating cost for fishing due to increase usage of fuel to fish at further out the sea
- No place to go after loss of livelihood and no one to help them in their plight
- Project proponent's representatives should be present in public consultations
- Potential detrimental effects on health and safety of the local community from pollution and hazardous materials from the operation of the proposed project

Needs

- Good Corporate Social Responsibility (CSR) programmes implemented, e.g. free shares to invest in (e.g. ASB and LKIM) for future livelihood or monthly compensations as renumeration for the lost of fishing income
- Future employment of local fishermen that have lost their livelihood as well as the larger local community by the project proponent, which includes the relevant training courses for the skills require to work with the project proponent
- Improvement of public health facilities such as hospitals for local community for present and future protection of the effects of such development
- Transfer fishermen to another area for involvement in fishing industry

In conclusion, the respondents voiced their concern and emphasised on the need for a win-win situation between the project proponent and the local community. This is due to an unsavoury experience where they were deceived by the Tg. Bin Project whereby not all fishermen gained from the said development.

5.3.9 Land Traffic

Quantitative and qualitative measures of existing traffic conditions were determined using two approaches, namely visual reconnaissance surveys and road inventory. Road inventory was carried along the main road and junctions located in the immediate vicinity of the proposed project area to determine the existing characteristic of the roads or junctions including roadway lanes, circulation, junction control and layout. The visual reconnaissance survey involved a classified traffic count survey were carried out in February 2013 at three selected sampling points as shown in Figure 5.97.

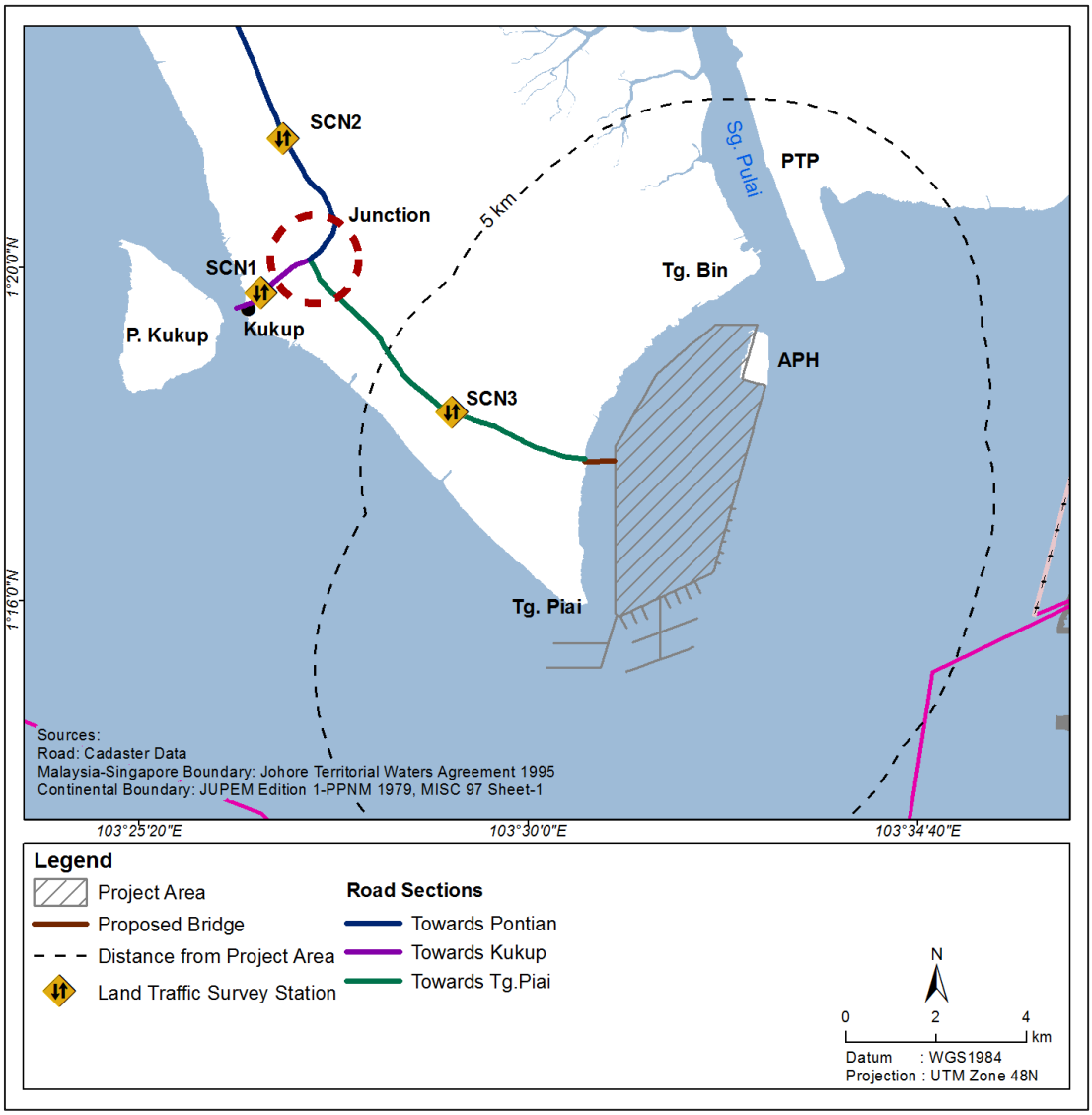


Figure 5.97 Location of the traffic survey stations

The sampling was carried for three different timings on a normal weekday as follows:

- Morning peak hours (0700 – 1000)
- Afternoon peak hours (1100 – 1300)
- Evening peak hours (1600 – 1900)

Two activities were observed: the volumes of turning vehicle movement at critical junctions, and screenlines for different type of vehicle consistent with those in the yearly Highway Planning Unit (HPU) traffic count. Evaluation of the existing junction performance was also carried out using the Signalised and Unsignalised Intersection Design and Research Aid (SIRDA) program. Secondary data was used to determine the traffic condition on weekends where classified count data were established based on a one week count from the Highway Planning Unit Census, 2012.

5.3.9.1 Results

Road Inventory

The Project area will be linked to the major towns by two types of roads namely the State Road J111 and the Federal Route FR95. Federal Route 95 is a federal road which connects

Pontian Kecil to Pulau Kukup town. Most parts of this road were built under the JKR R5 single lane road standard with a maximum operating speed limit up to 90 km/h. Jalan Serkat is a state road which connects Kukup town to Tg. Piai area. This road is a flat two lane single carrieageway road designed under R4 standard with an average travel speed of 50 km/hr. The intersection point between these two roads is a single lane road. Photo 5.44 and Photo 5.45 shows the state and federal roads at the study area.

Photo 5.44 State road J111

Photo 5.45 Meeting point of federal road FR95 and state road J111

Visual Reconnaissance Survey - Traffic Survey

The results of the traffic survey obtained at three sampling stations are presented in Figure 5.98 to Figure 5.100. Based on the traffic survey it was observed that the highest one hour traffic volume was recorded at 7 a.m. to 8 a.m. during morning peak hours; 12 p.m. to 1 p.m. during afternoon off peak hours and 6 p.m. to 7 p.m. during evening peak hours at all station except at station SCN1 during afternoon off peak hours where the highest one hour traffic

volume was recorded between 12 p.m. to 1 p.m. In general traffic volume at station SCN2 along federal road FR95 heading towards Pontian town was the highest compared to the other direction during all three durations. The affected road is currently under capacity where the maximum traffic during peak period between 200 – 500 pcu depending on the section of the road.

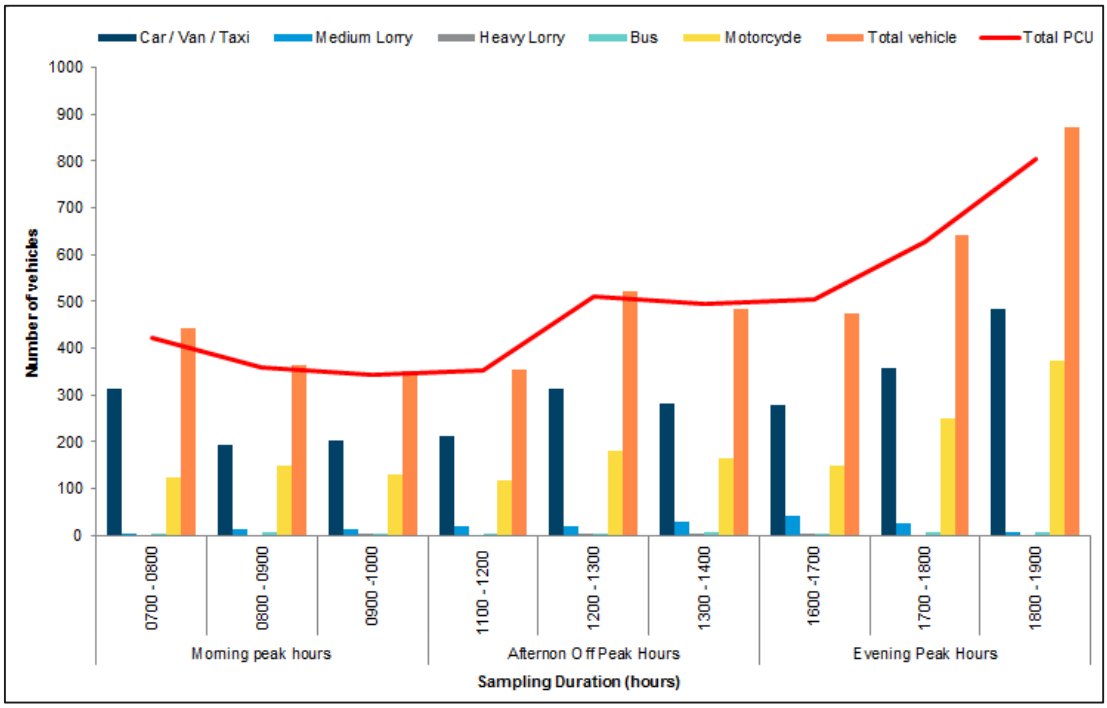


Figure 5.98 Existing traffic flow along federal route FR95 towards Pulau Kukup (SCN1)

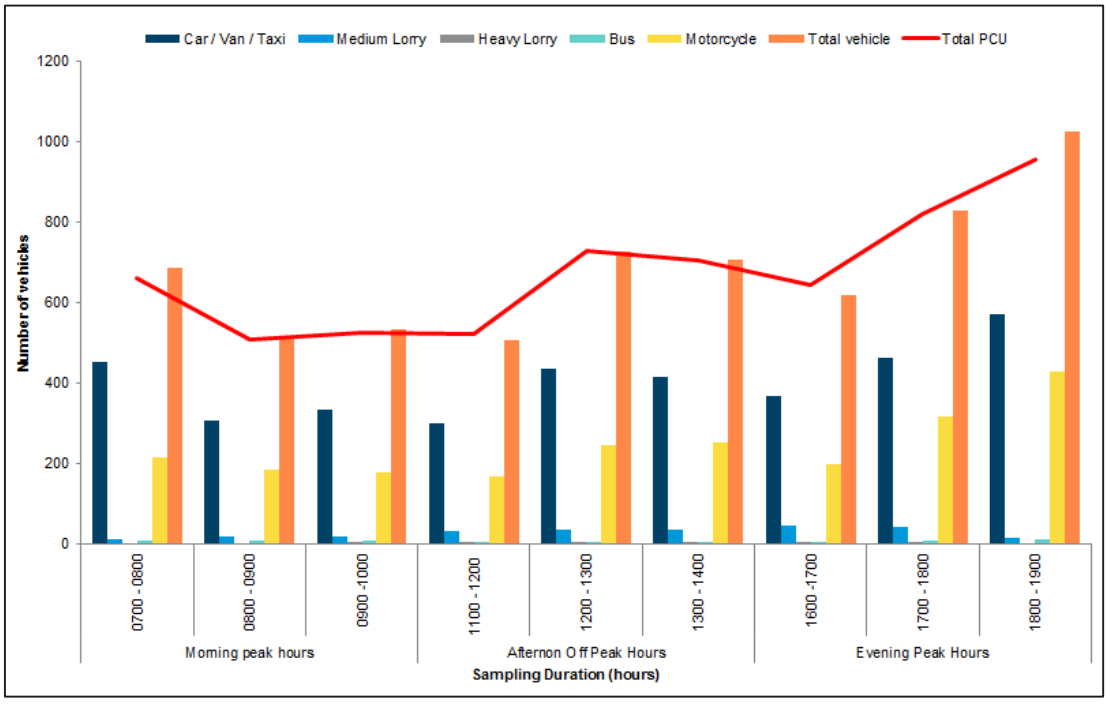


Figure 5.99 Existing traffic flow along federal FR95 towards Pontian (SCN2)

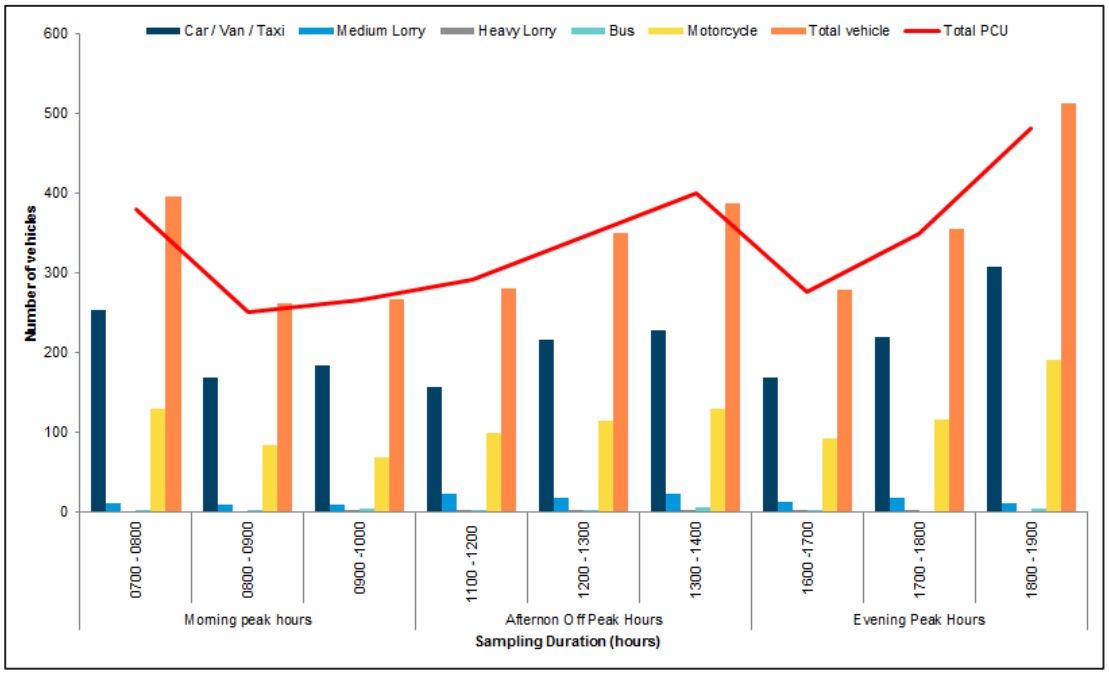


Figure 5.100 Existing traffic flow along state route J111 towards Tg. Piai (SCN3)

On a comparative basis, the classified count data derived from secondary data shows that total traffic number was constant between weekday and weekend. The pattern of traffic was generally similar except during morning hours due to commuting traffic to work places.

The traffic composition within the survey areas were mainly dominated by private cars with an average of 59 % to 62 % while heavy lorries and buses were the least dominant accounting on average less than 1 %.

Existing Road Capacity

Road capacity is defined as the maximum number of vehicles per unit time (one hour) which can be accommodated under given conditions with a reasonable occurrence. It is independent of the traffic demand but dependent on road characteristics including number of lanes, carriageway width and road environment. The existing characteristic of federal road FR95 which was assumed to have 1,600 pcu/hour/lane and state road; Jalan Serkat (J111) which was assumed to have 1,400 pcu/hour/lane. The road capacity analysis showed that the volume-to-capacity (V/C) ratios of the surveyed roads were below 0.28 which falls under level of service A during day time and evening time. The level of service at all the surveyed stations were classified as A which reflects a free flow traffic with no delay.

Junction Analysis

One major junction which will be affected by the proposed project is the junction which connects road from Tg. Piai area to Kukup town or Pontian Kechil as shown in Photo 5.50. At present, this junction operates with three (3) legged stop (priority junction) control. Evaluation on performance of this junction using SIRDA shows that the level of service (LOS) of this junction is A level with average travel speed at 55 km/hr and degree of saturations was less than 0.5 during both morning and evening peak periods. The traffic flow at this junction should be smooth or with little delays only. The schematic diagram of the existing junction's performance is shown in Figure 5.101 and Figure 5.102.

Photo 5.46 Priority Junction connecting road from Tg. Piai to Kukup or Pontian Kechil

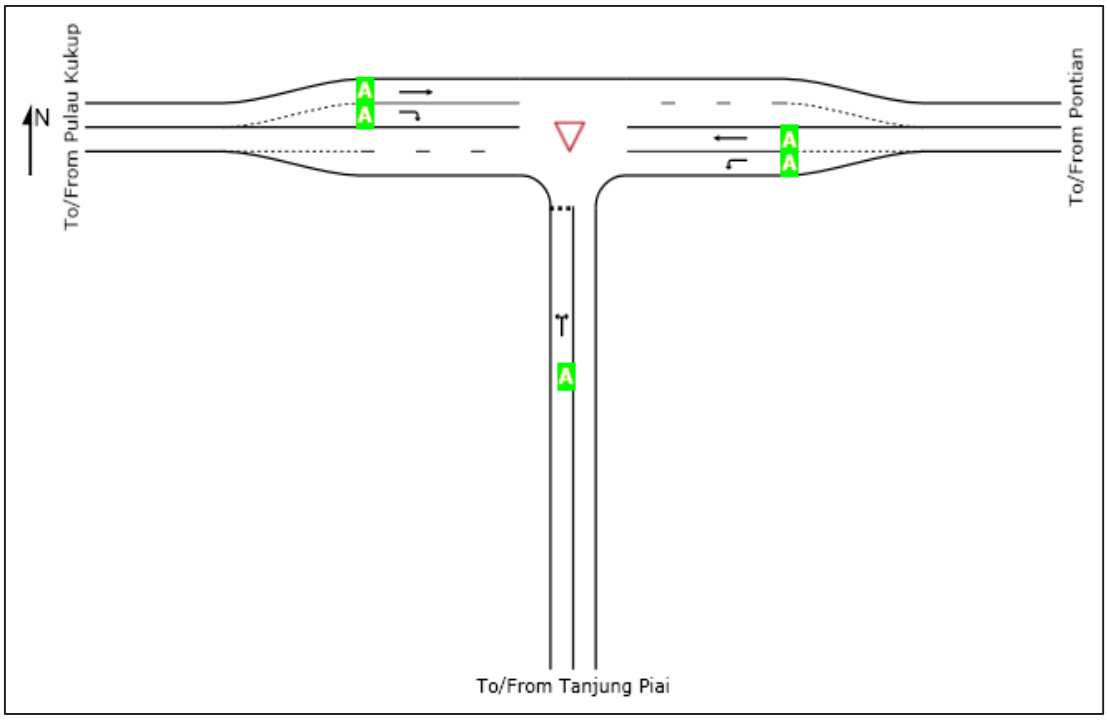


Figure 5.101 Existing junction performance during AM peak period

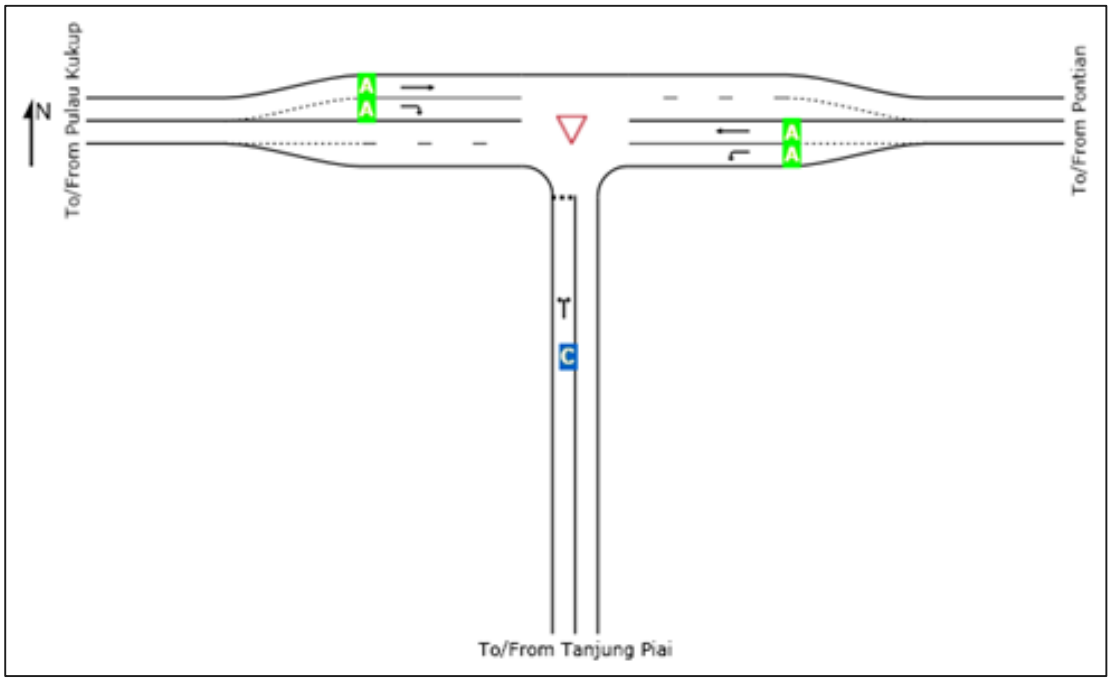


Figure 5.102 Existing junction performance during PM peak period

5.3.10 Marine Traffic and Navigation

The Project is located in Port of Tanjung Pelepas (PTP) Port Limit to the south west of the existing PTP container berths. There are a number of port operations within the PTP port limit including the following:

- PTP which operates a major container port located to the east of the navigation channel to the north of the Project site.
- ATB Oil Terminal. This has 5 berths able to handle tankers with a draft up to 17m and 893,000m^3 tank storage for petroleum products.
- Tg Bin Power Station Jetty.
- Ship To Ship transfer (STS) operations within the PTP port limit.
- The proposed APH facility. This includes a jetty for handling petroleum products. The project is presently abandoned in a partially constructed condition.

The closest adjacent ports are Kukup and Johor Bahru, which mainly handle ferry traffic and some STS operations respectively. The other major port close to the project is the port of Singapore. The location of these port facilities is shown in Figure 5.103 and further descriptions are given in Appendix H.

The Project is immediately north of the westbound lane of the IMO navigation traffic separation scheme (TSS) for the Straits of Malacca. The limits of this traffic separation scheme is shown in Figure 5.104. Typical shipping traffic tracks in the vicinity of the project based on AIS data for 1 to 7 July 2013 are shown in Figure 5.105.

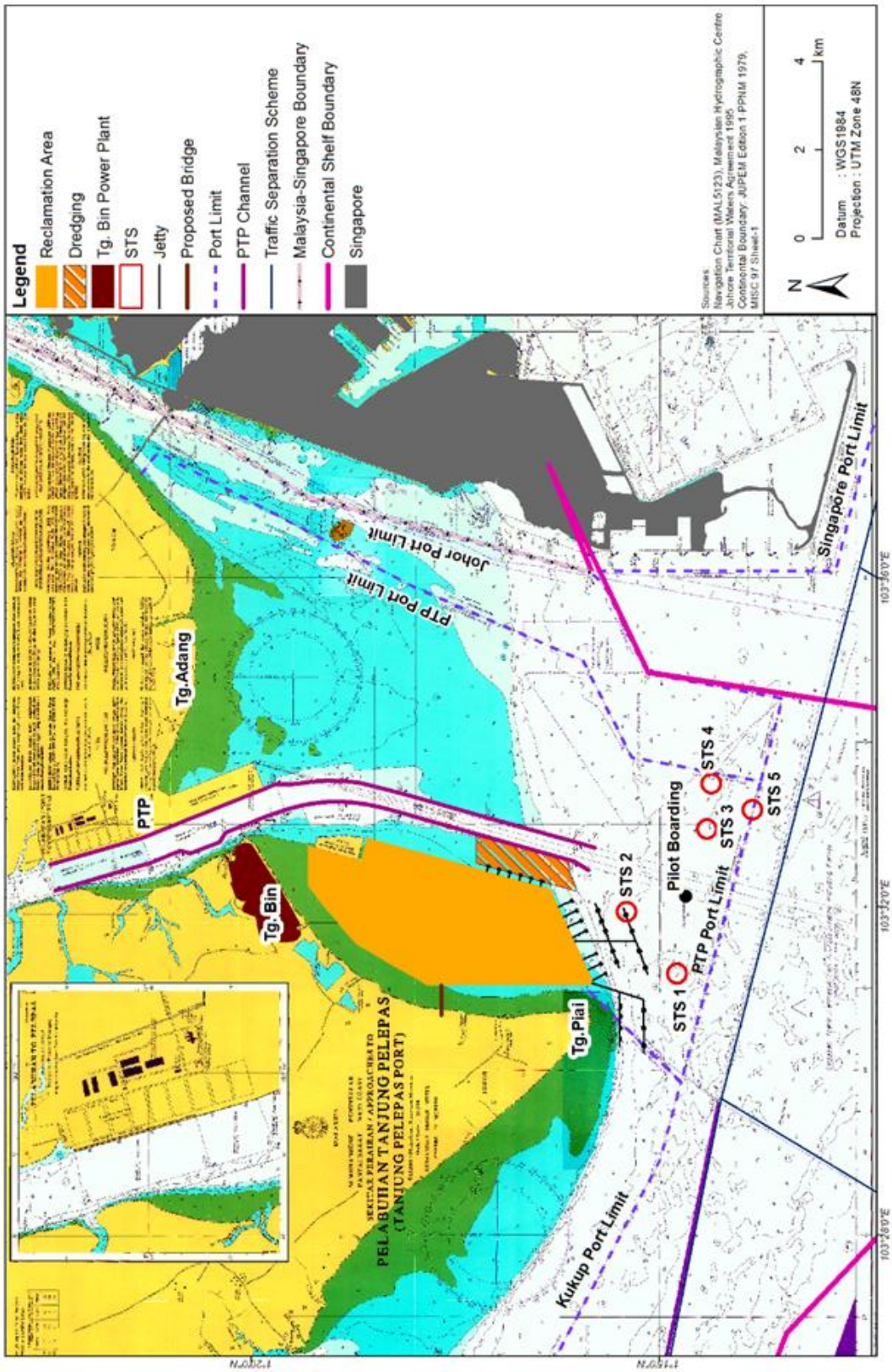


Figure 5.103 Adjacent Port Facilities

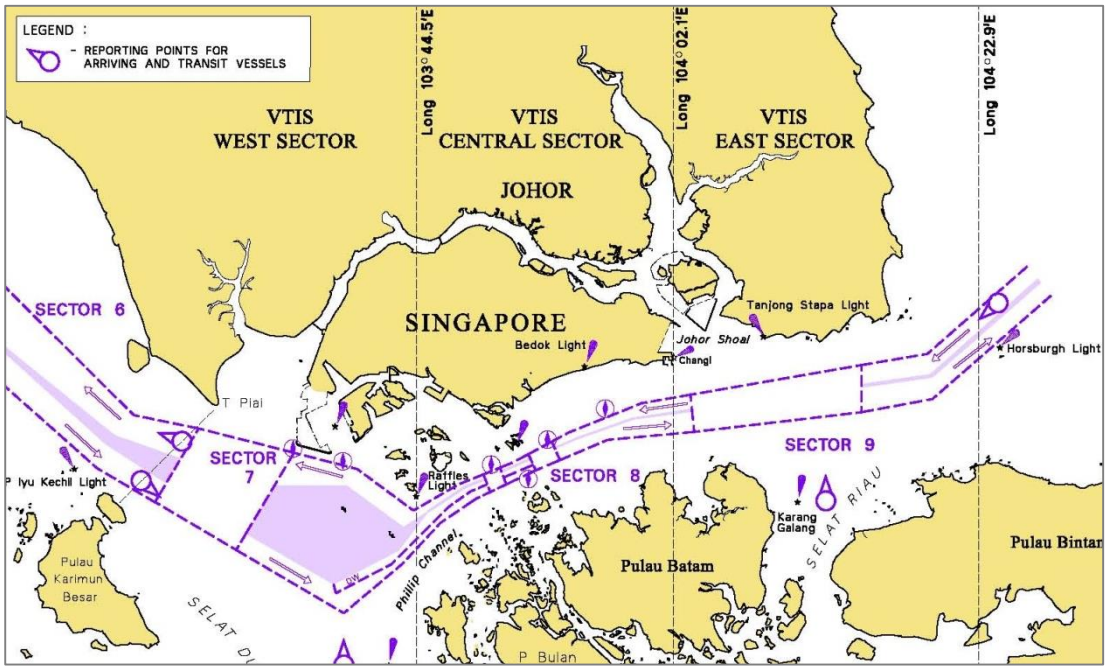


Figure 5.104 Limits of Traffic Separation Scheme

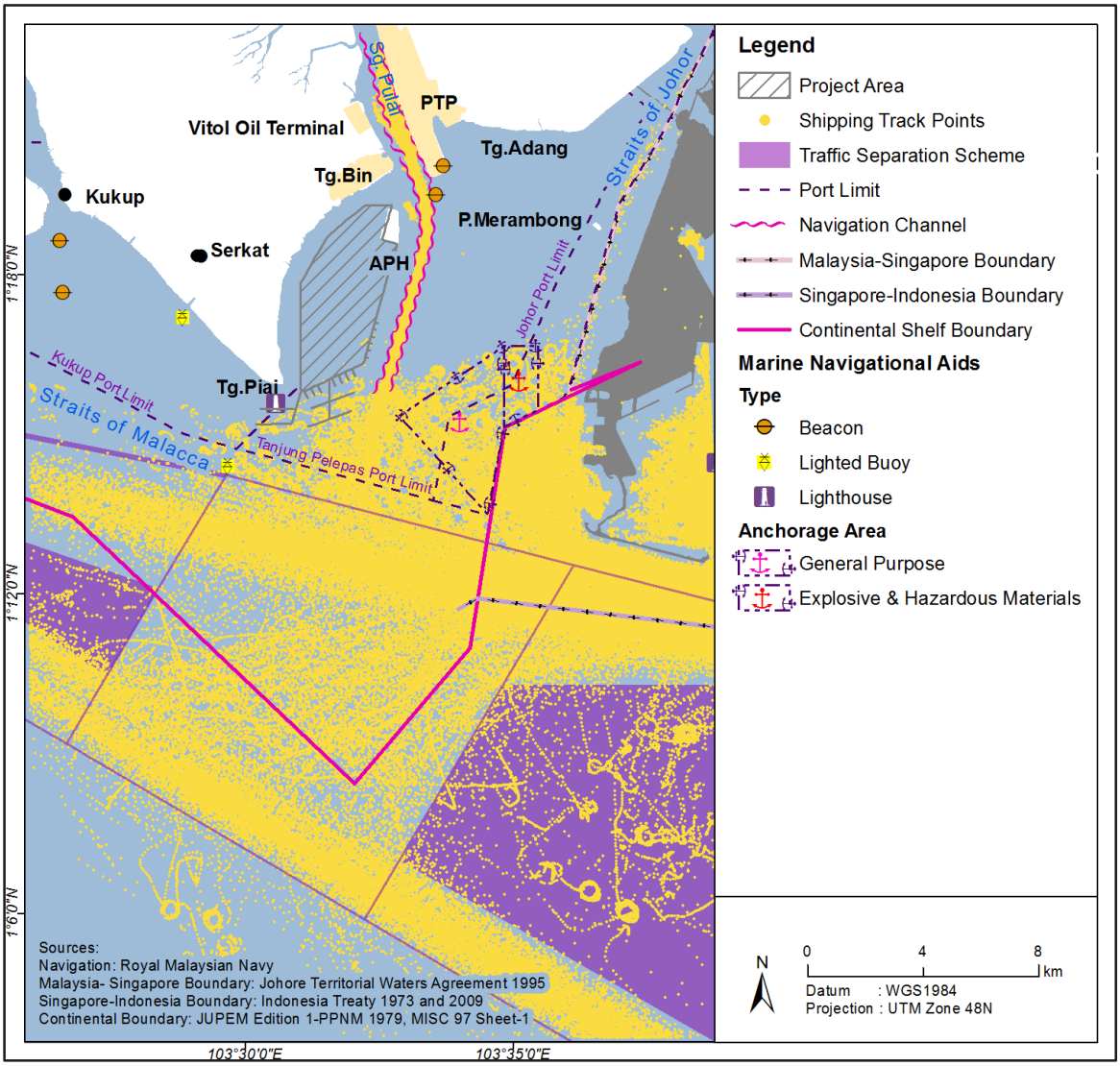


Figure 5.105 Shipping traffic tracks – 1 to 7 July 2013

5.3.10.1 Existing Navigation Aids

There is a light beacon to the south of Tanjung Piai. This presently marks the southern limit of the shallow water area at Tg Piai. The location of this light beacon is shown in Figure 5.106.

In addition to this there are light beacons marking the PTP access channel.

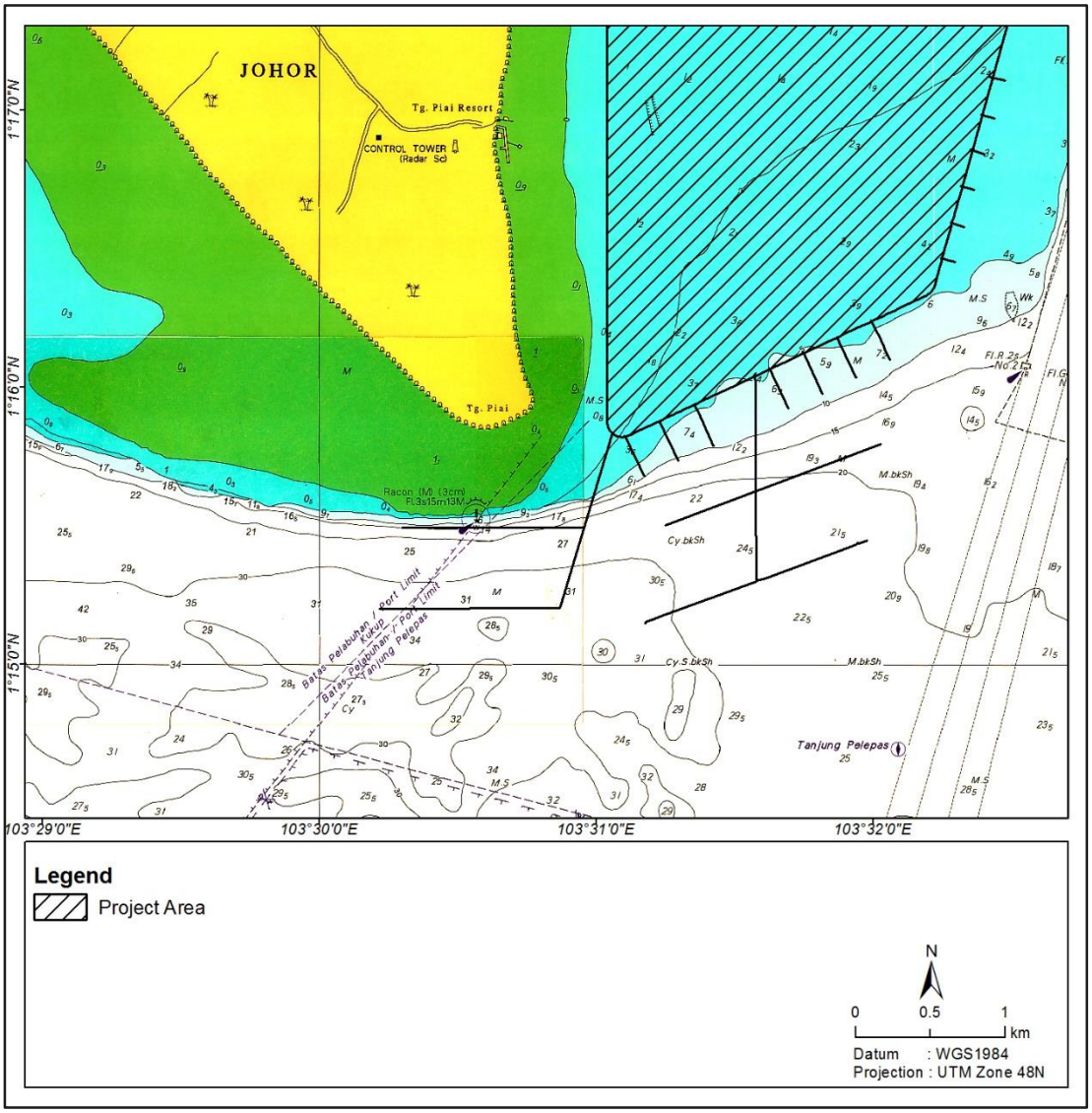


Figure 5.106 Existing Key Navigation Aids in the vicinity of the Project

5.3.10.2 Shipping Traffic Statistics

Malacca Straits

Between 2010 and 2013, the number of merchant vessels exceeding 300 GRT using the Straits increased by almost 5.2 per cent (see Table 5.30). LNG/LPG carrier using the Straits registered 18.7 per cent growth from 3,579 to 4248 while tanker rose 12.6 per cent over the same period. These figures exclude cross traffic and other vessel types plying the waterway. In addition almost 50 per cent of global energy shipments pass through the Straits annually.

Table 5.30 Shipping Traffic in the Malacca Straits (ships per year)

Ship Type	2010	2011	2012	2013
VLCC / Deep Draft Craft	43,33	4,539	4,732	4,825
Tanker	16,247	16,233	17,345	18,296
LNG / LPG Carrier	3,579	3,830	4,014	4,248
Cargo Vessel	8,445	7,996	7,950	7,613
Container Vessel	24,806	25,552	24,639	24,658
Bulk Carrier	11,642	10,851	11,678	12,658
Ro-Ro / Car Carrier	2,624	2,545	2,980	2,998
Passenger Vessel	1,071	877	861	1,063
Livestock Carrier	45	47	38	55
Tug / Tow Vessel	545	414	529	563
Government / Navy Vessel	37	57	50	58
Fishing Vessel	20	20	52	27
Others	739	577	609	911
Total	**74,133**	**73,538**	**75,477**	**77,973**

Source: Marine Department

Malaysian Ports in the Vicinity of the Project

The shipping traffic to the ports in the vicinity of the Project is summarised in Table 5.31 based on data supplied by the Marine Department. In respect of this shipping traffic the following should be noted.

1 PTP currently operates 12 container berths with a further 2 currently under construction and addition berths planned for the future. The shipping traffic to the PTP container berths will increase as these berths are commissioned.
2 The ATB Oil Terminal commenced operation in 2012, and traffic is still developing. When operating at full capacity it is expected to handle on average 5 ships per day (1,825 per year).

Table 5.31 Shipping Traffic Statistics for Malaysian Ports in the vicinity of the Project (Ships per year)

Port	2010	2011	2012	2013
Port of Tanjung Pelepas (PTP) Container Terminal	4,156	5,095	4,981	4,793
ATB Oil Terminal[5]			388	1,077
Tanjung Bin Power Plant Jetty	64	75	79	65
STS operations within the PTP port limit	375	531	584	817

Source: Marine Department

[5] The ATB facility commenced operation April 2012.

Port of Singapore

Shipping traffic data for the Port of Singapore has been obtained from the Maritime and Port Authority of Singapore (MPA). This is summarised in Table 5.32 with additional detail being given in Appendix N.

Table 5.32 Shipping Traffic Statistics for Port of Singapore (Ships per year)

Port	2010	2011	2012	2013
Port of Singapore	127,299	127,998	130,422	139,417

Source: Maritime and Port Authority of Singapore

5.3.10.3 Marine Safety

Data obtained from the Marine Department indicates that in the period 2006 and 2012 there were up to 3 accidents to shipping recorded at PTP. The type of accidents are summarised in Table 5.33.

Table 5.33 Accident Statistics for PTP

Year	Contact	Collision	Grounding
2006	0	0	1
2007	0	0	1
2008	0	0	0
2009	0	0	0
2010	0	0	0
2011	2	0	1
2012	1	1	0

Source: Marine Department

5.4 Committed Developments in the Vicinity of the Project

There are several development projects within the study area which have been approved by either state or federal authorities. These developments are either under construction stage, operation stage or will be constructed in near future. Among them are Port of Tanjung Pelepas Extension, Integrated Container Terminal (ICT), Tanjung Bin Power Plant (Phase 2), the Sungai Pulai Bridge Project and the proposed Coastal Protection along Tg. Piai by the Department of Irrigation and Drainage (DID).

Port of Tanjung Pelepas – Phase 3 Extension

PTP is located on the eastern side of Pulai River mouth in South West Johor. PTP is a naturally sheltered deep water port which covers an area of 500 acres. Photo 5.47 and Photo 5.48 shows the existing PTP area. The Phase 3 extension involves further reclamation to the south of the port to accommodate additional berthing and storage capacity.

Photo 5.47 Aerial view of PTP within Pulai River taken in May 2013

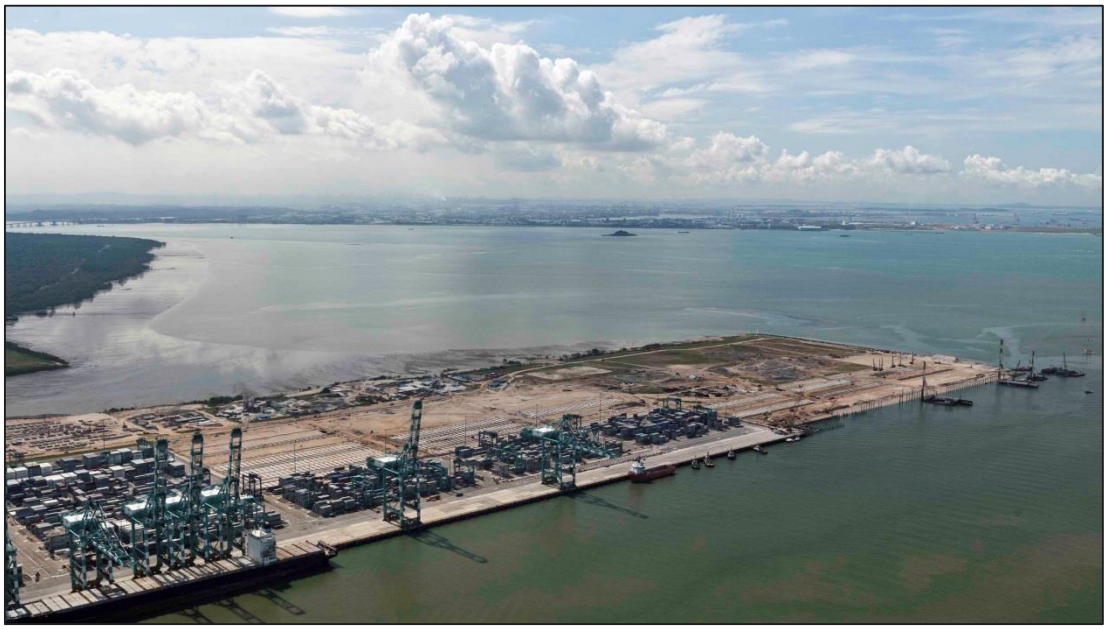


Photo 5.48 Aerial view of southern part of PTP taken in May 2013

Tanjung Bin Power Plant Expansion

Tanjung Bin Power Plant is located on the mainland to the north of the project area, west of Sg. Pulai rivermouth. The power plant comprises three (3) power-generating units, each with a nominal net capacity of 700 MW. Photo 5.49 and Photo 5.50 show the Tg. Bin area as in May 2013. The expansion of the existing power plant has been approved to have two (2) power-generating units with 1,000 MW capacity each.

Photo 5.49 Tg. Bin Power Station (May 2013).

Photo 5.50 Aerial view of Tg. Bin Power Station taken from river mouth of Pulai River in May, 2013

Integrated Container Terminal (ICT)

ICT is just 10 km away from either PTP or the Singapore Customs Checkpoint at Tuas and easily accessible via a 2 km diversion from the Second Link Highway. The depot had been specifically designed to meet industrial requirement in terms of location, service offerings, IT system, HSSE and security. ICT's existence and investment in infrastructure facilities are tailored to benefit the market as it is now vital and inevitable for an off dock depot to be operated adjacent to PTP, in line with the Johor's container port rationalisation initiatives. Current area of ICT is 6 acres with additional 4 acres reserved for expansion

Sg. Pulai Bridge

Sg. Pulai Bridge is one of the future development located northeastward of the proposed project area across Pulai River. It is a 6.3 km length of bridge which will connects Pontian and Johor Bahru District. Upon completion, this bridge is expected to induce development in the Serkat area.

Coastal Protection Scheme for Tg. Piai

A string of breakwaters and oil booms are proposed by the Department of Irrigation and Drainage (DID). These breakwaters and oil booms are to be built for the purposes of mitigating erosion and protecting the shoreline from oil spill. These protection structures, with a length of 4,918 m will be constructed to cover the eastern and western shoreline of Tg. Piai (Figure 5.107) and is in close proximity with the project, less than 500 m.

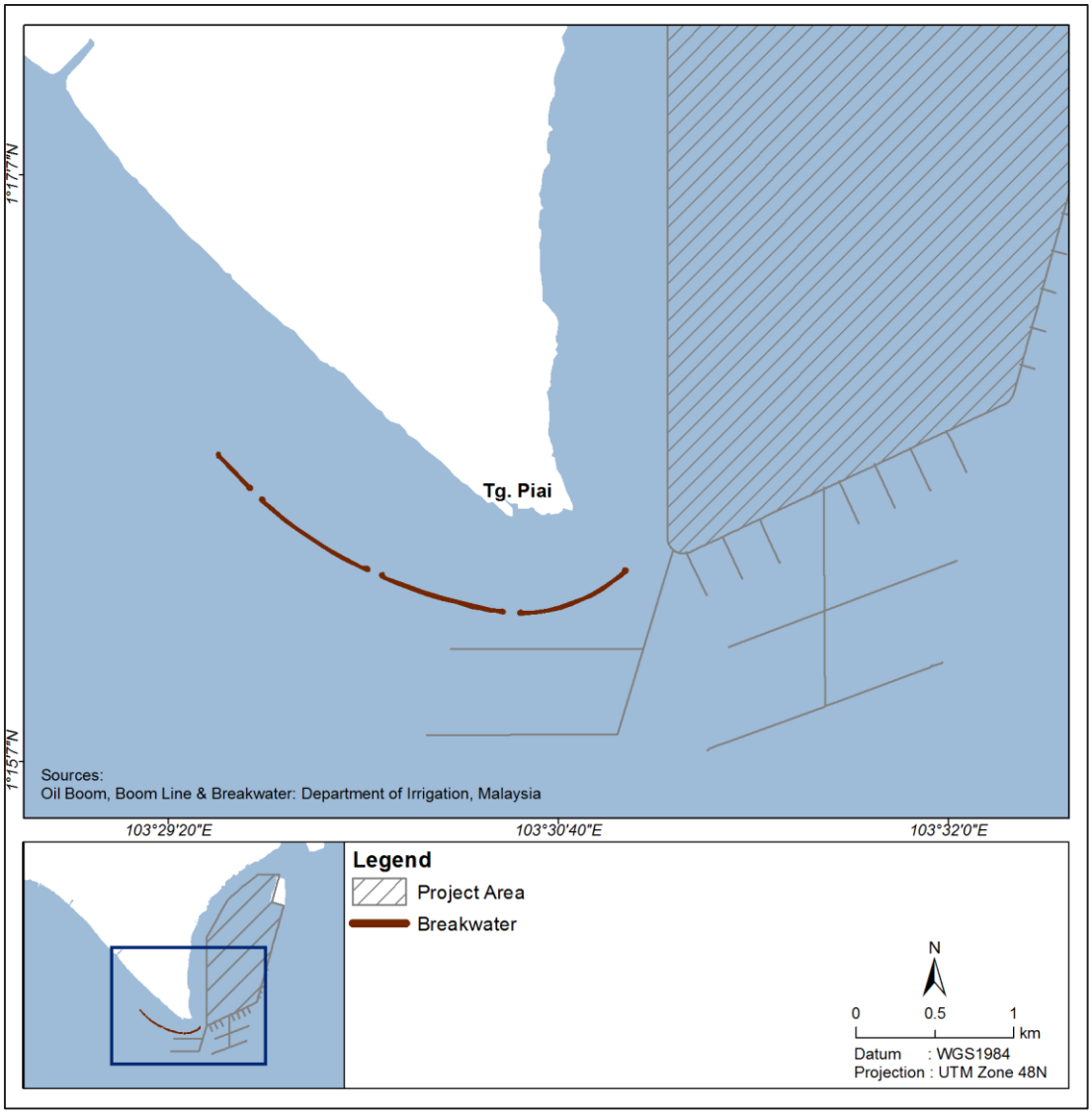


Figure 5.107 DID breakwaters and oil boom

5.5 Environmentally Sensitive Receptors

Based on the studies reported on here a number of environmentally sensitive receptors have been identified. In this context of this DEIA an *environmentally sensitive receptors* is defined as a 'special area that is very sensitive to any form of changes to the ecosystem due to natural processes or activities in or around it, either directly or indirectly and is determined

based on integration of sensitive characteristics, elements of disaster risk function, the value of life support and the heritage and legacy of the area' (DOE Siting and Zoning of Industries, 2012).

A summary of the key sensitive receptors as described above and their distance from the Project site is given in Table 5.34, while their locations are shown in Figure 5.108 and Figure 5.109 for the area within 10 km and 5 km from the project site respectively.

Table 5.34 Key sensitive receptors within the study area

Receptor	Distance from Project Area	Description
Biological Receptors		
Mangroves	0.6 km 7 km	• Tg. Piai State Park • Sg. Pulai Forest Reserve • Pulau Kukup State Park
Corals	6 km	Around Pulau Merambong
Seagrass	6 km 1.5 km	• Merambong Shoal • Sg. Pulai Estuary
Intertidal Mudflats	0	• Direct impact area • Tg. Adang • Western shoreline between Tg. Piai and Pulau Kukup
Shorebirds and waders	0	Mudflats.
Ramsar Site	1.1 km 7 km	• Tg. Piai Ramsar Site • Sg. Pulai Ramsar Site • Pulau Kukup Ramsar Site
Human Environment		
International Border	7.5 km	Malaysia – Singapore International Border
Port and Jetty	2.1 km 2.3 km	• Port of Tg. Pelepas (PTP) • Tg. Bin Power Plant Jetty
Water Intake	Approximately 2 km	Tg. Bin Power Plant water intake
Navigation	Less than 100 m	Navigation channel
Fishing Area	0	Fishing may occur within proposed project area
Tg. Piai Ramsar Site	1.1 km	Tourism activities, boardwalk, etc.
Population Area	~ 1 km	Kg. Serong Laut; Kg. Perpat Pasir

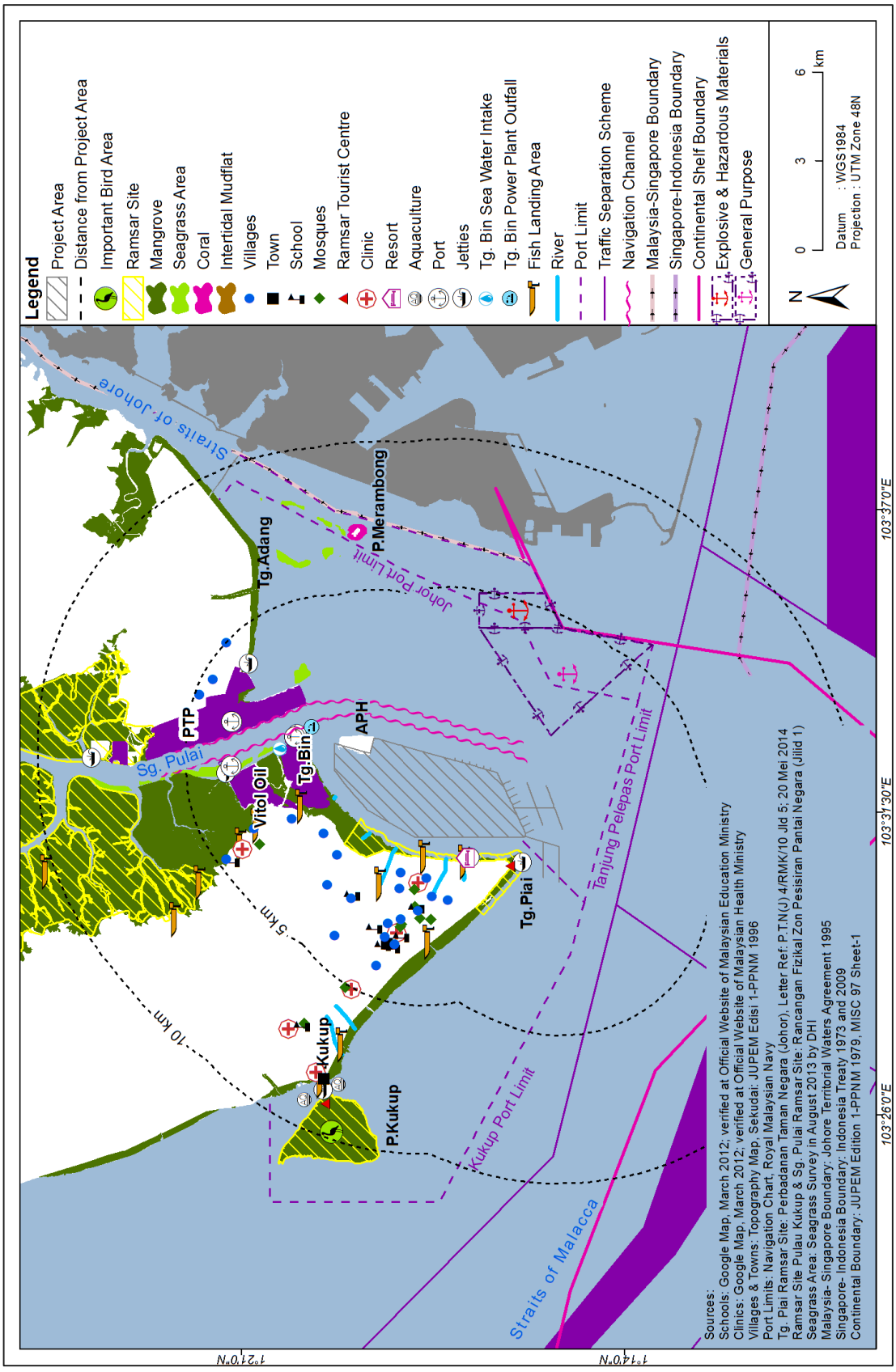


Figure 5.108 Summary of identified sensitive receptors – within 10 km of project. (see Drawings for A3 size figure).

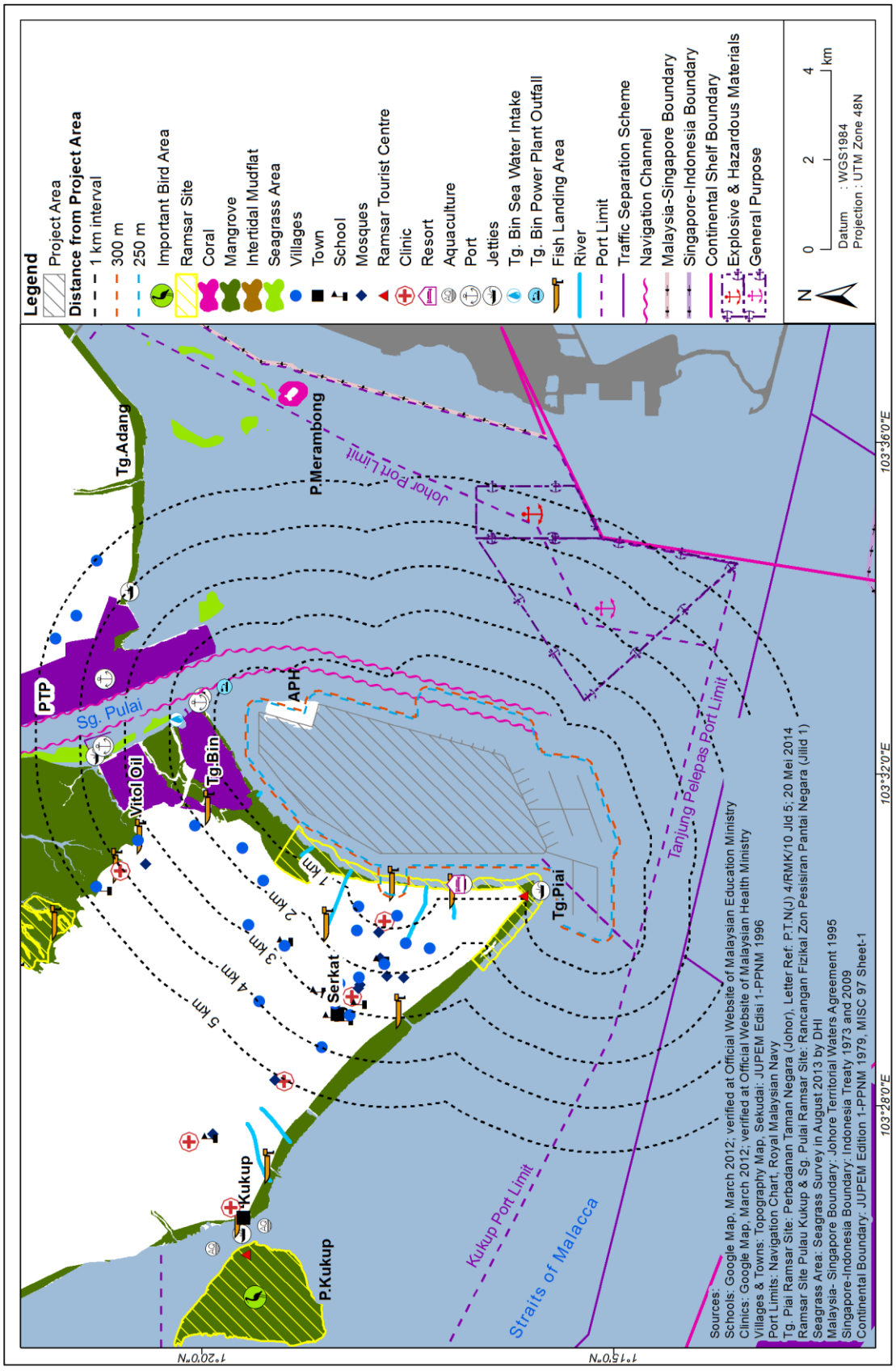


Figure 5.109 Summary of identified sensitive receptors within 5 km of project (see Drawings for A3 size figure)