政府總部
運輸及房屋局
運輸科
香港添馬添美道 2 號
政府總部東翼

Transport and
Housing Bureau
Government Secretariat
Transport Branch
East Wing, Central Government Offices,
2 Tim Mei Avenue,
Tamar, Hong Kong

本局檔號 OUR REF.: THB(T)L4/6/127
來函檔號 YOUR REF.:

電話 Tel. No.: 3509 8181
傳真 Fax No.: 2136 8017

By E-mail and Fax
(Fax No：2978 7569)

[English Translation]

Legislative Council Secretariat
Legislative Council Complex
1 Legislative Council Road, Central
Hong Kong
(Attn: Ms Sharon CHUNG)

23 June 2017

Dear Ms CHUNG,

Legislative Council Public Works Subcommittee

461TH – Central Kowloon Route – Main Works

Regarding the enquires from Hon. CHU Hoi-dick via his letter of 21 June 2017, our responses are as follows –

(I) Traffic Impact Assessment

2. The Executive Summary of the Traffic Impact Assessment (TIA) completed in 2014 by the consultants of the Central Kowloon Route (CKR) Project is at **Enclosure 1** for Members' reference.

(II) Considerations on the Western Harbour Crossing

(1) Arrangements after regaining rights to the WHC franchise by the Government on 2 September 2023

3. The Government has commenced a study on the rationalisation of traffic distribution among the three cross-harbour tunnels (namely, the Cross-Harbour Tunnel (CHT), Eastern Harbour Crossing (EHC) and Western Harbour Crossing (WHC)) and the three land tunnels connecting Kowloon and Sha Tin (namely, the Tate's Cairn Tunnel (TCT), Lion Rock Tunnel (LRT), and Eagle's Nest Tunnel and Sha Tin Heights Tunnel) early this year. Through the study, the Government will consider various factors in a holistic manner and formulate a toll adjustment proposal for rationalising the traffic distribution among the six tunnels (including WHC). The Government has undertaken earlier to submit the toll adjustment proposal for discussion at the Panel on Transport of Legislative Council (LegCo) in the 2017-18 legislative session.

(2) Impact of the reduction in tolls of WHC in 2023 on the estimated traffic flow of the CKR and whether such factor has been considered in the TIA

4. In the TIA for the CKR completed in 2014, the traffic flow was predicted based on the toll levels of the tunnels and bridges in the territory at that time without assessing the impact due to different toll levels of those tunnels and bridges. If the toll level of the WHC is reduced, it is anticipated that the traffic flow between Kai Tak, Kowloon Bay and Hong Kong Island West via the CKR would increase, but the actual rate of increase will depend on the future toll levels of various tunnels.

(III) Overview of Route 6

5. Route 6 is about 12.5 kilometre long (**Enclosure 2** refers), and comprises the CKR, the Tseung Kwan O - Lam Tin Tunnel (TKO-LTT) under construction and the Trunk Road T2 under planning. It will provide an express link between West Kowloon and Tseung Kwan O (TKO) to alleviate the traffic congestion along the existing major east-west corridors in Kowloon and in TKO. On the other hand, the Cross Bay Link (CBL) in TKO will connect the TKO-LTT and Wan Po Road to allay the traffic congestion in and cope with the long term traffic demand of the TKO area. The TIA for the CKR completed in 2014 adopted 2026 as the planning year. The table below shows the traffic capacity and the predicted traffic flow in 2026 on the CKR,

Trunk Road T2, TKO-LTT and CBL. The population and employment data for the Kowloon urban area and TKO are the main factors affecting the traffic flows.

Road	**Direction**	**Capacity**	**Predicted Traffic Flow in 2026 (in Passenger Car Unit /Hour) [volume/capacity (v/c) ratio]**	
			A.M. Peak	**P.M. Peak**
CKR	Eastbound	5 400	3 304 [0.6]	4 688 [0.9]
	Westbound	5 400	4 919 [0.9]	4 474 [0.8]
Trunk Road T2	Eastbound	3 600	1 605 [0.4]	3 017 [0.8]
	Westbound	3 600	2 688 [0.7]	1 866 [0.5]
TKO-LTT	Eastbound	3 600	2 446 [0.7]	3 335 [0.9]
	Westbound	3 600	3 442 [1.0]	2 219 [0.6]
CBL	Eastbound	3 600	1 475 [0.4]	1 880 [0.5]
	Westbound	3 600	2 035 [0.6]	1 600 [0.4]

6. For the progress of Route 6 and the CBL in TKO, please refer to the table below.

<u>Under Construction</u>			
Road Project	**Construction Commencement**	**Anticipated Completion Time**	**Construction Cost (in $ billion) (in money-of the-day prices)**
TKO-LTT (main tunnel)	July 2016	Mid-2021	15.09

Under Planning			
Road Project	**Anticipated Commencement of Construction**	**Anticipated Completion Time**	**Construction Cost (in $ billion) (in money-of the-day prices)**
CKR	If funding is obtained within this legislative year, the project can commence in the third quarter of 2017	2025	42.36
Trunk Road T2	Detailed design is in progress. Upon completion of the detailed design, we will formulate the construction programme and seek funding approval from the LegCo in a timely manner for the construction of the project so that its completion can tie in with that of the CKR.		
TKO-LTT (Cha Kwo Ling Tunnel Section)	The construction works will be taken forward in conjunction with the Trunk Road T2 project. We will seek funding approval from the LegCo in a timely manner for the construction of the project so that its completion can tie in with that of the Trunk Road T2.		
CBL	Detailed design is in progress. Upon completion of the advance preparation work including detailed design, we will seek funding approval from the LegCo in a timely manner for the construction of the project.		

7. The TIAs for the CKR and the other Route 6 projects have taken into account the growth in populations and employments of the Kowloon urban area and TKO. The TIAs have included the traffic forecasts for 2021 and 2026, and analysed the difference in overall traffic flow during peak hours of the east-west trunk roads in Kowloon urban area under the with- or without-CKR scenarios.

(IV) Operation of Air Purification System

8. The CKR will be provided with an advanced tunnel ventilation system to direct the exhaust inside the tunnel to sites far away from the densely populated areas. An Air Purification System (APS) will be installed in the ventilation system to effectively remove at least 80% of respirable suspended particulates and nitrogen dioxide (NO_2) from the exhaust to be discharged via the ventilation buildings.

9. The APS (see Figure 1) consists of electrostatic precipitators and NO_2 removal system, with silencer at the exhausts to reduce the noise level. The electrostatic precipitators make use of electrostatic charges created by an electric field to separate the respirable suspended particulates from the tunnel exhaust by electrodes through a precipitation tank. On the other hand, the NO_2 removal system absorbs NO_2 by means of filter medium such as chemical decomposition or activated carbon.

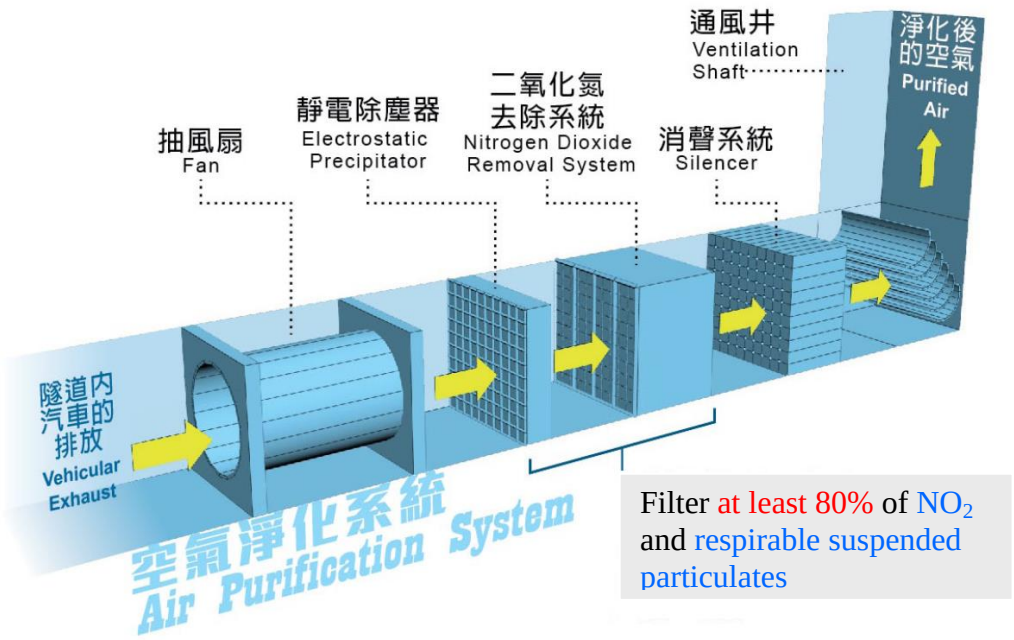

Figure 1: Air Purification System

(V) New Engineering Contract and the pain/gain share mechanism

10. According to the information provided by the Development Bureau (DEVB), New Engineering Contract (NEC) has been used in the United Kingdom (UK) and many other countries for more than twenty years. The majority of public works in UK is now procured by using NEC with promising performance. In fact, NEC is suitable for public works projects, especially for those projects with comparably high risks.

11. DEVB has been adopting the NEC in some public works projects for pilot trials since 2009 with an aim to improving the equitable risk sharing in engineering and construction contracts, whereby contracting parties are encouraged to adopt a partnering approach to take forward construction works. Recently, DEVB has promoted the use of target cost contract option in some larger scale public works contracts, and has also encouraged the adoption of NEC in more public works projects of different natures, so as to let the industry build up more knowledge and experience.

12. As mentioned by the Permanent Secretary for Development (Works) at the PWSC Meeting on 21 June, DEVB would brief Members on the latest situation of implementation of NEC in the Panel on Development in July 2017.

(VI) Future Uses and Means of Maintenance of Yau Ma Tei (YMT) Police Station Old Wing and New Wing

13. Based on the information provided by the Hong Kong Police Force (HKPF), the YMT Police Station is a Grade 2 historic building with special value and should be selectively preserved. The HKPF will continue to preserve the Old Wing and New Wing in a proper manner and work with the Architectural Services Department and other relevant departments to maintain the buildings.

14. The tunnel of the CKR will pass underneath part of the New Wing, kitchen, laundry and carpark of the YMT Police Station. The New Wing of the existing YMT Police Station will be occupied as works site during the construction of the CKR. Whilst both the Old Wing and New Wing of the existing YMT Police Station will be preserved, the existing kitchen, laundry and carpark will be demolished.

15. To maintain the existing services of the police station during construction, the police station was relocated to a new YMT Police Station at Yau Cheung Road in May 2016. In the meantime, the reporting centre in the Old Wing of YMT Police Station will remain in operation. As for the other areas in the Old Wing, they will be used by the HKPF as offices. Upon completion of the works, the Highways Department (HyD) will return the New Wing of YMT Police Station to the HKPF. The HKPF are now studying the future uses of the New Wing, taking into account the anticipated handover date, future operational needs and other factors.

(VII) Trees

(1) Total Tonnage of Felled Trees and Methods of Disposal

16. Based on an assumed average weight of 1.2 tonnes per tree, the 1 858 trees to be felled will weigh slightly over 2 000 tonnes. The yard waste is planned to be transported to the landfills for disposal. However, if there are other more suitable and practicable methods, the HyD will consider them based on actual circumstances.

17. It will be clearly stipulated in all CKR contracts that the contractor must comply with the requirements under the Waste Disposal Ordinance (Cap. 354) to dispose the waste properly.

(2) Species of the Newly Planted Trees

18. Of the 1 859 trees planned to be planted, the major species include *Elaeocarpus sylvestris, Lagerstroemia speciosa, Ilex rotunda, Crateva unilocularis, Xanthostemon chrysanthus, Grevillea robusta,* etc. As for shrubs, the major species include *Rhododendron simsii, Rhododendron pulchrum, Schefflera arboricola, Ixora chinensis, Codiaeum variegatum, Loropetalum chinense, Duranta erecta*, etc.

(VIII) Provision for Price Adjustment

(1) Justification, Computation Method and Operation

19. To cater for the movements in the costs of labour and materials in projects, the Government allows in the project cost a provision for price adjustment. We adopt the latest set of assumptions and the corresponding price adjustment factor (PAF) derived from the Government's forecast of trend rate of change in prices of public sector building and construction output to convert the cash flow of project cost estimated at the constant prices to money-of-the-day (MOD) prices.

20. As stated by the HyD at the PWSC meeting held on 21 June 2017, the cost for the CKR project is an overall estimate that includes the base estimate, project contingency, provision for price adjustment, etc. If the actual cost of any item is lower than the predicted cost, the difference can be used to cover additional expenditure for other items under the project. If the overall actual cost is lower than the predicted cost, the unused fund will be retained in the Government's Capital Works Reserve Fund. The works department

responsible for the project will manage the allocated fund in a prudent manner to ensure that the public fund is properly used. The HyD has all along been closely monitoring the spending situation of the project fund and strictly controlling the project expenditure in accordance with established procedures, with a view to completing the project within the original approved project estimate.

(2) Estimation of PAFs for public works in the past ten years

21. In estimating the provision for price adjustment, Government departments adopt the latest PAFs to derive the cost estimates of capital works projects in MOD prices. The Government derives the PAF from the latest set of assumptions based on the trend rate of change in prices of public sector building and construction output. In the process of making the trend assumptions, the Government takes full account of all the relevant factors, including the annual and quarterly survey data on the trend rate of change in prices of public sector building and construction output, the overall situation in the labour market, the latest trends of labour wages and prices of construction materials in the construction industry, as well as trends in global and local economic performance. To reasonably reflect the prevailing situation, the price adjustment factors are updated regularly.

(IX) Concrete Test

22. With regard to the quality assurance system for use of concrete in public works projects and the follow up actions on the alleged falsification of concrete test reports associated with the works under the Hong Kong-Zhuhai-Macao Bridge Hong Kong Section, the DEVB has reported on the matter in the paper no. CB(4)1148/16-17(01) (**Enclosure 3** refers) submitted to the LegCo Panel on Transport special meeting held on 5 June 2017.

Yours sincerely,

(Jocelyn NG)
for Secretary for Transport and Housing

c.c.

Secretary for Financial Services and the Treasury (Attn: Ms Margaret HSIA)	Fax No: 2523 5722
Secretary for Development (Attn: Mr John KWONG)	Fax No: 2537 1961
Director of Highways (Attn: Mr Tony LOK)	Fax No: 2714 5198
Commissioner of Transport (Attn: Mr K F CHEUNG)	Fax No: 2186 7519

Highways Department
Major Works Project Management Office

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主要工程管理處

Agreement No. CE 43/2010 (HY)
Central Kowloon Route
- Design and Construction

Final Updated Traffic Impact Assessment Executive Summary

(Ref: REP-101-01)

February 2014

ARUP Mott MacDonald

Arup-Mott MacDonald Joint Venture

Highways Department

Agreement No. CE 43/2010 (HY) Central Kowloon Route – Design and Construction

Final Updated Traffic Impact Assessment

Executive Summary

217722-REP-101-01

Final February 2014

Arup-Mott MacDonald Joint Venture
Level 5 Festival Walk
80 Tat Chee Avenue
Kowloon Tong
Kowloon
Hong Kong
www.arup.com

Arup-Mott MacDonald Joint Venture

Document Verification

Arup-Mott MacDonald Joint Venture

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Contents

1 GENERAL

On 30 June 2011, Highways Department (HyD) of the Government of the Hong Kong Special Administrative Region appointed ARUP – Mott MacDonald Ltd Joint Venture (hereinafter called AMMJV), under Agreement No. CE 43/2010 (HY), to provide professional services in respect of Central Kowloon Route – Design and Construction (hereinafter called "the Assignment").

2 DESCRIPTION OF PROJECT

The preferred alignment of Central Kowloon Route (CKR) is shown in **Figure 2.1**. The outline scope and description of CKR are given below:

a) dual 3-lane east-west trunk road about 4.7km long with about 3.9km in tunnel connecting West Kowloon with the proposed KTD;
b) access roads at the western end to link with the existing Yau Ma Tei Interchange of West Kowloon Highway as shown in **Figure 2.2**;
c) connection to future Trunk Road T2 and slip roads in Kowloon Bay and Kai Tak Development as shown in **Figure 2.3**;
d) demolition and re-provisioning of Government and community facilities affected by the CKR;
e) administration and ventilation buildings;
f) traffic control and surveillance system; and
g) associated environmental, geotechnical, marine, landscape, utility, drainage, traffic engineering and electrical and mechanical works.

CKR runs between Yau Ma Tei Interchange and interchange with the future Road T2 in the Kai Tak Development. The mainline is of dual-three standard. At both exits of the eastern and western ends of CKR, there is a fourth lane to be used as the climbing lane for facilitating traffic movements. It forms Route 6 together with Trunk Road T2 and Tseung Kwan O – Lam Tin Tunnel, scheduled for commissioning in 2021.

At the western end, CKR has slip road connections to West Kowloon Highway, Western Harbour Tunnel and Lin Cheung Road to/from West Kowloon Reclamation Area and Tsim Sha Tsui. At the eastern end, CKR has slip road connections to Kowloon Bay, Kwun Tong and the future Kai Tak Development and Trunk Road T2.

3 STUDY BACKGROUND AND METHODOLOGY

The objective of the Traffic Impact Assessment was to present the assessment and findings on the various traffic aspects related to the construction and permanent stages of CKR.

The east-west running road corridors in Kowloon have long been plagued by the problem of traffic capacity problems, attributed to the increase in property developments on both the western part (e.g. West Kowloon Reclamation, Lantau) and the eastern part (e.g. Tseung Kwan O) of the Kowloon Peninsula and the New Territories in recent years, without an upgrade in east-west traffic capacity of a comparable scale. The current flow

and V/C ratio figures indicate that many of the major links in Kowloon are already operating close to or above capacity. With further developments in the coming years at the West Kowloon Reclamation district and the Kai Tak Development, the demands for road capacity should be considerably increased in the future. The main objective in constructing the CKR is to address these east-west Kowloon traffic issues.

The forecast years for the TIA study were selected in accordance to the commissioning year of CKR. The traffic model development in the assignment was in a two-stage structure and approach, a territory-wide traffic model for obtaining strategic traffic figures, route choices, and strategic sensitivity tests; and local-level and district-level models of BDTMs (K1 and K2). The network configuration in the models was updated with committed schemes on both strategic and district levels. Traffic forecasts for the design years including 2016, 2021 and 2026 were prepared using the most up-to-date available planning data and model assumptions available at the time of the model development.

4 STUDY FINDINGS AND RECOMMENDATIONS

Existing Traffic Condition

The east-west running road corridors in Kowloon have long been plagued by the problem of traffic capacity problems. It can be partly attributed to the increase in property developments on both the western part (e.g. West Kowloon Reclamation, Lantau) and the eastern part (e.g. Tseung Kwan O) of the Kowloon Peninsula and the New Territories in recent years, without an upgrade in east-west traffic capacity of a comparable scale.

Table 4.1 and **Figure 4.1** demonstrate the level of utilisation on the major east-west road links, the observed traffic volumes and V/C ratios are tabulated.

Table 4.1 Observed Traffic Volumes and V/C Ratios for Major East-West Kowloon Road Links (Year 2012)

Road	Direction	Traffic Flow (pcu/hr) [V/C ratio][(1)(2)]	
		AM Peak	PM Peak
Lung Cheung Road (from Lion Rock Tunnel Road to Chuk Yuen Road)	EB	5530 [0.9]	4537 [0.8]
	WB	4646 [0.9]	4568 [0.9]
	WB (Slip road from Chuk Yuen Road)	950 [0.9]	555 [0.6]
Boundary Street (From Tai Hang Tung Road to Embankment Road)	EB	3112 [1.0]	3194 [1.1]
Prince Edward Road West (from Embankment Road to Kadoorie Ave)	WB	4884 [0.8]	4335 [0.7]
Argyle Street & FO (from Gullane Rd to Tin Kwong Rd)	EB	1997 [0.8]	2079 [0.9]
	WB	2004 [0.8]	1809 [0.8]
Chatham Road North (From Wuhu Street to Ping Chi Street)	EB	4640 [1.1]	4769 [1.1]
	WB	1394 [0.8]	2082 [1.2]
	WB (farside free flow lane)	2080 [1.3]	581 [0.4]

Road	Direction	Traffic Flow (pcu/hr) [V/C ratio](1)(2)	
		AM Peak	PM Peak
East Kowloon Corridor (From Ma Tau Kok Road to Chatham Road North)	EB	3159 [1.0]	3308 [1.1]
	WB	2398 [0.8]	1786 [0.6]
Gascoigne Road Flyover (Eastern Side of Nathan Road)	EB	1350 [0.8]	2265 [1.3]
	WB	1960 [1.2]	1763 [1.1]

Note:
(1) A v/c ratio is normally used to reflect traffic situation during peak hours. A v/c ratio above 1.0 indicates the onset of mild congestion. A v/c ratio above 1.2 indicates the onset of more serious congestion.
(2) V/C ratio above 1.2 indicates the onset of more serious congestion, and will be bounded to 1.3 due to the physical limitation.

From the results of the road link capacity assessment, many of the major links in Kowloon are already operating close to or above capacity at the moment.

Traffic Impacts during Operation

Based on the results from the model analysis, the majority of the trips using CKR have a west-end origin/destination in one of the districts of Northwest Kowloon, Kwai Chung, Tsing Yi, Tsuen Wan, and Northwest New Territories, and an east-end origin/destination in one of the districts of Kowloon Bay, Kwun Tong and Tseung Kwan O.

For detailed review of the traffic distribution effects attributed to CKR, the traffic flows at major east-west roads in Kowloon have been developed from the different future year traffic models. The results show that major east-west roads in Kowloon, including Lung Cheung Road, Prince Edward Road West and Chatham Road North, will be considerably over-capacity by 2021 if CKR is not commissioned by then. Travel speeds will be low and becomes susceptible to excessively long queues in the event of even minor incidents. With further developments in the coming years at the West Kowloon Reclamation district and the Kai Tak Development, the demands for road capacity should be considerably increased in the future. The findings from the study show that there is a general relief in traffic volumes for east-west Kowloon roads after 2021 offered by CKR when it is completed. **Table 4.2** & **4.3** and **Figure 4.2** summarises the corresponding critical V/C ratios for the pre- and post-CKR scenarios

Table 4.2 Observed Traffic Volumes and V/C Ratios for Major East-West Kowloon Road Links (Year 2021)

Road Link	Direction	Traffic Flow (pcu/hr)[V/C ratio](1)(2)			
		Without CKR		With CKR	
		AM Peak	PM Peak	AM Peak	PM Peak
Lung Cheung Road (from Lion Rock Tunnel Road to Chuk Yuen Road)	EB	6928 [1.2]	6258 [1.1]	5324 [0.9]	5671 [1.0]
	WB	5337 [1.0]	5003 [1.0]	4587 [0.9]	4176 [0.8]
	WB (Slip road from Chuk Yuen Road)	1110 [1.1]	631 [0.6]	935 [0.9]	490 [0.5]
Boundary Street (From Tai Hang Tung Road to Embankment Road)	EB	3702 [1.2]	3770 [1.3]	2518 [0.8]	2637 [0.9]
Prince Edward Road West (from Embankment Road to Kadoorie Ave)	WB	6385 [1.1]	5009 [0.8]	5028 [0.8]	4455 [0.7]

Road Link	Direction	Traffic Flow (pcu/hr)[V/C ratio](1)(2)			
		Without CKR		With CKR	
		AM Peak	PM Peak	AM Peak	PM Peak
Argyle Street & FO (from Gullane Rd to Tin Kwong Rd)	EB	2750 [1.1]	2504 [1.0]	1771 [0.7]	1781 [0.7]
	WB	2587 [1.1]	2215 [0.9]	1755 [0.7]	1835 [0.8]
Chatham Road North (From Wuhu Street to Ping Chi Street)	EB	5852 [1.3]	5430 [1.2]	4689 [1.1]	4512 [1.0]
	WB	1820 [1.0]	2106 [1.2]	1830 [1.0]	1209 [0.7]
	WB (farside free flow lane)	2080 [1.3]	1395 [0.9]	1820 [1.1]	1713 [1.1]
East Kowloon Corridor (From Ma Tau Kok Road to Chatham Road North)	EB	4160 [1.3]	3950 [1.3]	3291 [1.1]	3257 [1.1]
	WB	2275 [0.7]	2313 [0.7]	2676 [0.9]	1904 [0.6]
Gascoigne Road Flyover (Eastern Side of Nathan Road)	EB	2139 [1.3]	2367 [1.3]	1750 [1.1]	1900 [1.2]
	WB	2062 [1.3]	2150 [1.3]	1824 [1.1]	1951 [1.2]
Central Kowloon Route	EB	-	-	1643 [0.5]	2102 [0.6]
	WB	-	-	2209 [0.6]	1270 [0.4]

Note:
(1) A v/c ratio is normally used to reflect traffic situation during peak hours. A v/c ratio above 1.0 indicates the onset of mild congestion. A v/c ratio above 1.2 indicates the onset of more serious congestion.
(2) V/C ratio above 1.2 indicates the onset of more serious congestion, and will be bounded to 1.3 due to the physical limitation.

Table 4.3 Observed Traffic Volumes and V/C Ratios for Major East-West Kowloon Road Links (Year 2026)

Road Link	Direction	Traffic Flow (pcu/hr)[V/C ratio](1)(2)			
		Without CKR		With CKR	
		AM Peak	AM Peak	AM Peak	AM Peak
Lung Cheung Road (from Lion Rock Tunnel Road to Chuk Yuen Road)	EB	7012 [1.2]	6404 [1.1]	5443 [0.9]	5641 [1.0]
	WB	5308 [1.0]	5015 [1.0]	4717 [0.9]	4163 [0.8]
	WB (Slip road from Chuk Yuen Road)	1187 [1.2]	636 [0.6]	965 [1.0]	509 [0.5]
Boundary Street (From Tai Hang Tung Road to Embankment Road)	EB	3707 [1.2]	3975 [1.3]	2507 [0.8]	2632 [0.9]
Prince Edward Road West (from Embankment Road to Kadoorie Ave)	WB	6416 [1.1]	5101 [0.9]	5030 [0.8]	4431 [0.7]
Argyle Street & FO (from Gullane Rd to Tin Kwong Rd)	EB	2785 [1.2]	2557 [1.1]	1704 [0.7]	1847 [0.8]
	WB	2941 [1.2]	2367 [1.0]	1781 [0.7]	1822 [0.8]
Chatham Road North (From Wuhu Street to Ping Chi Street)	EB	5861 [1.3]	5448 [1.2]	4641 [1.1]	4629 [1.1]
	WB	1980 [1.1]	2111 [1.2]	1908 [1.1]	1222 [0.7]
	WB (farside free flow lane)	2080 [1.3]	1537 [1.0]	1830 [1.1]	1781 [1.1]
East Kowloon Corridor (From Ma Tau Kok Road to Chatham Road North)	EB	4160 [1.3]	3950 [1.3]	3394 [1.1]	3418 [1.1]
	WB	2410 [0.8]	2370 [0.8]	2619 [0.8]	1885 [0.6]
Gascoigne Road Flyover (Eastern Side of Nathan Road)	EB	2139 [1.3]	2289 [1.3]	2240 [1.3]	2500 [1.3]
	WB	2074 [1.3]	2150 [1.3]	2262 [1.3]	2517 [1.3]
Central Kowloon Route	EB	-	-	3304 [0.6]	4688 [0.9]

Road Link	Direction	Traffic Flow (pcu/hr)[V/C ratio][(1)(2)]			
		Without CKR		With CKR	
		AM Peak	AM Peak	AM Peak	AM Peak
	WB	-	-	4919 [0.9]	4474 [0.8]

Note:
(1) A v/c ratio is normally used to reflect traffic situation during peak hours. A v/c ratio above 1.0 indicates the onset of mild congestion. A v/c ratio above 1.2 indicates the onset of more serious congestion.
(2) V/C ratio above 1.2 indicates the onset of more serious congestion, and will be bounded to 1.3 due to the physical limitation.

Based on the results depicted in above tables, it was observed that there will be general improvement in the congestions in the study areas when comparing with the corresponding reference year scenario. Link performances are generally improved when comparing with those of 2026 do-nothing scenario. It implies that the implementation of CKR together with other component of route 6 and CBL imposes positive traffic effect in the entire Kowloon area.

Traffic Impacts during Construction

The construction of CKR will be in tunnel using different tunneling methods throughout its mainline section, thus minimizing the works interface and any associated traffic impacts on the ground level throughout most of the Kowloon area.

At CKR's east end, a cut-and-cover tunnel interface is proposed to be at the existing public transport interchange (PTI) at the Kowloon City Ferry Pier. Part of the PTI would be taken up as works area for a period of up to 5 years. The temporary arrangement of the PTI has been considered in this study based on the preliminary construction methodology, to minimise the adverse impacts on the public during the works duration. Full re-provision of the existing public transport and public parking facilities, comprising public meter parking and private-operated parking under Short Term Tenancy, would be maintained within the PTI or in the close proximity during the CKR construction period. **Figure 4.3** illustrates the typical temporary arrangements of the PTI. Upon completion of work, the PTI will be constructed to the future permanent layout that is designed under the Kai Tak Development Engineering Study.

Kai Fuk Road will be re-designed in association with the new slip roads between CKR and Kai Fuk Road. The works involved would comprise minor works at the interface between the new and existing roads, while the existing roads are still operational with live traffic. The principle is to maintain the existing road operational with as little disruption and lane closure as possible. **Figure 4.4** illustrates the typical temporary arrangement during the re-alignment works of Kai Fuk Road.

At CKR's western end, there would be a series of at-grade and sub-grade works for CKR. At the section of Kansu Street between Nathan Road and Ferry Street, coordinated construction works area and programme with GRF works have been assumed, and a set of temporary traffic management schemes (TTMS) has been developed. The principles in developing the TTMS was to minimise the impacts on traffic accessibility and road capacity as much as possible while enabling reasonable construction area sizes and sequences for a realistic and acceptable construction programme for CKR. Diversion routes

would be necessary but are kept to minimum detour for minimising impacts for the public. **Figure 4.5** shows the typical temporary traffic arrangements in the Kansu Street locale ◦

Construction works are also required for the reconstruction of the Hoi Wang Road from its existing alignment into the proposed, slightly skewed layout to suit the western CKR tunnel portal. In association, the two existing slip roads from Hoi Wang Road, towards Lin Cheung Road northbound, and towards Western Harbour Tunnel respectively, would also be re-aligned at the Hoi Wang Road ends. The existing Ngo Cheung Road would also be permanently decommissioned to make way for the supporting facilities and roads for CKR western portal. The westbound road function will be re-provisioned by a new permanent westbound carriageway for Lai Cheung Road between Ferry Street and Hoi Wang Road. The underlying principle is that all traffic movements and turning maneuvers at the neighbouring junctions are maintained during all times of the construction, and the requirement of a police emergency egress at Hoi Wang Road has to be satisfied at the onset of the commissioning of the Police Station. The slip road access to Lin Cheung Road northbound and Western Harbour Tunnel can maintain operational by some temporary decking means. **Figure 4.6** shows the typical temporary traffic arrangements at Hoi Wang Road.

The construction and demolition materials (C&DM) from the tunneling would be mucked out at access shafts at the eastern, central and western end of the tunnel as shown in **Figure 4.7**. The locations of the C&DM source are identified at the eastern, central and western portions of CKR. The temporary traffic implications have been reviewed accordingly for such proposed locations and delivery routings. The proposed route is via: West (Yau Ma Tei Hau Cheung Street and Kansu Street) – Tuen Mun Public Fill Reception Facility; Central (Ho Man Tin) – Tuen Mun Public Fill Reception Facility; and East (Kowloon City Ferry Pier and Kai tak Depressed Road) – Tuen Mun and Tseung Kwan O Public Fill Reception Facility.

The volume of construction trucks for the CD&M delivery is envisaged to be relatively minor. The routings between the site and the barging point for CKR were derived for minimising overlapping with the other projects, in particular MTRCL's Shatin-Central Link. The V/C ratios for the affected road section and the junction performance of the critical junctions along the proposed routings between the site and the public fill reception facility with the additional construction traffic are similar as before. This indicates that the additional impacts brought about by the C&DM delivery traffic are insignificant.

Impacts on Public Transport

As aforementioned, much of the CKR construction will be by means of bored tunnel method with minimal interface with the ground level. The impacts on public transport, in particular franchised buses, would therefore be localised to the east and west ends of CKR ◦

At the eastern end, full re-provision of the existing public transport and other transport facilities would be maintained within the PTI at the Kowloon City Ferry Pier or in the close proximity during the CKR construction period.

At the western end, all existing bus routes running along Shanghai Street and Canton Road and Yan Cheung Road are not affected in terms of routing by the works around Kansu

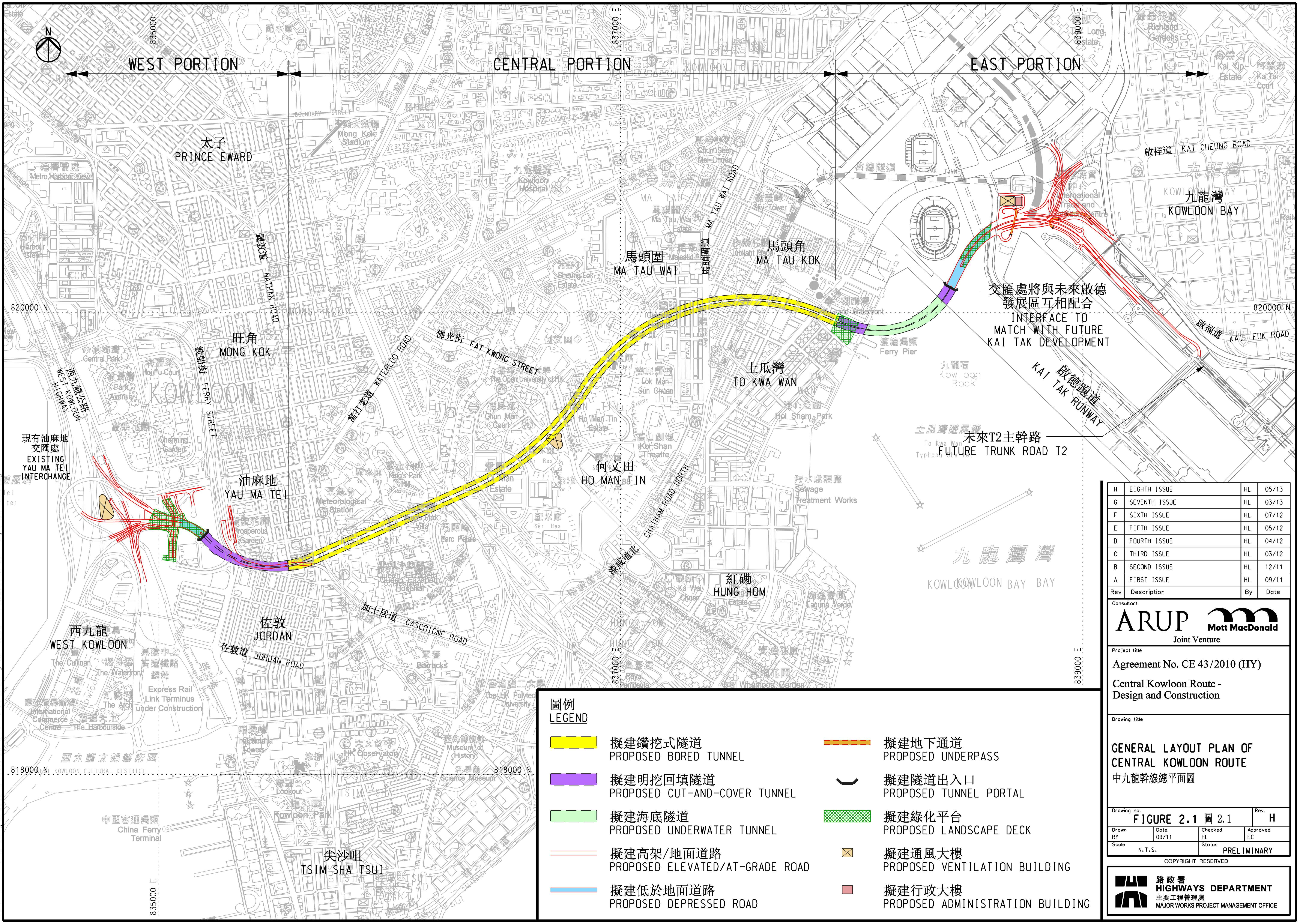
Street or Hoi Wang Road. The existing KMB Route 10 uses Ngo Cheung Road at present. Once Ngo Cheung Road is decommissioned, the route would be permanently re-routed to use the new Lai Cheung Road westbound, and the same right-turn to Hoi Wang Road northbound will be maintained. No bus stops are affected.

5 CONCLUSION

In conclusion, a number of major east-west road corridors in Kowloon are already operating around or even above capacity now, and the situation is envisaged to worsen with new developments. It is anticipated that the introduction of CKR by the year 2021 can address this problem by providing additional E-W road capacity and associated traffic relief to the existing roads. CKR would ultimately become a critical part of the Route 6 that would provide strategic connections between west and east Kowloon together with Trunk Road T2 and Tseung Kwan O – Lam Tin Tunnel.

Considerations would be made in the construction methodology and programme for minimising impacts on the general traffic during construction of the road. Different tunnel methods would be applied for the construction of the road link to minimise the impacts on the at-grade road network. At interfacing areas or tunnel portals where the works cannot be totally underground, TTMS would be developed for maintaining traffic and pedestrian movements and minimise adverse impacts as much as possible.

Figures


N
WEST PORTION
CENTRAL PORTION
EAST PORTION
835000 E
837000 E
839000 E
820000 N
818000 N
太子
PRINCE EWARD
旺角
MONG KOK
油麻地
YAU MA TEI
佐敦
JORDAN
尖沙咀
TSIM SHA TSUI
西九龍
WEST KOWLOON
現有油麻地交匯處
EXISTING YAU MA TEI INTERCHANGE
西九龍公路
WEST KOWLOON HIGHWAY
渡船街
FERRY STREET
彌敦道
NATHAN ROAD
窩打老道
WATERLOO ROAD
佛光街
FAT KWONG STREET
加士居道
GASCOIGNE ROAD
佐敦道
JORDAN ROAD
何文田
HO MAN TIN
馬頭圍
MA TAU WAI
馬頭角
MA TAU KOK
馬頭圍道
MA TAU WAI ROAD
土瓜灣
TO KWA WAN
紅磡
HUNG HOM
漆咸道北
CHATHAM ROAD NORTH
九龍灣
KOWLOON BAY
啟祥道
KAI CHEUNG ROAD
啟福道
KAI FUK ROAD
啟德跑道
KAI TAK RUNWAY
交匯處將與未來啟德發展區互相配合
INTERFACE TO MATCH WITH FUTURE KAI TAK DEVELOPMENT
未來T2主幹路
FUTURE TRUNK ROAD T2
Kowloon Hospital
Ferry Pier
Sky Tower
Kowloon Park
China Ferry Terminal
Express Rail Link Terminus under Construction
International Commerce Centre
Meteorological Station
Queen Elizabeth Hospital
Sewage Treatment Works
Hoi Sham Park
Ko Shan Theatre
The Open University of HK

圖例
LEGEND

擬建鑽挖式隧道 PROPOSED BORED TUNNEL	擬建地下通道 PROPOSED UNDERPASS
擬建明挖回填隧道 PROPOSED CUT-AND-COVER TUNNEL	擬建隧道出入口 PROPOSED TUNNEL PORTAL
擬建海底隧道 PROPOSED UNDERWATER TUNNEL	擬建綠化平台 PROPOSED LANDSCAPE DECK
擬建高架/地面道路 PROPOSED ELEVATED/AT-GRADE ROAD	擬建通風大樓 PROPOSED VENTILATION BUILDING
擬建低於地面道路 PROPOSED DEPRESSED ROAD	擬建行政大樓 PROPOSED ADMINISTRATION BUILDING

Rev	Description	By	Date
H	EIGHTH ISSUE	HL	05/13
G	SEVENTH ISSUE	HL	03/13
F	SIXTH ISSUE	HL	07/12
E	FIFTH ISSUE	HL	05/12
D	FOURTH ISSUE	HL	04/12
C	THIRD ISSUE	HL	03/12
B	SECOND ISSUE	HL	12/11
A	FIRST ISSUE	HL	09/11

Consultant
ARUP Mott MacDonald
Joint Venture

Project title
Agreement No. CE 43/2010 (HY)
Central Kowloon Route - Design and Construction

Drawing title
GENERAL LAYOUT PLAN OF CENTRAL KOWLOON ROUTE
中九龍幹線總平面圖

Drawing no. FIGURE 2.1 圖 2.1 Rev. H

Drawn	Date	Checked	Approved
RY	09/11	HL	EC

Scale N.T.S. Status PRELIMINARY

路政署
HIGHWAYS DEPARTMENT
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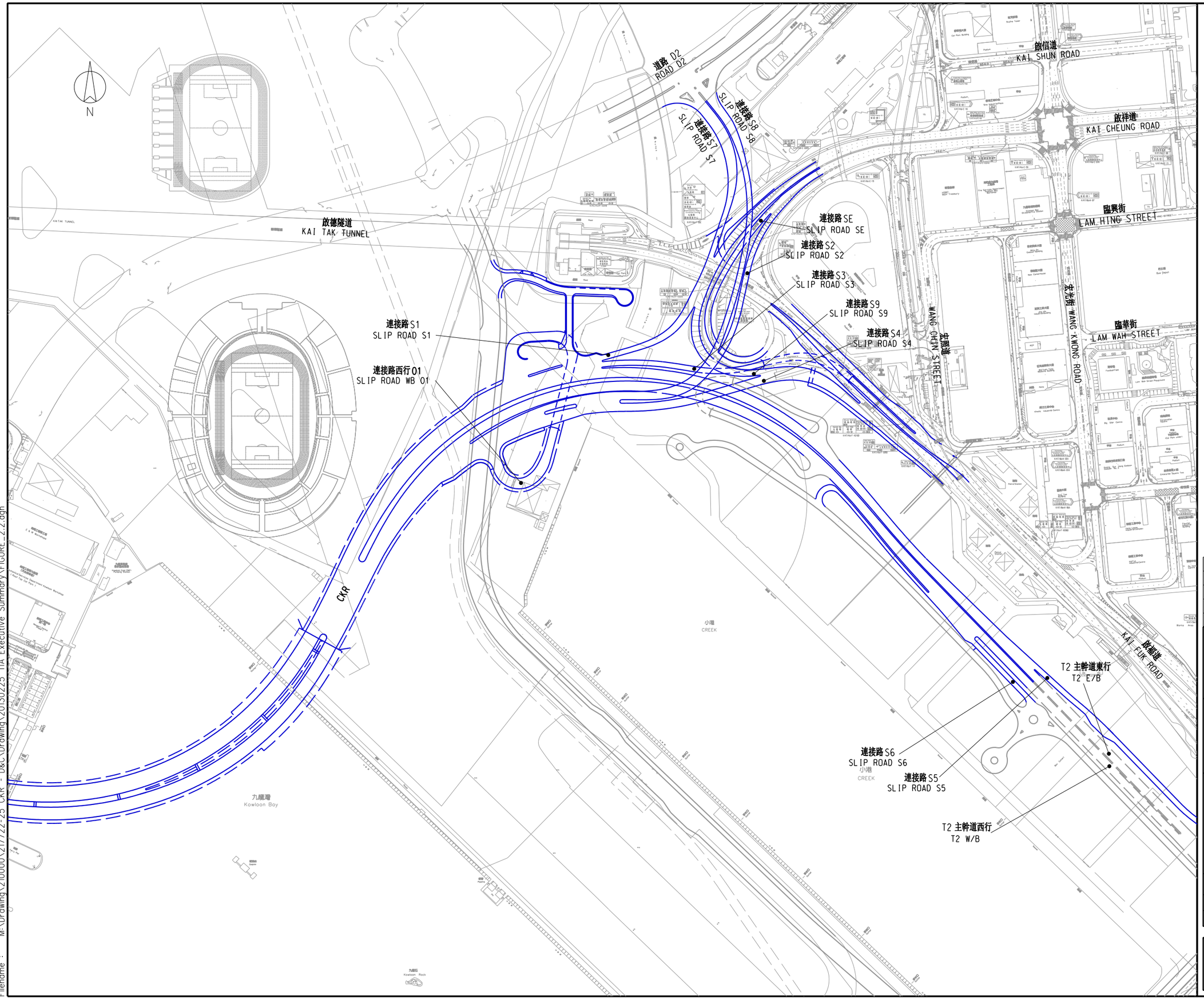
Printed by : 2/5/2014
Filename : M:\Drawing\210000\217722-25 CKR - D&C\Drawing\20140205 TIA Executive Summary\FIGURE_2.1.dgn



Rev	Description	By	Date

Consultant

ARUP 奧雅納 | Mott MacDonald 莫特麥克唐納

聯營公司
Joint Venture

Project title
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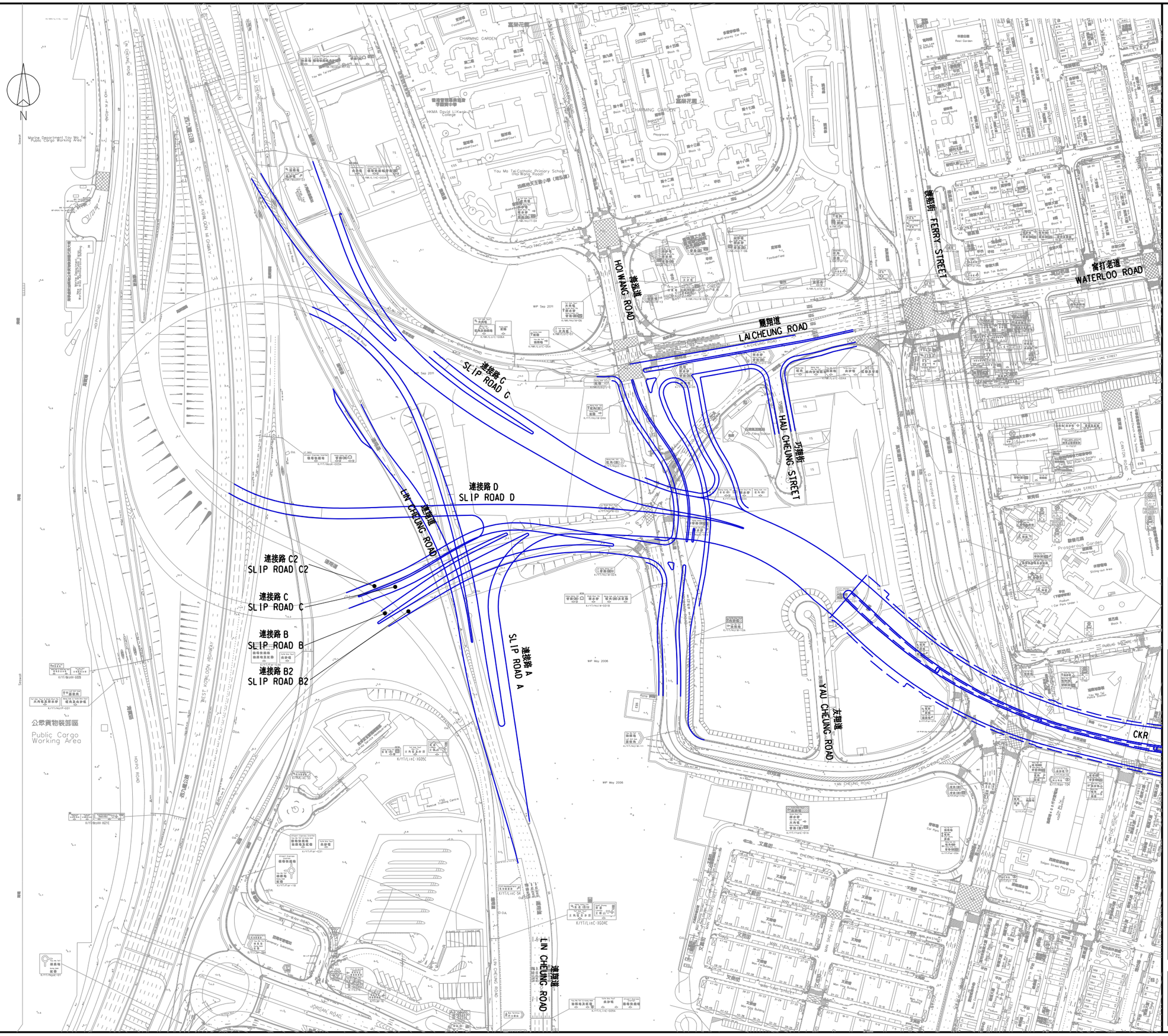
Agreement No. CE 43/2010 (HY)
中九龍幹線一設計及施工
Central Kowloon Route -
Design and Construction

Drawing title
Proposed Interchange
at CKR Eastern End
擬建的中九龍幹線西端交匯處

Drawing no.		Rev.
FIGURE 2.2 圖 2.2		-
Drawn: KHC	Date: Aug 12	Checked: FKFT	Approved: WCDC
Scale: 1:2000 @ A1		Status: PRELIMINARY	

路政署
HIGHWAYS DEPARTMENT
主要工程管理處
MAJOR WORKS PROJECT MANAGEMENT OFFICE

Printed by : 2/27/2013
Filename : M:\Drawing\210000\217722-25 CKR - D&C\Drawing\20130225 TIA Executive Summary\FIGURE_2.2.dgn



Rev	Description	By	Date

Consultant

ARUP 奧雅納 | Mott MacDonald 莫特麥克唐納

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Joint Venture

Project title
合約編號
Agreement No. CE 43/2010 (HY)
中九龍幹線一設計及施工
Central Kowloon Route - Design and Construction

Drawing title
Proposed Interchange at CKR Western End
擬建的中九龍幹線東端交匯處

Drawing no.			Rev.
FIGURE 2.3 圖 2.3			-
Drawn	Date	Checked	Approved
KHC	Aug 12	FKFT	WCDC
Scale		Status	
1:2000 @ A1		PRELIMINARY	

路政署
HIGHWAYS DEPARTMENT
主要工程管理處
MAJOR WORKS PROJECT MANAGEMENT OFFICE

Printed by : 2/27/2013
Filename : M:\Drawing\210000\217722-25 CKR - D&C\Drawing\20130225 TIA Executive Summary\FIGURE_2.3.dgn

界限街（由大坑東道至基堤道） Boundary St (from Tai Hang Tung Rd to Embankment Rd)	2012	
	上午 AM	下午 PM
東行 EB	1.0	1.1

大子道西(由基堤道至嘉道理道) Prince Edward Rd West (from Embankment Rd to Kadoorie Ave)	2012	
	上午 AM	下午 PM
西行 WB	0.8	0.7

龍翔道 (由獅子山隧道公路至竹園道) Lung Cheung Rd (from Lion Rock Tunnel Rd to Chuk Yuen Rd)	2012	
	上午 AM	下午 PM
東行 EB	0.9	0.8
西行 WB	0.9	0.9

亞皆老街及天橋 (由嘉齡道至天光道) Argyle St & FO (from Gullane Rd to Tin Kwong Rd)	2012	
	上午 AM	下午 PM
東行 EB	0.8	0.9
西行 WB	0.8	0.8

東九龍走廊 (由馬頭角道至漆咸道北) East Kowloon Corridor (from Ma Tau Kok Rd to Chatham Rd North)	2012	
	上午 AM	下午 PM
東行 EB	1.0	1.1
西行 WB	0.8	0.6

加士居道天橋 (彌敦道以東) Gascoigne Rd Flyover (Eastern side of Nathan Rd)	2012	
	上午 AM	下午 PM
東行 EB	0.8	1.3
西行 WB	1.2	1.1

漆咸道北 (由蕪湖街至平治街) Chatham Rd North (from Wuhu St to Ping Chi St)	2012	
	上午 AM	下午 PM
東行 EB	1.1	1.1
西行 WB	0.8	1.2

龍翔道 LUNG CHEUNG ROAD
黃大仙 WONG TAI SIN
石硤尾 SHEK KIP MEI
九龍塘 KOWLOON TONG
窩打老道 WATERLOO ROAD
界限街 BOUNDARY STREET
太子道東 PRINCE EDWARD ROAD EAST
亞皆老街 ARGYLE STREET
渡輪街 FERRY STREET
何文田 HO MAN TIN
彌敦道 NATHAN ROAD
馬頭圍道 MA TAU WAI ROAD
牛頭角 NGAU TAU KOK
九龍灣 KOWLOON BAY
觀塘道 KWUN TONG ROAD
觀塘繞道 KWUN TONG BYPASS
觀塘 KWUN TONG
利源東街 LEI YUE MUN ROAD
紅磡 HUNG HOM
加士居道 GASCOIGNE ROAD
尖沙咀 TSIM SHA TSUI
北角 NORTH POINT
油塘 YAU TONG
VICTORIA HARBOUR

圖例 ：
LEGEND ：

主要道路容車比率少於 1.2
LINK WITH V/C RATIO <1.2

主要道路容車比率大於 1.2
LINK WITH V/C RATIO ≥1.2

主要道路
CRITICAL ROAD LINKS

行車方向 TRAFFIC BOUND	容車比率 V/C RATIO
東行 EB	1.0

Rev	Description	By	Date

Consultant
ARUP 奧雅納
Mott MacDonald 莫特麥克唐納
聯營公司
Joint Venture

Project title
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Agreement No. CE 43/2010 (HY)
中九龍幹線一設計及施工
Central Kowloon Route - Design and Construction

Drawing title
2012 Critical Road Links Performance
2012年中九龍及西九龍主要路段的表現

Drawing no. FIGURE 4.1 圖 4.1
Rev. -
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路政署 HIGHWAYS DEPARTMENT
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Filename : M:\Drawing\210000\217722-25 CKR - D&C\Drawing\20130225 TIA Executive Summary\FIGURE_4.1.dgn

龍翔道 (由獅子山隧道公路至竹園道) Lung Cheung Rd (from Lion Rock Tunnel Rd to Chuk Yuen Rd)	2021 沒有中九龍幹線 2021 Without CKR		2021 有中九龍幹線 2021 With CKR		2026 沒有中九龍幹線 2026 Without CKR		2026 有中九龍幹線 2026 With CKR	
	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM
東行 EB	1.2	1.1	0.9	1.0	1.2	1.1	0.9	1.0
西行 WB	1.0	1.0	0.9	0.8	1.0	1.0	0.9	0.8

界限街（由大坑東道至基堤道） Boundary St (from Tai Hang Tung Rd to Embankment Rd)	2021 沒有中九龍幹線 2021 Without CKR		2021 有中九龍幹線 2021 With CKR		2026 沒有中九龍幹線 2026 Without CKR		2026 有中九龍幹線 2026 With CKR	
	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM
東行 EB	1.2	1.3	0.8	0.9	1.2	1.3	0.8	0.9

亞皆老街及天鵝 (由嘉齡道至天光道) Argyle St & FO (from Gullane Rd to Tin Kwong Rd)	2021 沒有中九龍幹線 2021 Without CKR		2021 有中九龍幹線 2021 With CKR		2026 沒有中九龍幹線 2026 Without CKR		2026 有中九龍幹線 2026 With CKR	
	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM
東行 EB	1.1	1.0	0.7	0.7	1.2	1.1	0.7	0.8
西行 WB	1.1	0.9	0.7	0.8	1.2	1.0	0.7	0.8

東九龍走廊 (由馬頭角道至漆咸道北) East Kowloon Corridor (from Ma Tau Kok Rd to Chatham Rd North)	2021 沒有中九龍幹線 2021 Without CKR		2021 有中九龍幹線 2021 With CKR		2026 沒有中九龍幹線 2026 Without CKR		2026 有中九龍幹線 2026 With CKR	
	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM
東行 EB	1.3	1.3	1.1	1.1	1.3	1.3	1.1	1.1
西行 WB	0.7	0.7	0.9	0.6	0.8	0.8	0.8	0.6

漆咸道北 (由蕪湖街至平治街) Chatham Rd North (from Wuhu St to Ping Chi St)	2021 沒有中九龍幹線 2021 Without CKR		2021 有中九龍幹線 2021 With CKR		2026 沒有中九龍幹線 2026 Without CKR		2026 有中九龍幹線 2026 With CKR	
	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM
東行 EB	1.3	1.2	1.1	1.0	1.3	1.2	1.1	1.1
西行 WB	1.0	1.2	1.0	0.7	1.1	1.2	1.1	0.7

加士居道天橋 (彌敦道以東) Gascoigne Rd Flyover (Eastern side of Nathan Rd)	2021 沒有中九龍幹線 2021 Without CKR		2021 有中九龍幹線 2021 With CKR		2026 沒有中九龍幹線 2026 Without CKR		2026 有中九龍幹線 2026 With CKR	
	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM
東行 EB	1.3	1.3	1.1	1.2	1.3	1.3	1.3	1.3
西行 WB	1.3	1.3	1.1	1.2	1.3	1.3	1.3	1.3

大子道西(由基堤道至嘉道理道) Prince Edward Rd West (from Embankment Rd to Kadoorie Ave)	2021 沒有中九龍幹線 2021 Without CKR		2021 有中九龍幹線 2021 With CKR		2026 沒有中九龍幹線 2026 Without CKR		2026 有中九龍幹線 2026 With CKR	
	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM	上午 AM	下午 PM
西行 WB	1.1	0.8	0.8	0.7	1.1	0.9	0.8	0.7

圖例 :
LEGEND :

主要道路容車比率少於 1.2
LINK WITH V/C RATIO <1.2

主要道路容車比率大於 1.2
LINK WITH V/C RATIO ≥1.2

主要道路
CRITICAL ROAD LINKS

行車方向 TRAFFIC BOUND	容車比率 V/C RATIO
東行 EB	1.0

Rev	Description	By	Date

Consultant
ARUP 奧雅納
Mott MacDonald 莫特麥克唐納
聯營公司
Joint Venture

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Agreement No. CE 43/2010 (HY)
中九龍幹線一設計及施工
Central Kowloon Route - Design and Construction

Drawing title
2021 and 2026 Critical Road Links Performance
2021及2026年中九龍及西九龍主要路段的表現

Drawing no. FIGURE 4.2 圖 4.2 Rev. -
Drawn KHC | Date Aug 12 | Checked FKFT | Approved WCDC
Scale 1:20000 @ A1 | Status PRELIMINARY

路政署 HIGHWAYS DEPARTMENT
主要工程管理處 MAJOR WORKS PROJECT MANAGEMENT OFFICE

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Filename : M:\Drawing\210000\217722-25 CKR - D&C\Drawing\20130225 TIA Executive Summary\FIGURE_4.2.dgn

圖例：
LEGEND：

工地
WORKS AREA

工地入口 / 出口
SITE ENTRANCE / EXIT

注水護欄
WATER BARRIER

緊急車輛通道
EVA ALLOWED

Rev	Description	By	Date

Consultant

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Project title
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Agreement No. CE 43/2010 (HY)
中九龍幹線一設計及施工
Central Kowloon Route - Design and Construction

Drawing title
Typical Temporary Traffic Arrangement Measure at Kowloon City Ferry Pier Bus Terminus for the Construction of Cut-and-cover Tunnel and associated Works Tunnel and associated Works
九龍城碼頭公共運輸交匯處明挖回填及隧道接駁工程的臨時交通措施

Drawing no.			Rev.
FIGURE 4.3 圖 4.3			-
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路政署
HIGHWAYS DEPARTMENT
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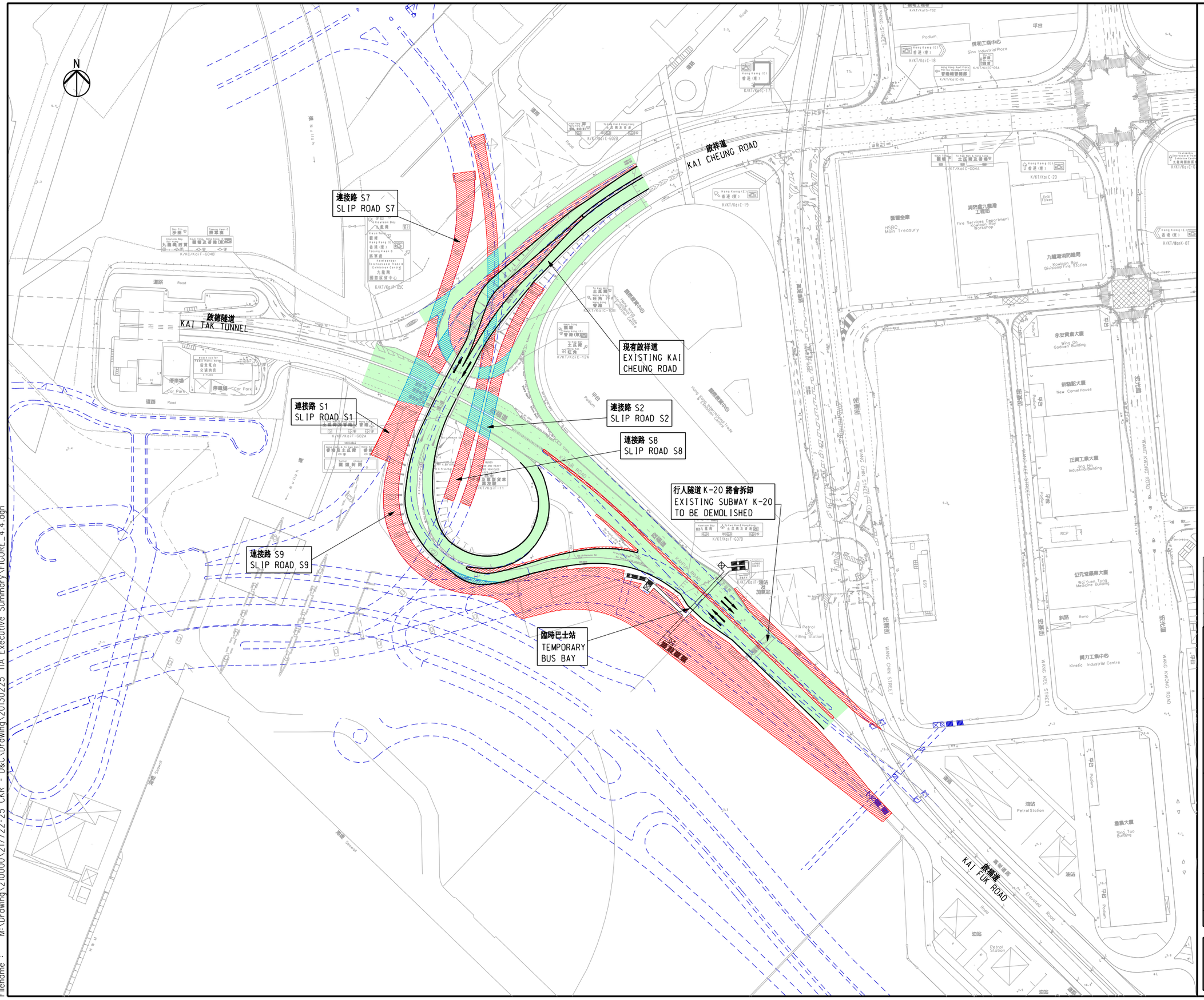


圖例：
LEGENDS：

- 受影響道路 AFFECTED ROAD SECTION
- 行車方向 TRAFFIC DIRECTION
- 工地 WORKING AREA
- 短暫 / 晚間 臨時封閉 SHORT PERIOD / MIDNIGHT ROAD CLOSURE FOR ELEVATED FRAME WORK / STRUTURE UP LIFTING

Rev	Description	By	Date

Consultant

ARUP 奧雅納 / Mott MacDonald 莫特麥克唐納

聯營公司
Joint Venture

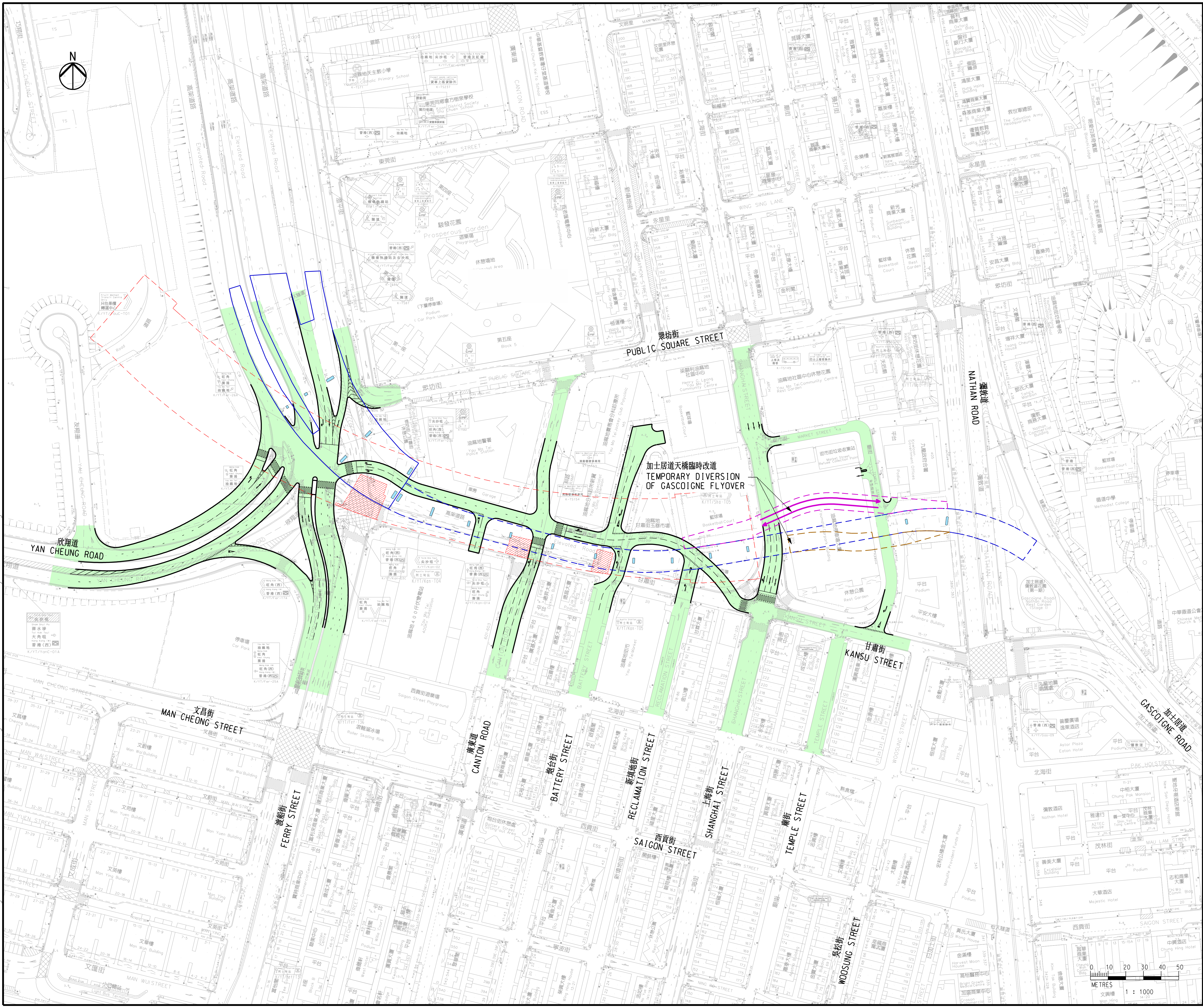
Project title
合約編號
Agreement No. CE 43/2010 (HY)
中九龍幹線一設計及施工
Central Kowloon Route - Design and Construction

Drawing title
Typical Temporary Traffic Arrangement Measure for the Construction of Eastern Interchange
東端交匯處工程的臨時交通措施

Drawing no.			Rev.
FIGURE 4.4 圖 4.4			-
Drawn	Date	Checked	Approved
KHC	JAN 13	WCEC	WCEC
Scale		Status	
1:1000 @ A1		PRELIMINARY	

路政署
HIGHWAYS DEPARTMENT
主要工程管理處
MAJOR WORKS PROJECT MANAGEMENT OFFICE

Printed by : 2/26/2013
Filename : M:\Drawing\210000\217722-25 CKR - D&C\Drawing\20130225 TIA Executive Summary\FIGURE_4.4.dgn



圖例：
LEGEND :

工地
WORKS AREA

Rev	Description	By	Date

Consultant

ARUP 奧雅納

Mott MacDonald 莫特麥克唐納

聯營公司
Joint Venture

Project title

合約編號
Agreement No. CE 43/2010 (HY)
中九龍幹線－設計及施工
Central Kowloon Route - Design and Construction

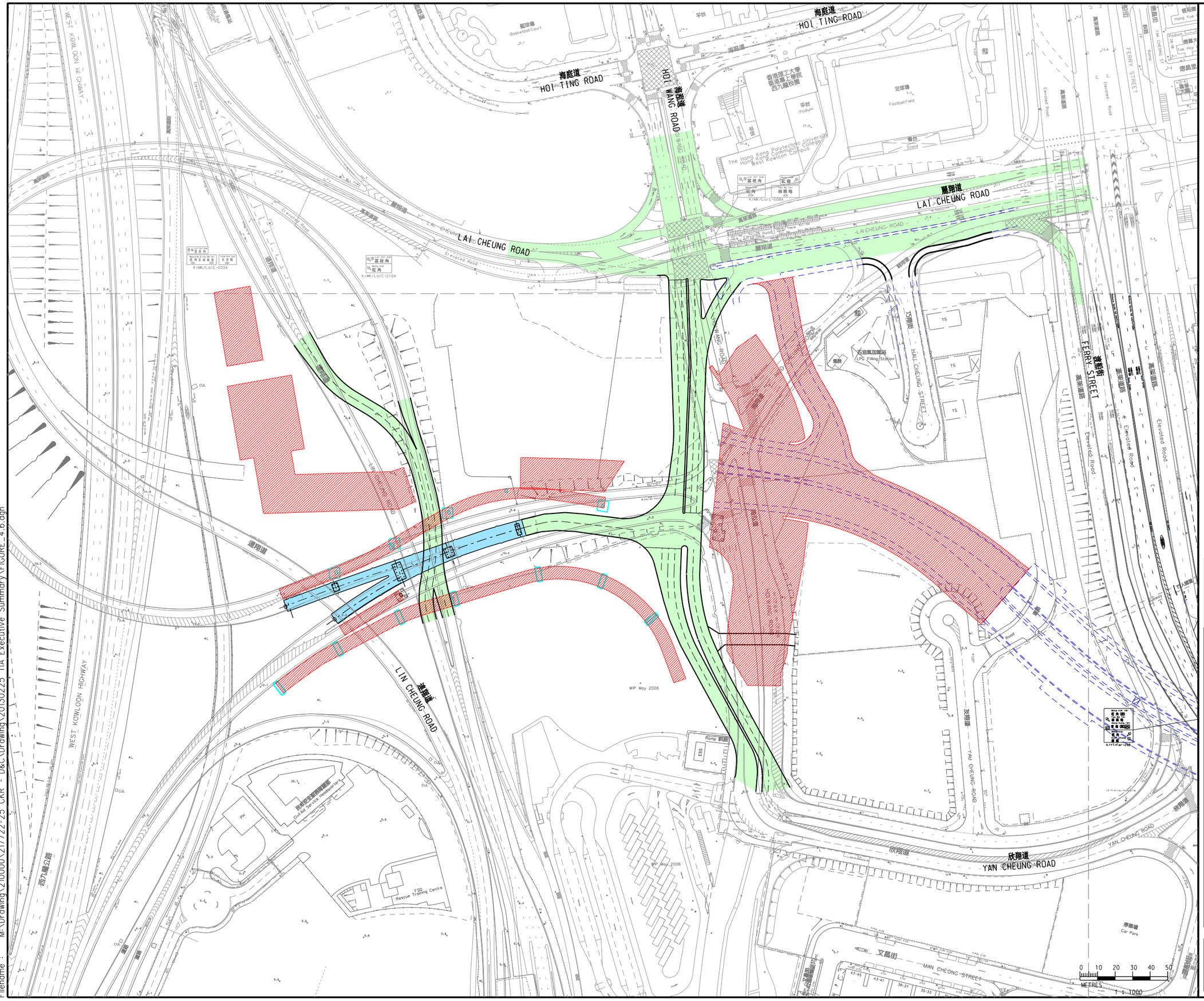
Drawing title

Typical Temporary Traffic Arrangement Measure at Kansu Street for the Construction of Cut-and-cover Tunnel and Gascoigne Road Flyover Re-alignment
甘肅街及渡船街明挖回填工程及加士居道行車天橋重新定線的臨時交通措施

Drawing no.			Rev.
FIGURE 4.5 圖 4.5			A
Drawn CHPH	Date 01/12	Checked BF	Approved EC
Scale 1:1000 @ A1		Status PRELIMINARY	

路政署
HIGHWAYS DEPARTMENT
主要工程管理處
MAJOR WORKS PROJECT MANAGEMENT OFFICE

Printed by : 2/27/2013
Filename : M:\Drawing\210000\217722-25 CKR - D&C\Drawing\20130225 TIA Executive Summary\FIGURE_4.5.dgn



圖例：
LEGEND:

臨時道路
TEMPORARILY REALIGNED CARRIAGEWAY

工地
WORKS AREA

Rev	Description	By	Date

Consultant

ARUP 奧雅納

Mott MacDonald 莫特麥克唐納

聯營公司
Joint Venture

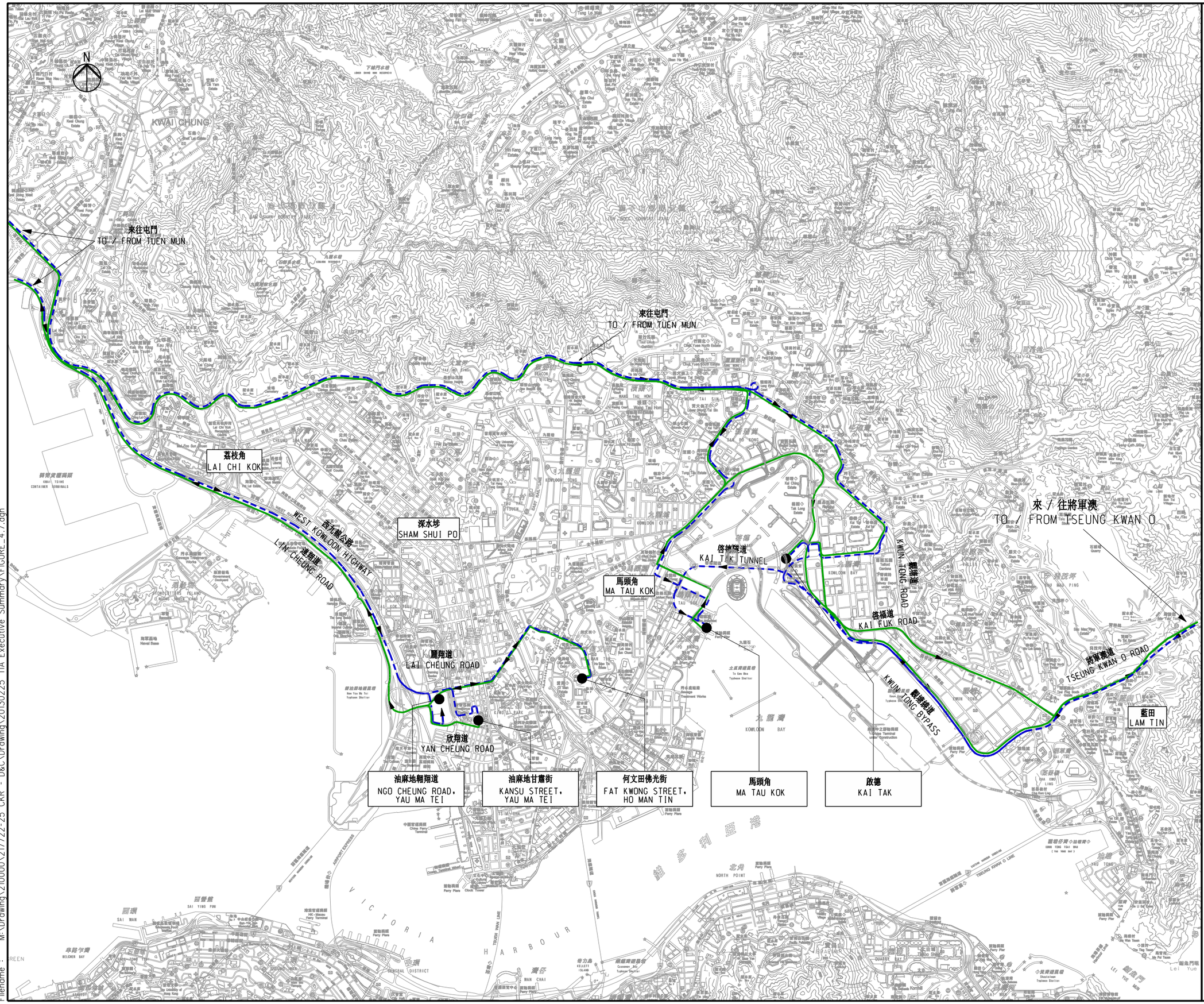
Project title
合約編號
Agreement No. CE 43/2010 (HY)
中九龍幹線－設計及施工
Central Kowloon Route - Design and Construction

Drawing title
Typical Temporary Traffic Arrangement Measure at Western Interchange and Hoi Wang Road Re-alignment
東端交匯處及海泓道將重新定線工程的臨時交通措施

Drawing no.			Rev.
FIGURE 4.6 圖 4.6			A
Drawn	Date	Checked	Approved
CHPH	01/12	BF	EC
Scale		Status	
1:1000 @ A1		PRELIMINARY	

路政署
HIGHWAYS DEPARTMENT
主要工程管理處
MAJOR WORKS PROJECT MANAGEMENT OFFICE

Printed by : 2/27/2013
Filename : M:\Drawing\210000\217722-25 CKR - D&C\Drawing\20130225 TIA Executive Summary\FIGURE_4.6.dgn



圖例：
LEGEND：

往公眾填料接收設施
TO PUBLIC FILL RECEPTION FACILITY

往工地
TO CONSTRUCTION SITE

Rev	Description	By	Date
A	FIRST ISSUE	KC	06/12

Consultant

ARUP 奧雅納 | Mott MacDonald 莫特麥克唐納

聯營公司
Joint Venture

Project title
合約編號
Agreement No. CE 43/2010 (HY)
中九龍幹線一設計及施工
Central Kowloon Route - Design and Construction

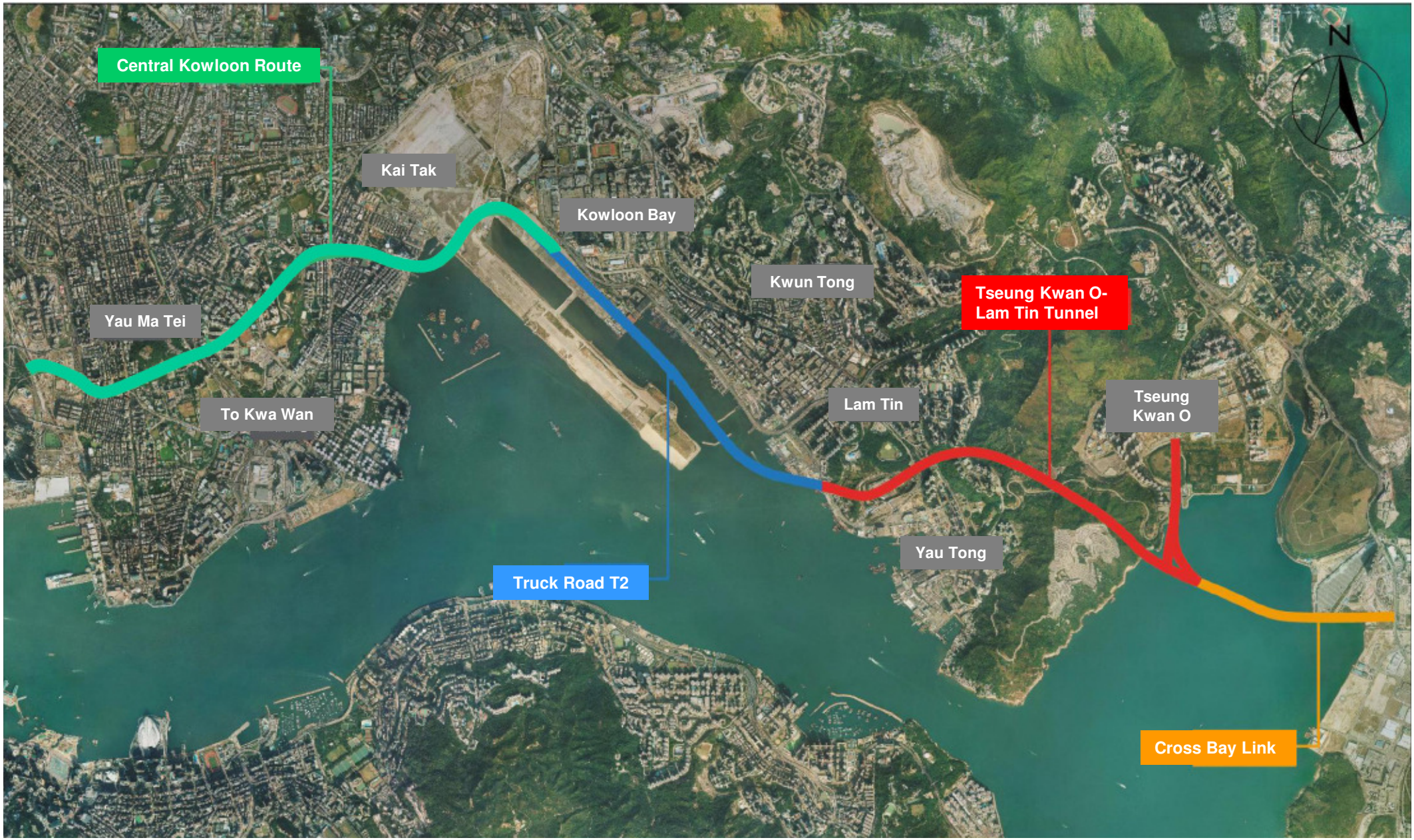
Drawing title
Construction Routing Arrangement for Eastern, Central and Western Portion
東段、中段及西段拆建物料運輸路線

Drawing no.		Rev.
FIGURE 4.7 圖 4.7		A
Drawn: CLL	Date: 06/12	Checked: BF	Approved: EC
Scale: 1:10000 @ A1		Status: PRELIMINARY	

路政署
HIGHWAYS DEPARTMENT
主要工程管理處
MAJOR WORKS PROJECT MANAGEMENT OFFICE

Printed by : 2/27/2013
Filename : M:\Drawing\210000\217722-25 CKR - D&C\Drawing\20130225 TIA Executive Summary\FIGURE_4.7.dgn

Route 6（Cross Bay Link not included)



CB(4)1148/16-17(01)

Legislative Council Panel on Transport

Quality Assurance System for Use of Concrete in Public Works Programme (PWP) Projects

P URPOSE

This paper provides information on the quality assurance system for use of concrete in public works programme (PWP) projects. The paper also reports the latest development and findings of the ongoing investigation into the alleged falsification of concrete test reports associated with the works under the Hong Kong-Zhuhai-Macao Bridge Hong Kong and related projects.

QUALITY ASSURANCE SYSTEM FOR CONCRETE IN PWP PROJECTS

2. The Government attaches great importance to quality of our PWP projects, including civil engineering and building works, and to achieve this, the Government has stipulated stringent quality requirements in PWP projects, in particular on concrete, which is one of the primary construction materials used in Hong Kong.

3. The quality of a concrete structure depends on a host of factors throughout its production process from its mix design, production, transportation, casting and curing. We have detailed specification stipulating stringent requirements at every stage of the process to ensure that the final concrete structure meets its designed performance. A flowchart showing the quality assurance measures throughout the process is given in **Annex 1**.

Production

4. First and foremost, concrete suppliers who supply structural concrete for all PWP projects must be certified under the Quality Scheme for the Production and Supply of Concrete (QSPSC)[1].

5. The QSPSC, is a Product Certificate Scheme administered by Hong

[1] Except for those located at remote areas (such as outlying islands) or where the volume of structural concrete involved is less than $50m^3$. For these "exceptional" projects, the quality system of the concrete supplier shall be approved by the authorized professional engineer or architect.

Kong Quality Assurance Agency[2], that consists of two parts: Administrative Regulations (AR) and Technical Regulations (TR). The AR requires (i) the concrete supplier to operate a system which complies with ISO9001, and (ii) the independent certification body certifying the supplier shall be accredited by Hong Kong Accreditation Service (HKAS) or United Kingdom Accreditation Service (UKAS). The TR includes the requirements on material audits and production control as well as tests of various concrete properties during the batching and mixing process, which provides assurance on all raw materials, such as cement, aggregates, etc. for the production of concrete conforming to relevant technical standards.

Transportation

6. There are standard requirements in respect of transporting ready-mix concrete to site, e.g. time of delivery and rate of rotation of mixer of a concrete truck. This is necessary because the properties of concrete are volatile and may vary during transportation from a batching plant to a site or after prolonged mixing/standing time. Slump tests for workability is therefore required to ascertain that the quality of ready-mix concrete is maintained before placing and compacting in permanent works. Ready-mix concrete failing such test would not be allowed to be used on site.

On Site Control

7. With the passed ready-mix concrete, placing, compaction and curing processes have to be conducted by skill labours and are subject to full time supervision of resident site staff to ensure proper workmanship which is vital for securing the final quality of the permanent works. At the same time, testing samples of ready-mix concrete will be taken for preparing concrete cubes (specimens) under the supervision of resident site staff. As explained above, quality of concrete is assured by the quality assurance system being implemented at the very early stage for manufacture of concrete. Testing of samples taken from ready-mix concrete on site serves as an extra check-point in PWP projects. This takes the form of concrete cube tests for compressive strength to ascertain that the quality of ready-mix concrete delivered to site resembles the design mix approved for use in the permanent works.

8. Concrete compression test is a well-established test for determining concrete compressive strength. The tests are conducted by a laboratory independent to the concrete supplier. To make a compression test result representative, testing procedures including measurements, curing and determining the compressive strength in test machine have to be properly carried out. In particular, the loading

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[2] A non-profit-distributing organization by the Hong Kong Government helps industry and commerce in the development of quality environmental, safety, hygiene, social and other management systems.

faces of the test machine must be cleaned and the concrete cube (specimen) is placed at the centre of loading area before applying load on it. If such preparation work is not properly carried out, even a small particle on the loading face of the test machine may affect the load distribution on the concrete specimen during testing and will lead to a misleading test result. Because of this, isolated cases of not meeting the required concrete strength do not necessarily imply non-compliance with the specified requirements for compressive strength. The compliance criteria for a batch of concrete does not depend on the individual test result alone but also count on the statistical averages and standard deviations of the measured concrete strength of all relevant cubes. This is in line with international practice.

Role of Public Works Laboratories

9. It is the Government's policy that materials compliance testing for all PWP projects must be done through the Public Works Laboratories (PWL) of the Civil Engineering and Development Department (CEDD). PWL comprises Public Works Central Laboratory (PWCL) and Public Works Regional Laboratories (PWRL). PWCL delivers the testing services through undertaking tests by its own team and by outsourcing to commercial laboratories.

10. Since the early 1980s, the PWRL have been established at strategic locations throughout Hong Kong to provide engineering-related compliance testing services to support PWP projects in different regions. All PWRL have been operated independently with respect to PWP projects in order to ensure their impartial status. Consultants who operate the PWRL should also declare any possible conflict of interest with the PWP projects for which they are assigned to provide testing services.

11. At present, there are five PWRL, viz. in Tsuen Wan, Tsz Wan Shan, Tai Po, Tin Shui Wai and North Lantau. From end 2012 to March 2017, a designated regional laboratory was set up at Siu Ho Wan (i.e. PWRL(SHW)) to serve the Hong Kong-Zhuhai-Macao Bridge local projects.

12. The PWCL and the regional laboratory at Tsuen Wan are manned by Government officers, comprising professional, technical and clerical staff. Other regional laboratories are overseen by a Government officer and operated by engineering consultants through consultancy[3] agreements. For PWRL(SHW), two Government officers were assigned to oversee the laboratory[4].

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[3] Approved by the Engineering and Associated Consultants Selection Board (EACSB)

[4] Unlike other PWRL, PWRL(SHW) might need to operate on weekends and/or public holidays in order to accommodate the project needs.

Laboratory Quality Management System

13. PWL, including both the PWCL and PWRL, are accredited by Hong Kong Accreditation Service (HKAS) under the Hong Kong Laboratory Accreditation Scheme (HOKLAS) for testing and calibration services. The quality management system of PWL meets the requirements of international standard ISO/IEC17025. As part of the quality management system, PWL regularly conduct internal audits and inter-laboratory comparison to confirm the quality standard of testing services by PWCL and PWRL. PWL are also subject to annual HOKLAS assessment audits by HKAS.

14. To cope with the testing demand by the ongoing PWP, the frequent and routine compliance tests of construction materials (such as concrete, steel, bituminous materials and aggregates) are also contracted out to HOKLAS accredited commercial laboratories that operate independently with respect to PWP projects. About 35% of the routine compliance tests were outsourced to contract laboratories in 2016. There are currently 20 laboratory testing term contracts. A dedicated team of professional and technical staff of the PWCL is responsible for administering the term contracts and auditing these outsourced tests.

15. To safeguard the reliability of the outsourced testing services, including both the consultants-manned regional laboratories as well as the contract laboratories, the PWL are exercising additional monitoring measures, including:

(1) surprise surveillance audits; and
(2) parallel testing.[5]

16. For each of the Consultants-manned regional laboratories, a Government officer is also stationed in the laboratory on a full-time basis to undertake auditing of testing activities and testing records, and to monitor the delivery and supervision of testing services by the Consultants. For PWRL(SHW), two Government officers were assigned to station in the laboratory. CCTV are installed in some areas of the laboratories for monitoring purposes. Besides, supervisory personnel and laboratory testing technicians as provided by the Consultants should possess adequate qualification and relevant experience that meet the requirements laid down in the consultancy agreements.

[5] To conduct the parallel testing, an independent laboratory is engaged to produce dummy identical samples. Those samples are distributed to selected laboratories for testing through public works contracts, without notifying the selected laboratories. Test results by the selected laboratories are compared to testify the performance of the laboratories

ALLEGED FALSIFICATION OF CONCRETE TEST REPORTS - INVESTIGATION AND FINDINGS

17. In July 2016, during the auditing of concrete compression test results, the Principle Technical Officer (PTO) of the CEDD who oversaw the concerned laboratory identified anomalies in isolated testing records. He noted that the testing time of some of the concrete compression tests had been tampered with. The testing time was changed, apparently with a view to showing compliance with the requirement[6] but in fact, the test was conducted late. The CEDD carried out an investigation of the incident. At the same time, the CEDD required the Consultants managing the concerned laboratory to provide a detailed investigation report to explain the incident and propose necessary remedial actions.

18. In September 2016, the Consultants submitted its investigation report, which admitted that some members of its laboratory staff had on occasions adjusted the clock on the compression testing machines in order to make the testing time shown in the records fall within the required timeframe. The investigation by the CEDD also concluded similar findings and examined the effect of such anomaly on test results. The altered testing time have resulted in a higher concrete compressive strength being measured. Nevertheless, the effect was considered insignificant because the delays in conducting the test was relatively short, and the rate of gain in compressive strength of concrete would have slowed down beyond the age of 28 days (see also **Figure 1**).

19. After the above investigation, the CEDD reported the case to the ICAC for necessary actions. The CEDD has rendered full assistance to the ICAC during its investigation. At the same time, concrete compression test results of other regional laboratories were also examined and no anomaly was found.

20. On 18 May 2017, the ICAC advised the CEDD that its investigation unveiled other suspected malpractice involving replacement of concrete compression test samples by a metal cylinder or a 'strong concrete cube' to falsify the tests. The malpractice might have started in early 2015.

21. The CEDD immediately commenced a follow-up investigation by examining the raw data of the concrete compression testing records of the concerned laboratory. Based on the available information from the ICAC, all tests in the period from January 2015 to June 2016 have been examined. Findings on suspected falsified test results have been passed to the Highways Department in batches from 28 May to 1 June 2017.

22. The CEDD will continue to collaborate with the ICAC on their investigation.

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[6] The compression of concrete cubes samples should be carried out at 28 days ± 8 hours.

FOLLOW-UP ACTIONS

Immediate actions after the unveil of the tampering of testing time

23. Immediate actions undertaken after the unveiling of the tampering of testing time included:

(i) replacement of the Consultants' staff in charge of the overall supervision of the laboratory;
(ii) deployment of additional Consultants supervisory staff to tighten the supervision of the concerned laboratory;
(iii) introduction of additional security measures in the computer system to prevent unauthorised reset of the computer clock;
(iv) arrangement of further refresher training on the timing requirements of the concrete test and reminder of the essence of the integrity to all laboratory staff of PWL; and
(v) issue of an adverse Quarterly Consultants' Performance Appraisal Report to the Consultants.

Immediate actions after the ICAC had advised the suspected malpractice of falsifying concrete compression tests

24. After the suspected malpractice of falsifying concrete compression tests which was advised by ICAC on 18 May 2017, further measures have been implemented to step up the quality assurance system of concrete compression tests. These include:

(i) deploying additional government staff to each of the Consultants-manned PWRL to strengthen the auditing of test and monitoring of supervision by the Consultants;
(ii) arranging different laboratories to carry out concrete compression tests for PWP projects on a rotational basis;
(iii) increasing the number of parallel testing;
(iv) strengthening of routine auditing check of test records; and
(v) others:
    (a) imposing requirement of taking photographs of the test samples before and after each test;
    (b) lengthening the retention period of all tested samples for random audit by Consultants' supervisory staff and Government officers;
    (c) installation of additional CCTV for detailed monitoring of concrete compression tests (being arranged); and
    (d) regular rotation of consultant staff to take part in testing of different materials (being arranged).

Regulating Actions against the Consultants Involved

25. To ensure the quality of consultancy services delivered by consultants, we established a mechanism to manage the performance of architectural and engineering consultants in 2001. Such a mechanism has been updated from time to time and the latest update was promulgated through DEVB Technical Circular (Works) (TC(W)) No.3/2016[7].

26. In view of the unacceptable performance of the Consultants in providing the services in respect of management and operation of the concerned laboratory, the CEDD has decided to suspend the Consultants from tendering for all categories of architectural and engineering consultancy agreements within the jurisdiction of the Architectural and Associated Consultants Selection Board (AACSB) and the Engineering and Associated Consultants Selection Board (EACSB) for a period of twelve months[8] (from 2 June 2017 to 1 June 2018) after seeking the Boards' endorsement. Depending on the development of the case, the Government may take further regulating action(s) against the Consultants whenever deemed appropriate.

27. To prevent recurrence of similar incidents, the DEVB issued a memorandum in May this year requesting the works departments to review and step up the monitoring of the performance of the architectural and engineering consultants managed by them, particularly from the integrity management and quality assurance perspectives. The works departments will continue to closely monitor the services delivered by the consultant and will conduct any necessary technical audits. In the meantime, the DEVB is conducting another round of review to further enhance the management of architectural and engineering consultants.

Development Bureau
June 2017

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[7] For details of DEVB TC(W) No. 3/2016, please refer to the link below:
http://www.devb.gov.hk/filemanager/technicalcirculars/en/upload/343/1/C-2016-03-01.pdf

[8] Towards the end of the suspension period, the CEDD will review whether the suspension period should be extended or not, depending on the development of the case.

Annex 1 - Quality Assurance System for Use of Concrete

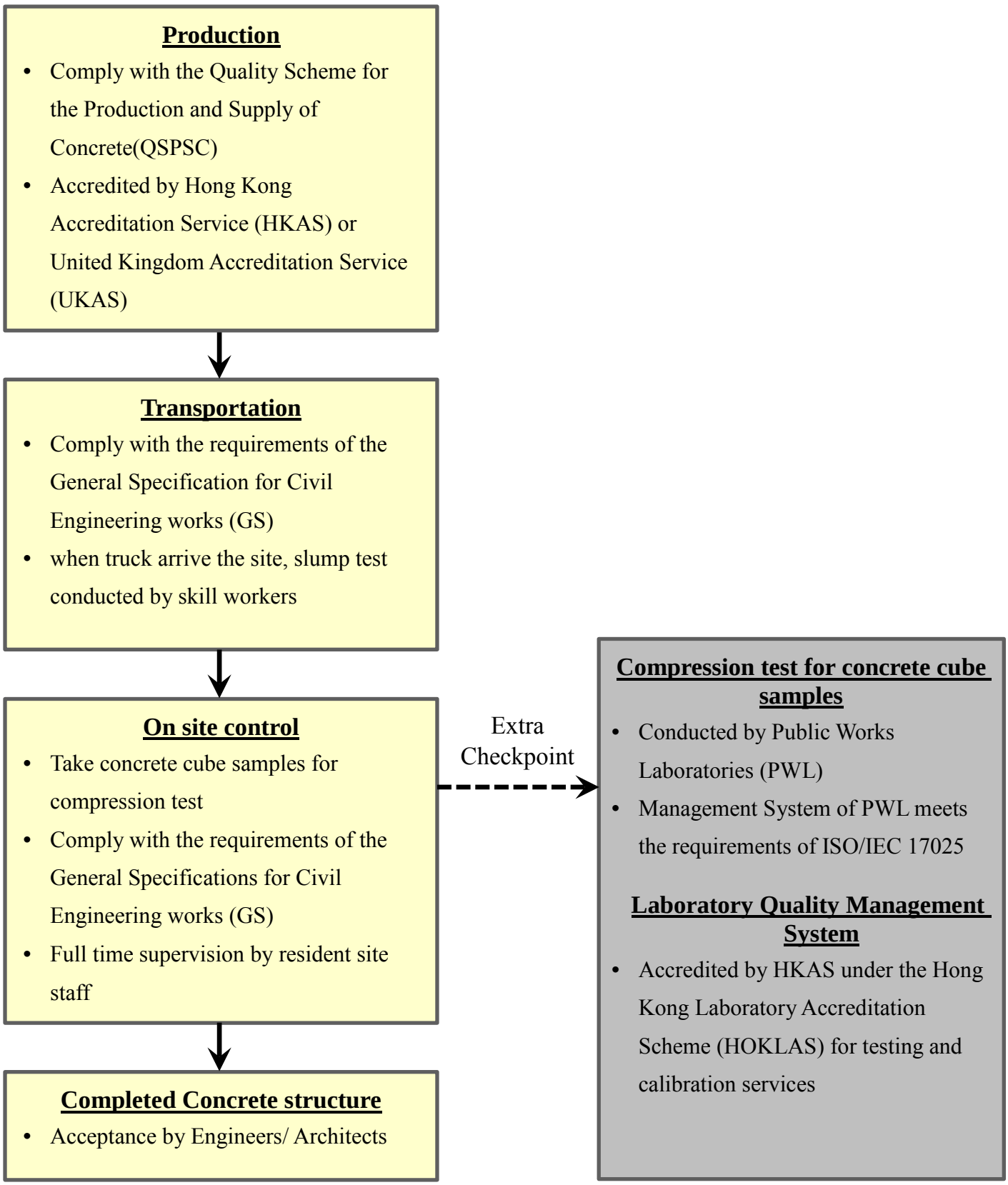
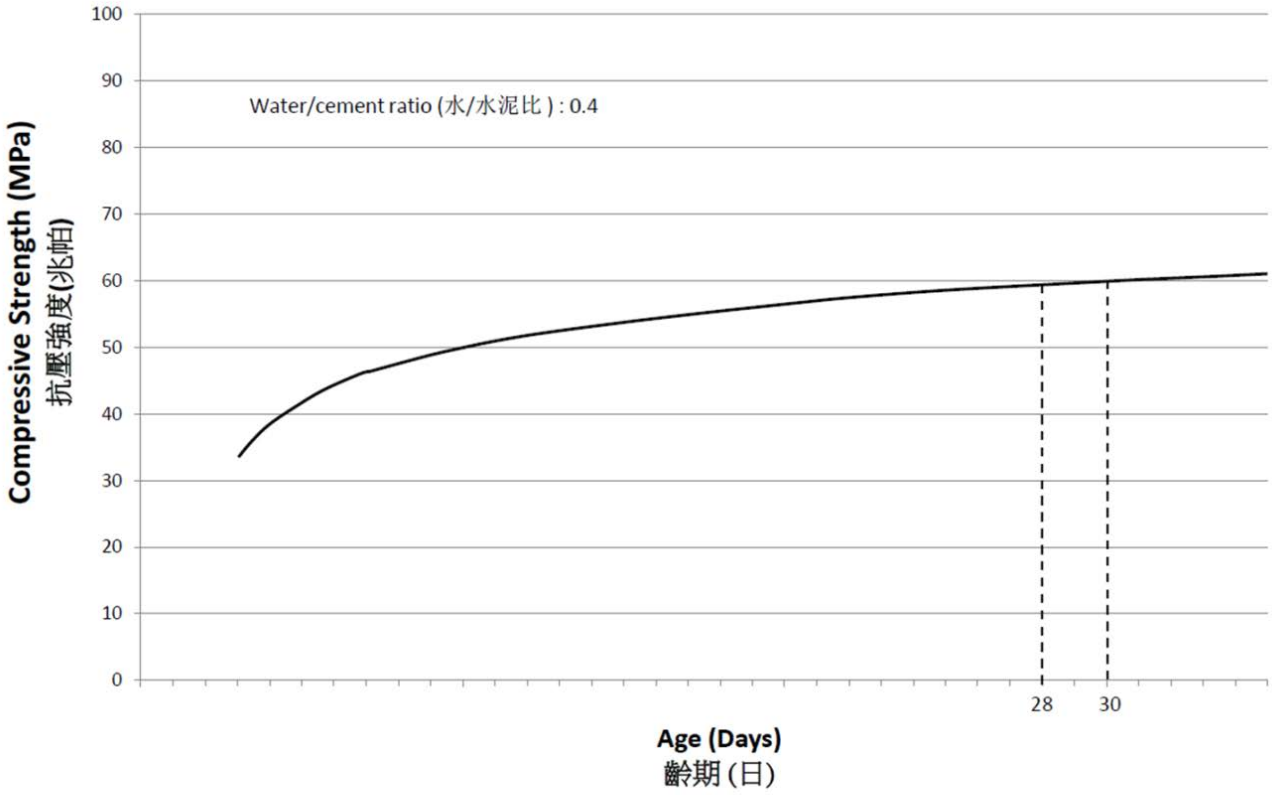


Figure 1 - Compressive Strength of Concrete against Time



Extracted from A.M. Neville, *Properties of Concrete* (4th Edition), p304; with conversion to natural scale from log scale
節錄於A.M. Neville, *Properties of Concrete* (第四版), 304頁, 並將對數刻度轉成自然刻度