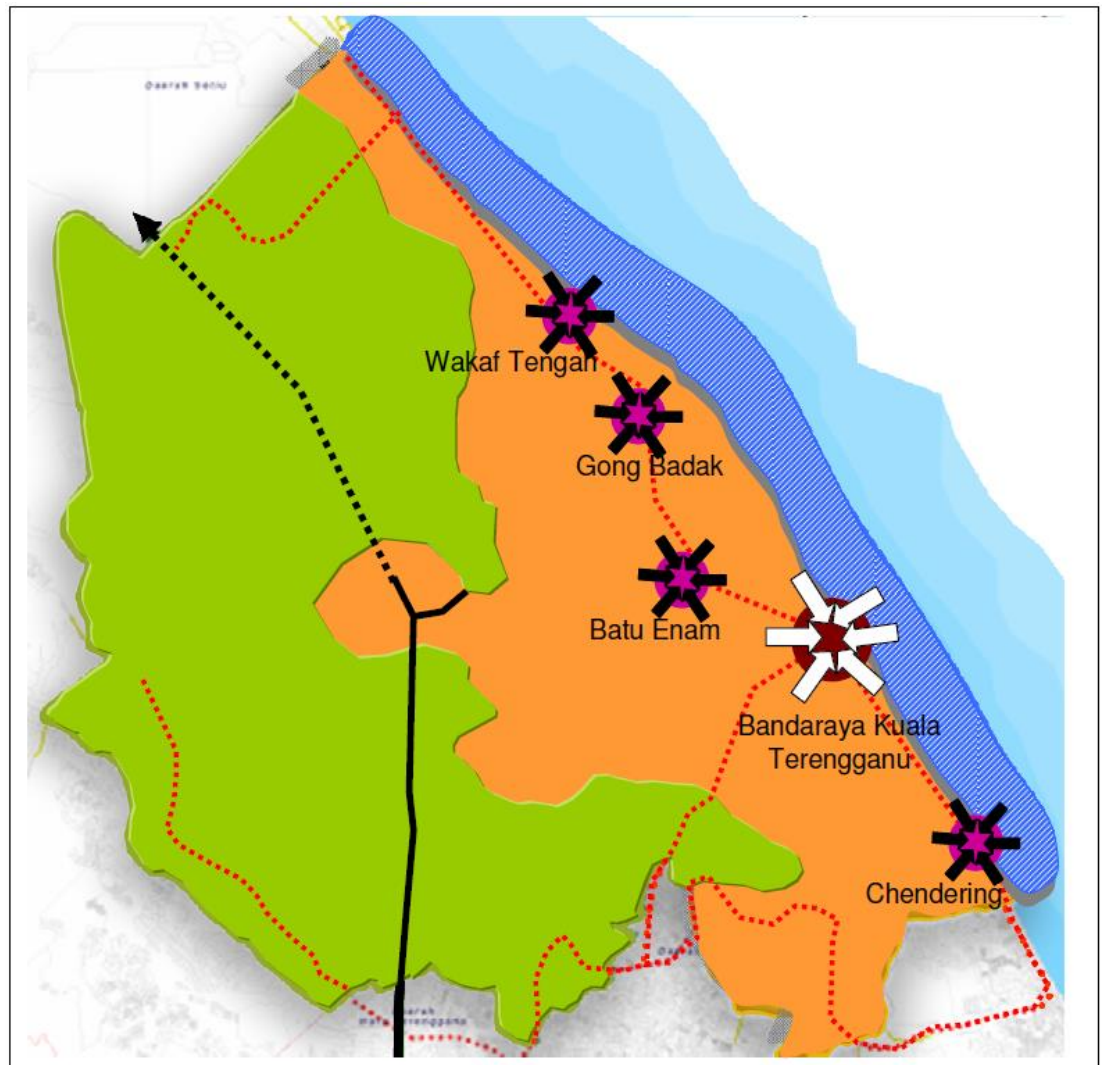




RAJAH 3 - 1

KONSEP PEMBANGUNAN TERTUMPU DAN BERSEPADU RANCANGAN TEMPATAN KUALA TERENGGANU



Figure 3.5 Coastal zone development in Kuala Terengganu (Source: RTD Kuala Terengganu).

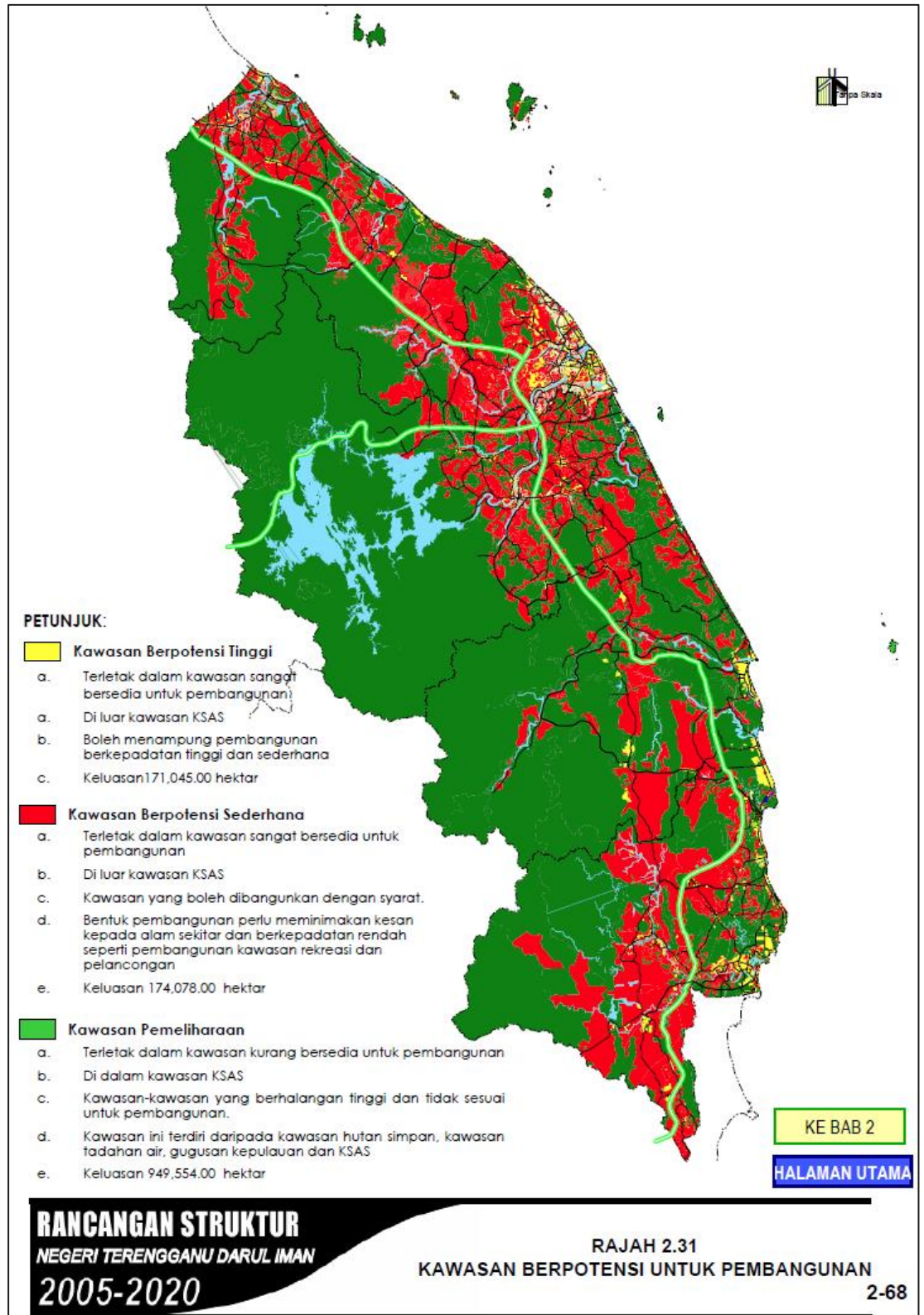


Figure 3.6 Potential areas identified for development in the RSN Terengganu.

In 2007, the Government of Malaysia launched the East Coast Economic Region (ECER) covering the States of Kelantan, Terengganu and Pahang, and the District of Mersing in Johor. ECER is one of the three economic development regions (i.e. Iskandar Malaysia and NCER) in Peninsular Malaysia, established to ensure equitable distribution of wealth across the country. This was done to ensure that the

nation's aspirations to become a high-income developed nation is fulfilled. Between 2008 to 2017, a total of RM 111.6 billion of committed private investments were secured that generated 149,400 job opportunities and 31,700 entrepreneurs and business opportunities. As a way forward, in 2019, the ECER Master Plan 2.0 was launched as a reference point to steer the next phase of ECER's socioeconomic development until year 2025 and beyond. Six strategic initiatives were identified (Figure 3.7)



Figure 3.7 Strategic initiatives under ECER Master Plan 2.0

Seven Key Development Areas (KDAs) were identified within ECER (Figure 3.8). Node 3 (Kuala Terengganu Growth Area), which covers the KTCC-Kenyir-Dungun area, is to link with the Lumut-Gua Musang-Kuala Terengganu Sub-Corridor. Although not earmarked in the ECER Masterplan, the Sunrise City project does have a significant contribution to the entire development as it is in close proximity to the KTCC, an 8,000-ha area earmarked as a Tourism Gateway. Five KDAs have been identified within KTCC¹. The project is located beside the Muara North Reclaimed Area, that is positioned as the new gateway to the city which is expected to open up new avenues to establish a variety of development components covering tourism, commerce, business, education and entertainment.

¹ These are Muara North Reclaimed Area, Muara South Reclaimed Area, Kampung Ladang/Tanjung, Heritage Island and Corniche Waterfront Corridor.



Figure 3.8 Key Development Areas (KDAs) within ECER.

The overall Sunrise City project masterplan's concept of a "Smart Growth" World Class Waterfront development is congruent with RSN Terengganu's Kuala Terengganu conurbation plan for urban development. The ten principles of "Smart Growth" are:

- Mixed land uses
- Compact building design
- Variety of housing choices
- Walkable neighbourhoods
- Distinctive, attractive communities with a strong sense of place
- Environmental preservation
- Strengthen and direct development toward existing communities
- Variety of transportation choices
- Fair and cost-effective development
- Community participation in planning

In line with the above, the Sunrise City development is not focused purely on commercial development, but elements of community inclusivity have been incorporated where housing developments will be created. The project incorporates housing and liveability aspects through the inclusion of the following (Figure 3.9):

- Promenade/Boardwalk
- Beaches
- Landscaped Parks
- Children Playground
- Viewing Towers/Vantage Points

- Fishing Jetties
- Sports venues
- Public Swimming Pools
- Recreational Tracks – Pedestrians, Jogging & Exercise, Cycling
- Skating Rings
- Picnic Areas
- Public Amenities
- Link Bridges
- Security Outposts

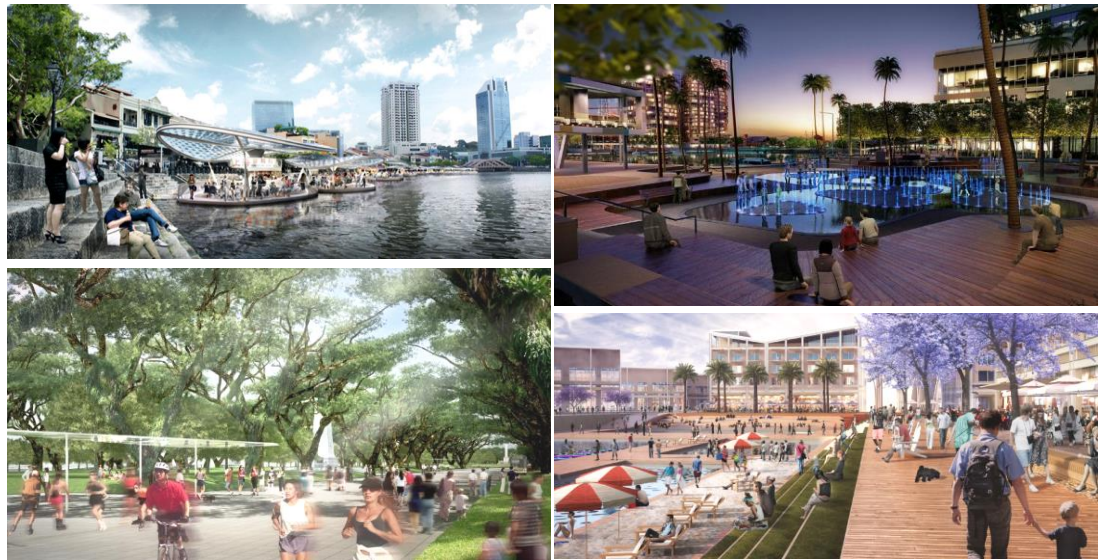


Figure 3.9 Artist's impression of public amenity and facilities in the Sunrise City Development.

As stated in the RSN Terengganu, Terengganu was placed third in terms of poverty level, which has led the State Government to identify several strategies to combat this issue, comprising the following:

- Empowering the community by creating a culture of competitiveness, globalness and innovativeness;
- Ensuring sustainable and balanced economic growth in addition to expanding and diversifying the economic base;
- Generating income especially for those in the lower income brackets and eradicate hardcore poverty in addition to improving the people's quality of life;
- Modernizing cities and growth centres as well as reducing the socioeconomic imbalance between areas;
- Creating a knowledgeable and skilled workforce, as well as increasing production efficiency towards increased competitiveness and endurance in all sectors; and
- Increasing the role/involvement of private sectors and non-governmental organizations in developing the state.

Through the Sunrise City project, it is envisioned that additional and more diverse economic activities that complements the existing developments will be generated. There will be more employment opportunities and increased collaborations (e.g. technology transfer) that will directly and indirectly increase competitiveness, skills

and endurance of the locals, retain local talent and attract talent to Terengganu, bridge the income gap whilst at the same time safeguarding the welfare of the people, environment and local heritage and culture, aligned with the State Government's strategic directions. As a new iconic attraction, the Sunrise City project will help raise the economic status of Terengganu in particular and Malaysia in general.

3.2 East Coast Tourism Hub

The ECER Development Documents has identified Terengganu State as a tourism hub for the east coast sector, while the Terengganu State government has identified tourism as one of the major economic drivers through Kuala Terengganu district also known as 'Bandaraya Warisan Pesisir Air'. As mentioned in Section Figure 3.1, the Kuala Terengganu-Kuala Berang-Marang conurbation (Figure 3.3) has been identified as the most important conurbation in Terengganu and will serve as the East Coast Tourism Hub.

The State government is targeting 6.5 million domestic and foreign tourists to visit Terengganu by 2025, from around 4 million in 2017 as shown in Figure 3.10, with a corresponding increase in tourism expenditure by RM 6 billion /3/. The increase in tourist arrivals to achieve the set target will be implemented through the Terengganu Tourism Master Plan 2018-2025, which outlines strategies such as adaptation of "smart tourism" by using digital technology to improve marketing and sales, service delivery and visitor experiences. Through the initiative, Terengganu will empower its tourism sector in terms of producing heritage products, upgrading of holiday resorts on the islands and improving the development of state parks /3/.

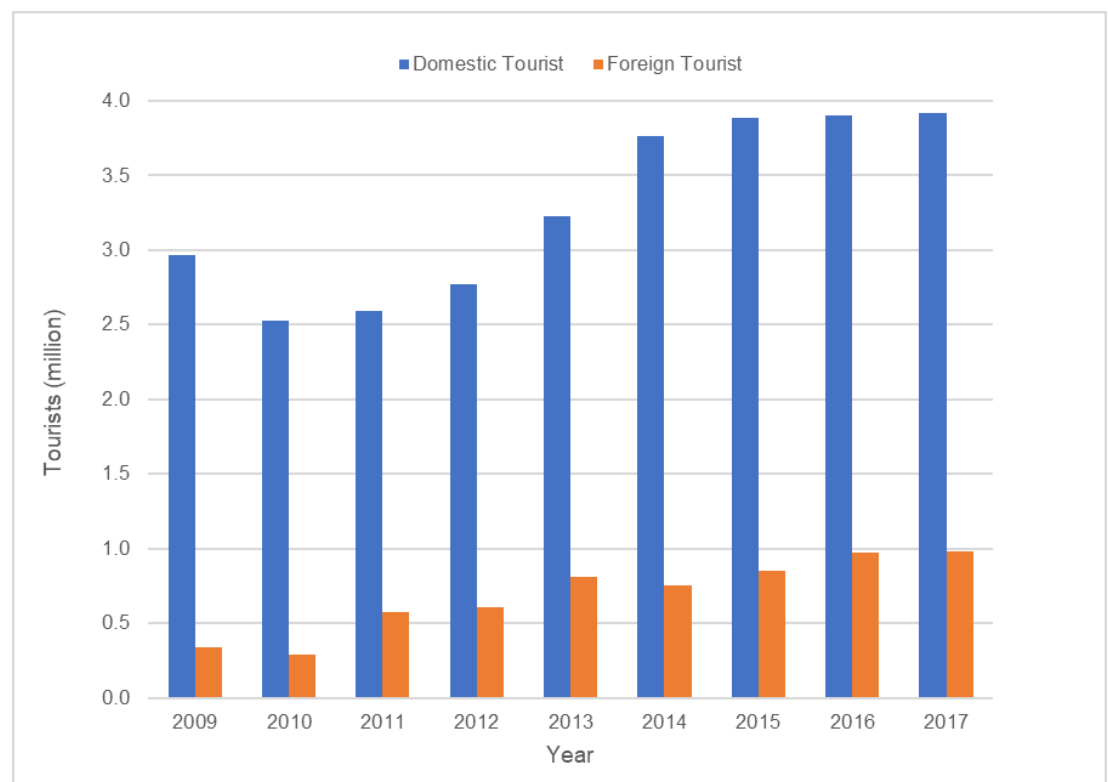


Figure 3.10 Tourism statistics of Terengganu (Source: UPEN Terengganu /4/).

The main attractions in Terengganu are the offshore islands. Terengganu has some of the most beautiful islands in Malaysia including the ever popular Perhentian Islands, coral-fringed Redang Island and Kapas Island. However, almost all island resorts are closed during the Northeast monsoon period, and inland tours will be promoted, especially inland fishing and city tours /5/.

The Sunrise City development will serve to broaden the tourist attraction base around Kuala Terengganu and, through the creation of relatively sheltered beaches and water spaces (see Figure 3.1), will increase year-round tourist receipts, boosting the sustainability of the industry. In addition to recreational beaches and resort islands, the project's tourist attractions will include a cruise terminal., which is expected to significantly boost tourism arrivals and ensure Terengganu captures a share of this rapidly growing market.

The Cruise Line International Association's most recent Asia Cruise Trends report /6/ indicate rapid growth of the industry in Asia, with a 53 % growth in number of ships deployed in Asia since 2013, and passenger capacity nearly tripling from 1.5 million to 4.2 million (Figure 3.11). Sailings in and through Asia increased 142 per cent from 861 cruises and voyages in 2013 to 2,086 in 2017. Southeast Asia alone contributed close to 20 per cent of Asia's overall cruise passengers. Projections to 2035 estimate up to 4.5 million cruise passengers in SEA (ASEAN's Report on Cruise Development in Southeast Asia 2017, cited by Ministry of Tourism & Culture Malaysia /7/).



Artists' impression of Sunrise City's proposed cruise terminal.
Source: BTC Architect.



Figure 3.11 Growth in cruise tourism in Asia /7/.

Despite this growing opportunity, there are currently only three cruise destinations on the East Coast of Malaysia, comprising P. Tioman and Kuantan Port in Pahang, P. Redang in Terengganu (Figure 3.12), and a planned cruise terminal in Melaka.

The Redang Port is located approximately 40 km from Kuala Terengganu, and is located in P. Redang, a resort island that has been gazetted as a marine park where

activities are subject to the provisions of the law under the Department of Marine Parks Malaysia. Pulau Redang is also one of the stopover destinations for Star Cruise vessels. The development of a cruise terminal within the Sunrise City development will complement the Redang facility and in the future alleviate development pressure within the environmentally sensitive marine park, whilst ensuring Terengganu state still capitalises from this growing tourism segment.

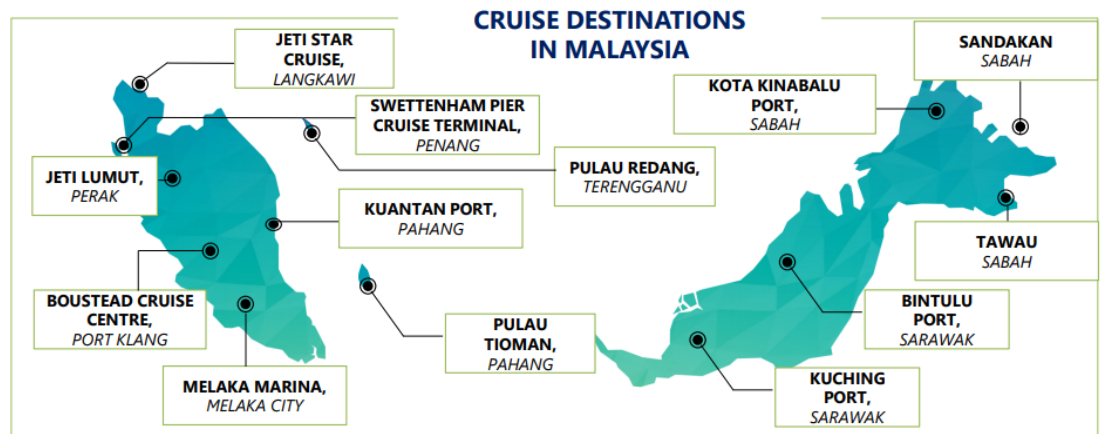


Figure 3.12 Cruise destinations in Malaysia. Source: Indian Ocean Rim Association (IORA) /7/.

3.3 Benefit of Sunrise City Project to the State and the Country

The expected economic benefits of the Sunrise City project to the Terengganu state and Malaysia are highlighted below:

- Expected contribution from Gross Development Value (GDV) of the project development at RM 1.3 billion including bringing additional income to the state in form of tax payment, premium, rental, assessment fee, submission fees and licensing fee as shown in Table 3.1 below.
- Generation of substantial Gross National Income (GNI) from foreign exchange earnings from foreign projects and gross domestic product (GDP) from local industries.
- Generation of job opportunities during construction (estimated 500 jobs) and during the operation period (estimated 155,400 jobs) – consisting of skilled and unskilled workers, technical staff and management personnel.
- In connection with other planned infrastructure developments, transforming Kuala Terengganu into a national and international service and tourist hub with a high-income society.
- Expand the capability and capacity of the local supporting industries, through the growth of local small and medium-sized enterprises (including tourism and service companies) which are the backbone of the country's economy.

Table 3.1 Gross Development Value (GDV) and tax to state.

Source of tax	Description	Estimated fee mill. (RM)
Land taxes (annual)	Total taxable land area 910 ac (39.6 mill sqft)	50.0
Properties assessment fees (annual)	GDV RM 20.3 mill	75.0
Land cost	Compensation 2 km waterfront from Pulau Warisan to Pulau Wan Man, Kuala Terengganu	50.0
Planning fee (stamp duty)		
Residential	GFA 23.0 mill sqft	153.9
Service apartment, SOHO	GFA 9.1 mill sqft	61.0
Retail office	GFA 6.0 mill sqft	40.4
Resort	GFA 2.2 mill sqft	14.4
Cruise Terminal	GFA 9.1 mill sqft	6.0
Town Centre	GFA 3.8 mill sqft	25.3
Contribution to authorities (SATU, TNB, IWK)		
Tenaga Nasional Berhad (TNB)	0.15% of total GDV	31.2
SATU	0.25% of the total GDV	52.1
IWK	0.1% of total GDV	208.3
Strata title	RM3,000 per unit (one off) Total unit=31,100	93.3
Levy fees on foreign purchase (one off)	2.00% of total GDV (one off)	416.5
TOTAL		1,277.4

4 Project Options

Project options have been assessed with respect to:

- The most suitable location along the coastline relative to Kuala Terengganu and its present harbour entrance,
- The Project area layout which is a balance between maximising the reclaimed area, minimising the hydraulic impacts and meeting the necessary navigation requirements, and
- The way the reclamation is to be carried out to meet both engineering efficiencies, costs and minimising environmental impacts.

By defining the Project and its core reclamation processes in this way the environmental impacts for the selected options can be specifically assessed.

4.1 Project Location

As described in Section 3, the purpose of the Sunrise City project is to improve the economy and alleviate the present crowding and future development pressure on the immediate Kuala Terengganu environment. Three Project location options close to the Kuala Terengganu town centre were considered (Figure 4.1):

- Pantai Mengabang Telipot – Pantai Tok Jembal;
- Pantai Teluk Ketapang – Seberang Takir; and
- Pantai Batu Burok – Kuala Ibai

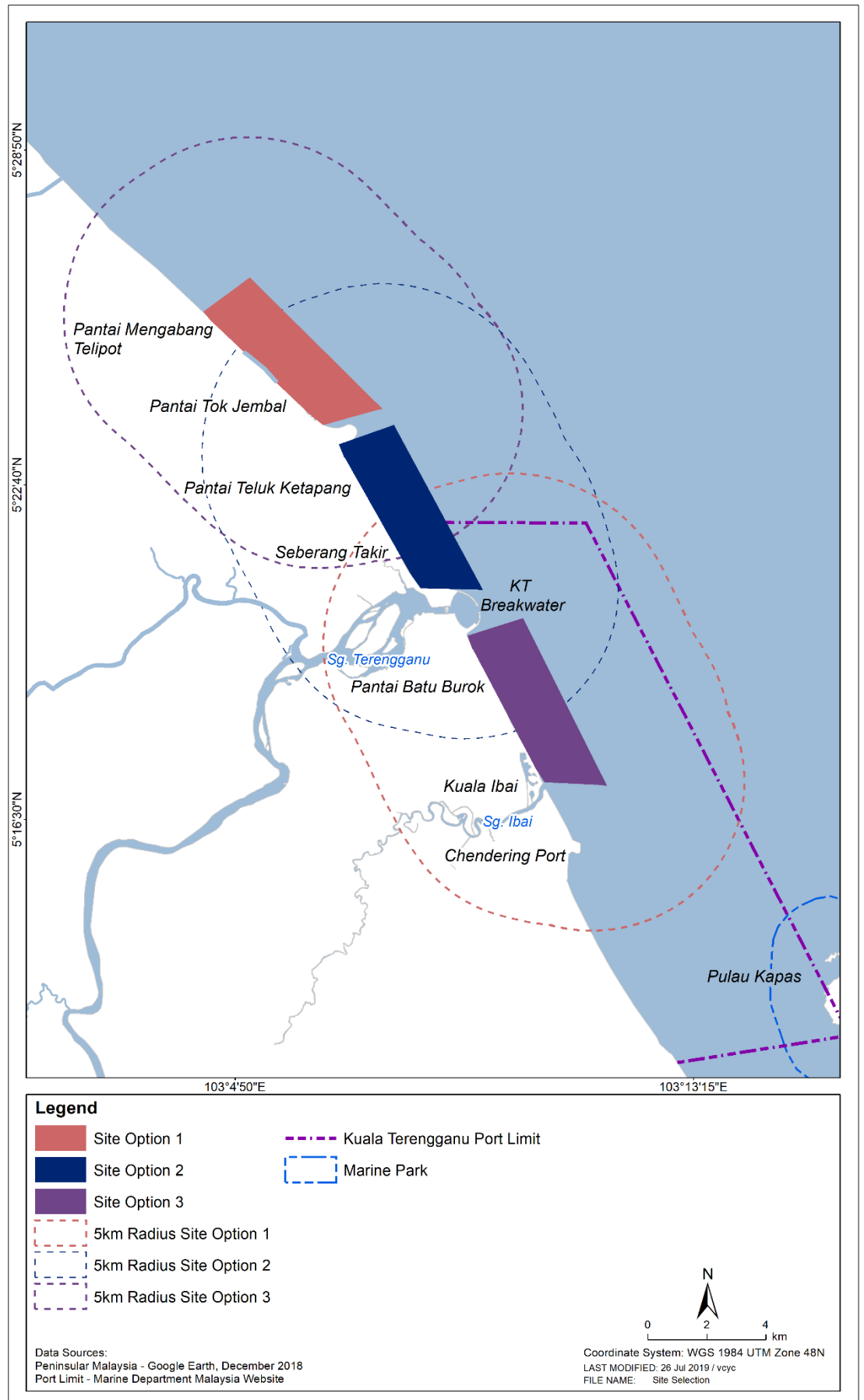


Figure 4.1 Site selection options.

4.1.1 Methodology for Site Evaluation

The site selection evaluation was carried out based on the environmental considerations and criteria listed in Table 4.1, considering an area of 5 km radius of each Project location option. A site option is deemed unsuitable if it meets three or more “high” sensitivity criteria.

Table 4.1 Criteria for site selection.

Components	Description
Physical	
Hydrodynamic	• Low sensitivity: Project is not anticipated to cause erosion to nearby coastline • High sensitivity: Project is anticipated to cause erosion to nearby coastline
Hydrology	• Low sensitivity: reclamation not blocking rivermouth • High sensitivity: reclamation may block rivermouth
Biological	
Sea turtles	• Low sensitivity: reclamation not located in proximity to sea turtle landing/nesting site • High sensitivity: reclamation located in proximity to sea turtle landing/nesting site
Human	
Land use	• Low sensitivity: ~ land use compatible with project development as per available development plans ~ absence of sensitive areas (e.g. cultural sites, areas of worship, palaces, etc.) along the shoreline which may be affected by the Project • High sensitivity: ~ land use not compatible with project development as per available development plans ~ presence of sensitive areas along shoreline
Marine traffic and navigation	• Low sensitivity: reclamation not within port limit • High sensitivity: reclamation within port limit
LKIM fisheries complex	• Low sensitivity: LKIM fisheries complex not impacted by reclamation • High sensitivity: LKIM fisheries complex impacted by reclamation

4.1.2 Assessment Results

The results of the assessment for the site options are presented in Table 4.2, Table 4.3 and Table 4.4.

Table 4.2 Assessment for Option 1.

Component	Sensitivity	Description
Physical		
Hydrodynamic	High	Reclamation activities may change the shoreline morphology. High possibility of causing erosion northwards of the shoreline.
Hydrology	High	Reclamation is blocking the rivermouth near Pantai Mengabang Telipot (refer to Figure 4.1). Significant mitigation measures such as redirection of river flow would be required to minimize impacts.
Biological		
Sea turtles	Low	No sea turtle landing/nesting site within 10km of reclamation site.
Human		
Land use	High	- According to RSN Terengganu, the coastal corridor along Option 1 has been slated for spatial development. - The Sultan Mahmud airport is located approximately 100 m from Option 1. - Universiti Malaysia Terengganu is located approximately 90 m from Option 1.
Marine traffic and navigation	Low	Reclamation site not located within the Kuala Terengganu port limit (Figure 4.2).
LKIM fisheries complex	Low	No LKIM fisheries complex is affected by the reclamation.

Table 4.3 Assessment for Option 2.

Component	Sensitivity	Description
Physical		
Hydrodynamic	Low	Reclamation activities within a “sheltered” area i.e. between the Sultan Mahmud Airport and Kuala Terengganu breakwater (refer to Figure 4.1). Low possibility of causing erosion northwards and southwards of the reclamation site.
Hydrology	Low	Reclamation is not blocking any rivermouth (refer to Figure 4.1).
Biological		
Sea turtles	Low	No sea turtle landing/nesting site within 10km of reclamation site.

Component	Sensitivity	Description
Human		
Land use	High	- According to RSN Terengganu, the coastal corridor along Option 2 has been slated for spatial development. - The Sultan Mahmud airport is located approximately 100 m from Option 2. - The Tengku Muhammad Ismail army camp is located approximately 200 m from Option 2.
Marine traffic and navigation	High	Reclamation site located partially within the Kuala Terengganu port limit (Figure 4.2).
LKIM fisheries complex	Low	The Pulau Kambing fisheries complex is located in the Sg. Terengganu rivermouth which will not be affected by the reclamation.

Table 4.4 Assessment for Option 3.

Component	Sensitivity	Description
Physical		
Hydrodynamic	High	Reclamation activities may change the shoreline morphology. High possibility of causing erosion northwards of the shoreline.
Hydrology	High	Reclamation is next to the Sg. Ibai river mouth (refer to Figure 4.1) and may cause upstream flooding. Significant mitigation measures would be required to minimize impacts.
Biological		
Sea turtles	Low	No sea turtle landing/nesting site within 10km of reclamation site.
Human		
Land use	High	- According to RSN Terengganu, the coastal corridor along Option 3 has been slated for spatial development. - Istana Badariah and Terengganu Royal Golf Club is located approximately 20 m from Option 3. - Istana Nur Nadhirah is located approximately 300 m from Option 3.
Marine traffic and navigation	High	Reclamation site located partially within the Kuala Terengganu port limit (Figure 4.2).
LKIM fisheries complex	Low	The nearest LKIM fisheries complex is located about 3 km away and will not be affected by the reclamation.

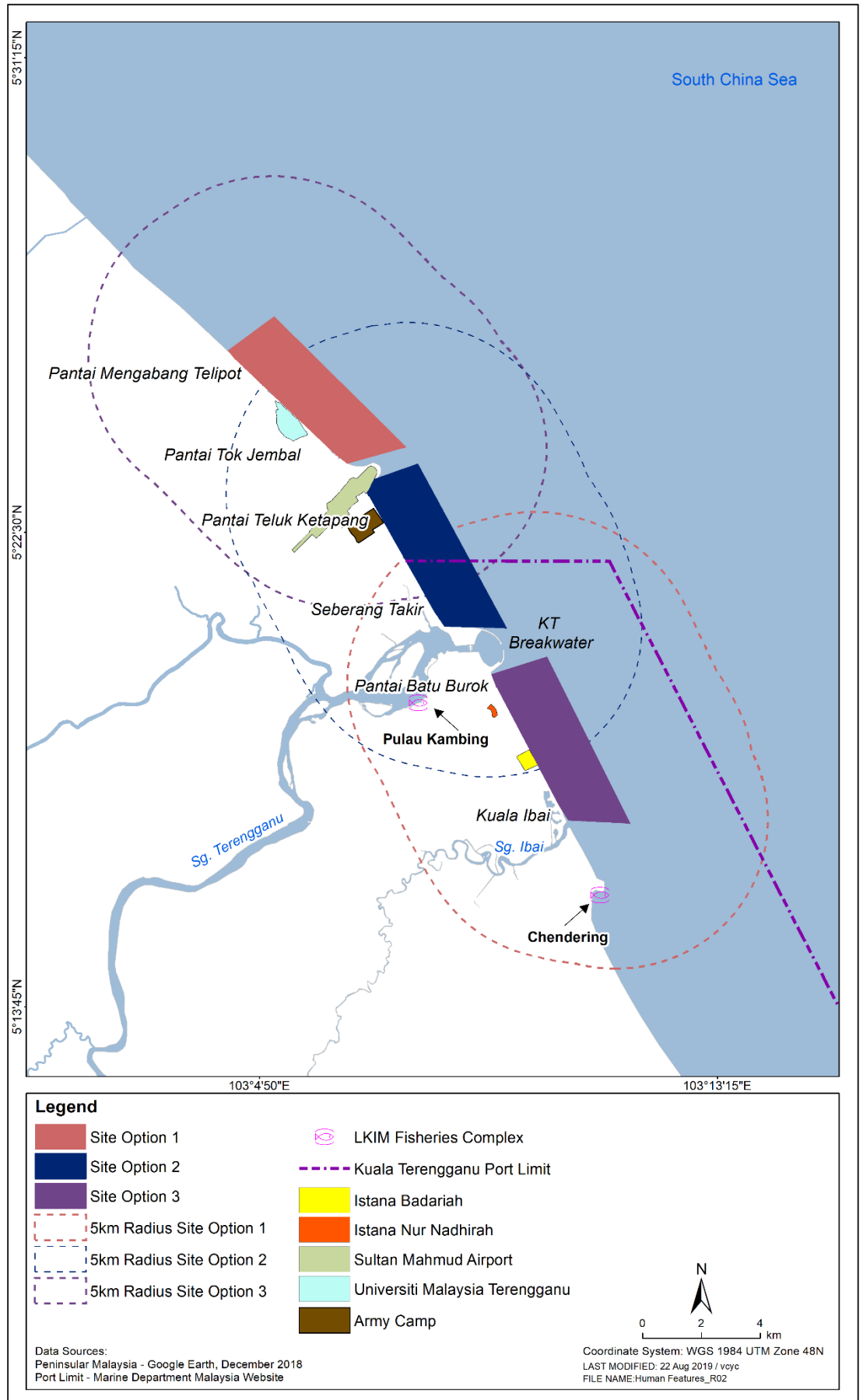


Figure 4.2 Human environment features.

4.1.3 Summary and Conclusion

As shown in Table 4.5, Option 2 was chosen as the most suitable site location for the Project as Option 1 and Option 3 have at least three “high” sensitivity values, which render these areas unsuitable.

Table 4.5 Summary of assessment results.

Component	Option 1 (Pantai Mengabang Telipot - Pantai Tok Jembal)	Option 2 (Pantai Teluk Ketapang – Seberang Takir)	Option 3 (Pantai Batu Burok – Kuala Ibai)
Physical			
Hydrodynamic	High	Low	High
Hydrology	High	Low	High
Biological			
Sea turtles	Low	Low	Low
Human			
Land use	High	High	High
Marine traffic and navigation	Low	High	High
LKIM fisheries complex	Low	Low	Low

4.2 Reclamation Layout

A total of nine layouts was assessed during design stage of the Project. Although this is the case, only three layout options are presented in this EIA as shown in Figure 4.3. Details of the remaining layout options can be referred to Appendix H. The key differences between the three layouts are summarised in Table 4.6. The main criteria in designing these layouts were to:

- Provide the maximum reclamation area which causes minimal morphological impacts;
- Provide suitable areas for recreational beaches;
- Provide an inner channel to maximise waterfront amenity with good water flow;
- Optimise breakwater length to provide safe operations at the cruise liner terminal and marine facilities; and
- Ensure adequate area for the turning basin.

Table 4.6 Key differences between layouts.

Layout	Key Attributes
Option 1	• No significant changes to current flow. However, a small eddy may form near the cruise terminal, which may affect berthing. • Flushing is adequate in the water bodies surrounding the reclaimed land thus no water quality issues anticipated. • Reclamation area not maximised at only 555 ha.

Layout	Key Attributes
	Layout design not optimized for navigation purposes as area for turning basin insufficient.
Option 2	- Layout reconfigured to maximize reclamation area (634 ha). - No significant changes to current flow. - Flushing improved due to small channel at northern area to allow flow into of the basin for the marine facility. - Current speed in the inner channel (i.e. channel between main reclamation area and mainland) is low. - Modification in cruise terminal area to ensure adequate area for turning basin. - Breakwater length increased to provide protection to vessels at turning basin from direct wave impacts.
Option 3	- Land area increased to 768 ha and modified to include two offshore islands for hotels/resorts. - The offshore islands act as breakwaters that protect the beaches from direct wave impacts. - The alignment between the breakwater and offshore islands at the eastern limits of reclamation reduces the eddy near the breakwater entrance. - The small channel at the northern area is closed. - Inner channel is widened, and a new channel is designed at the southern end. This design increases the current speed slightly thus improves the water flow at these areas.

Based on the key attributes, the shortlisted reclamation layout is Option 3 as it has the least potential impacts on hydraulic processes and meets all necessary navigation requirements.

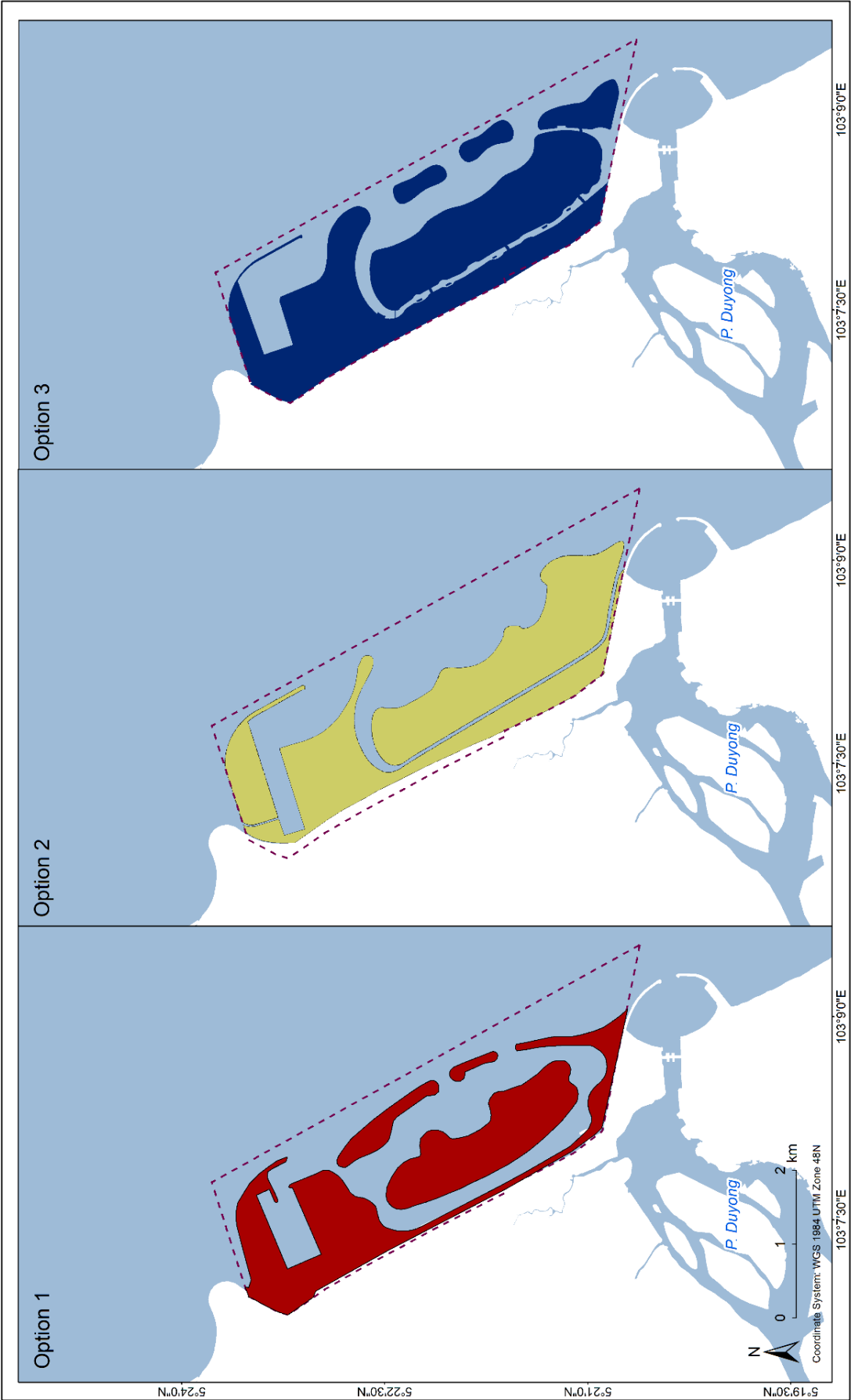


Figure 4.3 Project reclamation layout options assessed.

4.3 Reclamation Methodology Option

Reclamation for the Project will be done via hydraulic placement of material from the sea using Trailer Suction Hopper Dredgers (TSHD). Placement of material is generally done using three methods (Figure 4.4):

- Direct discharge / bottom door dumping;
- Rainbowing; and
- Pumping through pipelines.

A comparison between the suitability of techniques is shown in Table 4.7.

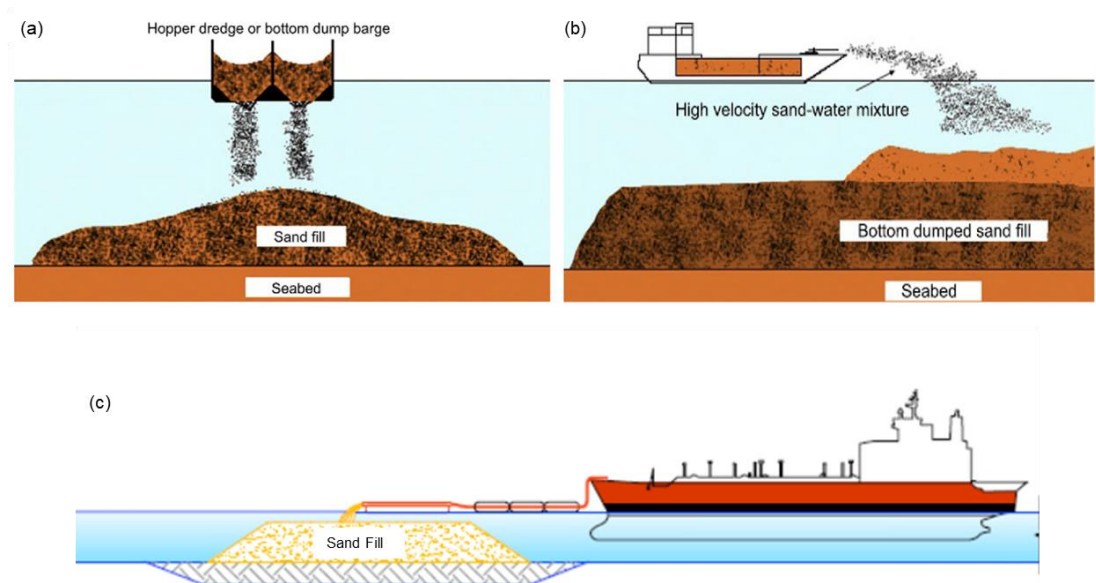


Figure 4.4 Reclamation fill discharge by (a) bottom dumping, (b) rainbowing /8/ and (c) pipeline /9/.

Table 4.7 Comparison of reclamation fill placement techniques.

Criteria	Reclamation Fill Placement Techniques		
	Direct Dumping	Rainbowing	Pipeline
Shallow area accessibility	X	✓	✓
Reduced environmental impact /10/	X	X	✓

For this Project, floating pipelines will be used to pump sand from the TSHD to the reclamation site for two reasons:

- 1 The reclamation site is located in shallow areas (-1 m CD to -8 m CD); and
- 2 It generates smaller, localised sediment plumes hence lower environmental impacts.

4.4 No Project Option

The “no project” option entails that all the possible benefits detailed in Section 3 Statement of Need will not be realised.

5 Project Description

5.1 Project Location

The Project is located within the State of Terengganu (Figure 5.1), at Pantai Teluk Ketapang, between the Sultan Mahmud Airport and the Kuala Terengganu breakwater. The capital city of Terengganu, Kuala Terengganu lies across Sg. Terengganu, approximately 1.5 km south of the Project site. Administratively, the Project is within Mukim Kuala Nerus, District of Kuala Nerus.

The nearest populated areas (Figure 5.1) are, from north to south, Kg. Telaga Batin, army camp, Kg. Ketapang, Taman Perumahan Telaga Daing, Kg. Telaga Daing, Kg. Baharu Seberang Takir, Kg. Hulu Takir, Kg. Banggol Pak Ibrahim, Taman Permint Perdana Phase 1 and Phase 3, Kg. Batin, Kg. Seberang Takir and Tg. Seberang Takir.

The Project is accessible via Jalan Lapangan Terbang (N65) and Jalan Tengku Ampuan Bariah which branches out into smaller, local roads known as Jalan Ketapang Pantai and Jalan Melati Ulung.

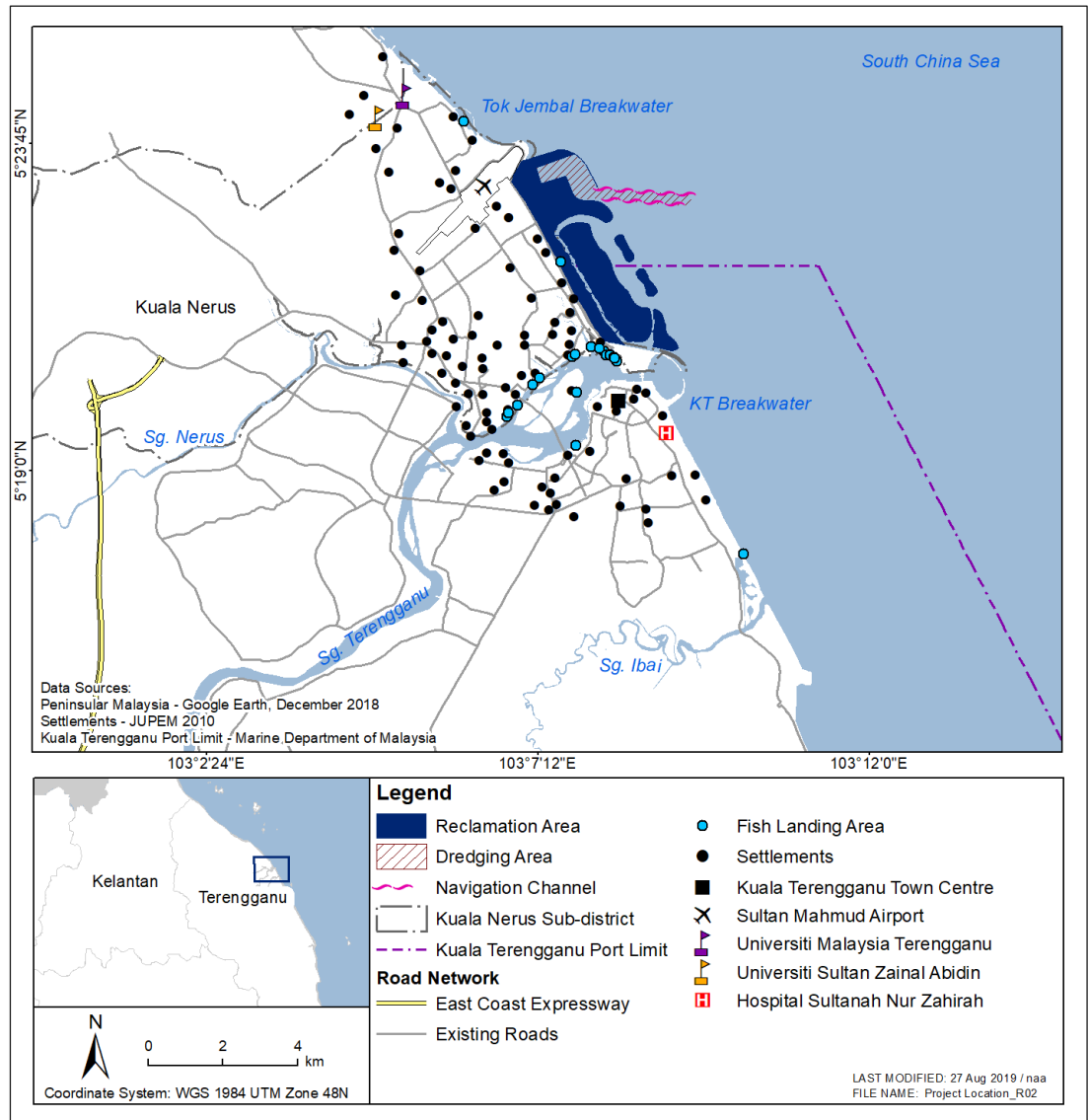


Figure 5.1 Regional setting of the Project.

As shown in Figure 5.2, the land use adjacent to the Project area is built-up / urbanised. There are several sensitive receptors within 5 km of the Project, which include fish aggregating devices, mangroves, port limit, the Sultan Mahmud airport, religious monuments and others.

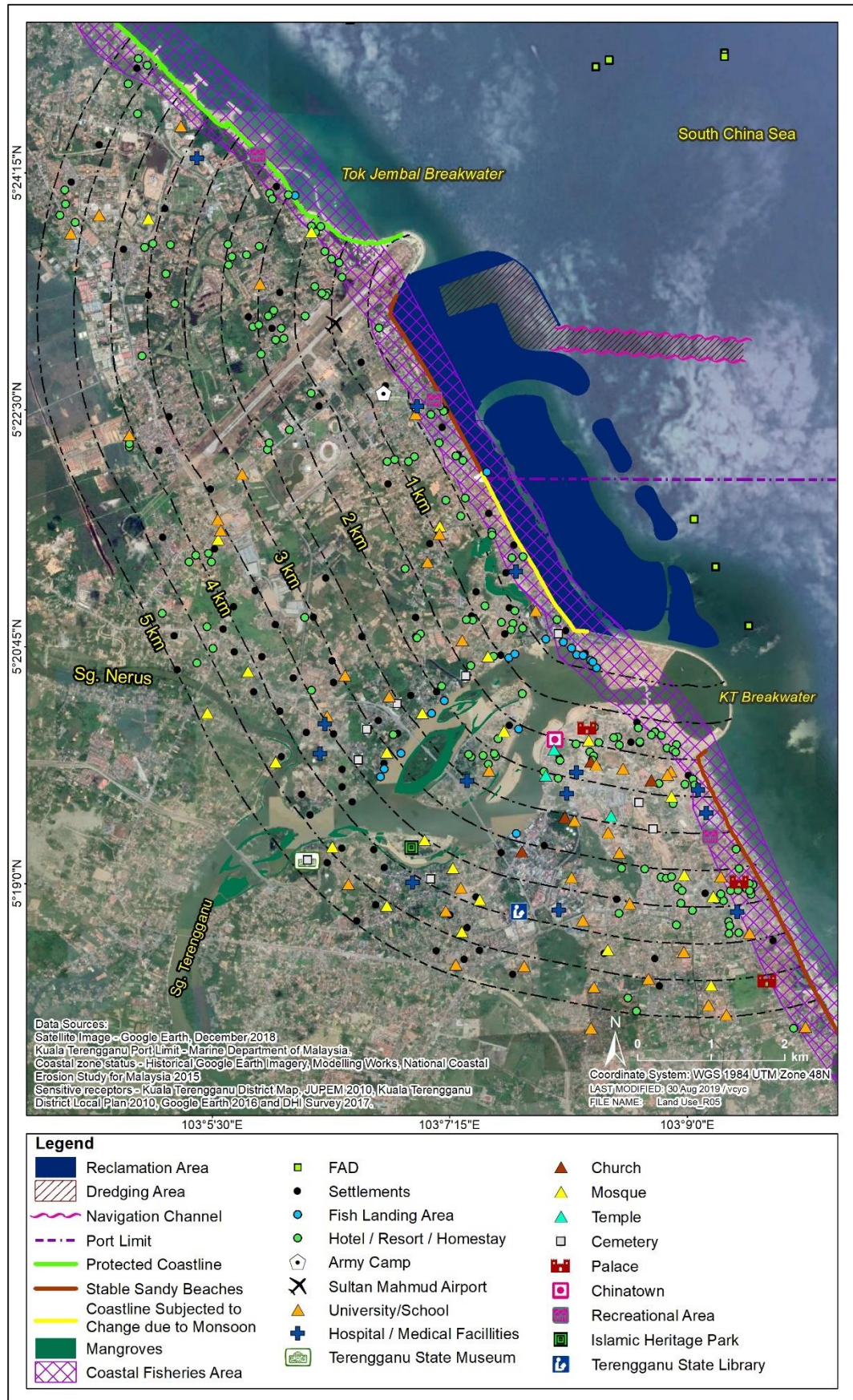


Figure 5.2 Land use and sensitive receptors within 5 km of the Project site (see Drawings for A3 figure).

5.1.1 Project Boundary

The Project area encompasses the reclamation area, dredging area and internal water ways as shown in Figure 5.3; the coordinates of the Project boundary points are listed in Table 5.1. The Project reclamation footprint covers an area of 1,898 ac (768 ha), while the dredging area is 439 ac (178 ha).

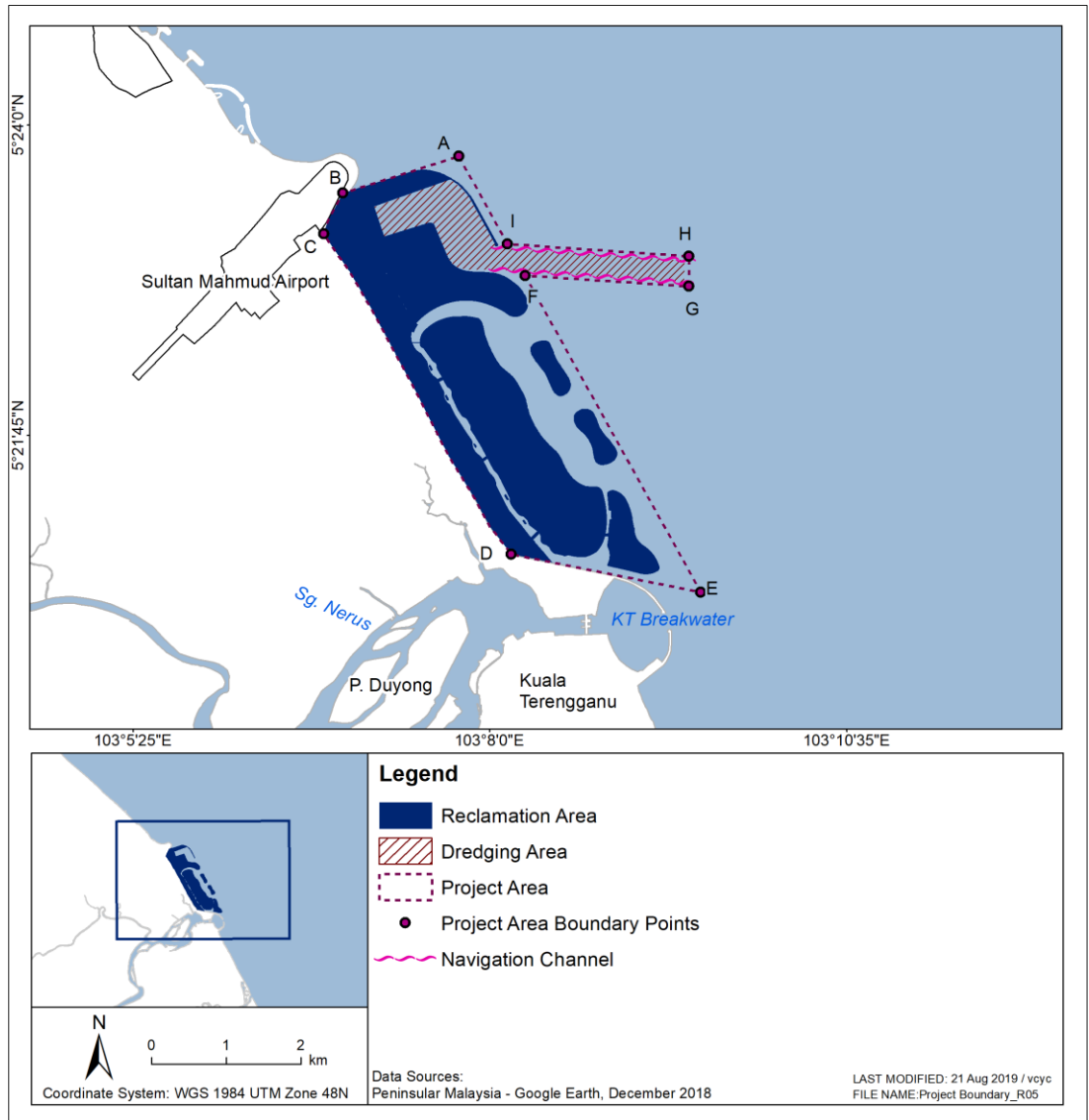


Figure 5.3 Project area which encompasses the reclamation area, dredging area and internal waterways.

Table 5.1 Coordinates of the Project boundary (WGS84 - degrees, minutes, seconds).

Point	Latitude (N)	Longitude (E)
A	5° 23' 46.93"	103° 7' 45.94"
B	5° 23' 30.76"	103° 6' 55.67"
C	5° 23' 13.00"	103° 6' 47.37"
D	5° 20' 53.86"	103° 8' 09.18"
E	5° 20' 37.57"	103° 9' 31.60"

Point	Latitude (N)	Longitude (E)
F	5° 22' 55.08"	103° 8' 14.87"
G	5° 22' 50.67"	103° 9' 25.97"
H	5° 23' 3.72"	103° 9' 25.93"
I	5° 23' 8.85"	103° 8' 7.19"

5.2 Project Concept

The Sunrise City project is a mixed development with marine facilities, to be sited on reclaimed land. The reclamation covers an area of 1,898 ac (768 ha). The conceptual topside development includes residential, tourism, marine, light industry, public facilities and other components as shown in Figure 5.4 and Table 5.2. Key elements of this master plan include a cruise liner terminal which will be a magnet to tourists globally, a fishing wharf for fishermen and beaches for public access in addition to recreational tracks, sports venues and a cultural and food hub for the local community to exhibit and sell local products. As described earlier in Section 1.4 Legal Aspects, separate EIAs will be conducted for the topside components and will not be addressed in this present EIA.

PROPOSED SUNRISE CITY MIXED DEVELOPMENT

The Sunrise City mixed development (i.e. “topside” development) to be constructed on the reclaimed land of the Project site is in the conceptual master planning stage. The present EIA does not address impacts of the topside development, and as such the information on the proposed development provided in this section is limited to avoid confusion. Nevertheless, further information on the conceptual masterplan is linked in this QR code.

Scan this QR code to watch a video presentation of the Sunrise City Conceptual Master Plan. If your smartphone does not have a reader, download one at get.neoreader.com



The reclamation and dredging stage of the Project that is the focus of this EIA will involve the following activities:

- Reclamation of 768 ha. Approximately 62 million m³ of fill material will be sourced from an approved marine borrow site for this reclamation.
- Capital dredging for a navigation channel and basin for the marine facilities, approximately 2.6 km in length, with an anticipated 7.7 million m³ of dredged material to achieve a depth of -12 m CD;
- Construction of a breakwater to protect the marine facilities, involving sand key dredging of 0.6 million m³;
- Construction of revetments along the reclamation shoreline;
- Construction of roads and bridges; and
- Construction of piled platforms within the canal.

These are discussed in further detail in the following sections.



Figure 5.4 Conceptual Sunrise City project topside components.

Table 5.2 Conceptual topside components.

Description	Approximate Area		
	Ha.	Ac.	%
Residential	85	209	11.0
Commercial			
- Main Town Centre	20	50	2.6
- Neighbourhood Centre / Mixed Development	185	458	24.1
- Hotels / Resorts	41	100	5.3
Industrial (Light Industry)	16	40	2.1
Recreational/Leisure	47	117	6.2
Public Facilities	37	91	4.8
Transportation	23	56	3.0
Utilities and Services (TNB, Reservoir, STP etc)	40	98	5.2
Green Area	111	275	14.5
Roads	94	232	12.2
Marine Facilities (Cruise Terminal and Fishing Wharf)	61	151	7.9
Breakwater	7	17	0.9
Piled Platforms	1	3	0.1
TOTAL	768	1,898	100.0

5.3 Project Components

5.3.1 Reclamation

An area of 1,898 ac (768 ha) will be reclaimed, and it is estimated that a total of 62 million m³ of sand is required to form the land to a platform level of +4.5 m CD. Reclamation will be carried out in five phases as shown in Figure 5.5. The land areas to be reclaimed during the phase are:

- Phase 1 – 612 ac
- Phase 2 – 430 ac
- Phase 3 – 240 ac
- Phase 4 – 383 ac
- Phase 5 – 233 ac

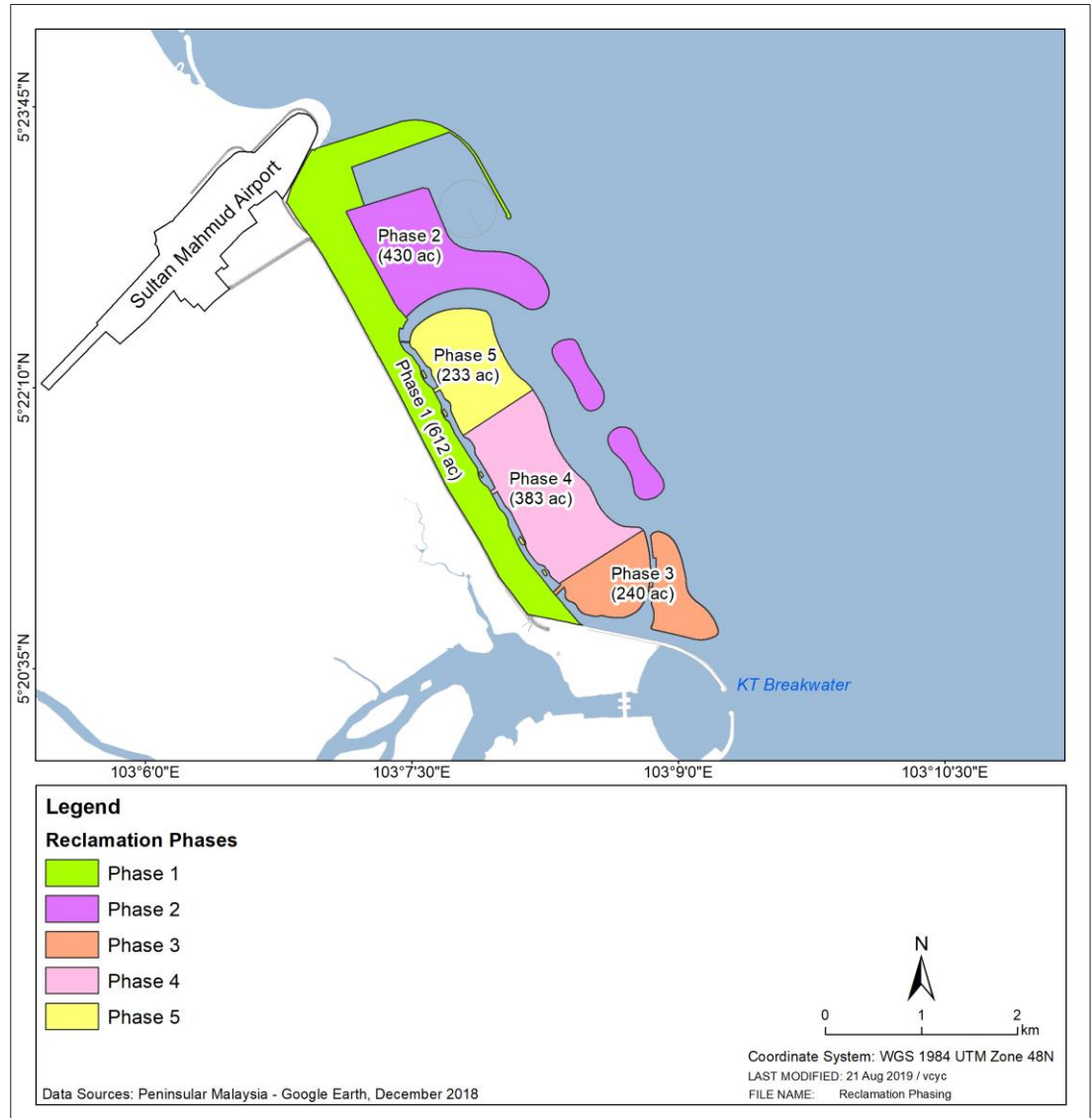


Figure 5.5 Reclamation phases.

5.3.1.1 Sand Source

Sand is proposed to be obtained from an approved marine sand source area which is located approximately 124 km south of the Project (Figure 5.6). The proposed sand source area has an estimated resource of 41 million m³, which is sufficient for Phase 1 to Phase 3 reclamation works. Thus, the remaining sand needed for Phase 4 and Phase 5 will be sourced from another area.

Potential future sand source areas that have been identified are shown in Figure 5.7. A separate First Schedule EIA will be conducted and submitted to DOE Terengganu for future sand source activities prior to the commencement of Phases 4 and 5, which is anticipated to be in five years' time (see Section 5.5 on Development Schedule).

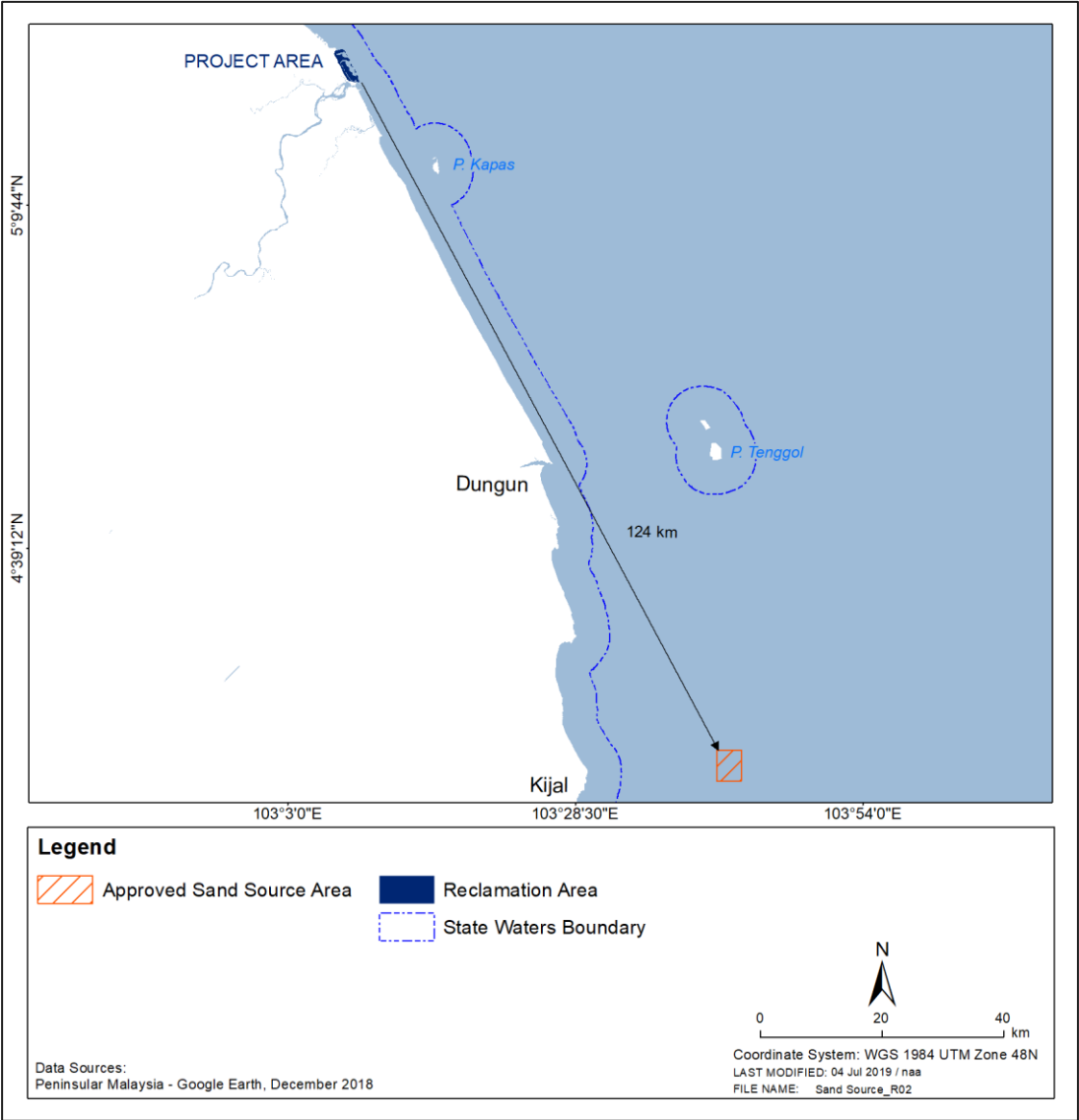


Figure 5.6 Location of approved sand source area for phases 1 to 3 /11/.

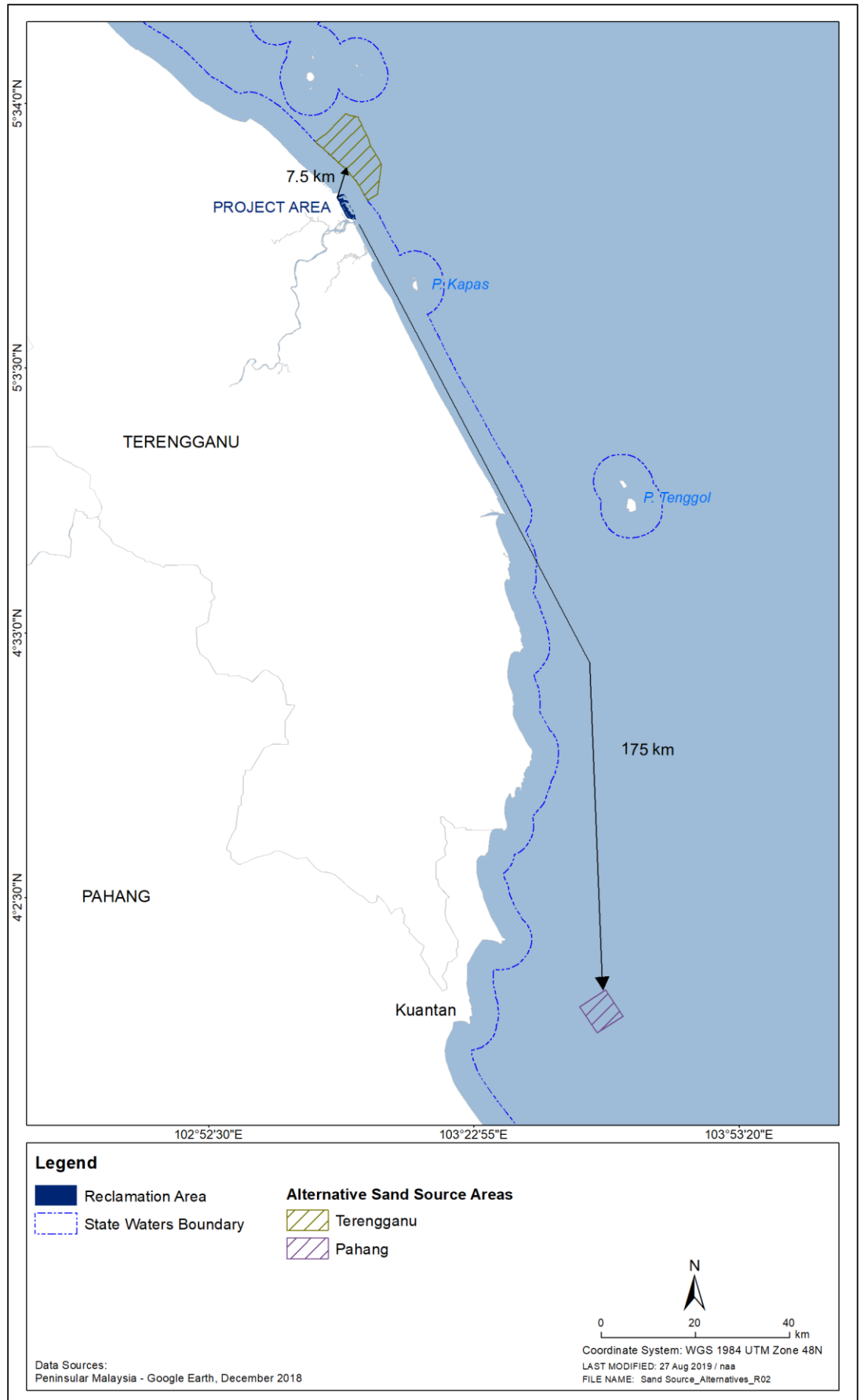


Figure 5.7 Alternative sand source areas identified for the Project.

5.3.2 Capital Dredging

Capital dredging will be carried out in two phases. Dredging to a depth of up to -12 m CD will be carried out within the marine facilities area for the breakwater construction (Phase 1) and for the navigation channel and turning basin for the cruise terminal (Phase 2), as shown in Figure 5.8. Details of each phase are summarised in Table 5.3. The total estimated quantity of dredged materials is 8.3 million m³. All dredged materials will be reused within the reclamation.

Table 5.3 Capital dredging description.

Phase	Estimated Dredge Volumes (million m ³)	Estimated Duration of Capital Dredging (months)	Dredged Depth (m CD)
1	0.6	1.6	-12
2	7.7	8.1	-12

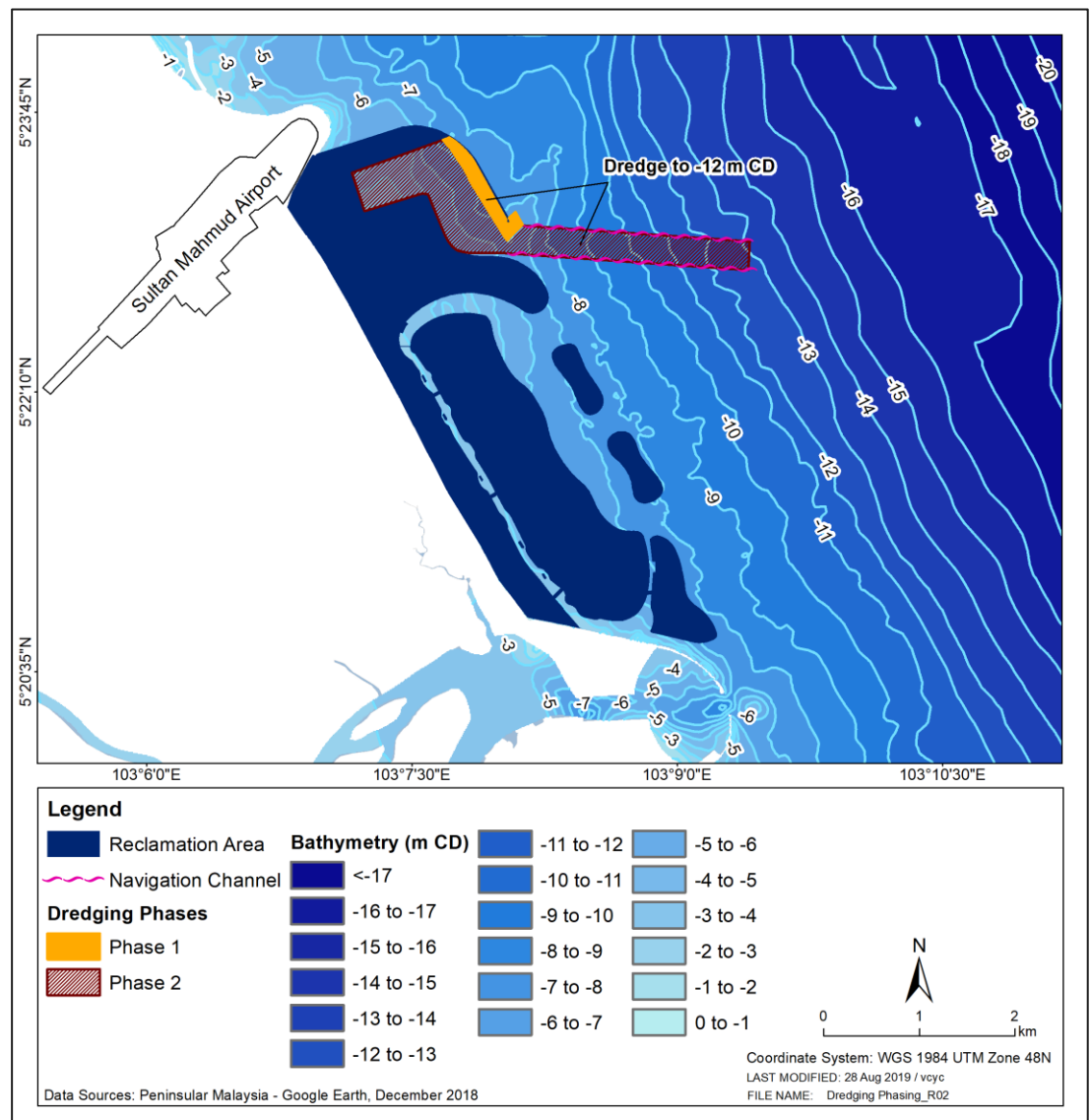


Figure 5.8 Project dredging area.

5.3.3 Breakwater

A breakwater will be constructed at the northern part of the Project to provide shelter against waves for the marine facilities (refer to Figure 5.4). As described in Section 5.3.2, dredging will be carried out to a depth of -12 m CD as part of the breakwater construction.

The breakwater of approximately 2.4 km will be a rubble mound structure with a rock core. Due to the water depths and wave conditions at the structure it is anticipated that this will be rock armour. A typical breakwater cross section is shown in Figure 5.9.

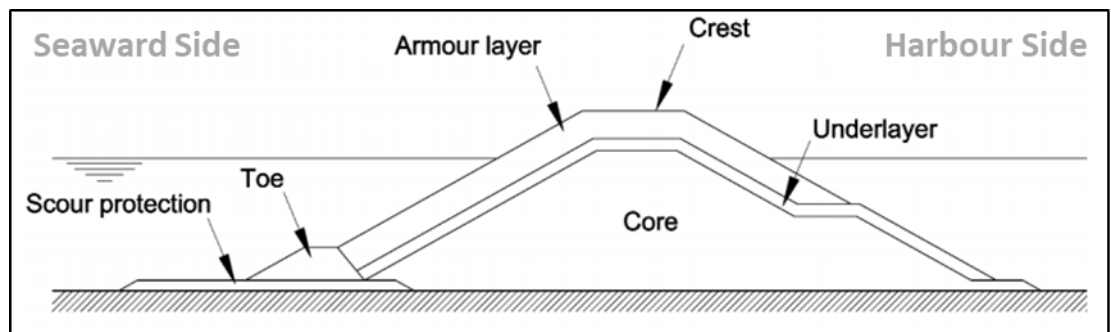


Figure 5.9 Typical breakwater cross section /12/.

5.3.3.1 Rock Source

Rock for the breakwater construction and for the reclamation revetment will be sourced from Hexatrend Quarry located at Paka, Terengganu (Figure 5.10) with delivery to the Project site by barge. It is estimated around 1,000,000 m³ of armour rock will be needed. Number of trips is estimated to be two per day, with each trip from the source to the Project area taking around 10 hours assuming a barge capacity of 2,000 m³ and total daily capacity of 3,000 m³.

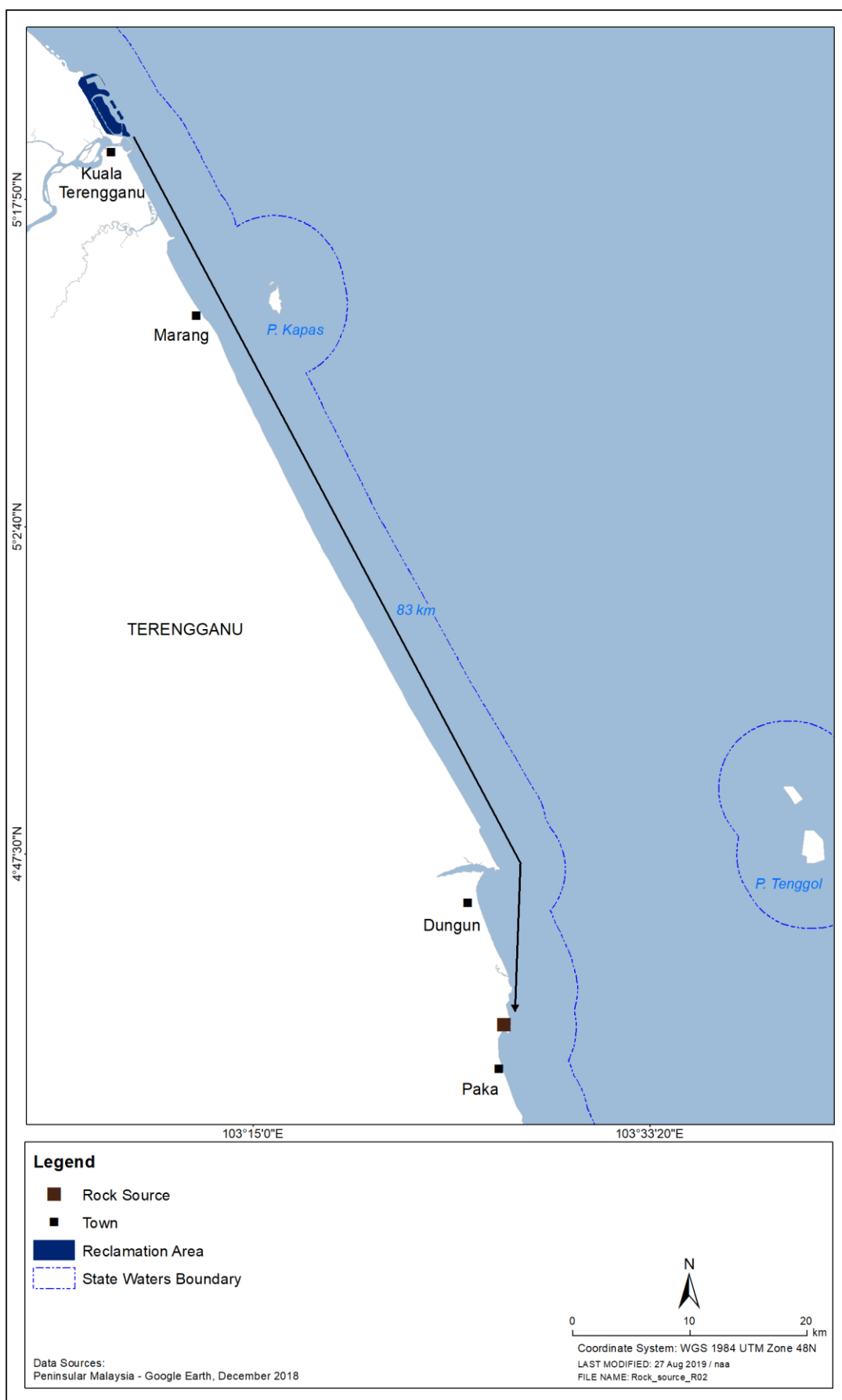


Figure 5.10 Location of Hexatrend Quarry.

5.3.4 Roads and Bridges

Four bridges will be constructed to connect the Phase 1 reclaimed land to Phase 3, 4 and 5 (refer to Figure 5.4). New roads will be built on the reclaimed lands which will connect to the existing, newly constructed four-lane highway.

5.3.5 Internal Piled Platforms

As shown in Figure 5.4, five piled platforms will be constructed within the inner channel. These are approximately 90 m in length and extend 30 m in towards the channel.

5.4 Project Activities

5.4.1 Pre-construction Stage

Pre-construction activities include the following:

- Project design;
- Hydrographic survey;
- Geotechnical investigation;
- Agency approvals; and
- Environmental assessment.

5.4.2 Construction Stage

The Project construction is anticipated to be carried out in the following stages:

- Setting up construction infrastructure
- Reclamation and dredging
- Construction of breakwater
- Construction of roads and bridges
- Construction of piled platforms in channel

A summary of the construction activities during the five reclamation phases are described in Table 5.4.

Table 5.4 Summary of construction activities during the five reclamation phases.

Phase	Activities
Phase 1	• Reclamation and capital dredging*
Phase 2	• Reclamation and capital dredging*
Phase 3	• Reclamation • Construction of two bridges connecting: i. Phase 3's two reclaimed lands. ii. Phase 3 to Phase 1
Phase 4	• Reclamation

Phase	Activities
	• Construction of one bridge connecting Phase 4 to Phase 1 reclaimed land. • Construction of three piled platforms.
Phase 5	• Reclamation • Construction of two bridges connecting Phase 5 to Phase 1 reclaimed land. • Construction of piled platforms.

** During Phase 1 and Phase 2, capital dredging works will be carried out concurrently with the reclamation works. All dredged material will be reused for reclamation. Phase 1 dredging is estimated to produce 0.6 million m³ whereas Phase 2 dredging is estimated to produce 7.7 million m³ of sand for reclamation.*

5.4.2.1 Setting up Construction Infrastructure

Prior to the commencement of Phase 1 reclamation, the following temporary works will be carried out:

- Temporary fencing / hoarding;
- Temporary site facility (Figure 5.11), such as site office, guard-house, equipment store and maintenance facility, canteen and toilets.

Access to the Project site will be from the existing roads as shown in Figure 5.11. Offsite accommodation will be arranged for workers during the construction phase at a suitable location. Utilities such as water, power supply, sanitation will be provided using portable units. There will be no direct discharge of domestic sewage and construction wastes into the sea and they shall be removed from site by approved contractors.

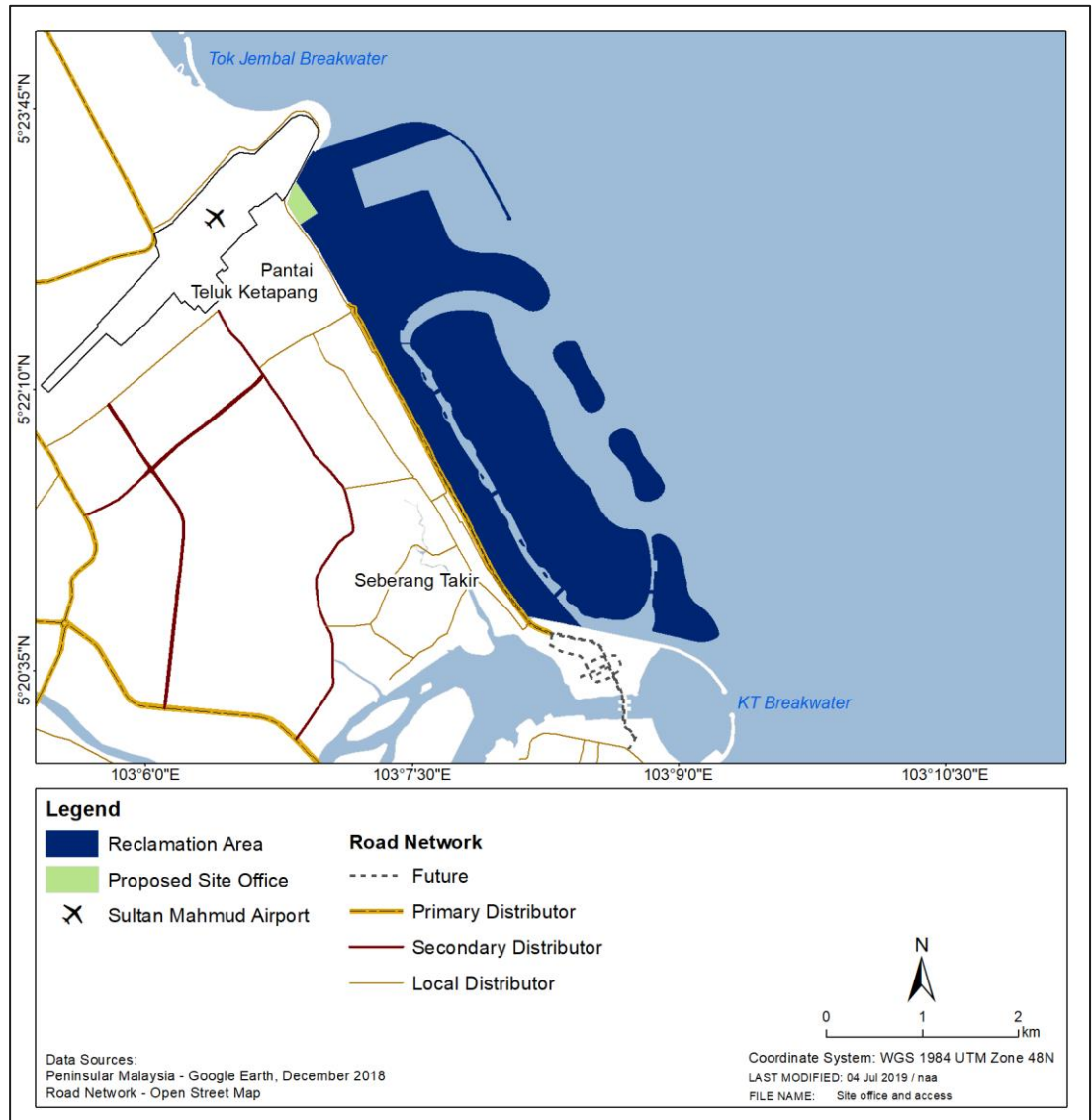


Figure 5.11 Location of proposed site office.

5.4.2.2 Reclamation

The reclamation area will be reclaimed to +4.5 m CD with reclamation works being carried out in five phases (refer to Figure 5.5). The completed reclamation areas will be protected from erosion by rock armoured revetments.

The bulk of the reclamation works will be carried out using Trailer Suction Hopper Dredgers (TSHD) bringing sand to the site from the approved offshore sand source (refer to Section 5.3.1.1) with the sand being pumped directly from the dredger to the reclamation areas. However, the material dredged during the capital dredging works will also be utilised for reclamation, this is described further in Section 5.4.2.3 below.

Sequence of Works

The sequence of works for the reclamation will be as follows:

- The reclamation site and sand source area will be surveyed.

- The required navigation markers to delimit the site working area will be installed in line with the requirements of the Marine Department of other Authorities.
- The sub-sea pipeline and equipment for sand pumping will be set up.
- Sand mining and delivery to site will commence using the TSHDs. On arrival at the reclamation site the TSHD will connect to the prepositioned sub-sea pipeline and sand will be pumped ashore to the reclamation site at suitable sites
- The sand discharged from the pipeline will initially be formed into a perimeter bund around the first area to be reclaimed. An overflow point will be installed in the bund to control the discharge of water when the sand is being pumped ashore.
- Subsequent deliveries of sand will be pumped to the lagoon formed by perimeter bunds
- The sand fill will be spread from the pipeline discharge point by bulldozer
- Filling and surcharging will proceed in sections
- Upon final completion the surplus surcharge sand fill will be placed on land or reclaimed areas within the Project boundary

Mining and Delivery of Sand

Two units of TSHDs will be used for mining of marine sand and transportation to the reclamation site (Figure 5.12). The TSHD is a self-propelled self-loading vessel. The hopper can be discharged by bottom dumping or pumping methods. For the reclamation filling, pumping via pipeline will be used.

The TSHD mines sand by lowering one or both drag heads to the seabed and hydraulically pumping dredged sand into the hopper via the suction pipe(s). The dredging depth and positioning can be accurately controlled by the on-board systems. When the hopper is full, or the mining operation is completed, the TSHD will proceed to the reclamation site for discharging.

The TSHD will require a working area with a safety distance of 200 m all around the vessel and while dredging will maintain a speed not exceeding 2 knots. While moving from the sand mining area to the reclamation area, the TSHD will proceed at a safe speed following the normal navigation safety rules and requirements in the area. Working hours for the dredging and reclamation works will be 24 hours per day, seven days a week including public holidays.



Figure 5.12 An example of a trailing suction hopper dredger (Source: PIANC /10/).

Reclamation Filling

Upon arrival at the reclamation site, the TSHD will be stationed at the designated site and sand will be pumped to the reclamation site via a submerged or floating pipeline (Photo 5.1) connected to the bow fitting on the TSHD. This arrangement will be used because the water depth closer to shore is too shallow for a large vessel to pump directly into the reclamation area.

Sand will be spread from the pipeline discharge point within the bunded areas by bulldozers working above tide level. If required by the geotechnical designers, the initial filling will include a surcharge layer placed to a level above the final design level to assist consolidation of the sub strata. This surcharge will later be removed and reused in other areas of the reclamation. Bulldozers, wheel loaders, backhoes and dump trucks will be used for forming and maintaining sand bunds around hydraulically filled areas.



Photo 5.1 Hydraulic pumping of sand through floating pipeline.

Reclamation Shore Protection Works

The newly created reclamation shoreline will need to be protected. The protection will be a rock armoured revetment. A drawing showing a typical revetment is shown in Figure 5.13. The key activities for the shore protection works for the reclamation will follow the sequence as listed below:

- Trimming the sand bund to the final profile
- After trimming the sand profile, prepared geotextile will be laid on the slope and toe apron
- Crushed rock armour layer will be placed on the geotextile and trimmed to the correct profile
- For the permanent revetment, a primary layer will be laid over a secondary layer and small rocks will be placed in the gaps to form the finished profile
- Along the top edge, the geotextile will be folded over the edge of the armour and backfilled with sand.

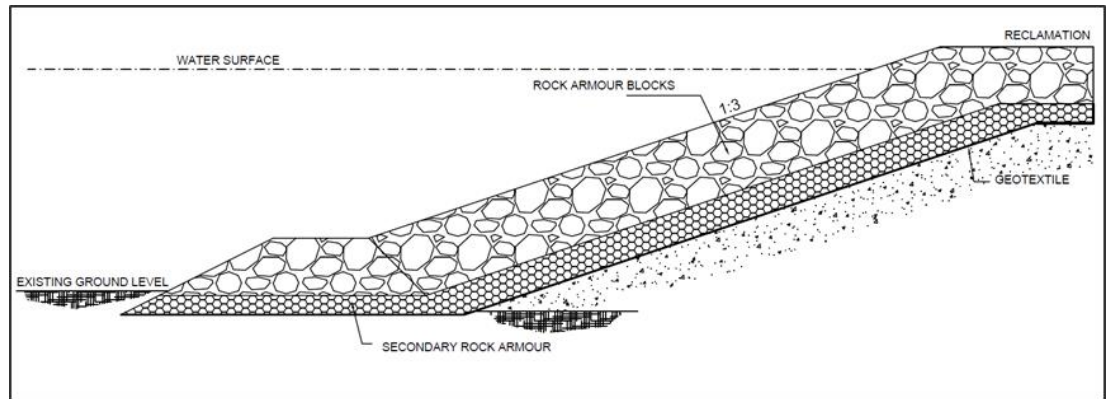


Figure 5.13 Typical revetment cross section.

A long-armed excavator working either from the land or on a flat top barge will cut or trim the slope to the required level and any excess sand is stockpiled at the top of the slope and later removed by dump trucks for reuse in the reclamation areas.

The laying of geotextile is done using a long-arm excavator for lifting the geotextile rolled on a pipe into the water from land side or from a flat top barge. Once the pipe is laid at the correct position, the workers unroll the geotextile to the toe of the slope, working during low-tide periods where applicable.

Once the geotextile is laid on the sand slope, secondary rocks are placed with a long-arm excavator from the land side or a flat top barge, a long-armed excavator operating from land is shown in Figure 5.14. The revetment receives a secondary layer followed by a primary armour layer.

Primary rocks are transported to the placing area by dump trucks or delivered by flat top barge if being placed by floating equipment. Each rock is placed side-by-side commencing from the bottom and gradually proceeding to the top of slope.



Figure 5.14 Long arm excavator for revetment construction