

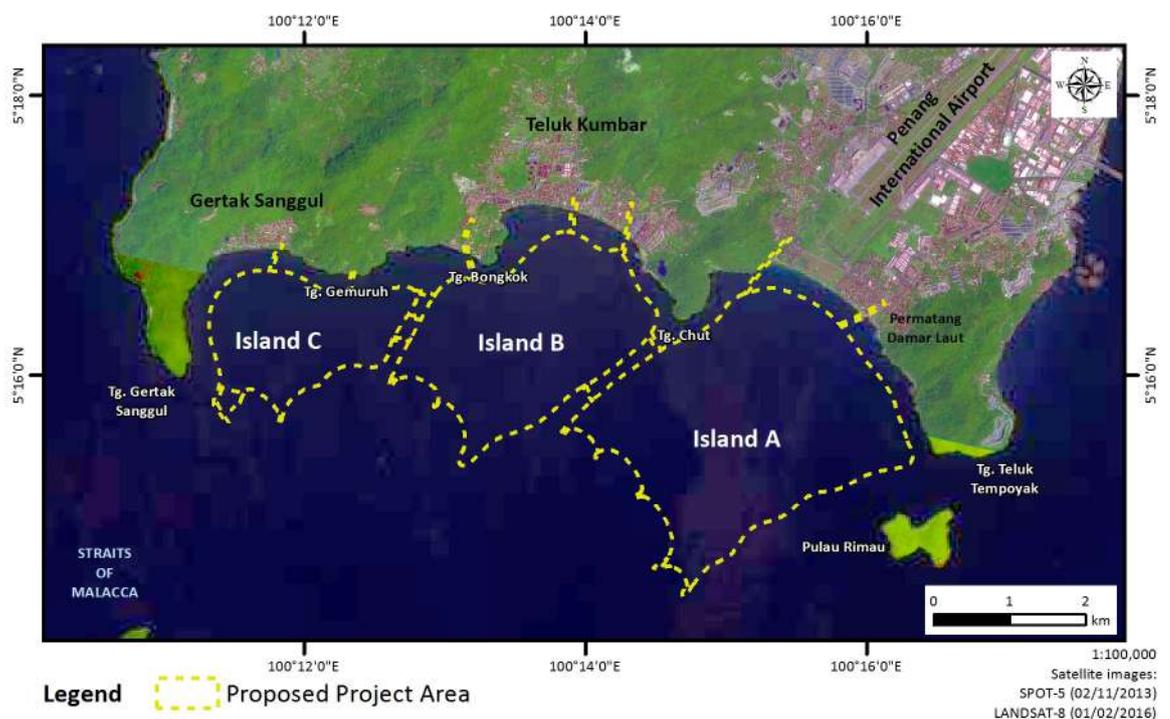
05 PROJECT DESCRIPTION

This chapter covers the details of the proposed Project which includes the following:

- a) Project site description;
- b) Project concept;
- c) Project components;
- d) Project activities and phasing;
- e) Top-side development land use; and
- f) Project implementation schedule.

5.1 Introduction

The proposed Project location stretches across the south coast of Penang Island along the coastline of Permatang Damar Laut to Gertak Sanggul from the east to the west. The site description of the Penang south coast is addressed according to the headlands namely Tanjung Teluk Tempoyak, Tanjung Chut, Tanjung Bongkok and Tanjung Gertak Sanggul (F5.1).

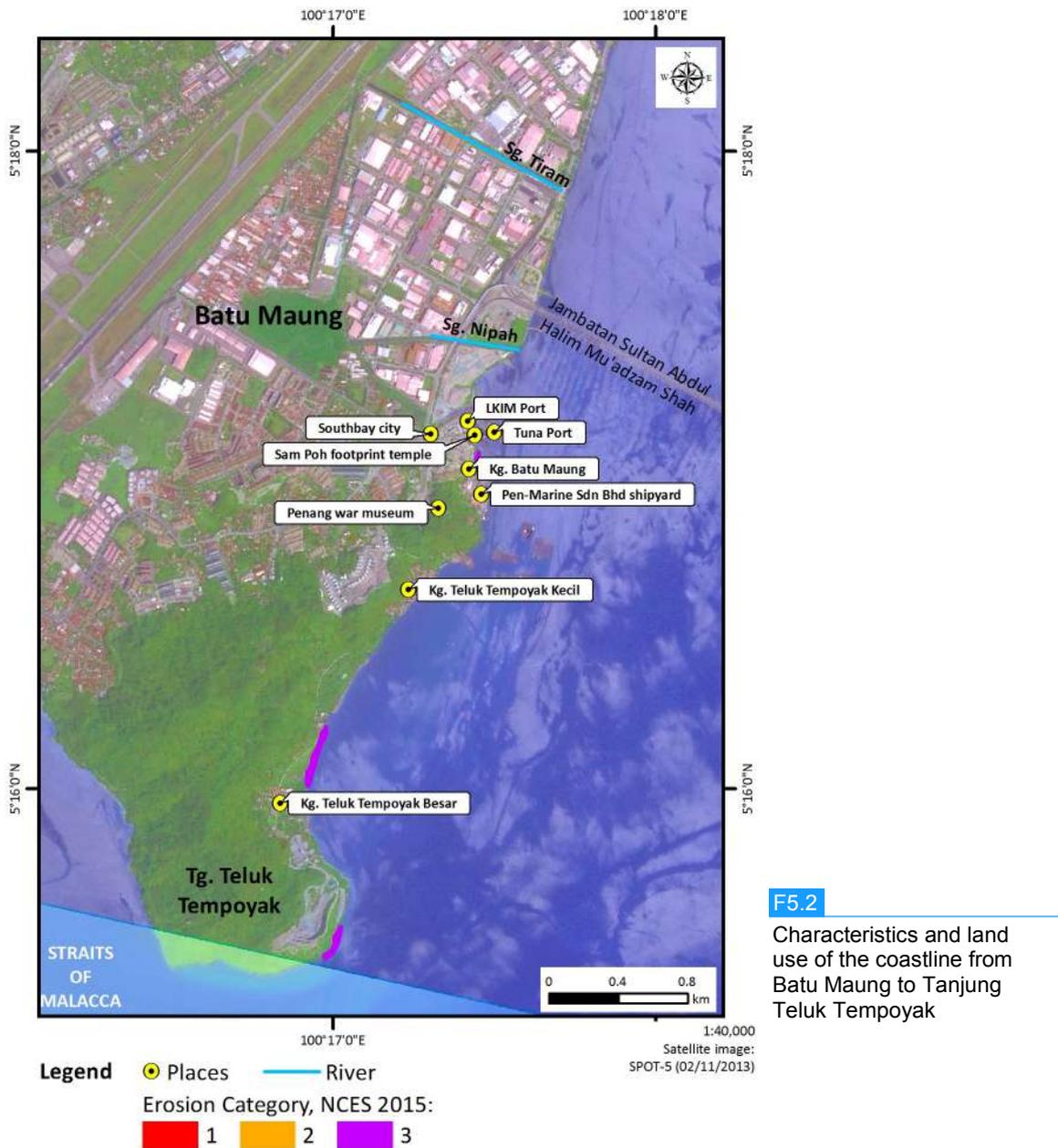


F5.1 Headlands along the south coast of Penang Island

These headlands are rocky and stable - making it resistant to erosion which creates log-spiral bays in between the headlands. Log-spiral bays normally emerge along an active coast with strong longshore currents. The coastlines here consist of rocky and sandy beaches. The main features and land use are described in the following sub-sections.

5.1.1 Batu Maung to Tanjung Teluk Tempoyak

The distance from Batu Maung to Tanjung Teluk Tempoyak along the coastline is about 3.6 km. Pulau Rimau is located approximately 830 m away from the tip of Tanjung Teluk Tempoyak. The coastal erosion category of the coastline from Batu Maung to Tanjung Teluk Tempoyak falls under Category 3 (“Acceptable”) based on the National Coastal Erosion Study (NCES) (DID, 2015) as shown in F5.2. Details of the erosion categorisation are tabulated in T5.1.



T5.1 Erosion categorisation

Category	Representative Description
1 (Critical)	Fast retreating coastline at the rate of more than 4 m/year with generally fairly dense human settlement, some commercial/industrial activities and being served by significant public infrastructure and facilities.
2 (Significant)	Retreating coastline at the rate of between more than 1 m/year but less than 4 m/year with generally sparsely populated area, some agricultural activities and being served by relatively minor public infrastructure and facilities.
3 (Acceptable)	Slowly retreating coastline of less than 1 m/year with generally no human settlement and minimal agricultural activities, and not served by public infrastructure and facilities.

Source: NCES (DID, 2015)

The coastline nearer to Tanjung Teluk Tempoyak is generally shallow with mudflats visible during low water. Two rivers are located within the area: Sungai Tiram and Sungai Nipah. The Bayan Lepas Free Industrial Zone (FIZ) is located at the north of Batu Maung. There are three fishing villages which are Kampung Batu Maung, Kampung Teluk Tempoyak Kecil and Kampung Teluk Tempoyak Besar. These are situated near *Lembaga Kemajuan Ikan Malaysia* (LKIM) Port in Batu Maung (F5.3). In 2009, LKIM took over the management of the Batu Maung fisheries port from the Malaysian International Tuna Port Sdn. Bhd. (MITP). F5.4 shows the tuna port situated near the LKIM port. The coastline at the MITP is surrounded by exposed mudflats. The Sam Poh Footprint Temple is situated close to the LKIM Port. There is also a local fishing jetty near the temple (F5.5).

An on-going development by Mah Sing Group Berhad called Southbay City is currently being constructed along the coastline. Next to this Southbay City is the historical Penang War Museum (F5.6). The War Museum was actually a fortress constructed over 20 acres of land. After clearing and restoration works were finally completed, this fortress was turned into the War Museum.



F5.3 LKIM Port at Batu Maung



F5.4 Malaysian International Tuna Port (MITP)



F5.5 A local fishing jetty near Sam Poh Footprint Temple



F5.6 Penang War Museum

Along the coastline, there is a shipyard operated by Pen-Marine Sdn. Bhd. (F5.7). There are edge protections along the coastline of this shipyard. Several aquacultures are also present near Kampung Teluk Tempoyak Kecil (F5.8). An abandoned fisherman's jetty is found at the coastline of Kampung Teluk Tempoyak Kecil. Rip rap rock and Labuan blocks protection are seen along the coast at a few locations (F5.9).



F5.7

Pen-Marine Sdn. Bhd.
shipyard



F5.8 Aquacultures near Tanjung Teluk Tempoyak

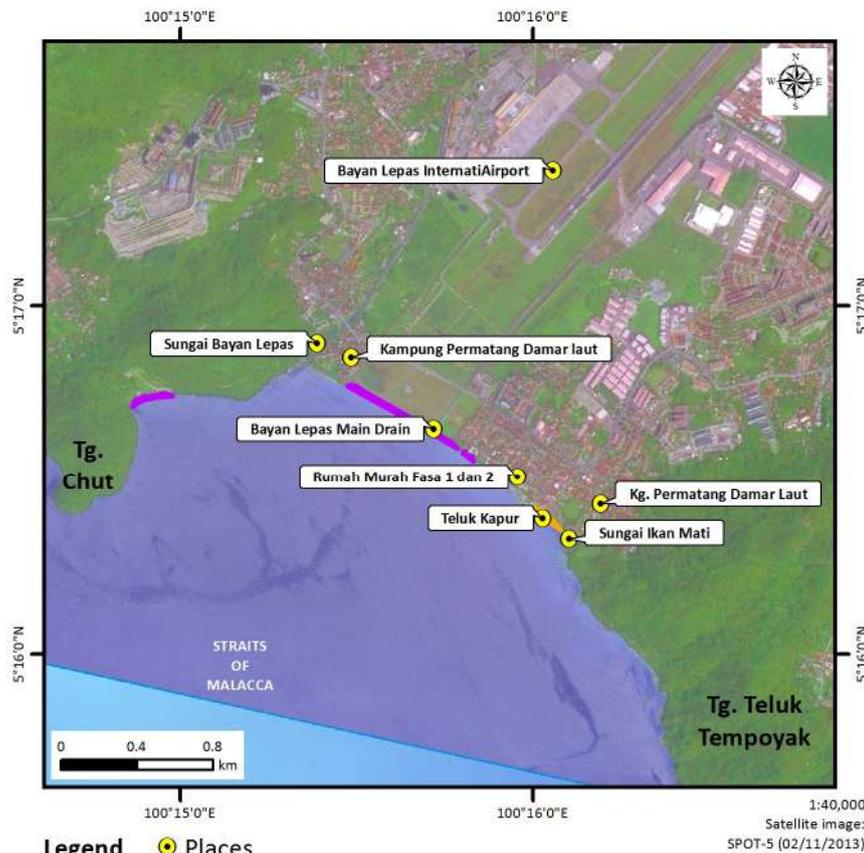


F5.9 Rip rap protection at Kampung Teluk Tempoyak Kecil

5.1.2 Tanjung Teluk Tempoyak to Tanjung Chut

Tanjung Chut is located approximately 6.5 km away to the west from Tanjung Teluk Tempoyak (F5.10). The western side of Tanjung Teluk Tempoyak is mostly covered by forests and fronted by rocky outcrops and sandy beaches (F5.11). The land use between the two headlands is already well-developed particularly at Bayan Lepas with the Penang International Airport. The coastline erosion conditions along Permatang Damar Laut are categorised as Category 3 (“Acceptable”), except for a small bay at the west of Tanjung Teluk Tempoyak near Sungai Ikan Mati which is categorised as Category 2 (“Significant”). Three (3) rivers or drainages are present within the headlands which are the Bayan Lepas Main Drain, Sungai Bayan Lepas and Sungai Ikan Mati.

There are low-cost housing projects and fishing villages along the coast within the two headlands namely Rumah Murah Fasa 1, Rumah Murah Fasa 2, Kampung Permatang Tepi Bendang and Kampung Permatang Damar Laut. Sungai Ikan Mati is located near Rumah Murah Fasa 1 at the eastern end of Teluk Kapur (F5.12). Rock protections were located along the beach fronting Rumah Murah Fasa 1 but there was no evidence of any significant erosion occurring in the area. A small breakwater is found between Rumah Murah Fasa 1 and Fasa 2 that provides a safe berthing area for fishing boats.



F5.10
Characteristics and land use of the coastline from Tanjung Teluk Tempoyak to Tanjung Chut

Legend ● Places
Erosion Category, NCES 2015 :
1 2 3



F5.11 Rocky headland of Tanjung Teluk Tempoyak



F5.12 Sungai Ikan Mati near Rumah Murah Fasa 1

The sandy beach fronting Rumah Murah Fasa 2 between the breakwater and Bayan Lepas Main Drain is narrow and steep, with shallow mudflat visible in the inter-tidal area during low water (F5.13). The Bayan Lepas Main Drain runs along the perimeter of Penang International Airport. A river training structure was observed at the outlet of Bayan Lepas Main Drain (F5.14). Two abandoned pillboxes believed to be from World War II (WW2) and abandoned jetty piles were found fronting the airport's coastline.

Sungai Bayan Lepas is located near Tanjung Chut. There are houses on stilts in the river with several fishing boats berthed along the river banks (F5.15). There are river training structures at Sungai Bayan Lepas river mouth.



F5.13 Beach fronting Rumah Murah Fasa 2



F5.14 River training structure at Bayan Lepas Main Drain outlet



F5.15 Houses on silts found in Sungai Bayan Lepas

5.1.3 Tanjung Chut to Tanjung Bongkok

The coastline is about 4.3 km in length between the rocky headlands of Tanjung Chut (F5.16) and Tanjung Bongkok (F5.17). A 600 m long beach at Teluk Pak Pajuh is located beside small rock outcrops. Teluk Kumbar which is located within the two headlands is a developed district, with many residential areas. There is a 2.2 km-long embayed beach along Teluk Kumbar's coastline. The coastline erosion condition along the bay is listed as Category 2 ("Significant"). Two main rivers are found here which are Sungai Batu and Sungai Teluk Kumbar.

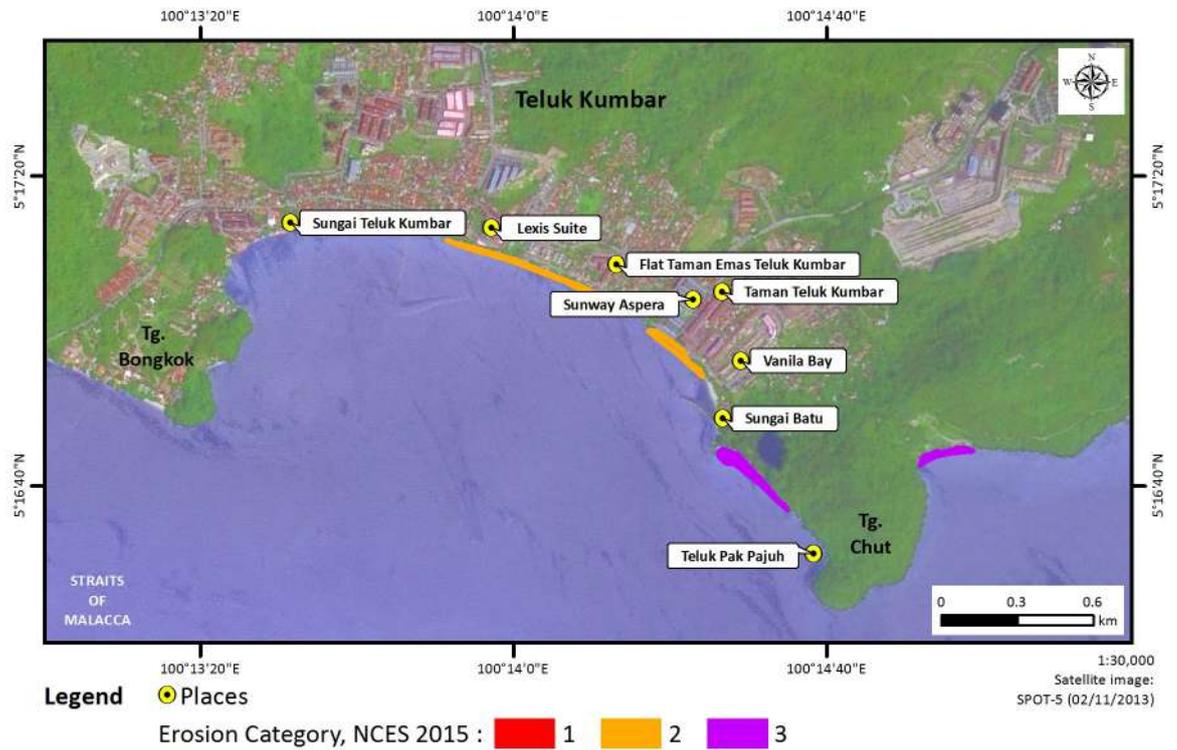


F5.16 Rocky coastline of Tanjung Chut

A breakwater of about 180 m long is found at the river mouth of Sungai Batu which has many boats berthing at the sheltered area (F5.18). A fishermen's jetty is also seen at the Sungai Batu river mouth as shown in F5.19.

Some erosion is visible along the coastline between the fishermen's jetty and Flat Taman Emas Teluk Kumbar with some coastal protection structures such as Labuan blocks, rip rap rock protection, gabion and vertical walls that were found in poor condition. A collapsed seawall brought about by high waves was discovered near Sungai Batu. It was currently undergoing repair works. The eroding coastline is about 500 m long.

A sandy beach with shallow mudflat is seen between Flat Taman Emas Teluk Kumbar and Sungai Teluk Kumbar (F5.20). This beach is used mainly by fishermen to berth their boats. A jetty of approximately 280 m long is located at the centre of the bay (F5.21).



F5.17 Characteristics and land use of the coastline from Tanjung Chut to Tanjung Bongkok



F5.18 Berthed fishing boats near the breakwater



F5.19 Fisherman's jetty at Sungai Batu river mouth



F5.20 Sandy beach with shallow mudflat at Teluk Kumbar



F5.21 Fishermen's jetties at Teluk Kumbar

The river mouth of Sungai Teluk Kumbar is used by fishermen to berth their boats near the river training walls. The river training walls are made of sand-filled geotextile bags (F5.22). Along the coastline of Tanjung Bongkok, pocket beaches are found as shown in F5.23.



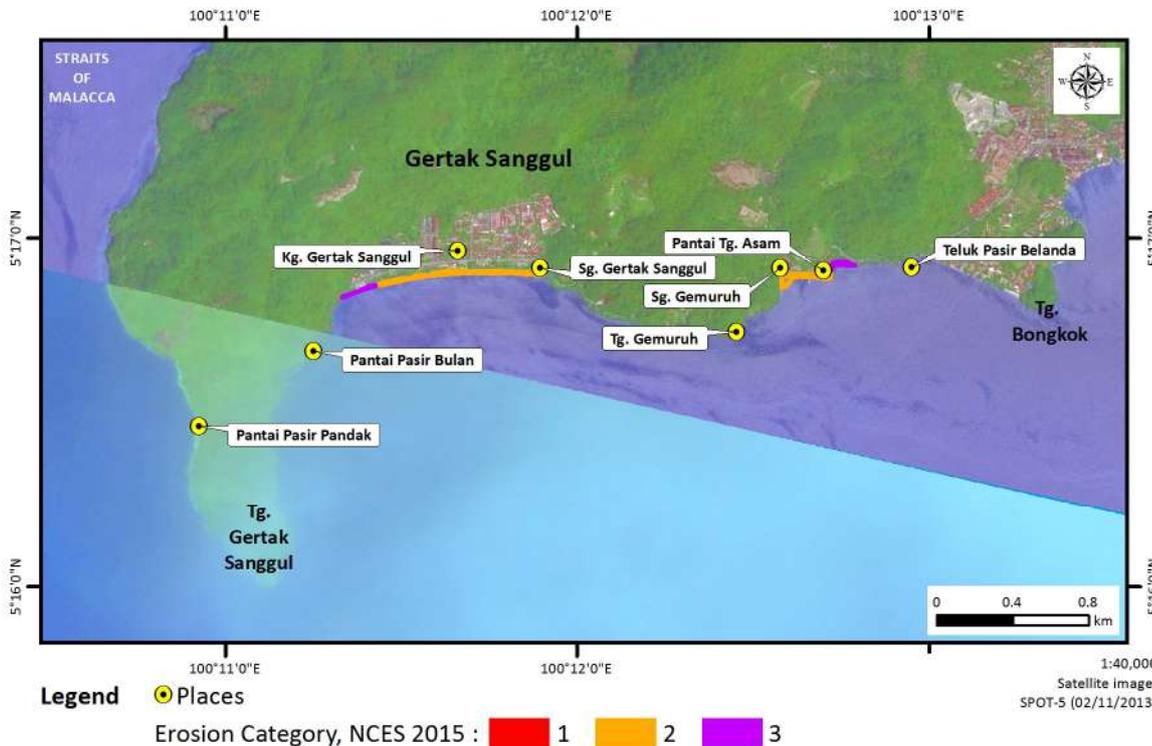
F5.22 Sand-filled geotextile bags as river training walls at Sungai Teluk Kumbar river mouth



F5.23 Pocket beach near Tanjung Bongkok

5.1.4 Tanjung Bongkok to Tanjung Gertak Sanggul

The length of the coastline from Tanjung Bongkok to Tanjung Gertak Sanggul is about 7.5 km. The coastline's stretch is characterized by two large bays with Tanjung Gemuruh at the centre (F5.24). The erosion condition at Pantai Tanjung Asam is listed as Category 2 ("Significant") while at the coastline of Gertak Sanggul is as Category 3 ("Acceptable"). There are two (2) rivers found between the headlands namely Sungai Gemuruh and Sungai Gertak Sanggul.



F5.24 Characteristics and land use of the coastline from Tanjung Bongkok to Tanjung Gertak Sanggul

There are five short sandy beaches separated by rock outcrops at Teluk Pasir Belanda. The beaches are narrow and seem to be stable with no significant erosion or accretion. Pantai Pasir Belanda is the longest beach with a length of about 600 m (F5.25).



F5.25 Pantai Pasir Belanda

Tanjung Gemuruh is covered by forests. It is also fronted by rocky outcrops and sandy beaches. The sandy beach along Kampung Gertak Sanggul coastline is about 1 km long. Sungai Gertak Sanggul discharges into the sea. River training structures made of sand-filled geotextile bags are present at the river mouth. However, many have degraded and are punctured.

A shallow mudflat is seen at the beach (F5.26). The trees along this beach are used by the fishermen to moor their boats. A few pipes were seen discharging directly onto the beach during the site visit as indicated in F5.27. A rundown jetty is located in the middle of the Kampung Gertak Sanggul coastline.



F5.26 Shallow mudflat along Kampung Gertak Sanggul coastline



F5.27 A pipe discharging directly into the sea

Tanjung Gertak Sanggul is covered by forest and fronted by rocky outcrops with sandy beaches namely Pantai Pasir Bulan (F5.28) and Pantai Pasir Pandak.



F5.28 Pantai Pasir Bulan

5.2 Project Concept

The proposed Project consists of three reclaimed islands with a total area of 4,500 acres (1,821.1 ha). The total quantity of fill material needed for the reclamation works is estimated at 189,100,000 m³. The proposed reclamation which has been included in the Draft Penang Structure Plan is an initiative of the Project Proponent to identify ways and means to not only reinvigorate the Penang economy but to also fulfill national economic growth objectives established for the north-west corridor of the Peninsular Malaysia.

5.2.1 Development Vision

The Penang State Government as the Project Proponent is fully cognisant of the environmental and social issues associated with a project of this nature and has actively sought to identify, alleviate and mitigate real and perceived detrimental impacts via detailed studies and impact assessments undertaken by independent professional recognised consultants and advisors.

The Penang State Government, however, has also seen the need to respond to the development pressures on the island, such as around the World Heritage zone, on the Penang Hills, and the negative impacts on the E&E sector due to the shortage of land.

The reclamation project offers an opportunity to address these issues, and at the same time facilitate the emergence of significant economic and social development opportunities through the green field reclamation project.

The Penang State Government is proposing a new approach to the management of land where ownership of the newly created land lies with the State Government. The subsequent use of the land will, in turn, be determined by the State as it responds to the ongoing development needs of the State.

To this end, the accompanying land use plans constitute an illustration of a possible land use. For this illustration, a number of assumptions have been made such as the need to provide for the expansion of the Bayan Lepas industrial area; to ensure the Penang International Airport remains a hub for high value products and international visitors; and that citizens of Penang are all offered opportunities to “live, work, learn and play” in a new-age connected Internet of Things environment.

The plans for the islands, in responding to the trend experienced in world-class cities, also seek to encourage the use of public transport, in line with the Penang Transport Master Plan’s ethos of “Moving people, not cars”. The actual use of the land will, however, be the subject of subsequent submissions for consent to develop where each application would be subject to usual assessment.

5.2.2 Smart City Concept

The “Smart City” development concept of PSR will facilitate a sustainable urban ecosystem to yield high quality of life for the *Rakyat*, and ultimately a “City for the Future” where all social and information systems are inter-linked to offer an ideal living environment. Smart City Concept covers six features as follows:

- a) Smart Mobility and Connectivity;
- b) Smart People;
- c) Smart Economy;
- d) Smart Living;
- e) Smart Environment and Smart Government; and
- f) Smart Governance.

5.3 Project Components

The major components of the Project are as listed below:

- a) Reclamation of Islands A, B and C; and
- b) Dredging of access channels.

5.3.1 Reclamation of Islands A, B and C

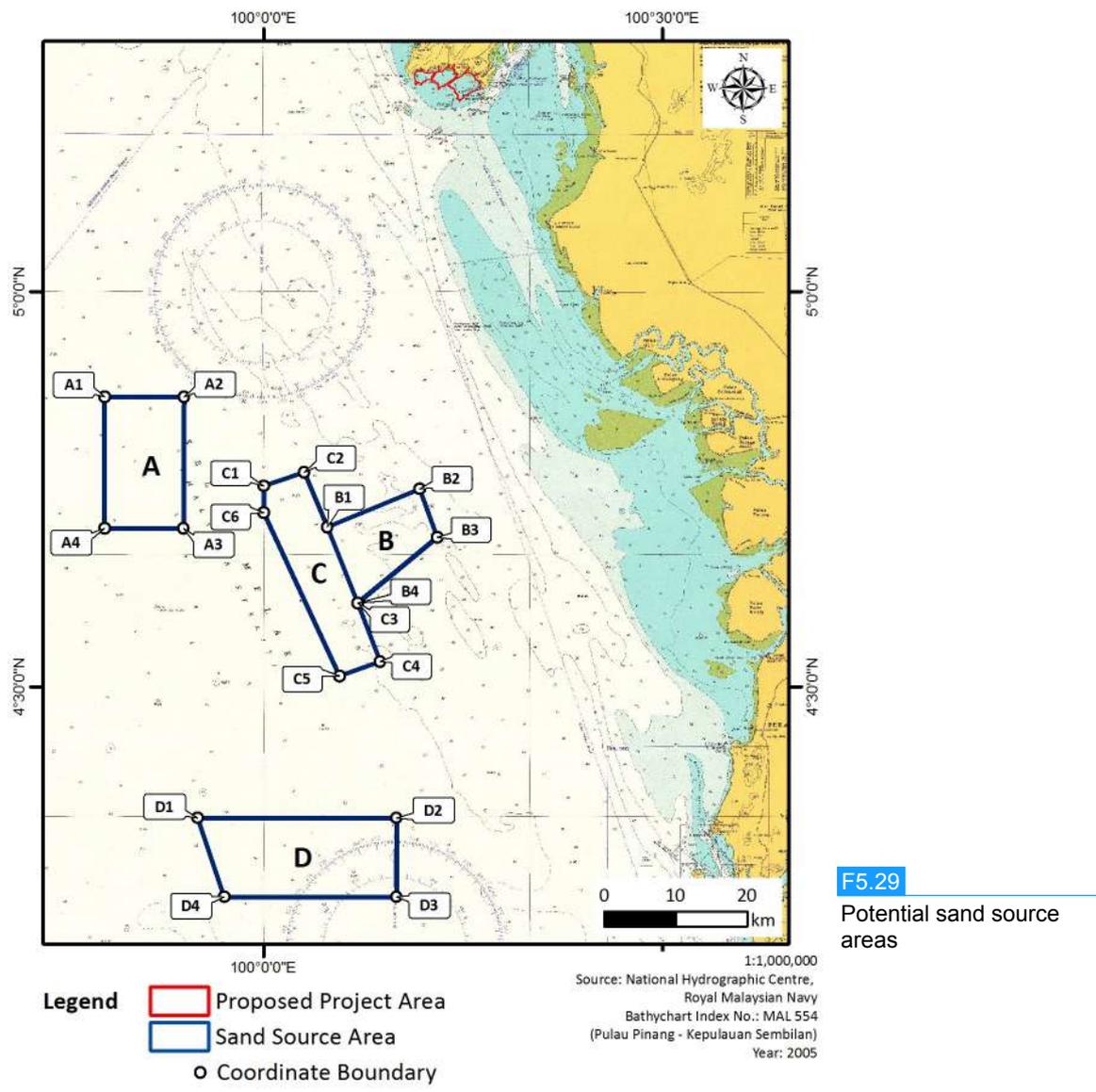
The reclamation of Islands A, B and C requires a total fill material volume of approximately 189.1 million m³. The proposed platform level of the islands is +4.5 m CD. The reclamation activities will be conducted in three phases. Phase 1 is the reclamation of Island B, Phase 2 is the reclamation of Island A and followed by Phase 3 with reclamation of Island C. There will also be bridges connecting the proposed reclaimed islands as well as in connecting these islands and Penang Island. A Trailer Suction Hopper Dredger (TSHD) with an estimated capacity of 17,000 m³ will be deployed to transport the sand.

5.3.1.1 Potential Sand Source Locations

There are four potential sand source areas offshore within Perak waters (F5.29). The coordinates for the potential sand source areas are tabulated in T5.2. Details of the potential sand source areas from the Project site are tabulated in T5.3. Other sand sources can only be considered if necessary approvals and licenses are obtained, including EIA approval from DOE and sand mining license from the Ministry of Natural Resources and Environment.

T5.2 Coordinates of the potential sand source locations

Point	Latitude	Longitude	Point	Latitude	Longitude
Area A			Area C		
A1	4° 52' 0.0" N	99° 48' 0.0" E	C1	4° 45' 12.0" N	100° 00' 0.0" E
A2	4° 52' 0.0" N	99° 54' 1.0" E	C2	4° 46' 17.0" N	100° 3' 4.0" E
A3	4° 42' 0.0" N	99° 53' 58.7" E	C3	4° 36' 20.0" N	100° 7' 5.0" E
A4	4° 42' 0.0" N	99° 48' 0.0" E	C4	4° 31' 55.0" N	100° 8' 46.0" E
Area B			C5	4° 30' 50.0" N	100° 5' 42.0" E
B1	4° 42' 7.0" N	100° 4' 47.0" E	C6	4° 43' 11.0" N	100° 0' 0.0" E
B2	4° 45' 0.0" N	100° 11' 45.0" E	Area D		
B3	4° 41' 20.0" N	100° 13' 4.0" E	D1	4° 20' 0.0" N	99° 55' 0.0" E
B4	4° 36' 20.0" N	100° 7' 5.0" E	D2	4° 20' 0.0" N	100° 10' 0.0" E
			D3	4° 14' 0.0" N	100° 10' 0.0" E
			D4	4° 14' 0.0" N	99° 57' 0.0" E



F5.29 Potential sand source areas

T5.3 Details of the potential sand source locations

Sand Source	Distance (nm)	Area (km ²)	Depth (m)	Criteria
Area A	30	205.3	40 to 60	Medium size sand with silt content of less than 20%. More coarse sand or sandy deposit found after 1.5 m seabed. Thickness of good sand layer is about 2.5 to 3.5 m below seabed.
Area B	35	129.1	40 to 50	Sand deposit is between 0.5 to 3 m below seabed.
Area C	44	197.6	45 to 60	The average particle size distribution is 86.4% sand, 9.4% gravel and 4.2% silt.
Area D	58	287.7	50 to 65	The surface sediment mostly consists of sand. Gravelly sand and sandy sediment are found at depths of 1 and 2 m.

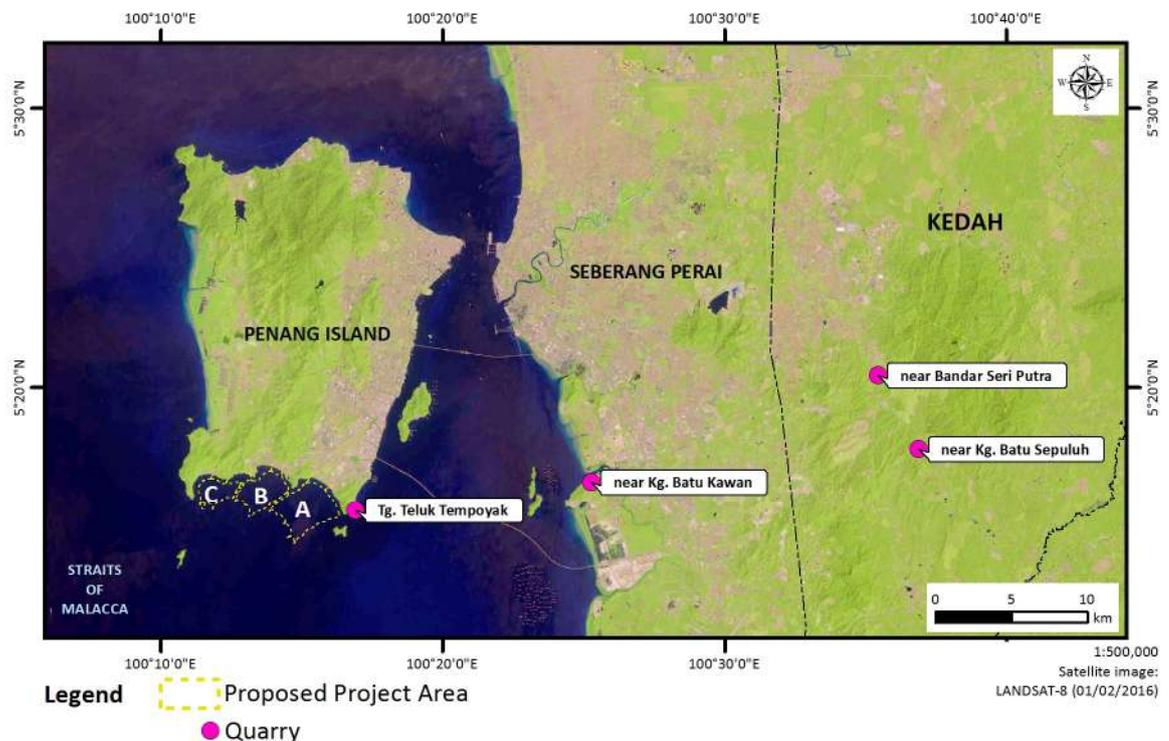
Sources: Approved EIA reports for respective sand source locations

Sand Source	Reference Number for EIA Approval/ Extension of Approval Letter	Date of EIA Approval/ Extension of Approval	T5.4
Area A	AS(B)A29/013/106/034	3 rd March 2014	Reference numbers for EIA approval letters for sand source locations
Area B	AS(B)A29/013/106/006	30 th May 2007	
Area C	AS(B)A29/013/106/040	21 st December 2015	
Area D	AS(B)A29/013/106/106	24 th August 2015	

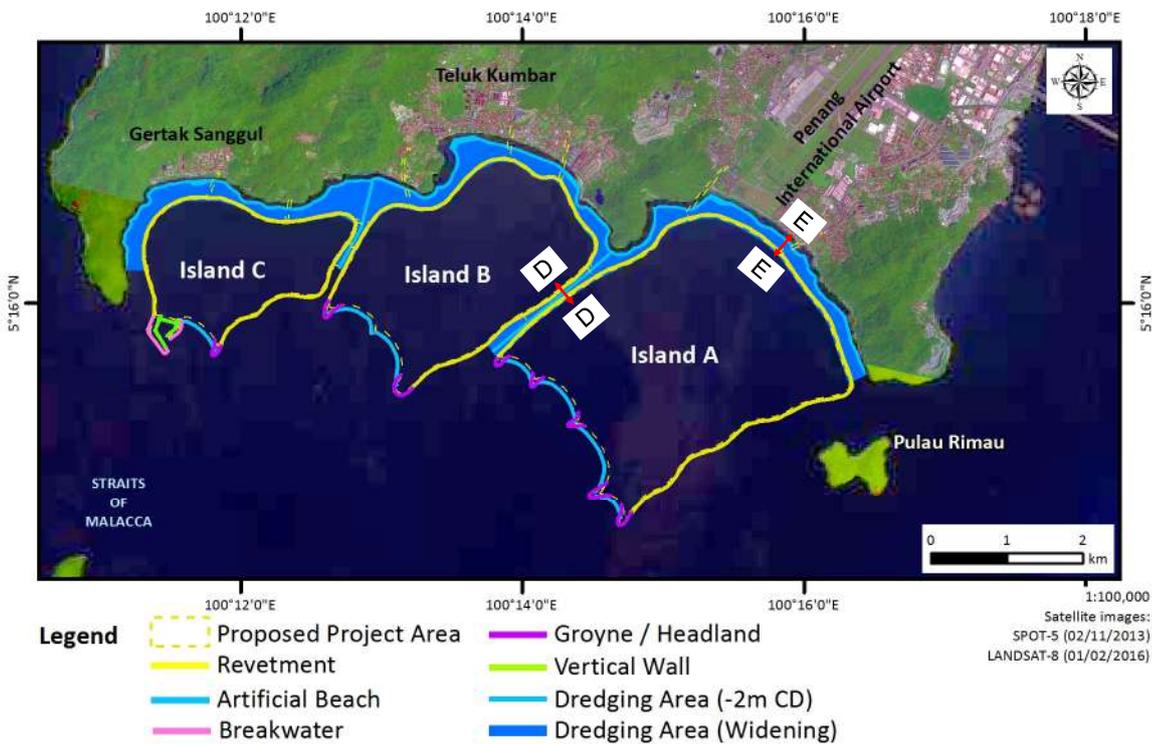
5.3.1.2 Potential Rock Source Locations

Several potential rock source locations are indicated in T5.5 and F5.30. Total rock volume required for the construction of revetment as edge protection of the reclaimed islands is 4.5 million m³. The overall reclaimed islands' edge protection is shown in F5.31.

Potential Rock Source Location	Distance to Batu Kawan Jetty (km)	Distance from Jetty to Project Area (nm)	T5.5
Batu Kawan, Pulau Pinang	-	16	Potential rock source locations
Kampung Batu Sepuluh, Kulim, Kedah	53	-	
Near Bandar Seri Mahkota	38	-	
Teluk Tempoyak	-	6	



F5.30 Potential rock source locations



F5.31 Proposed edge protection of the reclaimed islands and cross-section of dredged channels

5.3.2 Dredging of Access Channels between Islands

The access channels of 40 m wide and -2 m CD deep will be dredged between the reclaimed islands as well as between the reclaimed islands and Penang Island (F5.31). This is done to provide access for fishing boats to the jetties and work vessel to respective work area. The alignment of the dredged channel that runs along the foreshore follows the existing foreshore. Once the reclamation works start, all channels will be widened by up to about 250 m wide and -2 m CD deep. Dredging will be conducted for each phase of the reclamation process. Typical cross-sections of the proposed channels are shown in F5.32. This will be explained in detail under Project Activities (*Section 5.4*).

The estimated dredging volume is 6.9 million m³. Cutter suction dredgers (“CSDs”) such as IHC Beaver 1600 or 1200 are considered suitable for the dredging works given the relatively shallow draft requirements. The production rate of these dredgers is about 300 m³/hr.

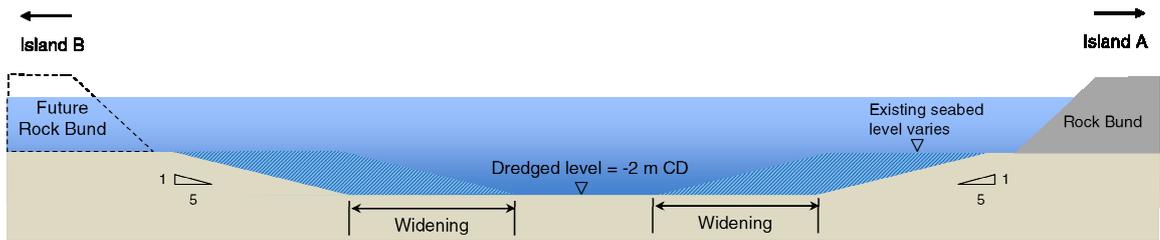
5.3.2.1 Disposal of Dredged Materials

The dredged material will be loaded onto split hopper barges and disposed of at a designated disposal ground to be approved by the Marine Department and DOE. A discussion with the Marine Department has proposed west of Pulau Kendi as the disposal ground (F5.33). The distance of the disposal ground from the Project area is about 15 nautical miles. The coordinates of the proposed disposal ground is tabulated in T5.6.

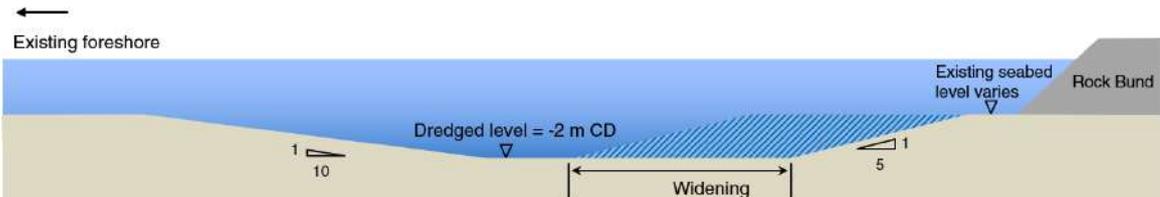
T5.6

Coordinates of the proposed disposal ground for dredged materials

Point	Latitude	Longitude
A	5°14'45.6"N	99°58'59.2"E
B	5°14'45.6"N	100°00'36.6"E
C	5°13'08.0"N	100°00'36.7"E
D	5°13'07.9"N	99°58'59.3"E

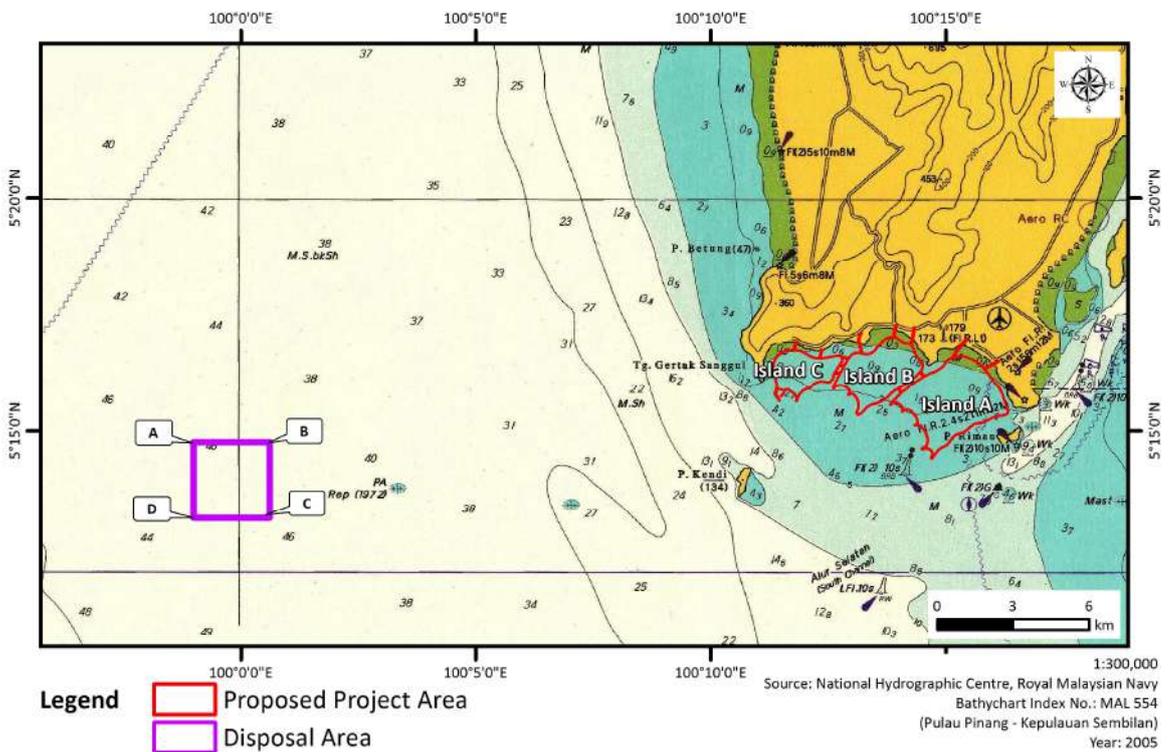


a) Access channel between Island A and Island B (section D-D on F5.31)



b) Access channel between Penang Island and Island A (section E-E on F5.31)

F5.32 Typical cross-sections of the proposed access channels



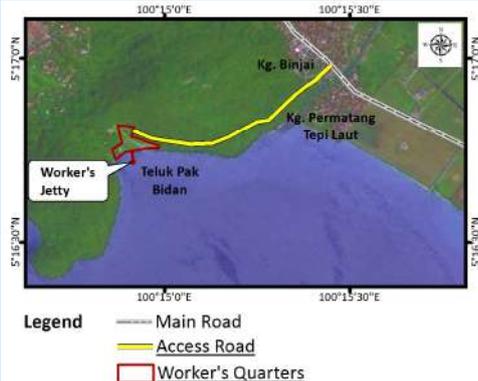
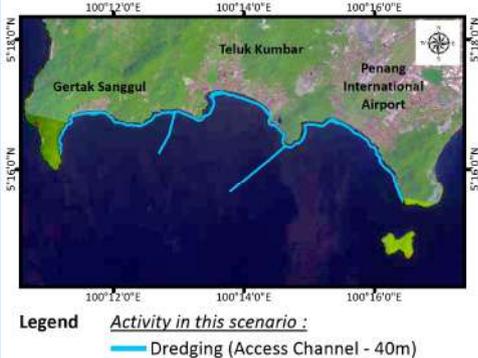
F5.33 Proposed disposal ground for dredged materials

A separate EIA study (First Schedule) is required for the disposal of dredged material at the designated disposal ground. This separate EIA will need to be submitted to DOE Penang for their approval.

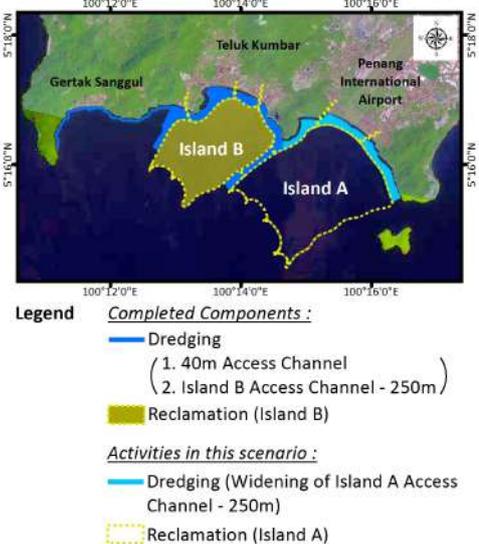
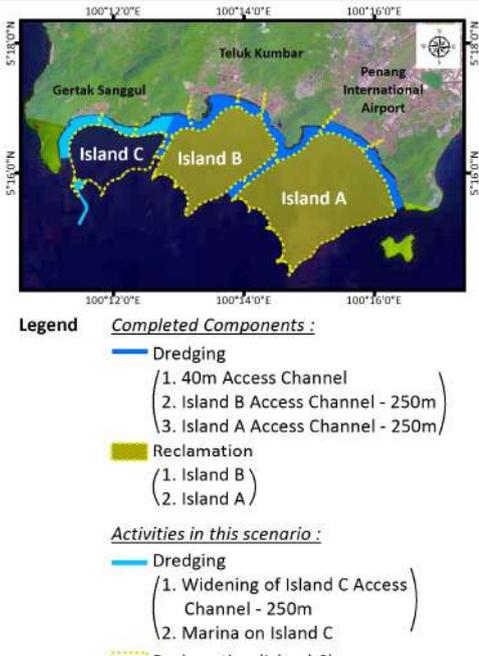
5.4 Project Activities and Phasing

The Project activities will be described according to the components as described in Section 5.3. The phasing of the Project will progress according to the phases described in T5.7. The estimated volumes of material for reclamation and dredging are shown in T5.8.

T5.7 Development phases

Phase	Description
<p>Pre-dredging Phase</p>	 <p>Legend</p> <ul style="list-style-type: none"> — Main Road — Access Road ■ Worker's Quarters <p>a) Land clearing; biomass removal and disposal b) Construction of access road ■ Length: Approximately 1 km c) Construction of temporary workers' jetty ■ Length: 50 m d) Construction of workers' quarters ■ Area: 4 acres</p>
<p>Dredging to Create Access Channel Phase</p>	 <p>Legend <i>Activity in this scenario :</i></p> <ul style="list-style-type: none"> — Dredging (Access Channel - 40m) <p>a) Dredging details: ■ Bottom width: 40 m ■ Length: 17.8 km ■ Depth: -2 m CD b) Dredging volume: 2.3 million m³ c) Offshore disposal ground - Off Pulau Kendi d) Work duration: 1 year</p>
<p>Phase 1: Reclamation and Widening of the Access Channel</p>	 <p>Legend <i>Completed Component :</i></p> <ul style="list-style-type: none"> — Dredging (Access Channel - 40m) <p><i>Activities in this scenario :</i></p> <ul style="list-style-type: none"> — Dredging (Widening of Island B Access Channel - 250m) ■ Reclamation (Island B) <p>a) Reclamation of Island B ■ Size: 1,400 acres ■ Total reclamation volume: 58 million m³ b) Widening of the dredged channel around Island B ■ Width: 250 m ■ Length: 8.1 km ■ Depth: -2 m CD ■ Dredging volume: 2.2 million m³ c) Construction of bridge piers d) Work duration: 7 years</p>

T5.7 Development phases (cont'd)

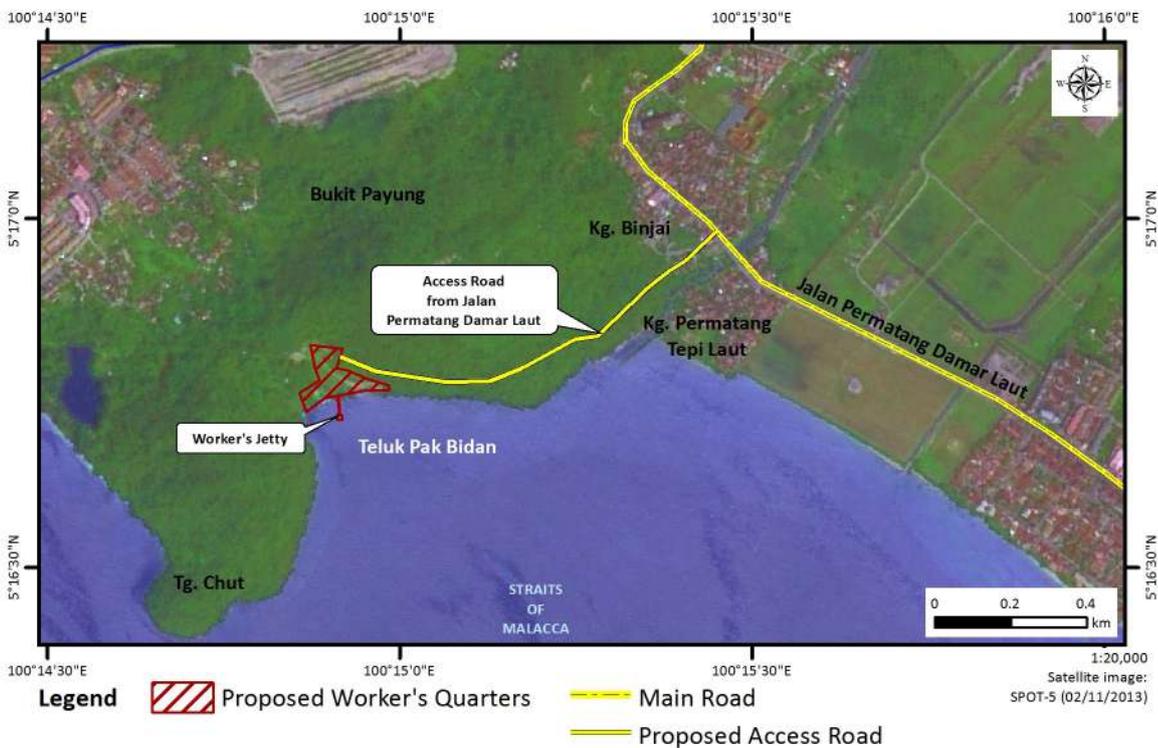
Phase	Description
<p>Phase 2: Reclamation and Widening of the Access Channel</p>	 <p>a) Reclamation of Island A</p> <ul style="list-style-type: none"> ■ Size: 2,300 acres ■ Total reclamation volume: 93.8 million m³ <p>b) Widening of the dredged channel between Island A and Penang Island</p> <ul style="list-style-type: none"> ■ Width: 250 m ■ Length: 5.2 km ■ Depth: -2 m CD ■ Dredging volume: 1.6 million m³ <p>c) Construction of bridge piers</p> <p>d) Work duration: 8 years</p>
<p>Phase 3: Reclamation and Widening of the Access Channel</p>	 <p>a) Reclamation of Island C</p> <ul style="list-style-type: none"> ■ Size: 800 acres ■ Total reclamation volume: 37.3 million m³ <p>b) Widening of the dredged channel between Island C and Penang Island</p> <ul style="list-style-type: none"> ■ Width: 250 m ■ Length: 5.5 km ■ Depth: -2 m CD <p>c) A marina and dredging of associated access channel at south-western corner of Island C</p> <p>d) Total dredging volume: 800,000 m³</p> <p>e) Construction of bridge piers</p> <p>f) Work duration: 7 years</p>

Project Activities	Volume of Material (m ³)	Total Volume (m ³)	T5.8
Reclamation: Phase 1 - Island B Phase 2 - Island A Phase 3 - Island C	58,000,000 93,800,000 37,300,000	189,100,000	Estimated volume of material for each Project activity
Dredging: Dredging Phase Phase 1 – Widening of channel Phase 2 – Widening of channel Phase 3 – Widening of channel	2,300,000 2,200,000 1,600,000 800,000	6,900,000	
Construction of revetment	4,500,000		

5.4.1 Pre-dredging Phase: Construction of Workers' Quarters

Prior to the start of the construction works, workers' quarters must be set up first. These quarters are proposed to be constructed near Bukit Payung along Teluk Pak Bidan. The area of the quarters is about four acres. The proposed location is about 1 km away via an existing access road connected to Jalan Permatang Damar Laut as shown in F5.34. The nearest fishing village is Kampung Permatang Tepi Laut. The layout of the quarters is shown in F5.35.

The quarters will provide facilities such as machineries yard, store yard, a jetty, cafeteria, kitchen, *surau*, recreational area and a sewage treatment plant (STP) to cater for about 500 workers. The sewage from the quarters will be treated to Standard A [Environmental Quality (Sewage) Regulations, 2009] and discharged to the sea. The disposal of biomass from land clearing will be disposed off to Pulau Burung landfill in Nibong Tebal.



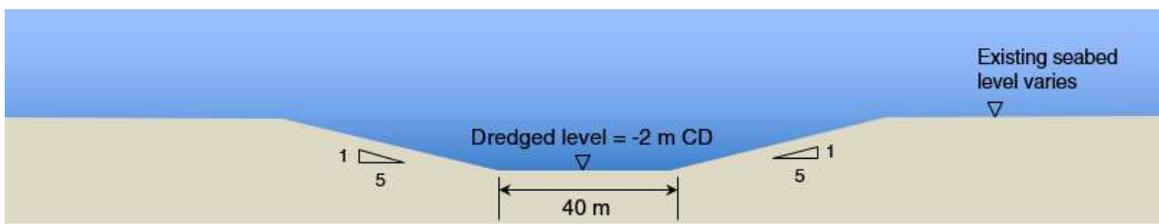
F5.34 Proposed location of the workers' quarters

5.4.2 Dredging to Create Access Channel Phase

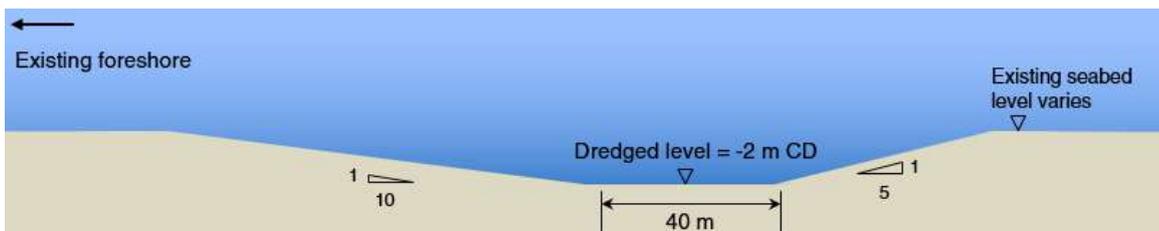
Dredging works are required to provide round-the-clock access of the fishing boats and work boats. In this phase, access channels of 40 m wide will be dredged between the footprints of the proposed reclaimed islands as well as between the footprints of these islands and Penang Island (F5.36). F5.37 shows a typical cross-section of the proposed dredged access channels.



F5.36 Proposed dredged 40-m wide access channel



a) Access channel around reclamation footprints (section D-D on F5.36)



b) Access channel between reclamation footprints and Penang Island (section E-E on F5.36)

F5.37 Typical cross-section of the proposed access channels for Dredging to Create Access Channel Phase

The calculations of the daily production and spill rates of a CSD are shown in T5.9. It is based on a 24-hour working day. It is assumed that the sailing duration to the disposal ground is about 4 hours based on a 15 nautical miles distance and a sailing speed of 4 knots. Four to five barges would be required for continuous dredging except for the time used for moving the discharge pipe from a laden barge to an empty barge.

Descriptions		Characteristics/Values	T5.9
Dredged material characteristics		Silt and clay	Calculation of daily production and spill rates of one CSD
Sediment density		*1,670 kg/m ³	
Barge capacity		1,500 m ³	
Dredging duration per barge load	Dredging without overflow	2 hours	* Sediment density is based on a seabed sediment sample on the area to be dredged
	Dredging with overflow	2 hours	
	Change of barge	0.5 hours	
	Total duration per barge load	4.5 hours	
Sediment spill budget per barge load	Percentage of fines	100%	
	Percentage of spill from cutter head	2%	
	Percentage of spill from overflow	20%	
	Total spill per barge load	240 tonnes	
Number of barge loads per day		5.33	
Daily production	Dredged volume per barge	1,200 m ³	
	Total dredged volume per day	6,400 m ³	
	Total spill per day	1,283 tonnes	

The total volume that needs to be dredged in this phase is 2,300,000 m³. The current plan is to dredge for 8 months. Therefore, two CSDs are required in the Pre-reclamation Phase, as shown in T5.10.

T5.10 Duration for the dredging works in Pre-reclamation Phase

Descriptions	1 CSD	2 CSDs
Daily dredged volume	6,400 m ³	12,800 m ³
Allowance weather and mechanical downtime	20%	20%
Total dredging duration	15 months	7.5 months
Total spill per day	1,283 tonnes	2,566 tonnes

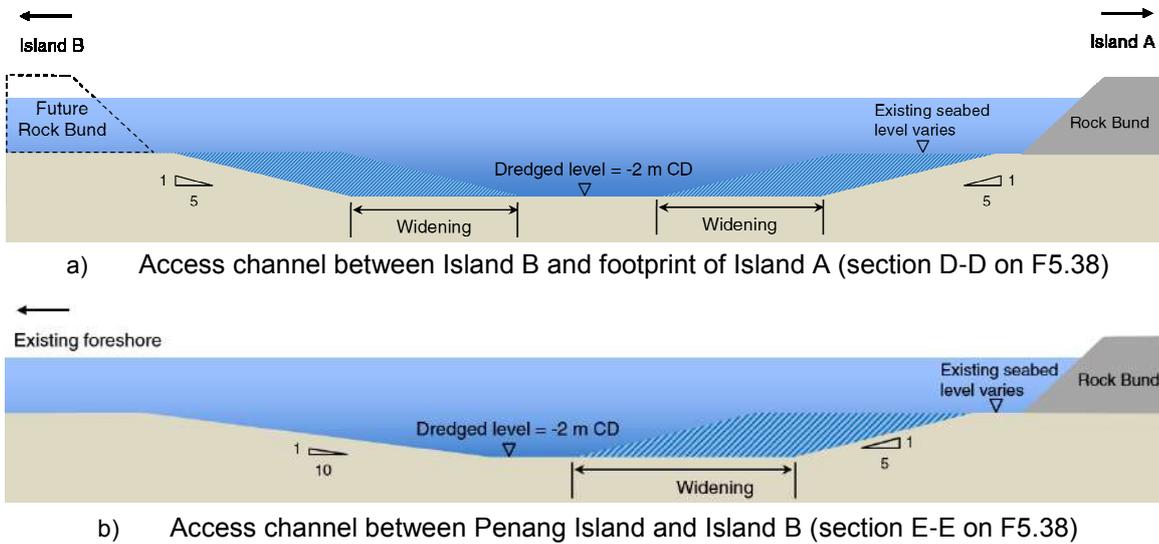
5.4.2.1 Phase 1: Reclamation of Island B and Widening of the Access Channel

The dredging works in Phase 1 include widening of the dredged channel around Island B as indicated in F5.38. F5.39 shows the channel widening works between Island B and the footprint of the other reclaimed islands as well as between Island B and the existing foreshore.

The total volume that needs to be dredged in Phase 1 is about 2,200,000 m³. This requires a CSD to dredge over a duration of 14.3 months, which is longer than the planned dredging programme of 12 months. Two CSDs are therefore required. The calculations of the total daily spill for one and two CSDs are shown in T5.11.



F5.38 Proposed channel widening works in Phase 1



F5.39 Typical cross-sections of the proposed access channels

T5.11 Duration for the dredging works in Phase 1

Descriptions	1 CSD	2 CSDs
Daily dredged volume	6,400 m ³	12,800 m ³
Allowance weather and mechanical downtime	20%	20%
Total dredging duration	14.3 months	7.2 months
Total spill per day	1,283 tonnes	2,566 tonnes

5.4.2.2 Phase 2: Reclamation of Island A and Widening of the Access Channel

In Phase 2, the dredging works include widening of the dredged channel between Island A and Penang Island, similar to that as schematically illustrated in F5.38.

The total volume of dredged material in Phase 2 is 1,600,000 m³. This requires one CSD to dredge over a period of 10.5 months, as shown in T5.12. The planned dredging duration is 16 months in case of further downtime.

Descriptions	1 CSD	T5.12
Daily dredged volume	6,400 m ³	Duration for the dredging works in Phase 2
Allowance weather and mechanical downtime	20%	
Total dredging duration	10.5 months	
Total spill per day	1,283 tonnes	

5.4.2.3 Phase 3: Reclamation of Island C and Widening of the Access Channel

The dredging works in Phase 3 include widening of the dredged channel between Island C and the Penang Island, similar to that as schematically illustrated in F5.38. The access channel and basin of the proposed marina are also to be dredged in this phase.

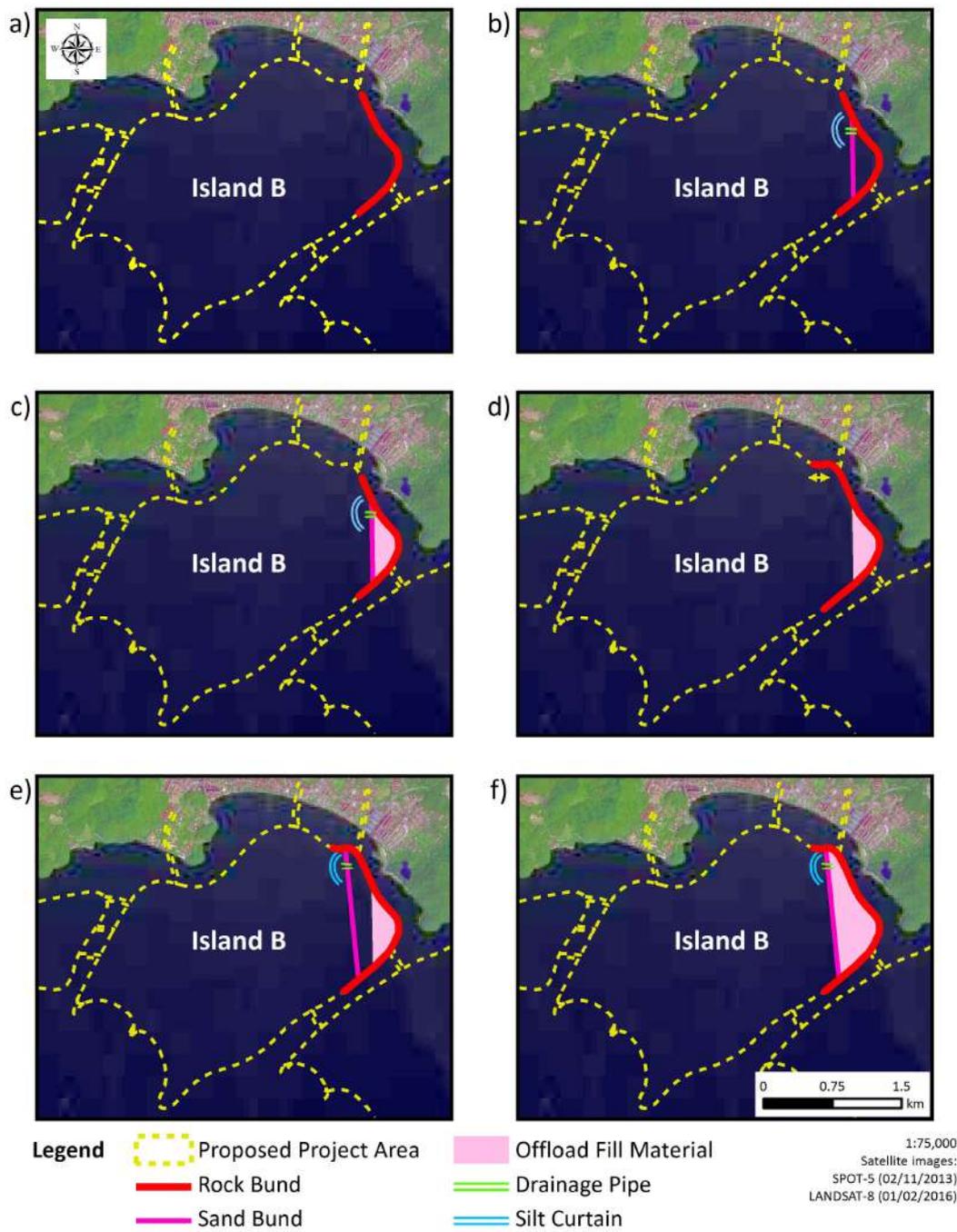
The total dredged volume in Phase 3 is 800,000 m³. One CSD is considered sufficient for a planned dredging programme of nine months, as shown in T5.13.

Descriptions	1 CSD	T5.13
Daily dredged volume	6,400 m ³	Duration for the dredging works in Phase 3
Allowance weather and mechanical downtime	20%	
Total dredging duration	10.5 months	
Total spill per day	1,283 tonnes	

5.4.3 Reclamation of Islands A, B and C

Reclamation works will be undertaken by first constructing perimeter bunds and temporary bunds before offloading fill material. Given the large reclamation area, it is considered that, practically, the land reclamation will need to be carried out progressively in a series of approximately 50-acre reclamation areas. The sequence of reclamation is schematically illustrated in F5.40 and described below:

- a) Construct a rock bund along the footprint of the permanent rock revetment. Both ends of the rock bund need to extend 150 m beyond the 50-acre reclamation area;
- b) Construct a temporary sand bund to close the 50-acre reclamation area as well as install drainage pipes and a silt curtain;
- c) Offload the fill material into the reclamation area enclosed by bunds;
- d) Extend both ends of the rock bund by 150 m;
- e) Construct a temporary sand bund to close the reclamation area as well as install drainage pipes and a silt curtain; and
- f) Offload the fill material into the reclamation area enclosed by bunds.



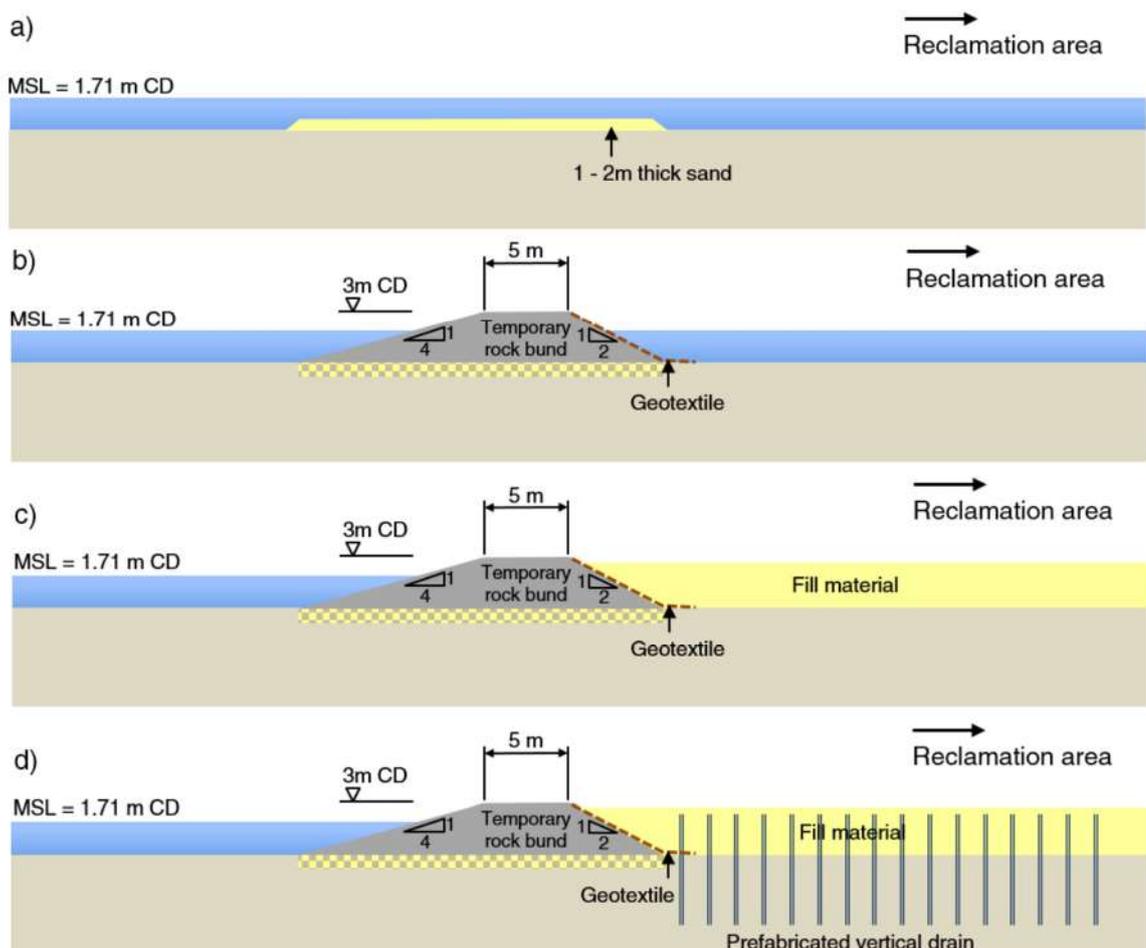
F5.40 Schematic illustration of reclamation sequence

Steps d) to f) will be repeated until the reclamation is complete. Further details of the rock and sand bund construction, silt curtain installation as well as reclamation is described in Sections 5.4.3.1 to 5.4.3.5.

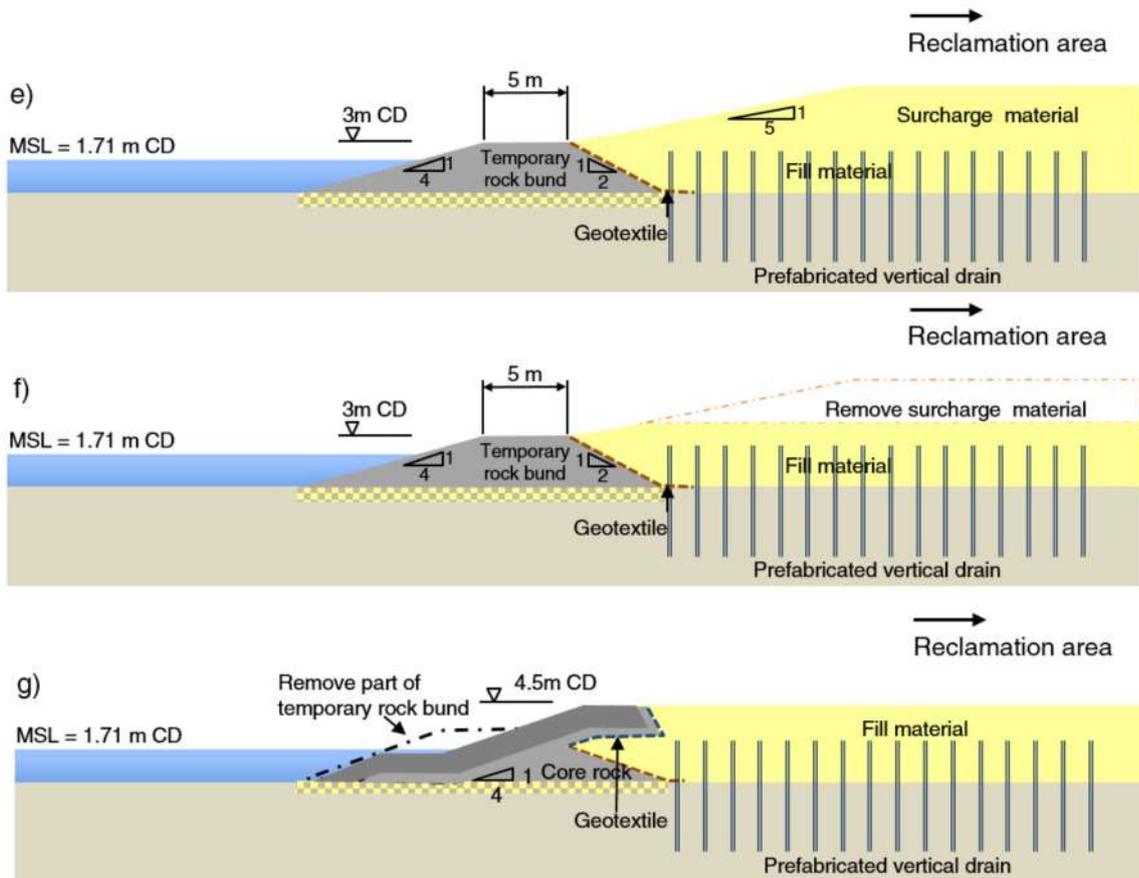
5.4.3.1 Rock Bund Construction and Reclamation

The rock bund construction, together with the reclamation works (including ground treatment), will be carried out in the sequence as schematically illustrated in F5.41 and described below:

- a) Place a layer of sand of 1 to 2 m thick over the footprint of the proposed rock bund;
- b) Construct a rock bund on top of the sand layer, using core rock material for the permanent revetment. A layer of geotextile is placed on the slope facing the reclamation area. The rocks will be delivered by barges and placed by a long-reach excavator operating from a barge. The initial layer of sand is expected to settle and mix with the existing sea bed material;
- c) Pump fill material into the reclamation area to a level just below the bund crest;
- d) Install prefabricated vertical drains;



F5.41 Rock bund construction and reclamation sequence

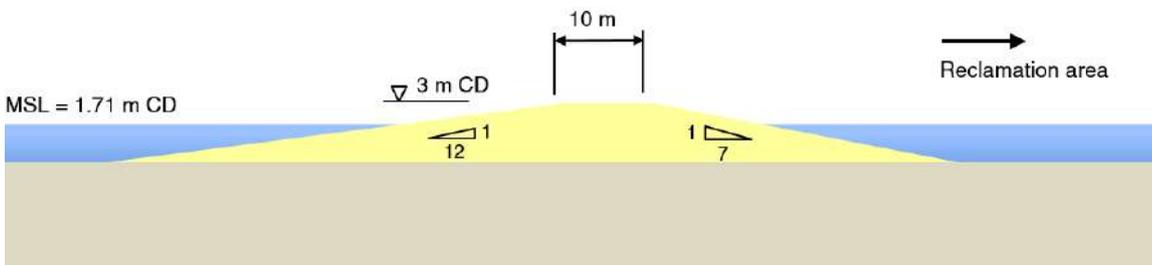


F5.41 Rock bund construction and reclamation sequence (cont'd)

5.4.3.2 Temporary Sand Bund

Temporary sand bunds will be constructed using the sand pumped from a Trailing Suction Hopper Dredger (“TSHD”). The bunds will be shaped by a long-reach excavator operating from a barge.

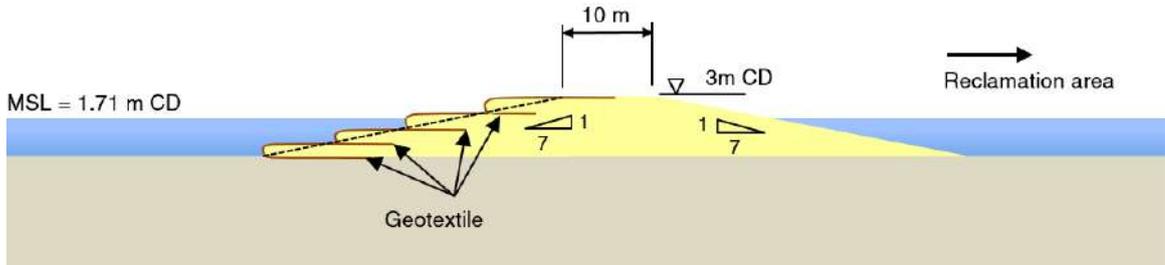
The temporary sand bunds will have a crest of 10 m wide as well as side slopes of 1-in-7 on the slope facing the reclamation area and 1-in-12 on the outer slope. The cross-section of a temporary sand bund is schematically shown in F5.42.



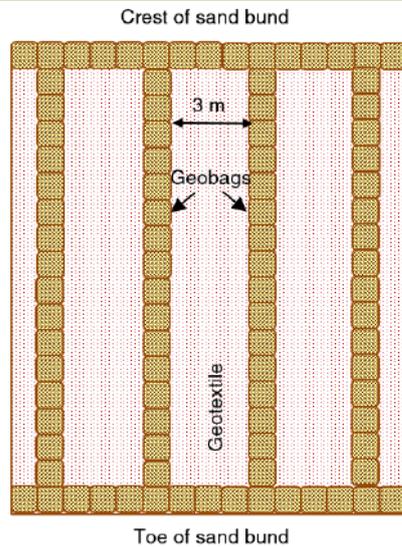
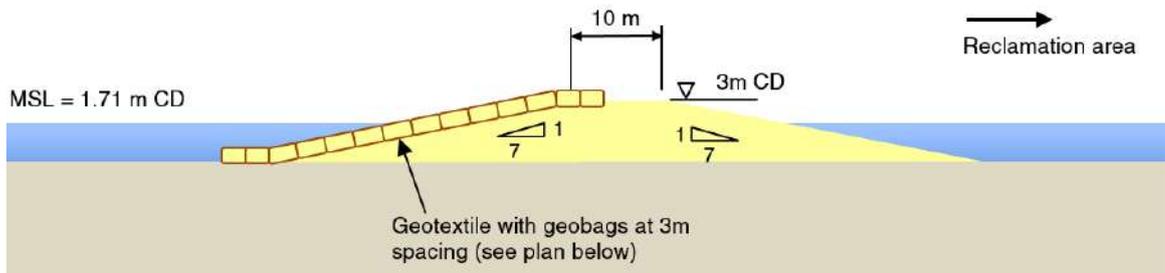
F5.42 Schematic cross-section of a temporary sand bund

5.4.3.3 Temporary Sand Bund with Geotextile

For sand bund that is expected to be exposed to wave or current actions for more than two weeks, the sand bund needs to be protected using geotextile as shown in F5.43. Alternatively, a geotextile with geobags arrangement as shown in F5.44 will be used. Both aim to protect the sand bunds from being eroded away.



F5.43 Schematic cross-section of a temporary sand bund with geotextile

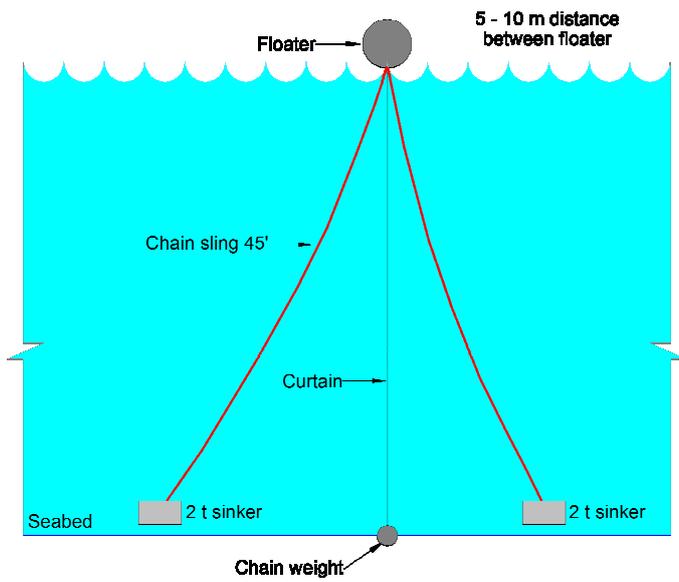


F5.44

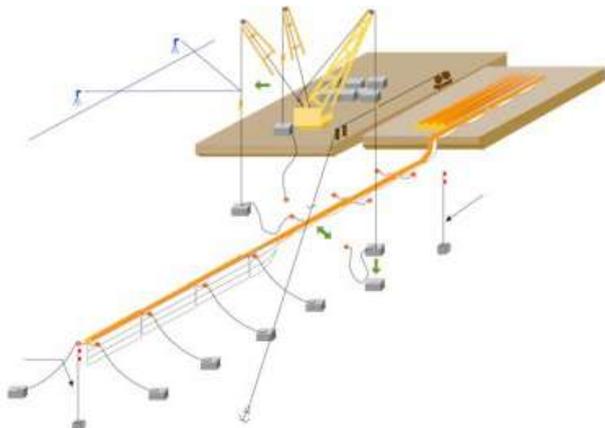
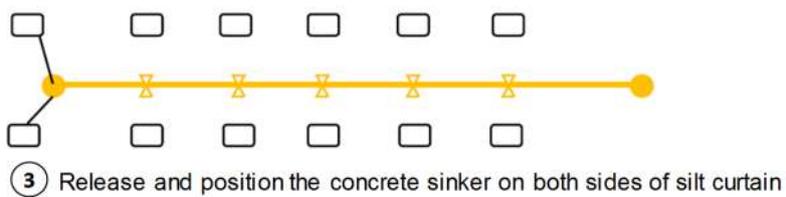
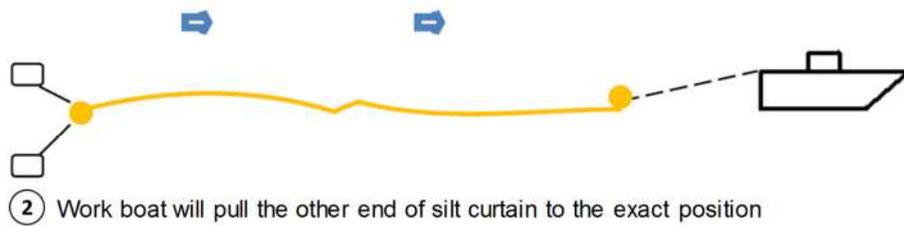
Schematic cross-section of a temporary sand bund with geotextile and geobags (top); and schematic plan of the geotextile and geobags arrangement (bottom)

5.4.3.4 Silt Curtain

A silt curtain will be used at the outlet of the drainage pipes. The typical arrangement of a silt curtain and its installation sequence is shown in F5.45 and F5.46 respectively.



F5.45
 Typical arrangement of a silt curtain



F5.46
 Installation sequence of silt curtain

5.4.3.5 Offloading of Fill Material

Fill material will be dredged at sand source areas and delivered to site by TSHD dredger(s) with hopper capacity and specifications for a typical 17,000 m³ TSHD.

It is expected that the dredger will be loaded with sand up to 70% of its hopper capacity. The dredging and offloading duration is about two hours each. At this stage, four potential sand source sites have been identified. They are approximately 35 to 40 nautical miles away from the Project site. It is currently assumed that the sailing duration is four hours each way between the sand source site and the Project site.

A reclamation (dredging-sailing-offloading-sailing) cycle will take 12 hours. It is assumed that the operation will be done non-stop, seven days a week. There will therefore be two reclamation cycles a day for each TSHD, with a daily reclamation rate of 23,800 m³ (T5.14).

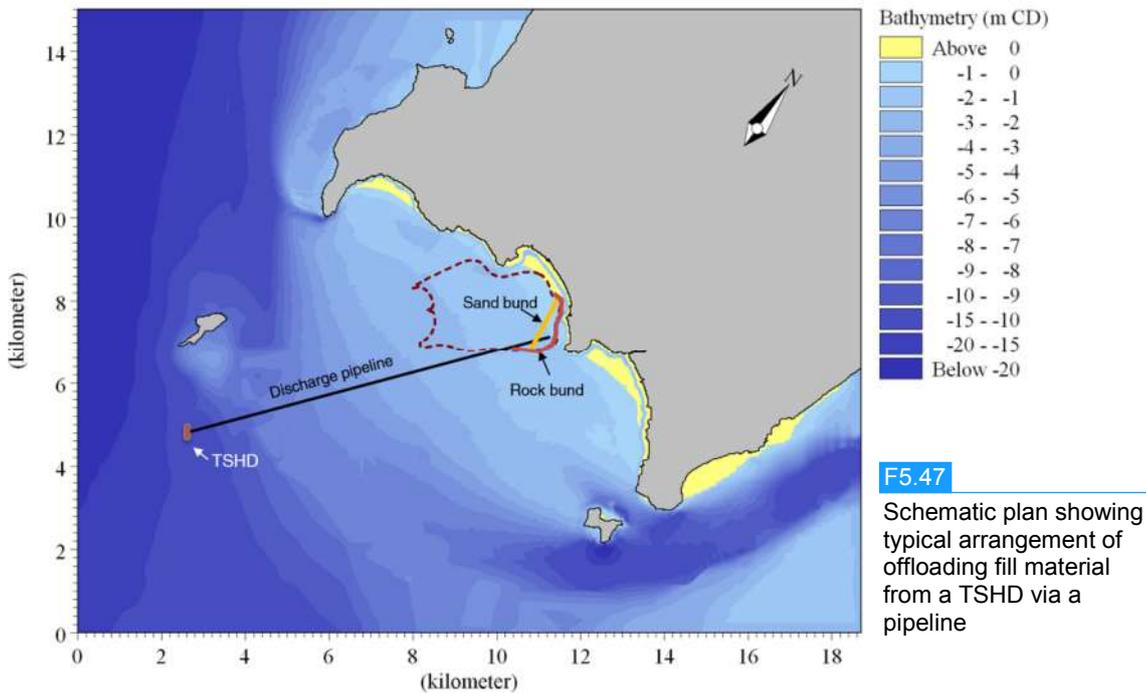
The sediment spill rate from offloading of fill material by each TSHD is shown in T5.15. It is currently planned to have up to four dredgers for offloading fill material in Phases 1 and 2, whilst up to two dredgers will be required in Phase 3. The corresponding daily sediment spill rates are given in T5.20.

Descriptions		TSHD	T5.14
Dredged material characteristics		Sand	Calculation of daily reclamation rate per TSHD
Dredged material density		2,000 kg/m ³	
Rated hopper capacity		17,000 m ³	
Hopper size during delivery (70% of rated capacity)		11,900 m ³	
Reclamation cycle	Dredging duration	2 hours	
	Sailing to Project site	4 hours	
	Offloading duration	2 hours	
	Sailing to sand source	4 hours	
	Total duration per hopper load	12 hours	
Sediment spill budget per barge load	Percentage of fines	10%	
	Percentage of spill from offloading	20%	
	Sediment spill per hopper load	476 tonnes	
Daily production	Number of reclamation cycle per day	2	
	Reclamation volume per day	23,800 m ³	
	Total spill per day	952 tonnes	

T5.15 Number of dredgers planned for each phase and daily sediment spill rate

Descriptions	Phase 1	Phase 2	Phase 3
Total reclamation volume	58,000,000 m ³	93,800,000 m ³	37,300,000 m ³
No. of TSHD	4	4	2
Total spillage per day	3,808 tonnes	3,808 tonnes	1,904 tonnes

It is considered that a 17,000 m³ TSHD would have a laden draught of around 11 m. As such, the anchorage area of the TSHD is likely to be to the southeast of Pulau Kendi (F5.47) where the seabed level is around 13 to 14 m CD. The fill material will be pumped to the Project site via a discharge pipeline, assisted with booster stations. The TSHD anchorage area and the pipeline will be marked for navigational safety.

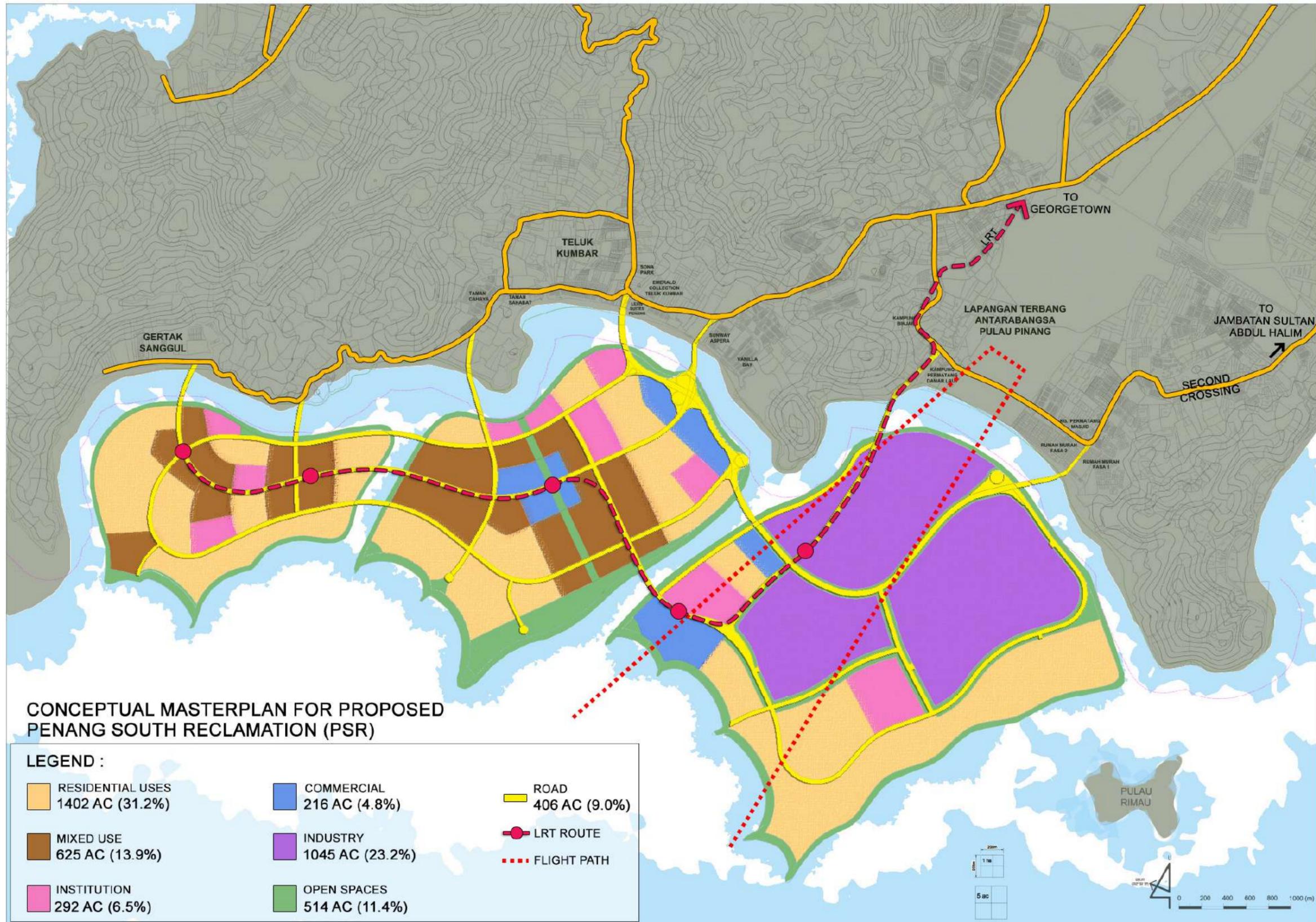


5.5 Topside Development Land Use

The proposed development’s land use will be made up of residential, commercial, mixed development, industrial (light and medium), public amenities, open spaces and recreational and infrastructure and utilities. The topside development will need separate EIA studies that are not covered in this EIA report as given in T5.16. The topside development is only addressed as the conceptual master plan of the reclaimed islands. F5.48 shows the conceptual master plan on the reclaimed island and size of each type of the land uses.

T5.16 Topside development EIA prescribed activities

Prescribed Activity	Term	Details
Industrial Estate Development (First Schedule)	Item 17	Development of industrial estate covering an area of 20 hectares or more
Housing (First Schedule)	Item 16	Housing development covering an area of 50 hectares or more
New Township (First Schedule)	Item 18	Construction of new township consisting of 2,000 housing accommodation units or more or covering an area of 100 hectares or more
Waste Treatment and Disposal	Item 14	c) Sewage i. Construction of sewage treatment plant with 20,000 population equivalent or more.



F5.48
Conceptual master plan for proposed Penang South Reclamation (PSR)

5.5.1 Industrial

For the expansion of the existing Bayan Lepas Free Industrial Zone (FIZ), approximately 1,045 acres of Island A will be allocated for industrial use. There will be no heavy industry in this area. The proposed industries to be developed on the reclaimed islands are light and medium that are related to green, high-technology and research based activities. The definitions of light and medium industries with the buffer zone distance are summarized in T5.17.

T5.17 Summary of definition of light and medium industries

Industry	Description	Buffer Zone	Buffer Distance
Light Industries	<ul style="list-style-type: none"> ■ None or very low pollution potential for air pollution, noise, vibration, odour, fire or explosion ■ Does not involve the use hazardous raw materials or production of hazardous products ■ Use of renewal or low greenhouse gas emission sources of energy ■ Generate no or very low amounts of wastewater with potential to contribute to water pollution ■ Generate mostly non-hazardous solid waste and no significant amount of scheduled wastes ■ Industries are small scale and mostly compatible with each other. 	<ul style="list-style-type: none"> ■ Buffer distance for specific processes or polluting sources which are difficult to control effectively may require greater buffer distance. ■ Where needed, modelling study is to be undertaken to determine actual buffer for these processes or sources. 	Minimum of 50 m or more
Medium Industries	<ul style="list-style-type: none"> ■ Moderate pollution potential and risk due to fire, explosion, and/or hazardous chemicals ■ Moderate air pollution potential (including odour) from low levels of residual air pollutants ■ Moderate potential for emission of greenhouse gases and/or ozone depleting substances ■ Moderate noise and/or vibration with no significant residual impact ■ Generate significant quantities of wastewater containing low levels of residual pollutants ■ Generate scheduled wastes which are mostly readily treated or managed within prescribed facilities 	<ul style="list-style-type: none"> ■ Buffer distance for specific processes or polluting sources which are difficult to control effectively may require greater buffer distances. ■ Where needed, modelling study is to be undertaken to determine actual buffer for these processes or sources. 	Minimum of 150 m or more

Source: Guidelines for Siting and Zoning of Industry and Residential Areas (DOE, 2012)

5.5.2 Residential

As a State Government Project, PSR is aimed to provide housing for entire spectrum of society including the lower income group.

The total residential areas allocated under the proposed Project will cover approximately 1,402 acres. 30% public housing will be allocated on the reclaimed island consistent with current Penang State policy. This allocation shall be updated in accordance to Penang State policy that prevails at the time of implementation.

5.5.3 Commercial

Retail and commercial areas of approximately 216 acres will be developed by applying the concept of “Smart Economy” and will supported by an ecosystem of business and industrial clusters within the PSR island and vicinity.

5.5.4 Mixed Development

The proposed mixed-use on the reclaimed islands covers about 625 acres and will be comprised of both residential and commercial properties. The proportion between residential and commercial is targeted to be approximately 50% residential and 50% commercial to encourage *Live, Play and Work* in-line with “Smart Living” features.

5.5.5 Institution

Approximately 292 acres are allocated for public amenities and government reserve to meet various needs of the residents. The spaces will house various public amenities and government offices including schools, hospital, mosque and places of worship, solid waste processing centre, sewerage treatment plant, water tanks etc. Provision of sufficient space for public amenities is crucial to fulfil the “Smart Living” features.

5.5.6 Open Space and Parks

A total 514 acres or 11.4% of the land on the reclaimed island will be allocated as public open space and parks. These open spaces include public parks, beaches, green swales and bicycle paths in-line with “Smart Environment” features. All open spaces and parks allocated will be open to public.

In addition to the 514 acres above, all development parcels will also be required to set aside land for open spaces within their respective development.

5.5.7 Infrastructure

First class infrastructure is crucial to the success of PSR as a “Smart City”. Infrastructure to be provided on the reclaimed islands includes road and public transport facilities as well as water supply, power supply, telecommunication, sewerage treatment plant and solid waste disposal systems.

5.5.7.1 Road and Public Transport

Road and Public Transport are important infrastructure to fulfil the “Smart Mobility and Connectivity” feature.

406 acres will be allocated to roads and public transportation. Public rail transportation networks will be extended onto all the three islands from Penang Island through extension of future Bayan Lepas LRT.

Road transport will be linked to Penang Island via nine (9) connecting bridges scattered along the south coast of Penang Island. The islands will have the following dedicated links:

- a) Link to 2nd Penang bridge (PIL 2A)
- b) Link to Jalan Tun Dr. Awang (JTDA)
- c) Link to future Pan Island Link 1 (PIL1)

The remaining 6 bridges will be linked to local road along south coast of Penang.

5.5.7.2 Water Supply

Total water demand for entire topside development when it is fully developed is estimated to be 250 MLD. Water supply system, including water pipe networks and water tank will be built to cater for the water demand for entire development.

Water supply will initially be tapped from the 900 mm diameter pipe at Jalan Permatang Damar Laut. Eventually, additional water main pipes from mainland will be required to satisfy water demand for the topside development. As the PSR Project is a long term development, *Perbadanan Bekalan Air Pulau Pinang* (PBAPP) and State Government will monitor the actual and projected water demand and construct the water supply infrastructure in phases.

As part of “Smart Environment” features, water saving initiatives will be encouraged such as recycling of treated wastewater.

5.5.7.3 Power Supply

The total estimated electricity for PSR is estimated to be approximately 1,300 MVA. The main power source for PSR is expected to be from Batu Kawan or Bukit Tambun on the mainland. The operation voltage is expected to be 275 kV.

Installation of solar panel and energy efficient features will be encouraged and all buildings on the reclaimed island will include “Smart Environment” features.

5.5.7.4 Sewerage System

The sewerage system will treat sewerage to Effluent Standard A of Environmental Quality (Sewage) Regulation 2009 in line with TOR approval condition 6 c) i). In addition, the effluent will be re-used in-line with the “Smart Environment” features.

5.5.7.5 Solid Waste Management

Sorting at source, recycling and smart management of solid waste will be implemented on the reclaimed island as part of “Smart Environment” features. A waste management station will be built on Island A to compact solid waste before final disposal at Pulau Burung, which has sufficient capacity for another 20 to 30 years. Solid waste disposal measures will also include adoption of the 4Rs concept: *Reduce, Re-use, Recycle and Renew*.

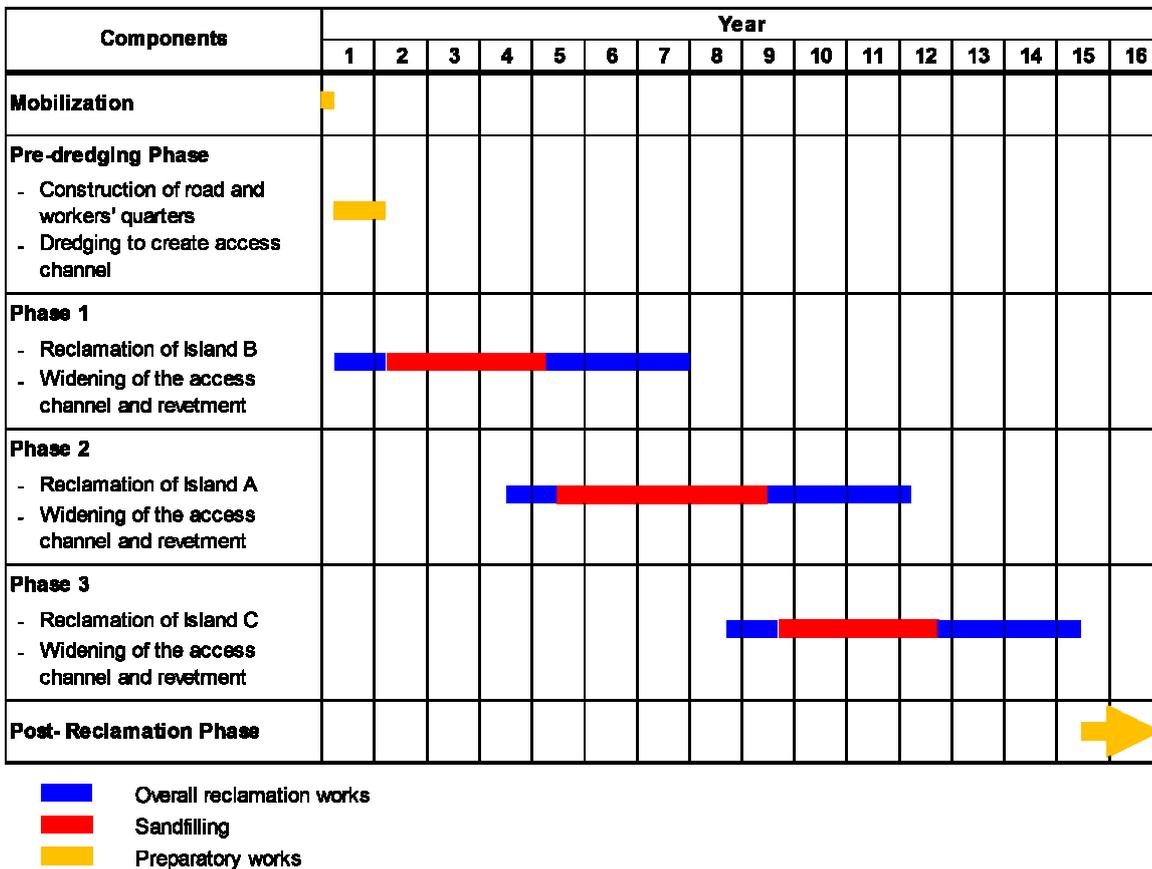
5.5.7.6 Telecommunication

Telecommunication play an important part in all the “Smart City” features of PSR. The reclaimed island will be provided with most up to date communication system on the reclaimed island, including fibre optics networks, 5G mobile networks, data centers, wifi in public areas etc. Telecommunication plan will be developed jointly with the major telecommunication service providers and Penang Development Corporation (PDC).

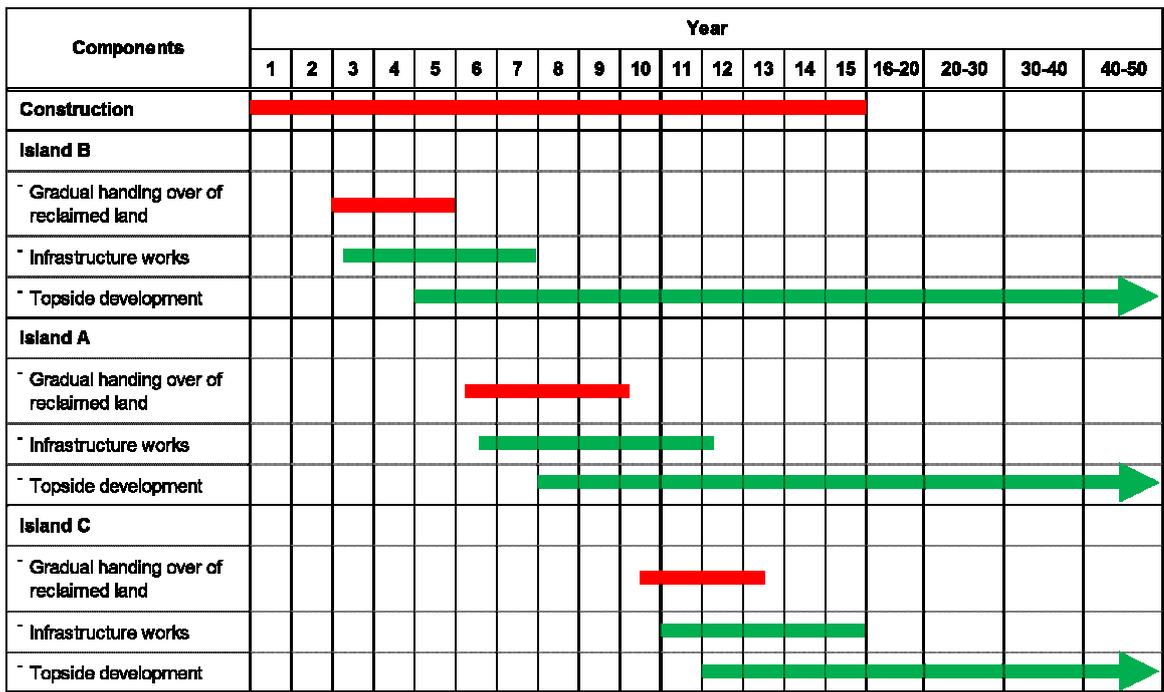
5.6 Project Implementation Schedule

PSR is a long term development Project spanning over a development period of 30 to 50 years. Reclamation works will be completed within 15 years whereas topside development could take further 15 to 35 years. The construction schedule and the development timeline for PSR are shown in T5.18 and T5.19 respectively.

T5.18 Construction schedule



T5.19 PSR development timeline



[Red square] Dredging and reclamation
[Green square] Topside development