LEGISLATIVE COUNCIL
PANEL ON PLANNING, LANDS AND WORKS

Proposals for Preservation of Queen's Pier in Central

Purpose

This paper informs Members of the outcome of our discussions with the professional bodies on the various proposals for preserving the Queen's Pier and presents a practical way to take the issue forward.

Background

2. The Central Reclamation Phase III (CRIII) contract was awarded in February 2003, after obtaining funding approval from the Finance Committee of the Legislative Council, and is scheduled for completion in mid 2009. The CRIII is needed to provide land for essential transport infrastructure including the Central-Wan Chai Bypass and Road P2 network, the Airport Railway Extended Overrun Tunnel (AR EOT) and the North Hong Kong Island Line (NIL). It will also provide land for a vibrant waterfront promenade for public enjoyment. The existing waterfront facilities including, inter alia, the Queen's Pier are affected by the reclamation. Under the work contract, the relocation of the marine operation of the Queen's Pier to the new Pier No. 9 and the demolition of the Pier were originally scheduled for February 2007.

3. In recognition of the nostalgic feelings attached to the Pier, we have utilized advanced laser scanning technology to store 3D images of the Pier and kept the plans. Our plan is to retain the "preservable" components of the Queen's Pier for "relocation" to the Central Harbourfront in future. The most suitable site for relocation will be identified, with the participation of professional bodies and the general public, under the Central Reclamation Urban Design Study to be undertaken by Planning Department.

4. On 23 January 2007, we briefed this Panel on our proposals to "relocate" the Queen's Pier. After listening to deputations of

professional and community bodies at the same meeting, the Panel suggested that the Administration should discuss with the professionals on the arrangements for preserving the Pier.

Present Position

5. We have since held three meetings with four professional bodies (Association of Engineering Professionals in Society Ltd. (AES); Conservancy Association (CA); Hong Kong Institute of Architects (HKIA); and Hong Kong Institution of Engineers (HKIE)) to discuss the methods for preserving the Pier. Our views and relevant views expressed by the four professional bodies on the proposals explored are set out in the Matrix at **Attachment A**.

(A) Relocation of the Marine Operation

6. A clear consensus which has emerged from our discussions with the professional bodies is that the marine operation of the Queen's Pier could be relocated to new Pier No. 9 to enable the CRIII works to proceed with the least disruption. Allowing time for serving the necessary transport and marine notices, the relocation of the marine operation will be completed by early April 2007 after Easter Holidays.

(B) Preservation of the Pier Structure

7. In our discussions with the professional bodies, we have explained that the planned infrastructure works which directly affect the Queen's Pier include the AR EOT, the extension of an existing drainage box culvert at Man Yiu Street and the Road P2 (as illustrated in **Attachment B**). The difficulties in relation to the modification of these works now to avoid the Queen's Pier are set out below :

(a) The existing overrun tunnel of the Airport Railway to the east of the Hong Kong Station is about 80 m long. This will have to be extended by a total of 500 m for the full operation of the Airport Railway comprising the Airport Express Line and the Tung Chung Line (TCL). About 40 m of the extension is required to enhance safety and has to be completed under the CRIII contract as soon as practicable. The remaining 460 m of the extension is

required for turn back of trains in order to enable shorter headways and hence higher capacities to meet future demand. The EOT is also required for the future North Hong Kong Island Line (NIL), which is an extension of the TCL along the north shore of Hong Kong Island to run from Hong Kong Station through onto the eastern half of the existing Island Line at Fortress Hill.

(b) The alignment of the NIL is controlled by a number of existing facilities. It has to join the existing AR EOT to the west and to run along the water channel of the Hong Kong Convention and Exhibition Centre (HKCEC) at the east, where some foundation piles of HKCEC were specifically designed and located for this purpose.

The alignment of the concerned section is also constrained by the existing overrun tunnel of Hong Kong Station, the provision of cross-overs for the turn back of trains and the need to connect a future station at Tamar. It is not possible to shift the alignment to avoid the footprint of the Queen's Pier.

(c) The existing stormwater drainage box culvert located at the waterfront of Man Yiu Street is the main strategic stormwater discharge route for Central. It has a catchment area of 73 hectares covering the core business areas of Central as well as the Peak area. Due to the reclamation under the CRIII, the stormwater drainage culvert has to be extended to the new waterfront to continue its operation. As the level of the culvert clashes with that of the EOT mentioned in (a) above, the culvert cannot be extended northwards along Man Yiu Street and has to run eastwards along the southern side of the EOT. Moreover, the extent of realigning the culvert to the south is constrained by the presence of General Post Office and Hongkong Land’s cooling water mains to the west of Edinburgh Place and the Hong Kong Bank’s cooling water mains and a 1350 mm diameter trunk sewer outside the Queen’s Pier. The culvert will therefore conflict with the Queen’s Pier. Apart from the horizontal alignment, the culvert at the concerned section is very shallow with the top level at about +3.0m PD and will thus conflict with the ground beams as well as the piled foundation of the Queen’s Pier.

In order to eliminate the conflict with the Queen's Pier, a S-curve will need to be introduced in the current alignment of the culvert. As the fall of the culvert is very gentle, i.e. about 0.05% due to the topographical constraints, such a change in alignment will affect the hydraulic performance of the culvert.

(d) Road P2 is a part of the road network to be provided in the CRIII area. Its purpose is to alleviate the traffic congestion in the Central Reclamation Phase I Area where the International Finance Centre I & II, the Four Seasons Hotel, Hong Kong Station of the Airport Railway and the ferry piers are located. Completion of Road P2 will provide great relief to the very congested junctions of Man Yiu Street / Harbour View Street and Connaught Place / Connaught Road Central.

Realignment of Road P2 will require amendments to the approved road scheme and will need to be gazetted under the Roads (Works, Use and Compensation) Ordinance and to go through relevant statutory procedures. The proposal to construct a temporary road to buy time for the said gazettal and statutory procedures is not reasonably practical as such a temporary road will also need to be gazetted and to go through the same statutory procedures. The time needed for consultation, gazetting and subsequent handling of the objections received will take at least one year. It will result in a serious delay to the completion date of the road as well as major cost implication to the CRIII contract. Such a delay also goes against our aim to complete the road as early as possible in order to alleviate the severe traffic congestion in Central.

(e) The implementation schedule for the various works under the CRIII contract is very tight. At present, the initial phase of the reclamation works and the relocation of most of the affected waterfront facilities have been completed. The remaining reclamation works and the construction of the above infrastructure is pending the relocation of the Queen's Pier. At this advanced implementation stage, altering any part of the project involving major and fundamental changes would have great programme implication to the CRIII

project as well as huge financial implication which, depending on the extent of the delay, could be as high as hundreds of million dollars.

8. Four proposals for preserving the Pier have been identified and we have examined them carefully, one by one, as detailed in Attachment A. Our findings are summarized as follows :

- Proposal (a) : In-situ preservation by shifting the alignments of the planned infrastructures which are in conflict with the Queen's Pier. This is not reasonably practical. Even disregarding the practicality issue, this proposal would have significant programme implications to the CRIII and would result in additional expenditure of hundreds of million dollars.

- Proposal (b) : In-situ preservation by filling the void underneath the Pier by sand/grouting; constructing the underground EOT and drainage culvert by underpinning and tunneling method; and constructing a temporary road to buy time for completing the statutory procedures for the amendment scheme of Road P2. This proposal is again not reasonably practical, as there is no reasonably practical solution for the AR EOT work. Setting aside the technical difficulties and the huge risk involved in the works, underpinning for construction of EOT would cost about $500 M and take more than 2 years to complete. The other additional works on filling underneath the Pier and construction of the stormwater drainage culvert with underpinning would incur additional construction costs of about $65 M and delay the CRIII contract by at least one year. Prolongation cost of the order of several hundred millions would also be incurred with the delay to the CRIII contract.

- Proposal (c) : In-situ reinstatement by rolling the superstructure (roof and columns) away for construction of the underground infrastructure and rolling it back upon completion of the construction; and shifting Road P2 away from the Queen's Pier. The technical feasibility of this rolling proposal is doubtful, and there is a high risk of the structural integrity of the Pier structure being damaged during and after the rolling operation. There would be a

delay of about 3½ years to the CRIII works with a prolongation cost for the CRIII in the order of several hundred millions. Additional construction cost of about $130 M would be incurred for the rolling operations, the EOT advance works and reassembling of the Pier structure.

- Proposal (d) : Preserve the above-ground structure of the Pier as far as practicable and store for reassembling in close proximity to its original location or at other appropriate location. This is technically feasible. This would result in a 4-month delay to the CRIII contract, with a substantial prolongation cost. The reassembling of the Pier structure would cost some extra $10 M. The overall cost estimate for this option is in the order of $50 M.

  Under this proposal, the metal wares and non-structural parts (including bollards, balustrades, baluster columns, handrails, the Chinese and English "Queen's Pier" plaques, other directory signs, navigation lights, precast concrete landing steps, planters and concrete benches) would be dismantled, and preserved, one by one. The roof would be preserved in parts by saw-cutting into 4 to 5 segments (with the central pitched roof portion intact or divided into two halves), but the flat roof would be reconstructed as a concrete and steel composite structure joined to the structural steel column inserts. The preserved pitched roof would be tied down to the concrete and steel composite roof. The existing concrete columns would be saw-cut at roof and deck level, and the columns would be strengthened by coring through them and providing structural steel column inserts. All major load bearing components for the Queen's Pier would therefore be substantially strengthened without change of appearance.

Way Forward

9. Proposal (d) presents a practical way forward, with relatively less delay to the CRIII works and less significant cost implications. We would strive to preserve the above-ground structure of the Pier as far as practicable and store the components properly for reassembling at its current location or at other appropriate location identified under the Central Reclamation Urban Design Study to be conducted shortly. For

example, there should be sufficient space for the reassembling of the Queen's Pier just to the west of its current location opposite the City Hall complex (as indicated in **Attachment C**). The professional bodies have suggested that landscaping and urban design enhancement be made to the open space formed by the reassembled Pier and the City Hall complex, complemented by adequate pedestrian provisions. This suggestion would be followed up in the Central Reclamation Urban Design Study.

10. We propose to start the preservation works in accordance with the aforementioned method as soon as practicable. For this purpose, we need to make a submission to Public Works Sub-committee (PWSC) to seek funding for the preservation of the Queen's Pier (para. 8 above). We plan to put the submission to PWSC in May 2007.

11. In the meantime, we will continue to discuss with the professional bodies on the best way to reassemble the Pier on the basis of proposal (d).

Housing, Planning and Lands Bureau
Civil Engineering and Development Department
March 2007

Attachment A – Views on Proposals for Preservation of Queen's Pier

Proposal	Views of the Administration	Relevant views expressed by the Professional Bodies [see note]
(a) In-situ preservation by shifting the alignments of the planned infrastructures which are in conflict with the Queen's Pier	The existing Queen's Pier will be affected by the Road P2, the Airport Railway (AR) Extended Overrun Tunnel (EOT) and the extension of the stormwater drainage culvert at Man Yiu Street. Realignments of these infrastructure to preserve the Queen's Pier in-situ are not reasonably practical due to the following considerations: • AR EOT – The existing overrun tunnel of the AR to the east of the Hong Kong Station is about 80 m long. This will have to be extended by a total of 500 m for the full operation of the AR comprising the Airport Express Line and the Tung Chung Line (TCL). About 40 m of the extension is required to enhance safety and has to be completed under the CRIII contract as soon as practicable. The remaining 460 m of the extension is required for turn back of trains in order to enable shorter headways and hence higher capacities to meet future demand. The EOT is also required for the future North Hong Kong Island Line (NIL), which is an extension of the TCL along the north shore of Hong Kong Island running from Hong Kong Station through onto the eastern half of the existing Island Line at Fortress Hill. • The alignment of the NIL is controlled by a number of existing facilities. It has to join the existing AR EOT to the west and run along the water channel of the Hong Kong Convention and Exhibition Centre (HKCEC) at the east, where some foundation piles of HKCEC were specifically designed and located for this purpose. The alignment of the concerned section is also constrained by the existing overrun tunnel of Hong Kong Station, the provision of cross-overs for the turn back of trains and connection to a future station at Tamar. It is not possible to shift the alignment to avoid the footprint of the Queen's Pier.	(i) HKIA opined that the possibility of preserving the Queen's Pier in-situ by shifting the alignments of the planned infrastructures should be considered, and other options should be explored only if in-situ preservation is found technically infeasible. (ii) In case in-situ preservation was not practicable and relocation deemed necessary, CA emphasized the importance of maintaining a strong link with the other buildings in the Edinburgh Place. CA considered that it would be most desirable if a temporary location facing the central part of Victoria Harbour could be identified for the strengthening of the preserved components pending the ultimate placement at the current location. CA reckoned that shifting of Road P2 is technically feasible. (iii) AES considered that shifting the planned AR EOT to avoid the Queen's Pier was technically infeasible. They also noted the substantial time and cost implications of making changes, if any, to the planned infrastructure given the huge construction contract of CRIII and the substantial contractual sum involved. (iv) Given the location of the cross-over, HKIE was

Proposal	Views of the Administration	Relevant views expressed by the Professional Bodies [see note]
	• Drainage Culvert - The level of the culvert clashes with that of the EOT, therefore the culvert cannot be extended northwards along Man Yiu Street and has to run eastwards along the southern side of the EOT. Moreover, the extent of realigning the culvert to the south is constrained by the presence of General Post Office and Hongkong Land's cooling water mains to the west of Edinburgh Place and the Hong Kong Bank's cooling water mains and a 1350 mm diameter trunk sewer outside the Queen's Pier. The culvert will therefore conflict with the Queen's Pier. Apart from the horizontal alignment, the culvert at the concerned section is very shallow with the top level at about +3.0m PD and will thus conflict with the ground beams as well as the piled foundation of the Queen's Pier. • In order to eliminate the conflict with the Queen's Pier, a S-curve will need to be introduced in the current alignment of the culvert. As the fall of the culvert is very gentle, i.e. about 0.05% due to the topographical constraints, such a change in alignment will affect the hydraulic performance of the culvert. • Road P2 – Realignment of Road P2 will require amendments to the approved road scheme and will need to be gazetted under the Roads (Works, Use and Compensation) Ordinance and to go through relevant statutory procedures. The time required for the planning/design revision, consultation, gazetting and subsequent handling of the objections received will likely take at least one year. • The implementation schedule for the various works under the CRIII contract is very tight. At present, the initial phase of the reclamation works and the relocation of most of the affected waterfront facilities have been completed. The remaining reclamation works and the construction of the planned infrastructure	also satisfied that shifting the planned AR EOT to avoid the Queen's Pier was technically infeasible. They also noted the substantial time and cost implications of making changes to any of the planned infrastructure given the huge construction contract of CRIII and the substantial contractual sum involved. (v) AES, CA and HKIE appreciated the conflicts of the planned infrastructures with the Queen's Pier, and recognized that shifting Road P2 to avoid the Queen's Pier would involve gazetting and resolution of objection procedure, and this might lead to delay to the CR III works. (vi) All professional bodies agreed that the relocation of the marine operations from Queen's Pier to the replacement Pier (Pier No. 9) was a separate issue and should be delinked from the present discussion on possible "preservation" of the Pier.

Proposal	Views of the Administration	Relevant views expressed by the Professional Bodies [see note]
	is pending the relocation of the Queen's Pier. At such an advanced implementation stage, altering any part of the project involving major and fundamental changes would not be practicable as this would have great programme implication to the CRIII project as well as huge financial implication which, depending on the extent of the delay, could be as high as hundreds of million dollars.	
(b) In-situ preservation by - filling the void underneath the Pier by sand/ grouting; - constructing the underground EOT and drainage culvert by underpinning and tunneling method; and - constructing a temporary road to buy time for gazetting the amendment scheme of Road P2	(i) AR EOT – The EOT at the concerned section comprises 4 separate tunnels (2 for AR and 2 for TCL) with a total width of about 27 m at a relatively shallow depth (top level at about –3.9 mPD). The EOT will be in conflict with the piled foundations of the Queen's Pier. Due to the tunnel configuration, construction by cut and cover method is required and construction by tunneling method is not practically feasible. Moreover, underpinning of the Queen's Pier to permit construction of the EOT underneath will present considerable difficulty. Frequent supports would be needed for the underpinning system. These supports have to be accurately positioned to match the tunnel alignment underneath for excavation below the Queen's Pier. The works for installation of these supports will require substantial demolition of the existing Queen's Pier structure. The fact that the reinforcement of the existing deck structure of Queen's Pier was seriously corroded is a main concern. (ii) Drainage Culvert – Conflict between the ground beams and the culvert precludes the construction of the culvert by tunneling method. Construction of the culvert by underpinning will be much more costly and time consuming. Some of the ground beams and part of the ground slab and columns of the Pier will need to be rebuilt.	(i) CA appreciated that there are a lot of engineering problems associated with the underpinning proposal. CA also appreciated the need to complete Road P2 timely for relief of traffic congestion. CA suggested more information be provided by the Government to support their views. (ii) AES and HKIE agreed that in view of the proximity of the planned underground infrastructures to the Queen's Pier and the width of these infrastructures, underpinning is not a reasonably practical solution. The need to take down parts of the existing Pier structure and the risks of damage to the remaining parts are the main concerns. (iii) AES and HKIE agreed that this would be a difficult option fraught with technical complications. However, should there be desire to pursue the technical feasibility of in-situ preservation option, despite that it would not be a reasonably practical solution, AES opined that underpinning was the only option that deserved further consideration.

Proposal	Views of the Administration	Relevant views expressed by the Professional Bodies [see note]
	(iii) Road P2 - The proposal to construct a temporary road to buy time for gazetting the amendment scheme of Road P2 is not reasonably practical as such a temporary road will also need to be gazetted under the Roads (Works, Use and Compensation) Ordinance. The duration may be further prolonged if the gazetting of the amendment scheme of Road P2 and that of the temporary road are not conducted in parallel, with additional resource spent on planning, design, construction and demolition of the temporary road. (iv) Setting aside the technical difficulties and the huge risk involved in the works, underpinning for construction of the EOT would cost about $500M and take more than 2 years to complete. The other additional works on filling underneath the Pier and construction of the stormwater drainage culvert with underpinning would incur additional construction costs as follows:- • $5M for filling of the void underneath Queen's Pier • $60M for construction of the culvert by underpinning. These additional works will likely delay the CRIII contract by at least one year. Prolongation cost of the order of several hundreds millions will be incurred with the delay to the CRIII contract.	AES however commented that the feasibility of such an option would depend on whether the alignment of the AR EOT could be adjusted to provide space for the underpinning.
(c) In-situ reinstatement by rolling the superstructure (roof and columns) away for construction of the underground infrastructure and	(i) The technical feasibility of the rolling proposal for the Queen's Pier is doubtful, and there is a high risk of the structural integrity of the Pier structure being damaged during and after the rolling operation. Due to its large size (circumscribed dimension of 61.6 m x 24.2 m) and slim structural form, the roof, especially the portion without the triangular shaped portals (thickness varying from 150 mm to 200 mm), is vulnerable to damage during	(i) CA commented that rolling is one of many methods for temporary removal of the existing Pier structure to facilitate the construction of the planned infrastructures. (ii) Both AES and HKIE expressed serious doubts on the feasibility of moving the roof and

Proposal	Views of the Administration	Relevant views expressed by the Professional Bodies [see note]
rolling it back upon completion of the construction; and shifting Road P2 away from the Queen's Pier	transportation or even at load transfer stage prior to transportation. Whilst temporary supports could be provided to protect the structure, given the large number of supports for the roof (34 columns and 2 load bearing walls), simultaneous load transfer to the temporary supports to prevent differential movements of the roof is practically difficult and full structural integrity during load transfer and transportation cannot be guaranteed. Loading transfer during reassembling has similar problem and it is hard to guarantee that the reassembled structure will be structurally sound without substantial strengthening. Due to the lack of space in the vicinity for storage of the transported structure, transportation can only be carried out after completion of the reclamation in front of the Pier. As such, the proposal will have great cost and programme implications to the CRIII contract. (ii) In-situ reinstatement will require realignment of Road P2 that needs to be gazetted under the Roads (Works, Use and Compensation) Ordinance with attendant statutory procedures to be gone through giving rise to long time delay. (iii) In-situ reinstatement can only be carried out after the construction of the EOT. Alternatively, it will require advance construction of the section of EOT underneath Queen's Pier after the temporary removal of the superstructure of Queen's Pier. (iv) Delay will be about one and a half year for reclamation to be formed in front of Queen's Pier for the rolling off of the Pier structure. Further delay of about two years will be incurred for the EOT advance works. Prolongation cost for the CRIII will be in the order of several hundred millions. Additional construction costs will be incurred as follows:- • $20M for rolling of the Pier structure	columns of the Queen's Pier by rolling, noting the size of the Pier, the structural form and the high risk of structural damages. In particular, they opined that the load transfer of the 34 columns could hardly be properly synchronized. Differential movements, which could not be easily determined and controlled, will arise and the Pier structure will be susceptible to damages. They also considered that the rolling method would be time consuming and would result in huge additional cost and excessive delay to the CRIII works. (iii) AES and HKIE accepted that the rolling method could not be adopted on practical consideration.

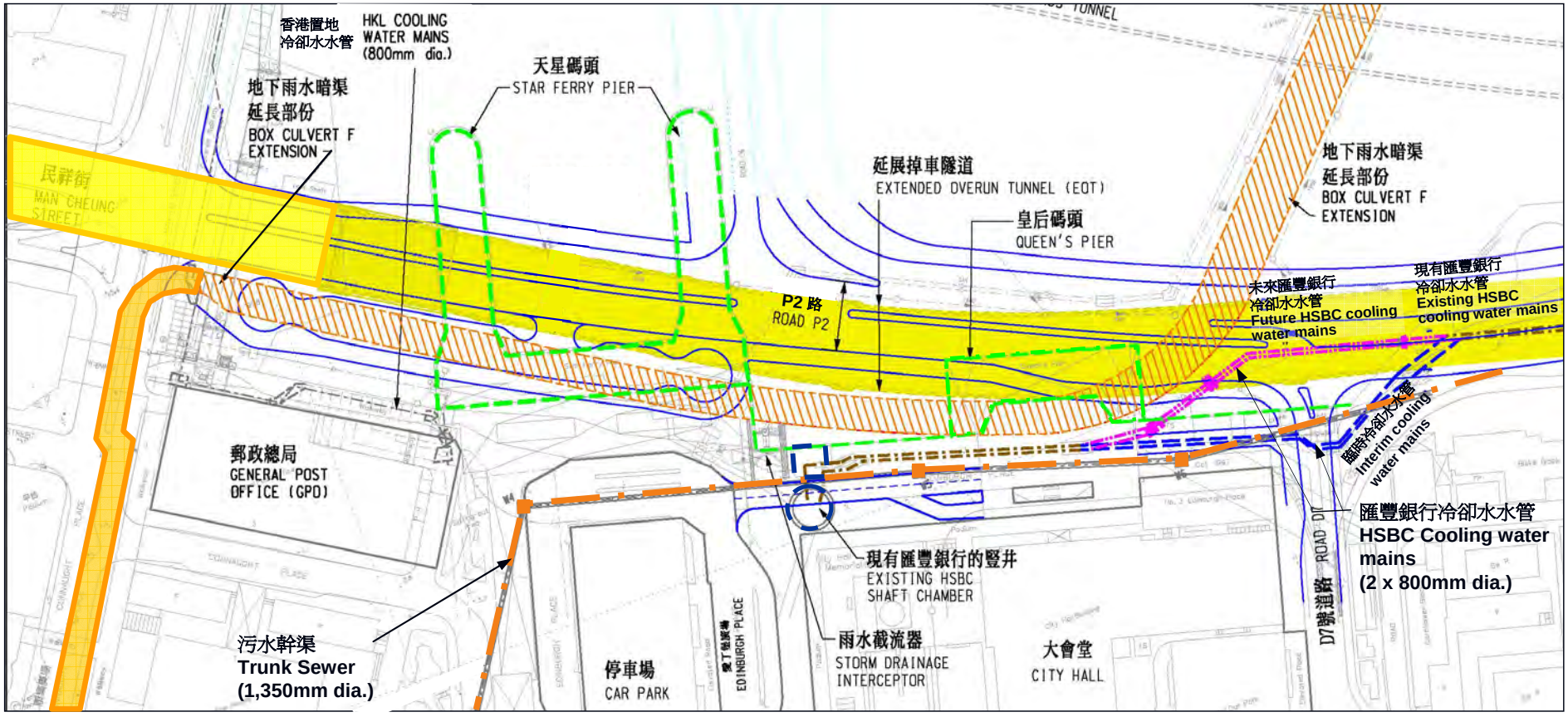
Proposal	Views of the Administration	Relevant views expressed by the Professional Bodies [see note]
	• $100M for EOT advance works • $10M for reassembling of the Pier structure	
(d) Preserve the above-ground structure of the Pier as far as practicable and store for reassembling in close proximity to its current location or at other appropriate location	(i) The results of preserving the superstructure by saw-cutting and lifting will be more predictable than by rolling although some wastage during saw cutting will be inevitable. The roof is to be preserved in parts by saw-cutting for lifting off to storage for subsequent reassembly. The lifting off of the whole roof is not very practical as it weighs about 570 tonnes and there is no readily available marine-based crane of sufficient capacity to lift off the whole roof. There is no readily available barge that is big enough for transporting the whole roof in one piece. The flat roof portion is also vulnerable to damage during lifting. A more practical way is to divide the roof into 4 to 5 segments (with the central pitched roof portion intact or divided into two halves). The columns should be saw-cut at roof and deck level whereas the load bearing walls will be dismantled block by block. As for the metal wares and non-structural parts, they can be dismantled one by one and be kept properly for subsequent reassembly. (ii) For subsequent reassembly, the aim is to reassemble the Queen's Pier using the preserved items to resemble its present appearance as far as practically possible. Noting that the age of the Queen's Pier is already over its design life (50 years for maritime structure) and structural enhancement would be required for the major load bearing components, the existing concrete columns will need to be strengthened by coring through them and providing structural steel column inserts. The flat roof will be reconstructed as a concrete and steel composite structure joined to the structural steel column inserts. The preserved pitched roof will be tied down to the concrete and steel composite roof to preserve the existing appearance of the Queen's Pier.	(i) HKIA commented that the "preservation" of the location of the existing Pier is most important. (ii) CA emphasized that if the Pier is to be relocated to close to the existing Pier location fronting the City Hall complex, urban and landscape design should be further enhanced with the areas abutting the new Pier designed as pedestrian precinct or public open space. Vehicular access must be limited to be used by emergency vehicles and those for gaining access to service the City Hall complex. CA suggested that Road D6 south of Road P2 as shown in the Central District (Extension) Outline Zoning Plan should be deleted. (iii) AES and HKIE agreed that the option is the most practical way forward with the least time and cost implications and with more assurance on the quality of the relocated Pier structure. (iv) AES and HKIE accepted that this arrangement would be a practical solution which would cause least disruption and complication.

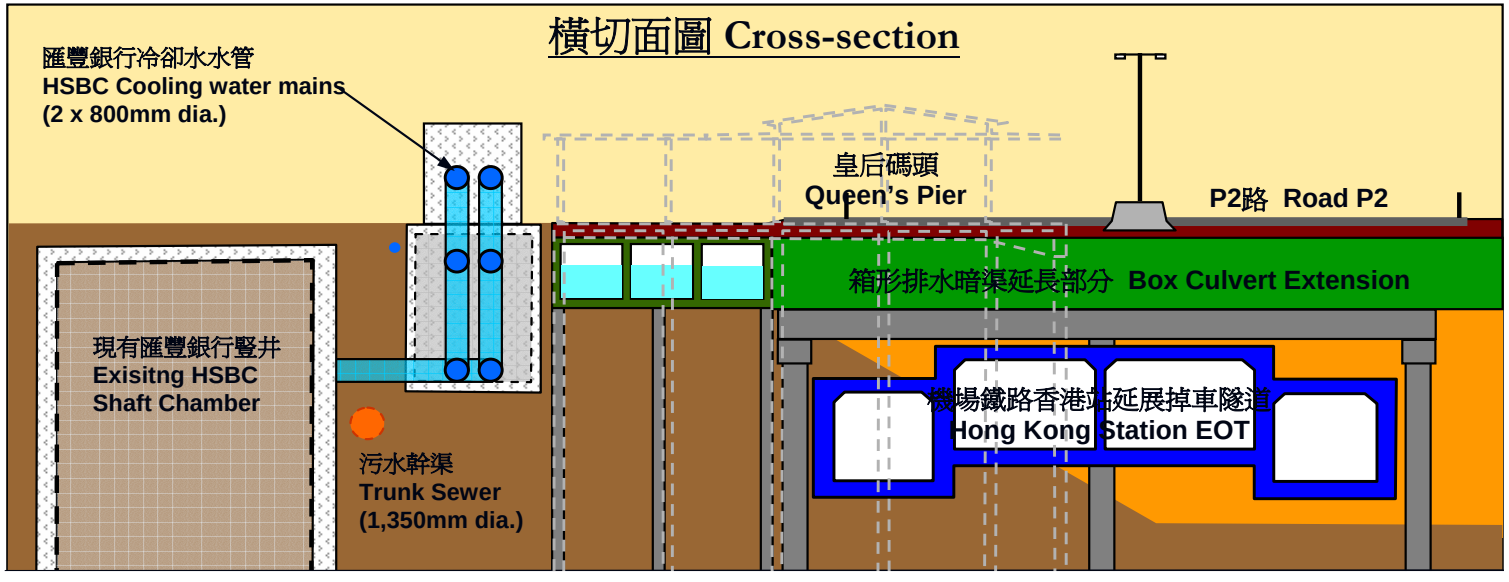
Proposal	Views of the Administration	Relevant views expressed by the Professional Bodies [see note]
	(iii) The delay to the CRIII contract will be about 4 months, with prolongation cost of tens of millions. Cost of preserving parts of the Pier will be about $10M. Cost of reassembling of the Pier will be about another $10M. (iv) Subject to the agreement of a permanent location for the reassembling the Queen's Pier in Central Reclamation Phase III area without affecting the construction of the AR EOT and other underground facilities, reassembling can commence upon completion of land formation. As such, reassembling of the preserved parts of the Pier at a temporary location pending ultimate relocation might not be necessary, noting that about $20M will be incurred for this temporary arrangement and that duplicating the reassembling processes might cause further damage to the preserved components. (v) During the Central Reclamation Urban Design Study, public engagement activities would be carried out with a view to obtaining public views on the design ideas and possible locations for reassembling the Pier as required under the Study Brief. Spacewise, the Pier could be relocated near to its existing location or in the future waterfront.	

Note: The Professional Bodies include Association of Engineering Professionals in Society Ltd (AES), Conservancy Association (CA), Hong Kong Institute of Architects (HKIA) and Hong Kong Institution of Engineers (HKIE).

已規劃的基礎設施 Planned Infrastructure

附件B
Attachment B





重新組裝皇后碼頭的可行位置
Possible Location for Reassembling of Queen's Pier

附件C
Attachment C