APPENDIX 8B

HKBCF – Construction & Demolition Materials Management Plan

Highways Department of HKSAR

Agreement No. CE 14/2008 (CE) Hong Kong-Zhuhai-Macao-Bridge
Hong Kong Boundary Crossing Facilities – Investigation

2nd Revised Construction and Demolition Material Management Plan

Rpt Ref. 054-03

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1 PURPOSE

1.1 In accordance with ETWB Technical Circular No. 33/2002, a Construction & Demolition Materials Management Plan (C&DMMP) should be prepared and submitted to Public Fill Committee (PFC) for approval for projects classified as designated projects under Schedule 2 of the EIAO, which generate more than 50,000m³ of construction and demolition (C&D) materials including rock or that requiring import fill in excess of 50,000m³. Hong Kong Boundary Crossing Facilities (HKBCF) is a designated project under the EIAO. In addition, it requires a total fill volume of more than 40 million m³ (bulked volume). Therefore, approval of C&DMMP by PFC is required.

1.2 The purpose of this C&DMMP is to introduce measures to minimize C&D materials generation and to maximize reusing the C&D materials generated within the project. The C&D materials are surplus materials arising from any land excavation or formation, civil/building construction, roadwork, building renovation or demolition activities. They comprise the materials of rocks, concrete, asphalt, rubbles, bricks, stones, timber and earth. As the marine deposit does not belong to the above materials, the proposed arrangement to deal with dredged marine deposit in this project will be submitted and agreed separately with the Marine Fill Committee. Therefore, the details of the dredge marine deposit are not covered in this C&DMMP.

2 BACKGROUND OF THE DEVELOPMENT

2.1 In the 8th Hong Kong-Zhuhai-Macao Bridge (HZMB) Advance Work Co-ordination Group meeting on 28 February 2008, the government of HKSAR (HKSARG), Guangdong Province and Macao Special Administrative Region agreed to build their own boundary crossing facilities and link roads within their respective territories. Therefore, the HKSARG will need to provide the Hong Kong Boundary Crossing Facilities (HKBCF) as well as the Hong Kong Link Road (HKLR) within Hong Kong to connect with the HZMB Main Bridge.

2.2 In May 2007, Highways Department commissioned a Site Selection Study (Consultancy Agreement No. CE 7/2007) for searching a suitable location of HKBCF within Hong Kong territory. The study was completed in early 2008 and it recommended locating HKBCF at the north-east waters of the Airport as a first priority option. The current Investigation Study for HKBCF commenced in July 2008 has also recommended locating HKBCF at the north-east waters of the Airport and developed the layout of HKBCF based on this recommended site. The Investigation Study is on-going to work out the details to such an extent to enable the Project to proceed to detailed design and construction stages.

3 SCOPE OF THE PROJECT

3.1 The proposed layout of HKBCF is shown in **Figure 3.1**. The scope of HKBCF project comprises, but not limited to the following:

(a) Reclamation to provide land of about 130 ha for the development of HKBCF. It should be noted that reclamation of about 20 ha for the Southern Landfall of Tuen Mun Check Lap Kok Link (TMCLKL) will be provided next to HKBCF. The issues related to reclamation and infrastructure at this area will be addressed separately under TMCLKL project.

(b) Cargo processing facilities including kiosks for clearance of goods vehicles, customs inspection platforms, X-ray building, etc.

(c) Passenger related facilities including processing kiosks and examination facilities for private cars and coaches, passenger clearance building, etc

(d) Accommodation for and facilities of the frontline departments including a police operation base with an observation tower, fire station cum ambulance depots and other buildings/facilities.

(e) Provision of Public transport interchange, and transport drop-off and pick-up areas.

(f) Other peripheral structures and supporting facilities such as vehicle holding areas, passenger queuing areas, road networks, footbridges, fencing, sewage and drainage systems, water supply system, utilities, electronic system, and traffic control, surveillance and information system, etc.

(g) Provision of Automated People Mover (APM) to serve the transit passengers between HKBCF and the Airport.

(h) Provision of road access for connection of HKBCF to HZMB Hong Kong Link Road, TMCLKL and Airport.

(i) Landscape works.

4 IMPLEMENTATION PROGRAMME

4.1 Currently, it is targeted to commence the construction works of HKBCF in 2010. The completion date of HKBCF will need to match the HZMB Main Bridge. The HZMB Main Bridge is now endeavoured to commence the construction works in 2009 and is expected to be completed by 2015. In order to tie in with the HZMB Main Bridge, HKBCF needs to be completed with sufficient parts by 2015 for the commissioning of HZMB.

4.2 As there is an extremely tight programme for HKBCF, it has been planned that the HKBCF should be completed in 2 phases – Phase 1 (which will be large enough for facilities to handle the first few years of operation of HZMB) and then Phase 2 (for facilities to handle long term need at HKBCF). Phase 1 is to be completed in 2015 and Phase 2 is to be completed in 2016. An outline phasing demarcation of HKBCF is shown in **Figure 4.1**.

4.3 It has been planned that HKBCF will be implemented under two contracts: reclamation contract and infrastructure contract. In view of the reclamation construction sequence, the reclamation works need to be carried out first, before the BCF infrastructure works could start. This implementation strategy would allow the early commencement of the reclamation contract as it is not necessary to wait for the completion of the design for the infrastructure works, which is time-consuming due to the involvement of many end-users. Therefore, there is programme benefit to implement the HKBCF project under the reclamation contract and infrastructure contract.

5 DEVELOPMENT CONSTRAINTS

5.1 The preferred site option of HKBCF is based on the reclamation at the north-east waters of the Airport. One of the major advantages of this option is that it can afford synergetic benefit for transit passengers (i.e. hassle free arrangement for air-land transit passengers) between HKBCF and the Airport). It could also provide a better road connection with the Airport and TMCLKL. In addition, the recommended site is located in the area which is developed and away from the Chinese White Dolphins active area when compared to other options. Therefore, this option of locating HKBCF at the north-east waters of the Airport would result in less environmental impacts than other site locations.

5.2 Although there are advantages of locating HKBCF at the north-east waters of the Airport, the major development constraints that need to be considered in this project are shown in **Figures 5.1 and 5.2** and summarized as follows:

(i) The HKBCF will need to match the HZMB Main Bridge. Therefore, it is essential to design the method of reclamation and infrastructure that could meet the programme requirements.

(ii) The Airport is a major development in the vicinity of HKBCF. The proposed layout of HKBCF should avoid/minimise impact on both the existing and future development layout of the Airport.

(iii) The HKBCF development must avoid infringing the Airport Height Restriction (AHR) during both construction and operation stages. The zone around the runway is particularly critical as the AHR contours there are particularly low.

(iv) The operation of East Sea Rescue Station of FSD, SkyPier and Marine Cargo Terminal at the north-east corner of the Airport shall be maintained throughout the construction and operation phases.

(v) There are 3 existing submarine telecommunication cables (2 nos. for HGC and 1 no. for NWT) connecting between Tuen Mun and Airport Island across the Urmston Road. The proposed HKBCF development will inevitably conflict with the submarine telecommunication cable and therefore require diversion.

(vi) The marine access of Tung Chung Navigation Channel to/from Tung Chung and Airport Channel needs to be maintained. The proposed HKBCF development should avoid encroaching upon or affecting the operation of Tung Chung Navigation Channel.

(vii) Contaminated mud pits are found at the east of Sha Chau (i.e. at north of Airport Island) with one of them still in operation. In addition, seven numbers of proposed contaminated mud pits will fail in the vicinity of HKBCF, with four of them located at the east of Sha Chau and the remaining three at South of Brothers. The site options of HKBCF should avoid encroaching upon these mud pits.

(viii) Sufficient distance should be provided between HKBCF and Tai Mo To to minimise the impact on navigation safety and the hydrodynamic impact on the deep-waters adjacent to Tai Mo To.

5.3 The measures to overcome the development constraints including the following:

(a) Appropriate construction method for HKBCF will be considered to meet the programme requirements.

(b) Close liaison with the Airport Authority Hong Kong on the interface issues between HKBCF and the Airport to avoid/minimise the impact on both the existing and future development layout of the Airport.

(c) High building and construction plant for HKBCF is avoided in order to avoid infringing the AHR. Close liaison with the Civil Aviation Department and Airport Authority Hong Kong will be made to ensure aviation safety will not be affect by the HKBCF development.

(d) Close liaise will be made with the relevant utility undertakers to divert the existing submarine telecommunication cables before the commencement of reclamation works in HKBCF.

(e) In designing the layout of HKBCF, sufficient distance will be provided between HKBCF site and the adjacent existing/planned features such as East Sea Rescue Station of FSD, SkyPier and Marine Cargo Terminal at the north-east corner of the Airport, Tai Mo To, Tung Chung Navigation Channel and proposed contaminated mud pits at east of Sha Chau and South of Brothers.

6 DEVELOPMENT OPTIONS

6.1 Reclamation Footprint

6.1.1 Various reclamation footprints of HKBCF have been considered. For the seawall, it can either take the sloping or vertical form. The following criteria have been considered in selecting the seawall form:

- The appearance of vertical seawall is more artificial as it uses the concrete blocks rather than the natural stone in the sloping seawall. To minimize the visual impact, sloping seawall should be used as far as practicable.
- The ecological value of sloping seawall is larger than the vertical seawall.
- Construction cost of vertical seawall is higher than sloping seawall and therefore the vertical seawall should only be considered where there is requirement of berthing or cargo handling.

As the HKBCF reclamation area is accessible abundantly by land transport, there is no substantial need for berthing of vessels. Accordingly, the seawall along HKBCF's periphery will substantially be sloping seawall with rock-armour surface, as this type of seawall is generally more cost-effective and performs well in wave adsorption, whereas the vertical type of seawall is usually adopted only if there is a need for berthing of vessels. (At detailed design stage, the need for berthing may arise, but it is not anticipated that the extent involved will be significant, i.e. at most this will lead to some local short sections of vertical seawalls.)

6.1.2 The overall reclamation footprint of HKBCF is shown in **Figure 3.1**. The size of reclamation is about 130ha. There is not much room to change the reclamation footprints of HKBCF due to the operation requirements of BCF and the development constraints such as AHR and the existing/planned features mentioned in Section 5 above. Therefore, this C&DMMP will mainly discuss the recommended reclamation method of HKBCF with a view to minimize C&D materials generation and to maximize reusing the C&D materials generated within the project or from other sources.

6.1.3 Apart from the reclamation, the following items of works in HKBCF will also involve dredging and filling. Although the scale of these works is much less than the main reclamation of HKBCF, they will be covered in the following Sections of this C&DMMP.

(i) About 450m marine portion of APM tunnel between HKBCF and Airport which will be constructed by the Immerse Tube Method.

(ii) Reprovision of the East Sea Rescue Station of FSD as it is in conflict with the proposed alignment of APM.

6.2 Construction method of seawalls

6.2.1 The seawall is a retaining structure to protect the reclaimed fill. Both the dredged and non-dredged options of seawall have been considered for the HKBCF. Typical section of the dredged and non-dredged seawall is shown in **Figure 6.1.**

6.2.2 The design of seawall should achieve a minimum Factor of Safety to ensure the stability against the slip failure and provide adequate bearing capacity to support the seawall without significant settlement. Based on the available ground investigation results, preliminary assessment of the seawall stability and settlement is summarised in the following table:

	Evaluation Results	
	Dredged Option	**Non-dredged Option (without ground improvement)**
Stability Assessment – in terms of Factor of Safety	Min. 1.42 > 1.3 (OK)	Max. 0.33 << 1.3 (Failed)
Settlement Assessment – in terms of Total Residual Settlement (mm)	Max. 485mm < 500mm (OK)	Min. 3000mm >> 500mm (Failed)

6.2.3 From the above assessment, it was found that the non-dredged option without ground improvement fails to provide sufficient stability and settlement control to the seawall. As a common practice, full-dredging is adopted for forming the seawall base so as to ensure the stability and minimise the settlement of the seawall. However, it is important to consider the feasibility of non-dredged option with ground improvement measure for the seawall with a view to minimize the dredging of the marine deposit.

6.2.4 For the non-dredged option with ground improvement measure for seawall, the use of band drains and surcharge is considered to be inadequate as it could not improve the shear strength of marine deposit to ensure the seawall stability. The use of Sand Compaction Pile (SCP) and Deep Cement Mixing (DCM) as the seawall foundation was adopted in some overseas projects. However, there is no track record of the application of SCP and DCM in Hong Kong. The feasibility to adopt SCP or DCM for the seawall foundation will be discussed in the following Sections.

6.2.5 DCM is an applied chemical solidification technique which inserts and mechanically mixes cementing agents with soft soils to create a stiff soil-cement mix. However, it is important to note that the marine application of DCM may result in possible leakage of cement grout into the surrounding waters during the mixing process and this would cause adverse environment impacts. For the land application of DCM after the seawall is constructed, there are difficulties for DCM to penetrate through the rockfill in seawall core. In view of the above, it is considered that application of DCM is not suitable for the seawalls in HKBCF.

6.2.6 SCP is considered to be one of the effective ground improvement methods for the seawall structure on soft marine deposit. This is because SCP can increase the shear strength of ground by installing well compacted sand piles in the ground and stabilizes the seawall structure. Although there is lack of track record in the application of SCP in Hong Kong, the use of SCP as the seawall foundation has been widely adopted in Japan and Korea reclamation projects.

6.2.7 It is important to note that the application of SCP is subject to some site constraints. As the HKBCF is located next to the Airport Island, the Aviation Height Restrictions (AHR) would impose constraint to the working height of SCP plant. According to the information from SCP contractor, the minimum height of SCP plant is 40m above the sea level. Allowing for safety margin, SCP is applicable only to the seawalls where the AHR contour is +45 mPD or above.

6.2.8 Another important issue of SCP is the up-heaving of seabed after installation of SCP. In the shallow water, the up-heaved seabed may affect the operation of the SCP barges as well as other vessels. In HKBCF, the seabed is about -3 mPD to -10.5 mPD. With the consideration of lower replacement of SCP to reduce the effect of up-heaving, the seabed level should be -6 mPD or below so as to have adequate water depth to ensure the proper operation of SCP barge without affecting by the up-heaving of seabed.

6.2.9 In considering the above constraints, the non-dredged method of SCP could only be applied at the seawalls located at the northern edge of HKBCF site in Phase 2. The extent of seawalls without restrictions on the use of SCP is shown in **Figure 6.2**. It should also be noted that SCP is required to be mobilized from overseas as the SCP is new to local contractors. According to the information from the overseas SCP contractor, their plant are currently working in Japan and Korea and they would require about 1 year advance notice for booking their plant to work in Hong Kong. The 1 year advance notice includes the mobilization time and travelling time of their plant to Hong Kong. This should be taken into account in considering whether the adoption of SCP could meet the programme requirements of HKBCF.

6.2.10 For the environmental performance of SCP, it serves to reduce the amount of dredging, hence reducing the amount of seawall-filling too. Therefore, it should constitute an improvement to the conventional fully dredged method. Nevertheless, after discussions with EPD, it is considered that a full-scale trial may be required for SCP to establish the viability of SCP. The full-scale trial cannot be accommodated in the construction programme of HKBCF. Therefore, SCP may be worth considering for the portion of seawall mentioned in 6.2.9 above provided that the following issues can be overcome:

(a) That further data could be obtained to obviate the need for a trial such as arrangement of water quality monitoring under a relevant overseas project;

(b) That the actual mobilization time of the SCP plant will enable the method to be applicable to a significant proportion of HKBCF's seawalls.

For item (b) above, the feasibility to adopt SCP in HKBCF will be further discussed together with the envisaged programme of different reclamation options in Section 6.3 below. .

6.3 Reclamation options of HKBCF

6.3.1 Both the dredged and non-dredged options of reclamation have been considered for the HKBCF. Typical section of these two reclamation options is shown in **Figure 6.1**.

6.3.2 In the fully dredged reclamation method, dredging will be carried out to remove the marine deposit until to a firm stratum, commonly the alluvial layer. This serves to eliminate post-reclamation settlement due to consolidation of soft material deposit layer. Instead of dredging the marine deposit, the non-dredged reclamation method will leave the marine deposit in place, but will add measures to prevent the occurrence of mud wave, and to accelerate consolidation of the marine deposit so as to mitigate the risk of excessive post-reclamation settlement. These measures will include:

- Laying of geotextile and sand blanket over the marine deposit;
- Installation of band drains to accelerate consolidation of marine deposit;
- Placing the reclamation fill in thin layer with adequate leading edge to prevent the occurrence of mud wave; and
- Surcharging.

6.3.3 Two reclamation options are formulated and they are referred to as Sequence A and Sequence B as described below:

- Sequence A – Fully-dredged at seawalls and reclamation areas critical to completion.
- Sequence B – Minimize the fully-dredged areas.

6.3.4 The reclamation layout of Sequence A is shown in **Figure 6.3**. In Sequence A, the non-dredged method with band drains and surcharge is assumed except the following areas where the fully-dredged method is required:

1) Seawall areas – full-dredging of seawall trench is required to ensure the seawall stability. However, the non-dredge method of SCP will be considered at the northern edge of HKBCF site in Phase 2 as discussed in Sections 6.2.9 and 6.2.10 above.

2) Critical reclamation areas and temporary seawalls – There is a very tight programme to complete the Passenger Clearance Building (PCB) in Portion A and other Government buildings in Portion B of HKBCF due to the long period of testing and commissioning required for the facilities in these buildings. In this option, fully-dredged method is assumed in Portions A and B to assess the programme benefit by fast tracking the reclamation works. In addition, temporary seawall as shown in **Figure 6.3** is proposed in order to enable early commencement of filling in Portions A & B by protecting the reclaimed fill from the wave action.

3) Portion D – This area is to provide land for main roadlink connecting to Airport Island. The reclamation area is narrow in shape and the dredged trench for the seawall at both sides of Portion D nearly overlap each other. Therefore dredged reclamation is adopted in Portion D.

4) Automatic People Mover (APM) station and tunnel – APM station and tunnel are underground structures and the dredging of marine sediment at these areas is required to avoid the stability and seepage problems due to deep excavation in the soft materials during the construction of these structures after the land is reclaimed.

6.3.5 Different to Sequence A, Sequence B minimize the fully dredged areas and use the non-dredged reclamation method with band drains and surcharge in HKBCF as far as practicable. In this way, the reclamation method of Portions A & B is changed from fully-dredged to non-dredged. In addition, no temporary seawall for phased reclamation is assumed in this option. However, the fully-dredged method for permanent seawall areas, Portion D, APM station and tunnel remains unchanged for the reasons stated in Section 6.3.4 above. The reclamation layout of Sequence B is shown in **Figure 6.5**.

6.3.6 In Sequence B, sufficient length of seawall as highlighted in **Figure 6.5** needs to be constructed first to protect the filling against the wave action mainly from the north-west and north-east directions. Therefore, the seawall at the northern edge of HKBCF site, where there is no constraint on the use of SCP, becomes critical in programme so as to enable the filling at Portions A and B in HKBCF Phase 1 as soon as possible. As mentioned in Section 6.2.9 above, 1 years advance notice from the commencement of the Works is required for booking the SCP Plant to work in Hong Kong. The long mobilization period of SCP would cause delay to the project in this case. Therefore, the fully-dredged method is assumed for all seawalls in Sequence B.

6.3.7 The estimated volume of marine deposit to be dredged, weight of C&D materials generated and weight of imported fill in Sequences A and B is summarized in the following table:

Option	Bulk Volume of Marine Deposit to be Dredged (million m^3) [1]	Weight of C&D materials generated (million tonnes) [2]	Weight of imported fill materials (million tonnes) [2], [3]
Sequence A	29.00	7.41 [4]	86.87
Sequence B	17.80	7.41 [4]	69.17

Notes:

1. *For the quantity of dredging, a bulking factor of 1.3 is applied. The quantity of dredging does not include the excavated muddy soil mentioned in Section 7.5.2 below.*
2. *The quantities of C&D materials and fill materials are based on the insitu density of soil and rock to be 2.0 tonnes/m^3 and 2.5 tonnes/m^3 respectively. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
3. *Fill materials include sand fill, public fill, rock fill, seawall armour and surcharge.*
4. *C&D materials would be generated mainly from the infrastructural works and therefore there is no difference between Sequence A and B. The C&D materials in the above table also include the last stage of surcharge which is about 4.5 million tonnes. This surcharge material is imported public fill and it become surplus after the last stage of surcharging.*

6.3.8 A brief review on the construction programme of Sequences A and B has been carried out. Assuming that the construction of HKBCF would commence in August 2010, the anticipated completion date of HKBCF Phases 1 and 2 in each reclamation option is given below:

Option	Anticipated Completion date of HKBCF Phase 1	Anticipated Completion date of HKBCF Phase 2
Sequence A	Dec 2014	Oct 2016
Sequence B	Dec 2015	Oct 2016

The envisaged construction programme of Sequences A and B is shown in **Figures 6.4 and 6.6** respectively. The assumed construction rates and the period allowed for the surcharging and the infrastructure works of HKBCF are attached in **Appendix A**.

6.3.9 Sequence A has significant programme advantage than Sequence B as the commissioning of HKBCF Phase 1 would be one year earlier. This is achieved by adopting the fully-dredged method at the critical reclamation areas of Portions A and B in HKBCF Phase 1 and the provisions of temporary seawalls to enable early commencement of filling in these critical reclamation areas. However, additional dredging and filling are required in Sequence A to expedite the reclamation works.

6.3.10 Although a longer construction time is required in Sequence B for HKBCF Phase 1 due to the non-dredge method, it still meets the current targeted commissioning date of HKBCF Phase 1 in 2015. In order to minimize the dredging and disposal of marine deposit, Sequence B is considered to be the preferred option for HKBCF reclamation. As the completion of HKBCF will need to match the HZMB Main Bridge, the reclamation method of HKBCF will be reviewed closely.

6.3.11 In view of the above, the estimated quantities of dredging and filling works in the following Sections of this C&DMMP will base on Sequence B of HKBCF reclamation.

6.4 Reclamation fill options

6.4.1 The use of sandfill and public fill as the reclamation material has been considered. Sandfill has the advantage that the material is quite uniform and the residual settlement due to creeping of fill material could be easily controlled within an acceptable limit without scarifying the implementation programme.

6.4.2 For public fill, strict site control is necessary to ensure that the public fill does not contain unsuitable material such as oversized boulder, rubbish, topsoil with organic matter. In general, the grading of public fill is much more variable than that of sandfill and this lead to longer time to achieve the required limit of residual settlement due to creeping of fill material.

6.4.3 It should also be noted that there is programming advantages to use sandfill as vibrocompaction could be carried out to reduce the surcharge period required for the reclamation. For public fill, it would be impracticable for the vibrocompaction to penetrate through the public fill.

6.4.4 The residual settlement comprises residual consolidation (primary and secondary) settlement of soft marine deposit and alluvial clay and residual creep settlement due to fill material. The amount of creep settlement contributes as one of the major component of the total residual settlement and hence the use of sandfill and public fill will be one of the control factors for the control of residual settlement.

6.4.5 A residual settlement limit of 500mm is proposed for the proposed reclamation of HKBCF based on the following considerations:

1) Allowable settlement of utilities at piled structure/pavement interface
2) Allowable settlement of utilities at existing airport island/new reclamation interface
3) Long term function of underground drainage system
4) Integrity of buildings on shallow foundation
5) Integrity of the roadwork pavement

6.4.6 The amount of sandfill and public fill to be used in the reclamation should be aimed to achieve the required residual settlement limit of the project. Four options of reclamation filling: completely use of public fill, completely use of sandfill, use of sandfill below +1.50mPD & public fill above +1.50mPD, use of sandfill below +2.50mPD & public fill above +2.50mPD, have been evaluated.

6.4.7 The majority of reclamation area in Sequence B would be carried out by the non-dredge reclamation method. Based on the available ground investigation results, preliminary assessment of residual settlement of non-dredged reclamation method under Sequence B is summarized in the following table:

Options (Non-dredged reclamation with sandfill/ public fill)	**Max. thickness of MD (m)**	**Max. thickness of alluvial clay (m)**	**Max. residual settlement (mm)**
All public fill	28	33	680
All sandfill	28	33	440
Sandfill below +1.50mPD & public fill above +1.50mPD(Note 3)	28	33	530
Sandfill below +2.50mPD & public fill above +2.50mPD(Note 3)	28	33	455

Note:
1. This assessment is carried out based on the GI information of HKBCF reclamation where non-dredged reclamation option is adopted.
2. 1m spacing band drain through the marine deposit, 8m high surcharge and 9 months surcharge period is assumed.
3. The vibrocompaction needs to be carried out at +2.5mPD above the sea level. The use of public fill below +2.5mPD would cause obstruction to the vibrocompaction.
4. The estimated settlement is round up to nearest to 5mm.

6.4.8 For the dredged areas such as seawall trench, the preliminary estimated residual settlement of different reclamation fill options is summarized in the following table:

Options (Fully-dredged reclamation with sandfill/ public fill at the back of Seawall)	Max. thickness of alluvial clay (m)	Max. thickness of sandfill / public fill (m)	Max. residual settlement (mm)
All public fill	33	0 / 32	780
All sandfill	33	32 / 0	430
Sandfill below +1.50mPD & public fill above +1.50mPD(Note 3)	33	28.5 / 3.5	520
Sandfill below +2.50mPD & public fill above +2.50mPD(Note 3)	33	29.5 / 2.5	445

Note:
1. This assessment is carried out based on the GI information of HKBCF reclamation where dredged reclamation option is adopted.
2. No surcharge is placed near the seawall due to the stability issue.
3. The vibrocompaction needs to be carried out at +2.5mPD above the sea level. The use of public fill below +2.5mPD would cause obstruction to the vibrocompaction.
4. The estimated settlement is round up to nearest to 5mm.

6.4.9 From the above assessment, it was found that the options of using public fill as filling material and public fill above +1.50mPD fail to achieve the required residual settlement limit of 500mm. Both the options of sandfill and use of sandfill below +2.50mPD & public fill above +2.50mPD are capable to achieve the required residual settlement limit.

6.4.10 In order to maximize the use of public fill, the option of using sandfill below +2.50mPD and public fill above +2.50mPD is therefore adopted.

7 MANAGEMENT OF C&D MATERIALS

7.1 C&D Materials Quantities

7.1.1 The C&D materials generated from the HKBCF project will come from the following major items of works:

- Excavation for the shallow foundation of buildings;
- Excavation for the bored piles of viaducts, footbridges and other structures;
- Excavation for the basement structure of APM underground station in HKBCF; and
- Modification of existing roads in Airport Island for new roads connection.

7.1.2 In addition, substantial amount of filling materials would be imported for the construction of seawalls and reclamation. A breakdown of the estimated quantities of public fill and C&D waste generated and the filling material required in this Project is summarized in the following Sections.

7.2 Generated Public Fill Material

7.2.1 The estimated quantities of different types of public fill that generated from this Project is given in Table 7.1 below:

Table 7.1 Estimated Quantities of Public Fill Generated

Material	Weight (million tonnes)	Remarks
Phase 1		
Inert C&D Soft Materials	1.60	• Bored pile excavation for viaducts, footbridges and other structures. • Excavation for the shallow foundation of the buildings. • Excavation for the land portion of APM tunnel by cut-and-cover method.
Grade III or below rock	0.35	• Bored pile excavation (i.e. rock socket) for the viaducts, footbridges and other structures. • Excavation for the land portion of APM tunnel by cut-and-cover method.
Total for Phase 1:	**1.95**	
Phase 2		
Inert C&D Soft Materials	0.95	• Bored pile excavation for viaducts, footbridges and other structures. • Excavation for the shallow foundation of the buildings. • Excavation for the basement of APM underground station in HKBCF.
	4.5	• Materials generated from removal of surplus surcharge materials from the reclamation at last stage.
Grade III or below rock	0.01	• Bored pile excavation (i.e. rock socket) for the viaducts, footbridges and other structures.
Total for Phase 2:	**5.46**	
Total for Phase 1& 2:	**7.41**	

Notes:

1. *The above quantities are based on the insitu density of soil and rock to be 2.0 tonnes/m^3 and 2.5 tonnes/m^3 respectively. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
2. *The above quantities are estimated from ground investigation information currently available. These quantities will be reviewed when the foundation design of infrastructure works and the further ground investigation information are available in the detailed design stage.*

7.3 Recyclable Material

7.3.1 Recyclable material would be generated from excavating the existing bituminous carriageways in Airport Island. The excavated bituminous material will be disposed of at an asphalt recycling plant in Tuen Mun, which is capable to produce asphalt mixes using in excess of 50% Recycled Asphalt Pavement material from excavation. The estimated quantity of bituminous materials being excavated and recycled is about 18,000 tonnes or 10,000 m^3 (bulk volume) based on the insitu and bulk density of bituminous materials to be 2.0 tonnes/m^3 and 1.8 tonnes/m^3 respectively.

7.4 Fill Materials for Seawalls and Reclamation

7.4.1 As discussed in Section 6.4 above, sandfill is proposed for the reclamation below +2.5mPD and public fill for the reclamation from +2.5mPD to the formation level in order to achieve the residual settlement limit.

7.4.2 Apart from the reclamation, additional materials is also required for the construction of seawalls. Sandfill and selected public fill (rock materials) are proposed for the filling of seawall trench. Discussions have been made with MTRCL as substantial C&D materials would be generated from their new railway projects between 2010 and 2018. Apart from the public fill (soft materials), rock fill materials would also be generated from the tunnel excavation works in MTRCL's projects. The creep settlement of these public fill (rock materials) is expected to be similar to the sandfill and therefore it could be used together with the sandfill for filling the seawall trench and seawall core to achieve the residual limit of reclamation. According to the latest information from MTRCL, about 6.8 million tonnes public fill (rock materials) would be available during the construction of seawall in HKBCF (i.e. Early 2011 to Mid 2012). Based on the available information and recent discussions with MTRCL, it is proposed to use the above public fill (rock materials) for filling the seawall trench and seawall core in HKBCF subject to further discussions with MTRCL on the detailed arrangements of delivery of these materials to HKBCF.

7.4.3 Apart from the public fill (rock materials), the estimated quantities of public fill (soft materials) to be generated from MTRCL's railway projects is about 22 million tonnes between 2011 and 2016 according to the latest information from MTRCL. The public fill (soft materials) available from MTRCL's projects are more than that required in HKBCF from +2.5mPD to the formation level. In addition, there would be about 1.68 million tonnes of surplus C&D material to be generated from HKLR project in 2013 and 2014 and this material could also be reused as filling material in HKBCF. Detailed arrangement will be discussed with MTRCL and the project team of HKLR.

7.4.4 For the public fill (soft materials) to be used in the reclamation of this project, it should (besides meeting the general requirements for public fill) also comply with the requirements for General Filling material as stipulated in the General Specification for Civil Engineering Works.

7.4.5 For the public fill (rock materials) to be used in seawalls, it should (besides meeting the general requirements for public fill) also comply with the requirements of Grade 400 Rock Fill material as stipulated in the General Specification for Civil Engineering Works for the filling in seawall trench and seawall core.

7.4.6 The estimated quantities of filling materials required for the seawalls and reclamation of HKBCF is summarized in Table 7.2 below:

Table 7.2 Estimated Quantities of Filling Materials Required

Works	**Weight (million tonnes)**			
	Sand Fill	**Public Fill (soft materials) (including Surcharge)**	**Public Fill (rock materials)**	**Armour**
Reclamation	23.90	19.30$^{(2)}$	--	--
Seawalls	19.52	--	7.15	1.50
Total	**43.42**	**19.30$^{(2)}$**	**7.15**	**1.50**

Notes:

1. *The above quantities are based on the insitu density of soil and rock to be 2.0 tonnes/m^3 and 2.5 tonnes/m^3 respectively. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
2. *The public fill material to be imported includes the surcharge material. The disposal of last stage surcharge material is not included in the above table. The quantity of the disposal of last stage surcharge material is included in Table 7.1 above.*

7.4.7 The anticipated settlement of reclamation during the surcharge period is in average about 3m. The quantity of public fill in Table 7.2 above allows the additional fill taking account of the anticipated settlement. To maximize the use of public fill, the surcharge would be formed by public fill. After removal of the surcharge in each stage, the surcharge material would be reused as the reclamation fill or the surcharge for the subsequent stages of reclamation works. Therefore, the quantity of surcharge material is included as public fill in the above table. However, the last stage surcharge materials would need to be disposed off site and the quantity of this disposal is given in Table 7.1 above.

7.4.8 Sandfill is assumed from various sources such as Mainland China. Public fill is assumed from the Fill Bank and other projects which generate substantial C&D materials. According to the latest information, there should be more than 10 million tonnes public fill (soft materials) available from the Fill Bank, 22 million tonnes public fill (soft materials) and 6.8 million tonnes public fill (rock materials) available from MTRCL's railway projects during the reclamation works of HKBCF. Arrangement will also be made to reuse the surplus C&D materials from HKLR and TMCLKL projects as far as practicable. Therefore, there should be sufficient supply of public fill from the above sources. Liaison with relevant parties such as CEDD and MTRCL is in progress to confirm the detailed arrangement of supplying the public fill materials to HKBCF.

7.5 C&D Wastes

7.5.1 For the Passenger Clearance Building (PCB) and other government buildings, steel formwork is assumed for the casting the standard sections such as columns and beams. However, it is considered that timber formwork will still be required for the non-typical sections of RC structures of these buildings. In addition, construction of some sections of the viaducts and footbridges are more effective by the in-situ method considering the site constraints and curvature of these structures. Preliminary estimate shows that the area of timber formwork, a source of C&D waste, required is 0.9 million m^2. Assuming the formwork could be reused for 3 times, the area of formwork required is 0.3 million m^2. For 19mm plywood, the volume of formwork being need in this project is 5,700m^3, say 6,000m^3

7.5.2 For the bored pile foundation of viaducts, footbridges and other structures located within the non-dredged areas of HKBCF reclamation, it is estimated that an average thickness of 20m soil excavated from the bored piles of these structures would be muddy in nature as the marine deposit at these areas had not been dredged. The total insitu volume of muddy soil spoil generated would be around 0.2 million m^3. Based on the current GI information, this muddy material (i.e. marine sediment) is classified as Category L sediment (i.e. Type 1 – Open Sea Disposal) and Mp sediment (i.e. Type 1 – Open Sea Disposal (Dedicated Sites)). As the excavated muddy material could not be reused as fill material and therefore they would be disposed together with the dredged Category L and Mp sediment from the reclamation works of HKBCF. However, if Category Mf or H sediment (i.e. Type 2 – Confined Marine Disposal) is found at the areas of above bored pile foundation in the detailed GI works to be carried, a review will be carried out to see if the Mf or H material excavated from bored piles needs to be disposed to the landfill site.

7.5.3 In view of the above, the total estimated insitu volume of C&D waste to be disposed due to the used timber formwork = 6,000m^3 (insitu volume). Assuming the insitu and bulk density of C&D waste is 2.0 tonnes/m^3 and 1.8 tonnes/m^3 respectively, the total estimated quantity of C&D waste to be disposed is about 12,000 tonnes or 6,700 m^3 (bulk volume).

7.6 Disposal Programme for C&D Materials

7.6.1 An envisaged programme has been derived for the recommended option of HKBCF reclamation works based on Sequence B as shown in **Figure 6.6**. The tentative programme for the infrastructural works of HKBCF is also shown in this programme. This programme will be subject to further review as the project progresses.

7.6.2 It is anticipated that most of the C&D materials generated from the works in HKBCF Phase 1, though limited in quantity, would be utilized as fill materials for subsequent reclamation works in HKBCF Phase 2, and thus minimizing disposal of C&D materials off site. Similarly, the surcharge materials would be reused as the reclamation fill or the surcharge for the subsequent stages of reclamation works. However, the last stage surcharge materials will need to be disposed off site. Taking account of the reuse of materials on site, the tentative programme for disposal of C&D materials and C&D Waste are given in Table 7.3 below:

Table 7.3 Tentative Disposal Programme for C&D Materials

Material Type	**Weight (million tonnes)**							
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**Total**
Insert C&D Soft materials (exclude surcharge)						0.55	0.15	0.70
Grade III or below rock						0.01		0.01
Surplus surcharge						4.50		4.50
C&D Waste				0.003	0.005	0.003	0.001	0.012
Total				**0.003**	**0.005**	**5.063**	**0.151**	**5.222**

7.6.3 According to the latest information from the Public Fill Committee, the projects of SENT Landfill Extension and Central Kowloon Route would require Public Fill (soil material) in 2015 and beyond 2015. Discussions have been made with the project office of these two projects and the preliminary advice from them shows that arrangement could be made to deliver the surplus C&D material generated from HKBCF to their projects and reuse it as filling materials. However, this is subject to further review of the programme and arrangement between the projects. Based on the information received in the above discussions, the estimated quantity of C&D material that could be delivered to these two projects in 2015 and 2016 is given below:

(i) SENT Landfill Extension – Public Fill (soft material) of 0.8 million tonnes in 2015 and 0.9 million tonnes in 2016.

(ii) Central Kowloon Route – Public Fill (soft material) of 0.2 million tonnes in 2015.

In view of the above, the inert C&D soft materials (including surplus surcharge) of about 1.0 million tonnes in 2015 and 0.15 million tonnes in 2016 generated from HKBCF may be delivered to the above two projects subject to further liaison with the project office of these two projects. The remaining 4.05 million tonnes of inert C&D soft materials would need to be disposed to the public fill reception facilities.

7.6.4 To minimize the disposal of C&D material to the public fill reception facilities, a review will be carried out to see whether the temporary stockpile area of sufficient size would be available in HKBCF or SENT Landfill Extension to temporary stockpile part of the surplus C&D material generated from HKBCF in 2015 and reuse in SENT Landfill Extension in 2016.

7.6.5 The quantity of surplus C&D rock material (Grade III or below) generated from HKBCF is only 0.01 million tonnes. Efforts are being made to identify the project that could receive this small quantity of surplus C&D rock material. However, other projects like Central Kowloon Route and MTRCL's railway projects would produce more C&D rock material in 2015 and therefore it is easier for these projects to make the arrangement with other project for disposal of these materials. Therefore, it is assumed that the surplus C&D rock material generated from HKBCF would disposal to the public fill reception facilities.

7.6.6 Apart from the C&D materials to be reused on site, the tentative programme of fill materials to be imported for the construction of seawalls and reclamation is given in Table 7.4 below:

Table 7.4 Tentative Programme for Fill Materials to be Imported

Material Type	Weight (million tonnes)							
	2010	2011	2012	2013	2014	2015	2016	Total
Soil (sandfill)	2.47	22.50	16.60	1.85				43.42
Others (armour)			0.90	0.60				1.50
Others (public fill – soft materials)		0.45	12.05	4.30	0.65			17.45
Others (public fill –rock materials)		5.05	1.75					6.80
Total	**2.47**	**28.00**	**31.30**	**6.75**	**0.65**			**69.17**

7.7 Materials Minimization Strategy

Minimizing Generation of C&D Material

7.7.1 Generation of C&D materials will be minimized with the following measures:

(i) Minimize the reclamation area – The BCF layout has been considered in the Value Management Workshop as well as the Option Assessment Report with a view to minimize the reclamation area necessary to support the infrastructure required for the operation of BCF.

(ii) Use the non-dredged reclamation method as far as practicable – The recommended reclamation method is Sequence B which maximum the use of non-dredged reclamation method with band drains and surcharge as far as practicable.

(iii) Adoption of steel formwork for standard sections of RC structures – The reduction in using steel formwork for the RC structural works would minimize the generation of C&D waste.

Optimising Usage of Fills in the Contracts

7.7.2 The fill required for reclamation will utilize the excavated C&D materials from the infrastructure works, which can be effectively achieved through the following:

(i) The Resident Site Staff (RSS) will monitor the Contractor's management on the C&D materials.

(ii) Arranging ad-hoc coordination meeting with the contractors as necessary, and advise the contractors regarding the ways to utilize and import fill materials in the C&D material management.

(iii) Arranging and identifying temporary storage area for surplus fill such that it could be used at later stage.

Maximizing the Use of Recycled C&D Material

7.7.3 Recycling of C&D material will be maximized with the following measures:

(i) The bituminous material excavated during the road realignment works will be disposed of at an asphalt recycling plant in Tuen Mun. The recycled material can then be used for pavement construction in HKBCF or other roadwork projects.

(ii) The top soil excavated during the modification of existing roads in the Airport Island is considered to be minimal as the infrastructural works would be carried out in the reclaimed land or urban area. Even there is excavated top soil, it could be stored aside and reused at the designated planting areas within HKBCF.

8 CONCLUSION

8.1 This C&DMMP presents the estimated quantities of C&D materials produced and the fill materials required in the reclamation and infrastructure works of the HKBCF, their respective volume are summarized in Tables 8.1 and 8.2 below:

Table 8.1 Summary of C&D Materials and Waste Generated and Disposed of

Material	Estimated Quantities[1]				
	Generated	Reused on Site	Reused in Other Projects [4]	Disposed of at Public Fill Reception Facilities	Disposed of at Landfill
Inert C&D Soft Material	2.55 (1.42)	1.85 (1.03)	0.70 (0.39)		-
Surplus Surcharge	4.50 [2] (2.50)	-	0.45 [5] (0.25)	4.05 [5] (2.25)	-
Grade III or below Rock	0.36 (0.18)	0.35 (0.17)	-	0.01 (0.01)	-
Others C&D (Reusable Bituminous Material)	0.018 (0.01)	0.018 [3] (0.01)	-	-	-
C&D Waste	0.012 (0.0067)	-	-	-	0.012 (0.0067)

Notes:

1. *The unit of above figures is million tonnes (measured in weight). For those figures in brackets, they are bulk volume and the unit is million m^3. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.*
2. *All the surcharge material is the imported public fill and it is included in the imported public fill (soft materials) in Table 8.2 below. The last stage of surcharge is about 4.5 million tonnes and the figure represents the surplus surcharge material to be disposal off site.*
3. *The bituminous material will be reused for pavement construction in HKBCF or other roadwork projects.*
4. *The disposal of surplus C&D material to other projects is subject to further discussions with the project office of these projects.*
5. *If temporary stockpile area is available as mentioned in Section 7.6.4 above, more surplus C&D material could be delivered to SENT Landfill Extension project. In this case, the estimated quantity of "Reused in Other Project" is 1.2 million tonnes (0.67 million m^3) and the "Disposal to Public Fill Reception Facilities" is 3.3 million tonnes (1.83 million m^3).*

Table 8.2 Summary of Reclamation Material Requirement

Material	Estimated Quantities[1]		
	Total Required	Reused from other C&D materials within the site	Import from outside sources
Sand Fill	43.42 (24.12)	-	43.42 (24.12)
Armour	1.50 (0.75)	-	1.50 (0.75)
Public Fill (soft materials) including surcharge	19.30 (10.72)	1.85 (1.03)	17.45 (9.69)
Public fill (rock materials)	7.15 (3.58)	0.35 (0.18)	6.80 (3.40)

Note:

1. The unit of above figures is million tonnes (measured in weight). For those figures in brackets, they are bulk volume and the unit is million m^3. The density of soil and rock (bulked) is 1.8 tonnes/m^3 and 2.0 tonnes/m^3 respectively.

8.2 Various means to minimize the C&D materials generation and to maximize the reuse of C&D materials have been considered, as discussed in Section 7.7 above.

9 RECOMMENDATION

9.1 This report provided the estimated quantities of C&D materials that would be generated and used in this project. It is envisaged that detailed figure would be refined slightly during the detailed design in reviewing and updating this C&DMMP accordingly. To this, the following actions are recommended:

(1) This C&DMMP shall be regularly reviewed and updated during the detailed design as well as construction stage. The construction work on site should also be closely monitored.

(2) Appropriate specification should be included in the contract document to control the generation of C&D materials.

(3) The resident site staff supervising the reclamation work should be fully aware of this plan and closely monitor the works on site such that recommendations in this plan would be carried out duly.

(4) This plan should be provided to the contractor in due course, probably at an early stage of the construction in the preparation of Waste Management Plan.

(5) Continue liaison with MTRCL or other relevant parties to agree the quantities and arrangement of delivery the public fill materials generated from their projects for use as reclamation fill in HKBCF.

(6) Further discussions will be made with the project office of other projects to receive the surplus C&D materials generated from HKBCF.

APPENDIX A

Assumed Construction Rates and Period Allowed in the Programme

Appendix A

Hong Kong-Zhuhai-Macao Bridge
Hong Kong Boundary Crossing Facilities
<u>Assumed construction Rate of major reclamation activities</u>

The following construction rates are based on 16 working hours per day (i.e. 7:00 am to 7:00pm without noise permit + 7:00pm to 11:00pm with noise permit). In view of the distance between HKBCF site and the sensitive receivers in Tung Chung, there would be stringent requirements to obtain noise permit to work through mid-night (i.e. 11:00pm to 7:00am). There is risk to assume the construction plant could work 24 working hours per day at this stage as delay would occur if the noise permit for working 24 hours could not be obtained during construction. Therefore, 16 working hours per day is assumed.

<u>Dredging - Grab dredger</u>

Assume $11m^3$ grab dredger and 1.5 min for each cycle of dredging considering the average dredging depth is about 15m below sea level.

For 16 working hours per day, the construction rate of $11m^3$ grab dredger is:
= 16 x 60/1.5*11 m^3
= 7040 m^3 /day

For 25 working days per month, the construction rate of $11m^3$ grab dredger is about 180,000 m^3 /barge/month

<u>Sandfilling – Trailer Suction Hopper Dredger</u>

Assume 9,000 m^3 Trailer Suction Hopper Dredger (TSHD) with cycle time of each operation is 5 hours based on following assumptions:

- 1.5 hours travelling time to sand borrow area
- 1 hour to collect the sand
- 1.5 hours travelling time back to the site
- 1 hour to fill the sand in reclamation

For 16 working hours per day and 25 working days per month, the construction rate of TSHD is
= 16/5*9000*25
= 720,000 m^3 /TSHD/month

If the filling work is carried out at the non-dredged areas, extra time is required to place the fill carefully to avoid the mud wave. Therefore the filling rate at non-dredged areas is assumed to be half = $360,000m^3$/TSHD/month

<u>Geotextile</u>

Width = 40m
Length = up to 150m per day (i.e. 16 hours)
Construction rate = $6,000m^2$ per day or $150,000m^2$/barge/month (25 working days per month)

Appendix A

Vertical Drain (by marine method)

The average depth of marine deposit is about 20m
A panel = 4 row x 12 column i.e. triangles of 1m spacing
Two vertical drains to be installed at the same time
A panel takes 24 shots to complete
Assume 1 shot = 3.5 minutes
1 panel = 84min to complete
Shift location of barge take 25min to 30 min
Hence each cycle = 120 min to complete 48 nos. vertical drains.

For 16 working hours a day, 8 panels could be completed in a day

The construction rate=384 nos or 7,680m/day or 192,000m/barge/month (25 working days per month).

Vertical Drain (by land method)

The average length of each band drain = 30m (10m filling + 20m thick marine deposit)
Assume installation time of each band drain = 4.0 minutes

For 16 working hours a day, the no. of band drains to be installed = 16x 60/4 = 240 nos. day.

For 25 working days per month, the construction rate = 240 x 30m x 25
= 180,000m/rig/month

Summary of Construction Plant

Plant	Quantity	Assumed Construction Rates
Grab dredger	8 ~ 10nos.	180,000m^3/barge/mth
Installation of band drains (marine method)	5~ 8nos.	192,000m/barge/mth
Installation of band drains (land method)	20 nos.	180,000m/rig/mth
Laying of geotextile	5 nos.	150,000m^2/barge/mth
Sand filling (TSHD)	2 ~ 4 nos.	720,000m^3/TSHD/mth(Note 1)
		360,000m^3/TSHD/mth(Note 2)
Installation of SCP	4 nos.	8,750m/barge/mth

Note:

1) The construction rates are based on 16 working hours/day and 25 working days/month
2) The construction rate of TSHD is 720,000m3/TSHD/mth for dredging area and 360,000m3/TSHD/mth for non-dredging area

ARUP

Other Programme Requirements

Items	Period Allowed
Surcharge Period (non-dredge area)	9 months (8m high surcharge)
Surcharge Period (fully-dredge area)	3 months (4m high surcharge)
Passenger Clearance Building	2 years 9 months
Government buildings	2 years
Other infrastructure works	1year 6 months

Note:

1) The period allowed for the surcharge period takes into account the latest available ground investigation information.

2) The period allowed for the infrastructure works include the testing and commissioning

FIGURES

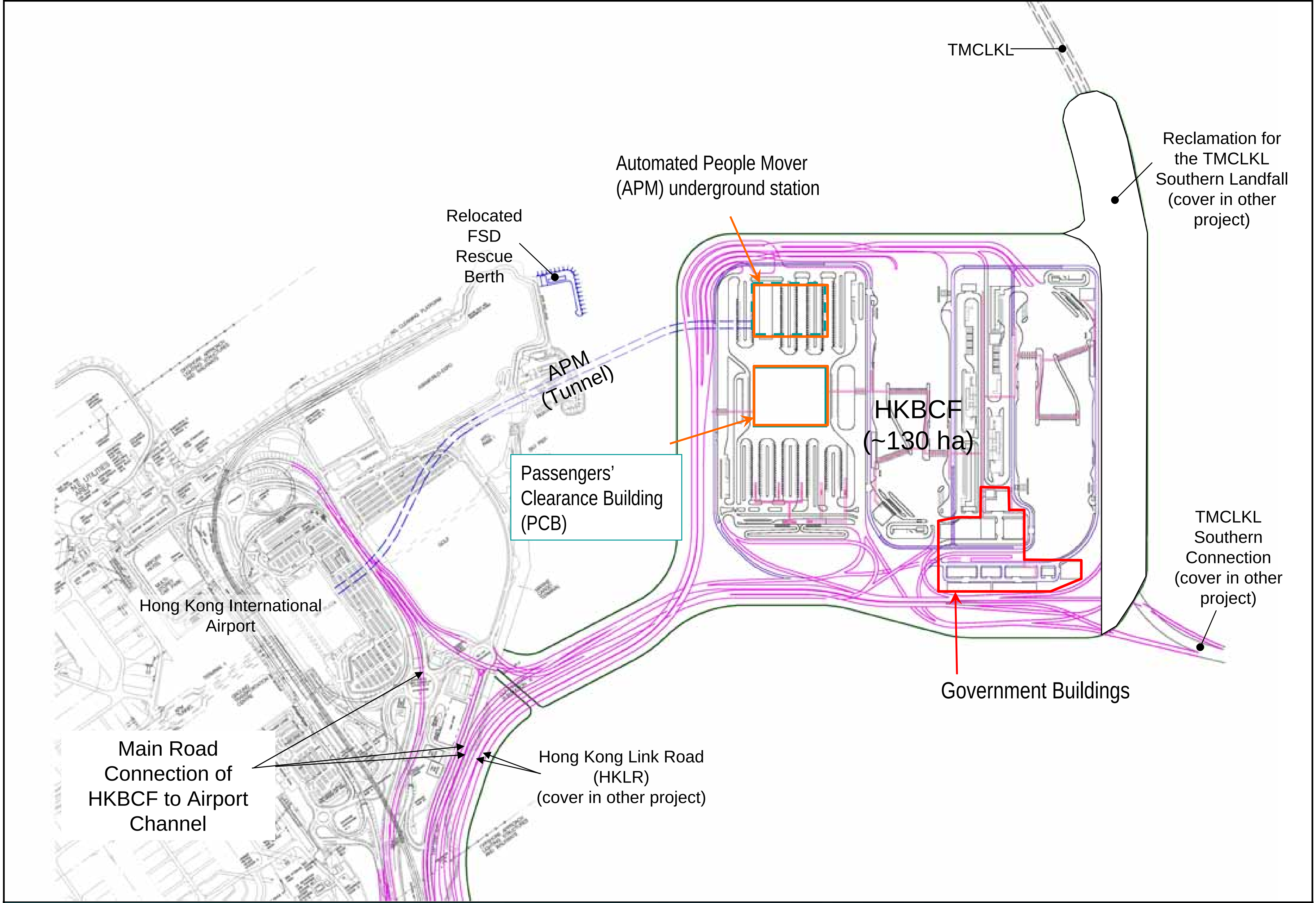

Figure 3.1 – Overall Layout of HKBCF

ARUP

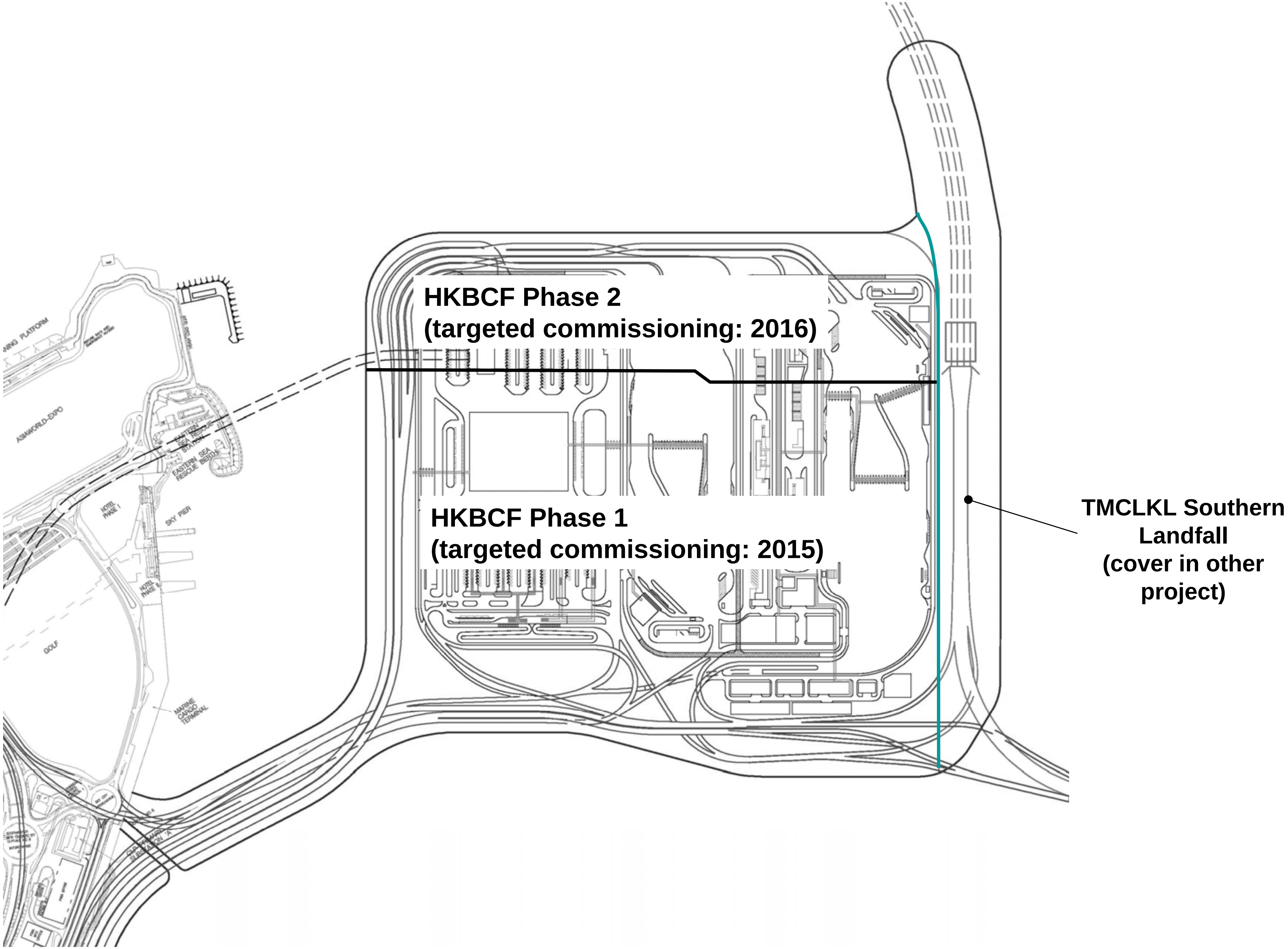

Figure 4.1 – Outline Phasing Demarcation of HKBCF

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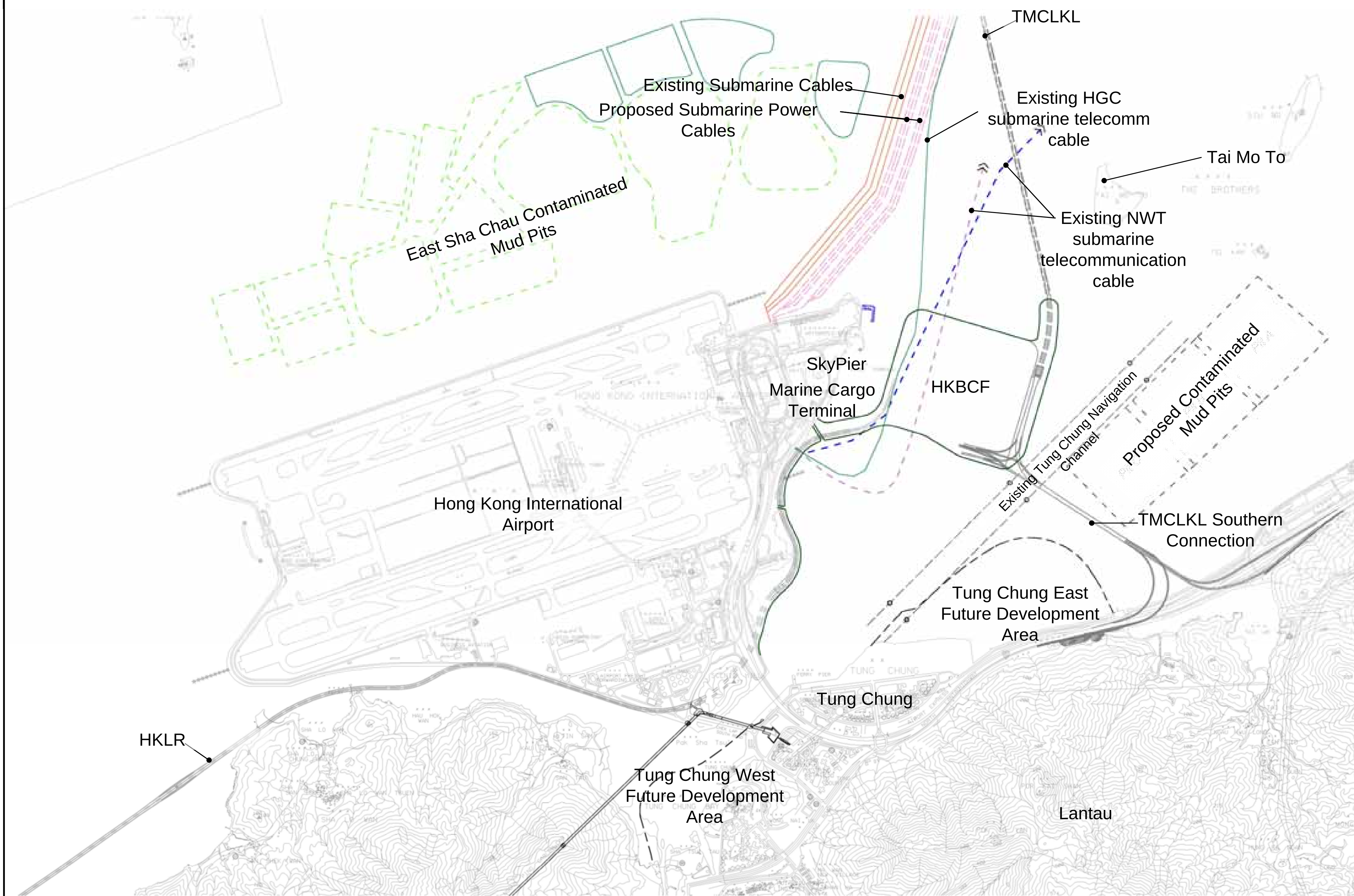

Figure 5.1 – Development Constraints (Sheet 1 of 2)

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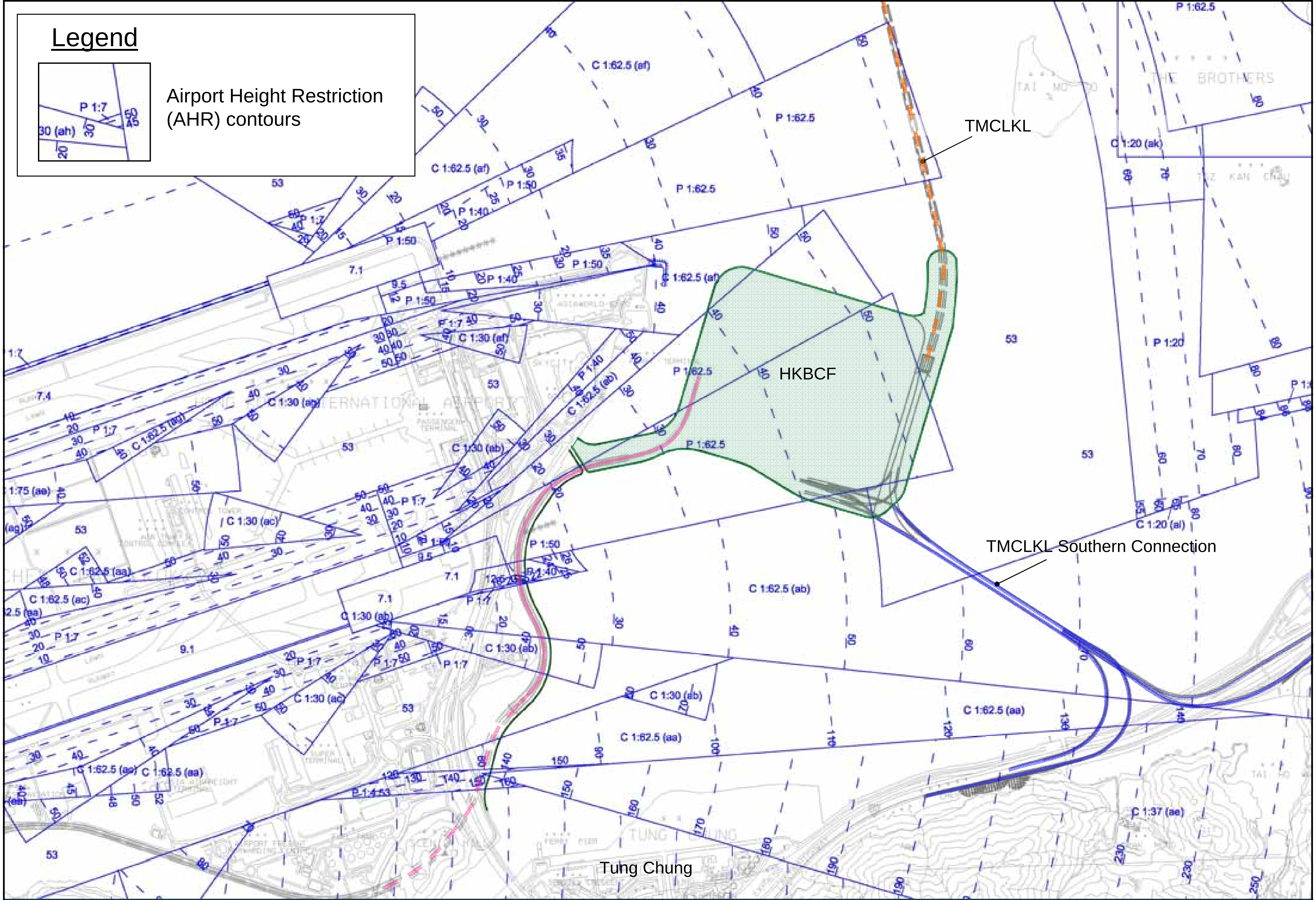
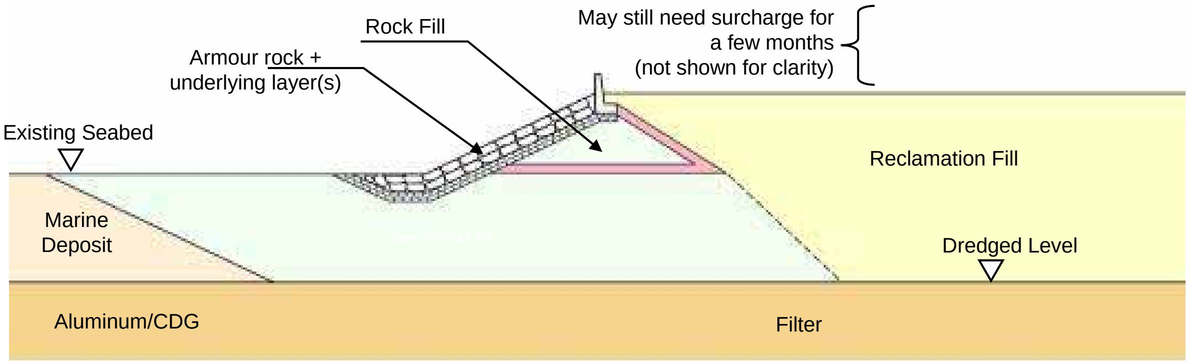


Figure 5.2 – Development Constraints (Sheet 2 of 2)

Seawall Method

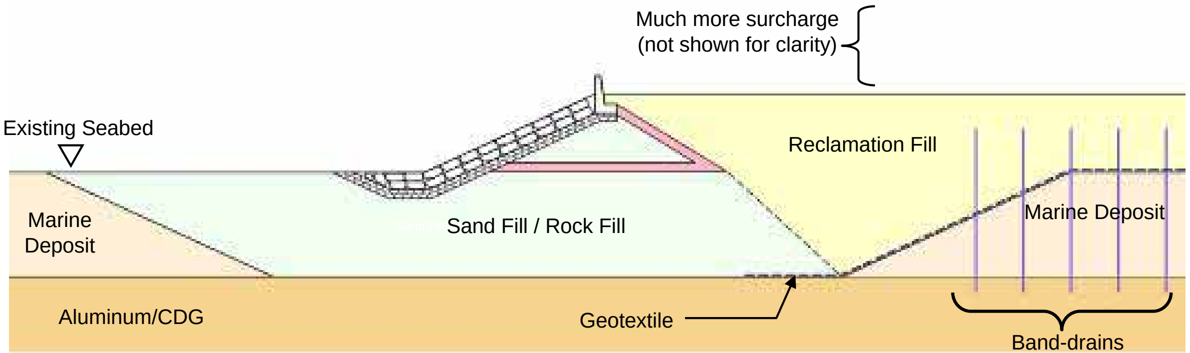
Reclamation Method

Fully-dredged Seawall



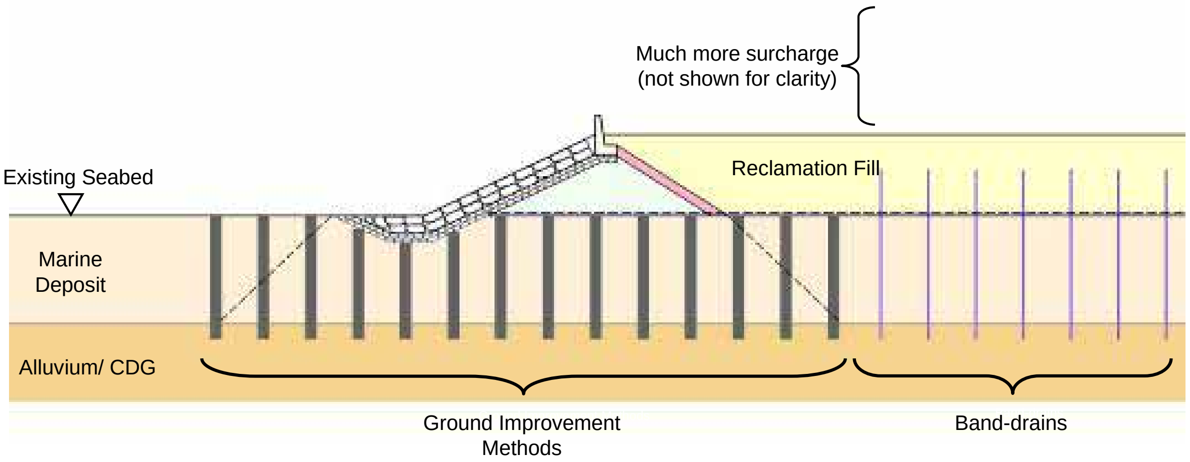
Fully-dredged Reclamation

Fully-dredged Seawall



Non-dredged Reclamation (with Band Drains)

Non-dredged Seawall with Ground Improvement Method



Non-dredged Reclamation (with Band Drains)

Figure 6.1 – Typical Sections of Dredged & Non-dredged Seawalls/Reclamation

ARUP

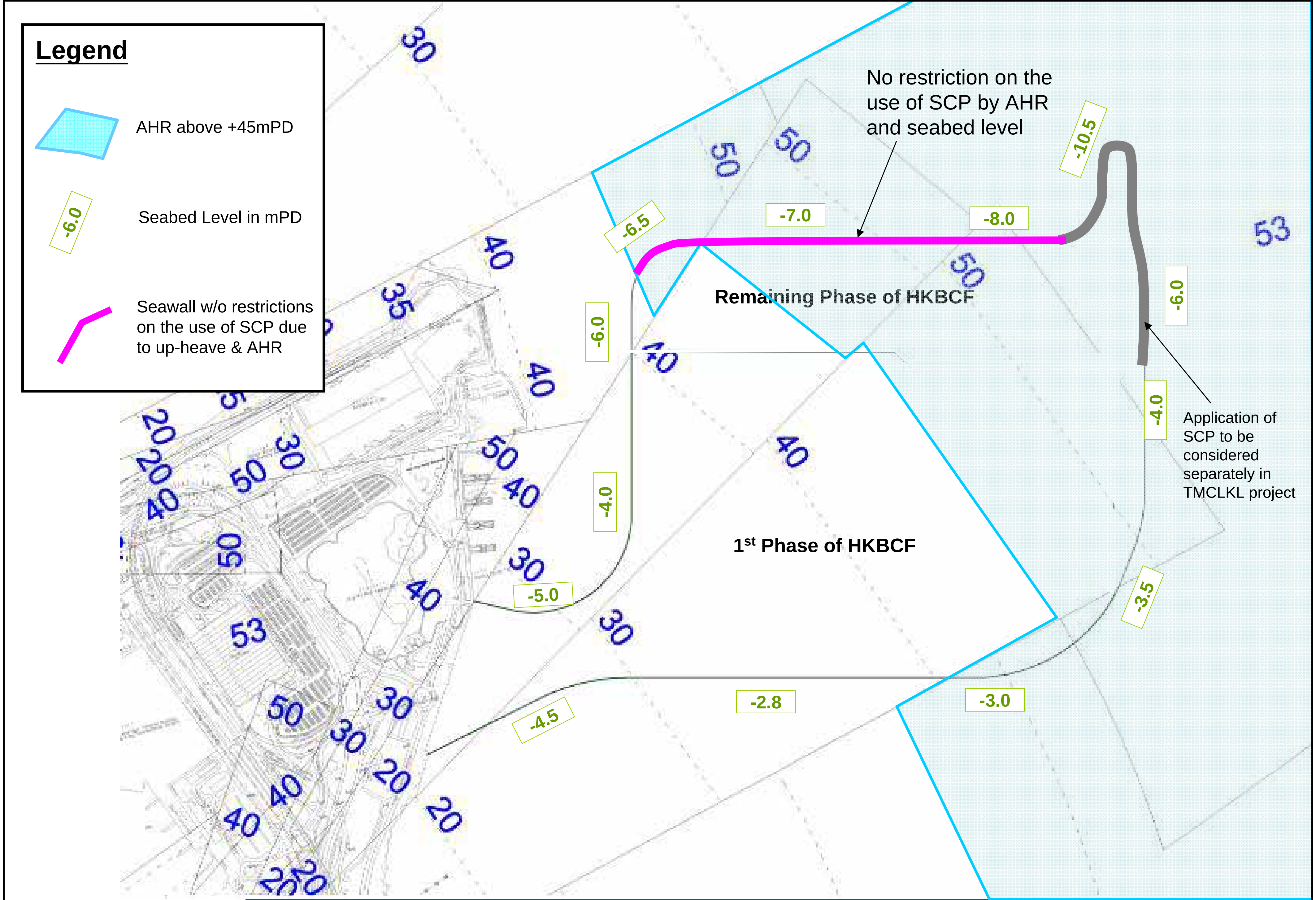


Figure 6.2 – Extent of Seawall without Restrictions on the Use of Sand Compaction Pile

ARUP

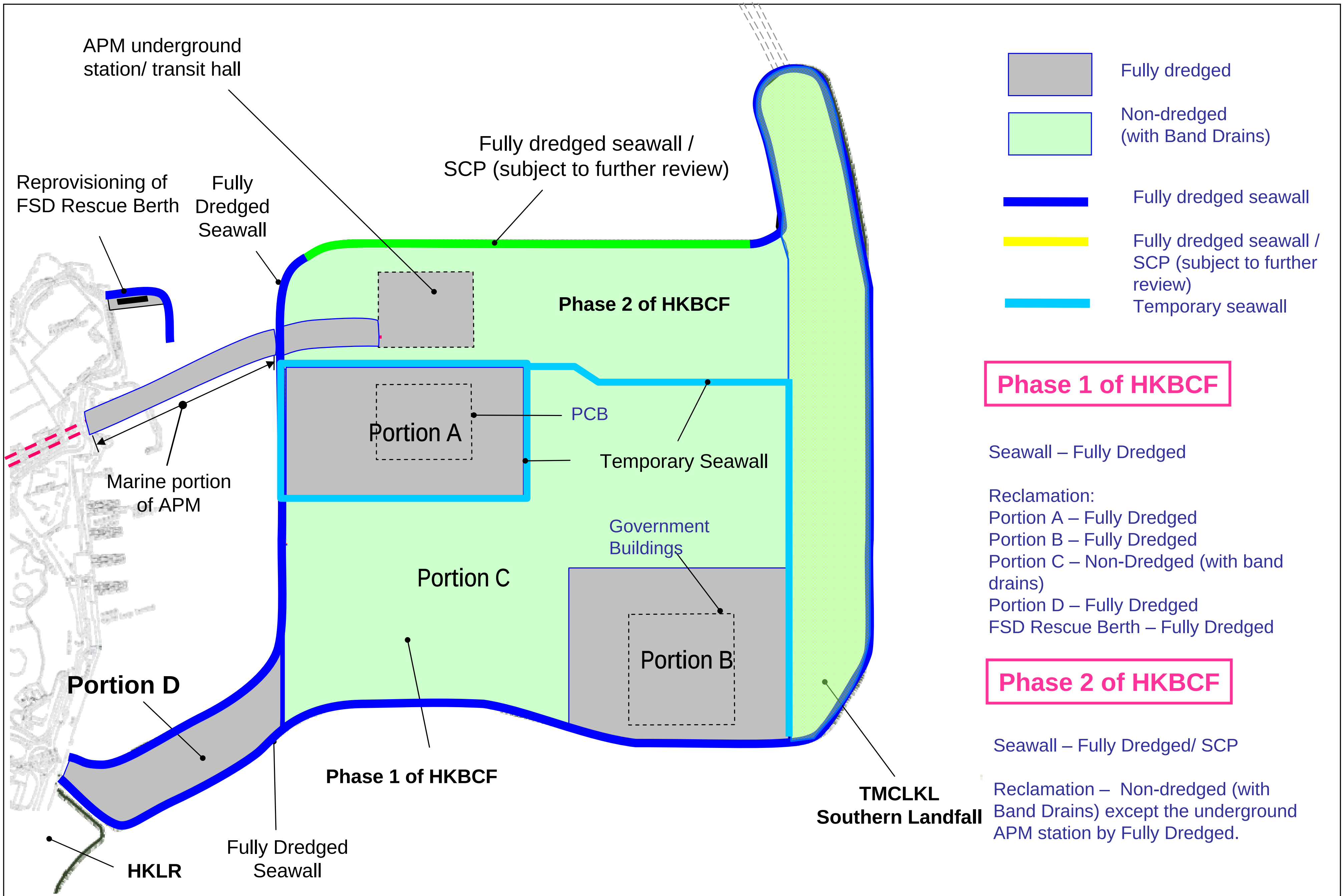
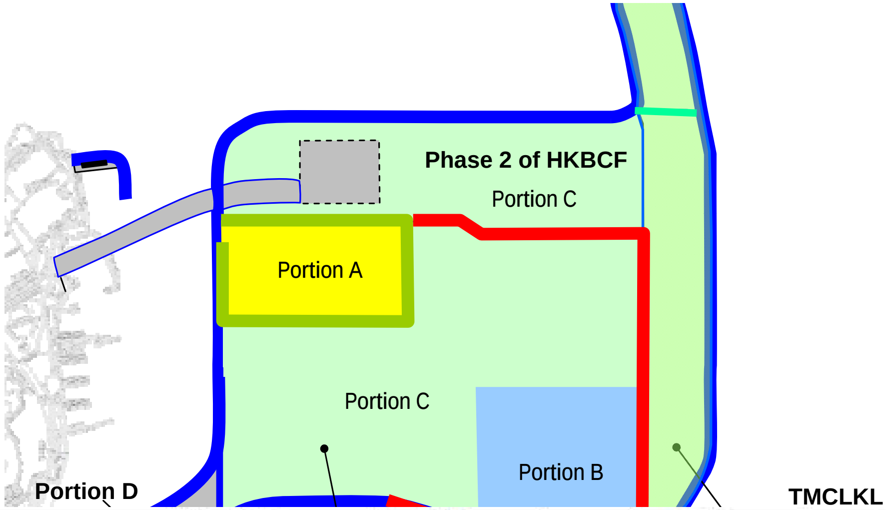
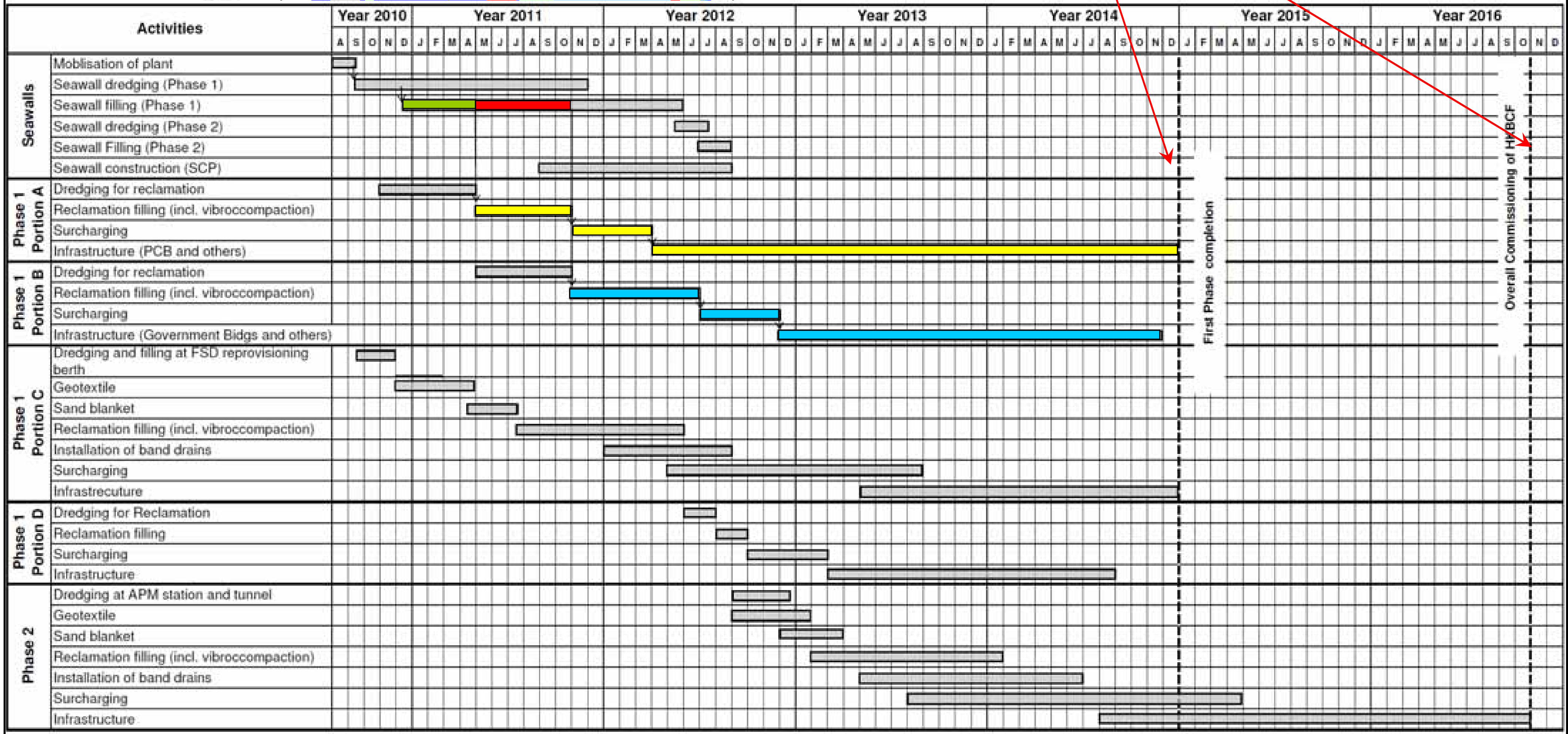


Figure 6.3 – Reclamation Layout of Sequence A

Figure 6.4 – Envisaged Programme for Sequence A of HKBCF Reclamation



Commissioning of HKBCF Phase 1 in Dec 2014 and Phase 2 in Oct 2016



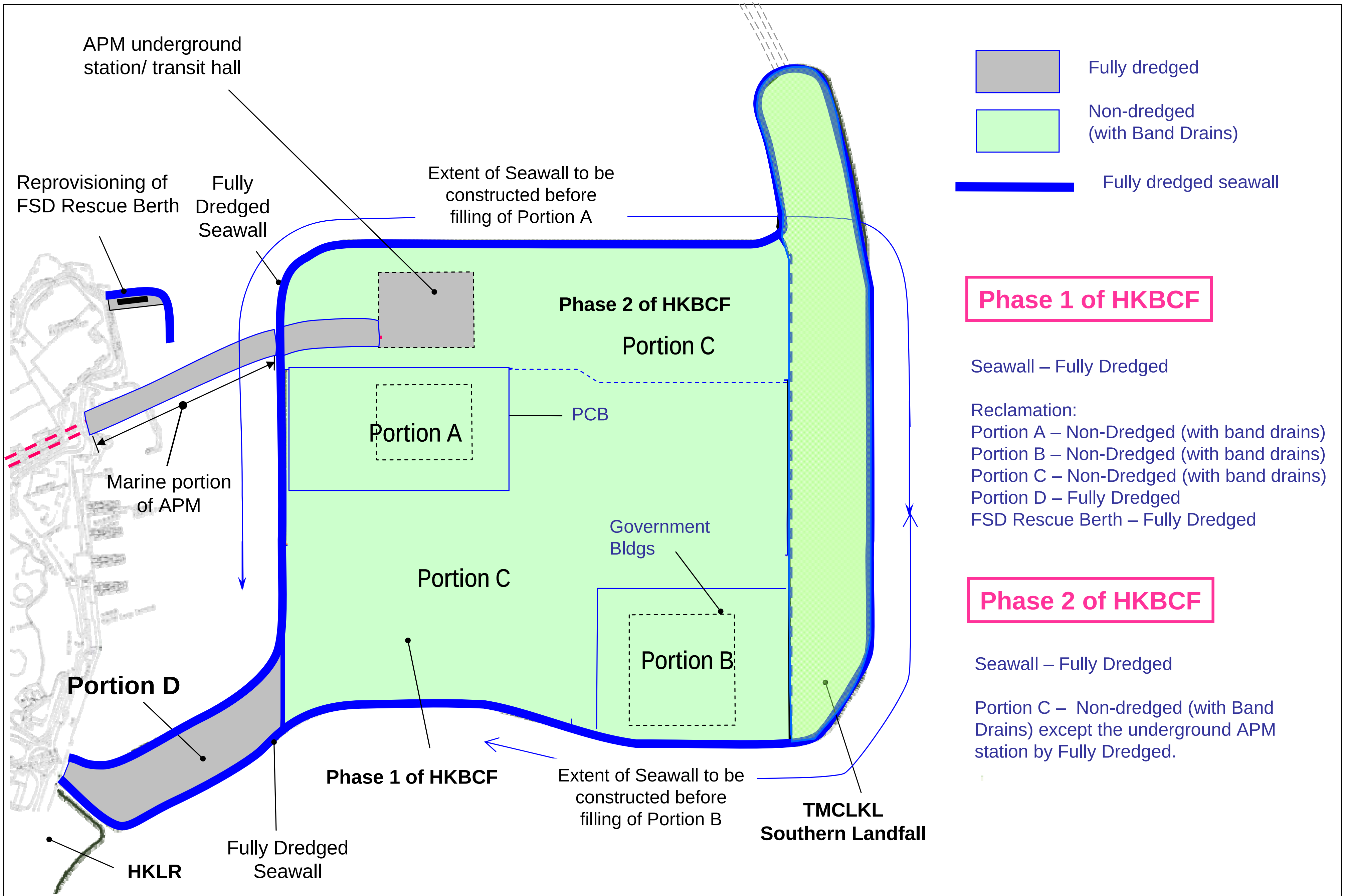
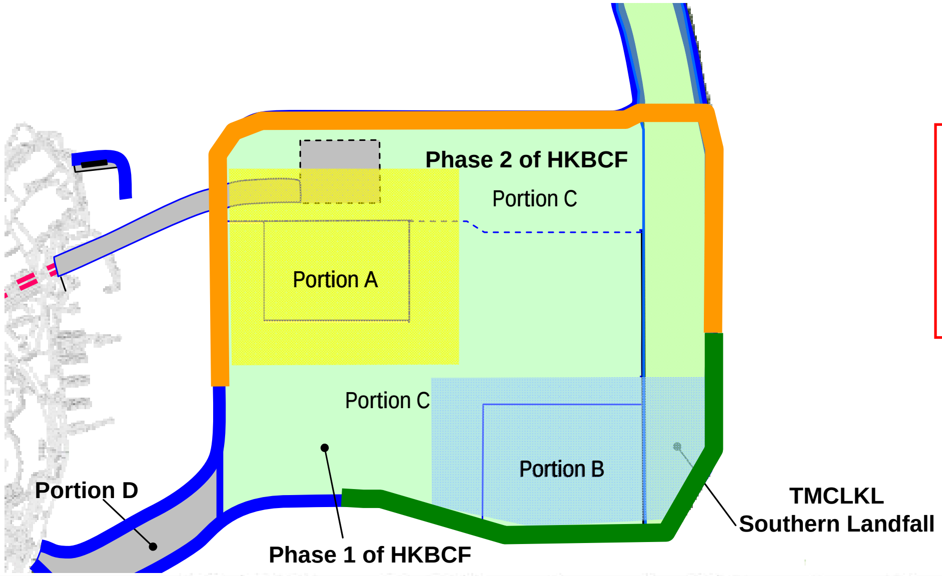


Figure 6.5 – Reclamation Layout of Sequence B

Figure 6.6 – Envisaged Programme for Sequence B of HKBCF Reclamation



Commissioning of HKBCF Phase 1 in Dec 2015 and Phase 2 in Oct 2016