

CHAPTER 4

Highways Department

Tsing Yi Section of Route 8

**Audit Commission
Hong Kong
4 April 2014**

This audit review was carried out under a set of guidelines tabled in the Provisional Legislative Council by the Chairman of the Public Accounts Committee on 11 February 1998. The guidelines were agreed between the Public Accounts Committee and the Director of Audit and accepted by the Government of the Hong Kong Special Administrative Region.

Report No. 62 of the Director of Audit contains 8 Chapters which are available on our website at <http://www.aud.gov.hk>

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TSING YI SECTION OF ROUTE 8

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TSING YI SECTION OF ROUTE 8

Executive Summary

1. Route 8 connects Sha Tin with North Lantau. In order to alleviate the anticipated traffic congestion at Route 3 between West Kowloon and Tsing Yi, the Government decided in 1998 to construct Tsing Yi Section (connecting Cheung Sha Wan with Tsing Yi) of Route 8. The Tsing Yi Section project was implemented by the Highways Department (HyD) through awarding four works contracts, namely Contracts A, B, C and D. In addition, the HyD awarded Contract E for the installation of a traffic control and surveillance system (TCS System), and Consultant X was appointed for the design and construction supervision of the five contracts.

2. Between December 1998 and November 2008, the Finance Committee of the Legislative Council approved funding of \$12,191.7 million for the design, investigation and construction of Tsing Yi Section. The 7.6-kilometre dual three-lane expressway of Tsing Yi Section was completed and open to traffic in December 2009. As of December 2013, the Government had incurred \$9,926 million for the Tsing Yi Section project.

3. The construction of Tsing Yi Section was to provide an alternative route between Cheung Sha Wan and Tsing Yi, and its timely completion was important for the full commissioning of Route 8. In the event, Tsing Yi Section was completed 16 months later than the original target completion date. The Audit Commission (Audit) has recently conducted a review of the HyD's planning and implementation of Tsing Yi Section, covering Contracts A, C, D and E.

Additional time and cost under Contract A

4. Contract A mainly involved the construction of Ngong Shuen Chau (NSC) Viaduct. In April 2002, the HyD awarded Contract A to Contractor A at a contract sum of \$1,538.7 million. In the event, the contract works were substantially completed in August 2007, nine months later than the original target completion

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date of November 2006, at a final contract sum of \$1,647.7 million, with contract sum increase mainly due to price fluctuation adjustments (paras. 1.10, 2.2 and 2.3).

5. ***Works item omitted from Bills of Quantity (BQ).*** Under Contract A, two tests were required to be carried out on completed piles, namely full-depth coring test on 5% of completed piles and proof drilling test on all completed piles. However, the BQ of Contract A only included the full-depth coring test but not the proof drilling test. Hence, Contractor A was unable to include a tender rate for the latter and eventually made a financial claim for performing the test. In the event, Contractor A was paid a sum of \$32.8 million for settling his claim on the missing BQ item on proof drilling test (paras. 2.4 to 2.6).

6. ***HyD not informed before Contractor A was requested to review the piling design.*** In December 2003, the HyD and Contractor A entered into a Supplementary Agreement for implementing Contractor A's alternative-design works for NSC Viaduct to substitute part of the original works. In April 2004, during the construction stage, Consultant X requested Contractor A to review the founding levels of some piles. In order to avoid delaying the works, while conducting the piling-design review, Contractor A carried out the piling works to deeper founding levels than those certified by an Independent Checking Engineer. Subsequently, Contractor A made a financial claim for carrying out additional works to lower the pile founding levels, and was eventually paid a sum of \$12 million and granted an extension of time (EOT) of 46 days for settling his claim. According to the HyD, Consultant X had not sought its comments before requesting Contractor A to review the pile founding levels (paras. 2.12 to 2.15, 2.17 and 2.19).

7. ***Inadequate consultation before including private land in contract as a temporary works area.*** Under Contract A, a piece of private land on Stonecutters Island (Lot A) was earmarked to be used as a works area by Contractor A. In April 2000, the road scheme for Tsing Yi Section was gazetted which included the proposed declaration of Rights of Temporary Occupation of Lot A as a works area. In August 2003, the owner of Lot A raised objection to the proposed temporary occupation of Lot A as a works area on the grounds that he had not been consulted on the issue since the notice gazetted in April 2000, and that the creation of a works area on his land would seriously interrupt his business operation leading to a substantial financial loss. Subsequently, the HyD made use of three nearby alternative land lots, instead of Lot A, as temporary works areas for Contract A.

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In the event, Contractor A was paid a sum of \$23.8 million and granted EOTs of 66 days for settling his claims for additional costs and time arising from changes in the works area (paras. 2.22 to 2.24).

8. ***Financial implications not provided for informed decision.*** In May 2002, a Traffic Management Liaison Group (TML Group) including representatives from the Transport Department (TD) and the Hong Kong Police Force (HKPF) was set up to review temporary traffic arrangements proposed by Contractor A. In August 2003, Contractor A informed the TML Group that a three-time launching scheme would be introduced for the erection works of three bridges. In December 2003, the representatives of the TD and the HKPF of the TML Group raised objection to the three-time launching scheme on the grounds of the prolonged traffic impact on West Kowloon Highway. Subsequently, after obtaining agreement of the TML Group, a two-time launching scheme was adopted. After completing the erection works for Bridge I, on the grounds that the works had no adverse traffic impact and only a few minor complaints had been received, the TML Group agreed in November 2004 that the works could be reverted back to the three-time launching scheme. In the event, Contractor A was paid a sum of \$17 million and granted an EOT of 26 days for settling his claim for additional costs and time arising from the change of the three-time launching scheme to the two-time launching scheme. Audit notes that the TML Group had not been informed of the financial implications of possible contract claims arising from the change (see paras. 2.30 to 2.42).

Additional cost under Contract D

9. Contract D involved the construction of Nam Wan Tunnel and West Tsing Yi Viaduct. In April 2003, the HyD awarded Contract D to Contractor D at a contract sum of \$1,479.3 million. In the event, the contract works were substantially completed in November 2007, five and a half months later than the original target completion date of May 2007, at a final contract sum of \$1,699.4 million, with contract sum increase partly due to price fluctuation adjustments (paras. 1.10, 3.2 and 3.3).

10. ***Additional cost arising from different tunnel lengths for different lining thickness between BQ and Ground Investigation (GI) Drawings.*** Under Contract D, Contractor D was responsible for constructing concrete linings covering the inside surface of the twin tunnels and the cross passages of Nam Wan Tunnel. The thickness of the linings was to be determined by referring to Q-values (under

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the Norwegian Geotechnical Institute System) measured in-situ on the excavated rock face. In the tender BQ, the estimated tunnel lengths for lining thickness of 400 millimetres (mm), 500 mm and 600 mm were stated at 787 metres (m) each. On the other hand, GI Drawings with estimated Q-values for different tunnel sections (provided to tenderers for reference upon request) reflected that the estimated tunnel lengths for lining thickness of 400 mm, 500 mm and 600 mm were “1,855 m”, “130 m” and “320 m” respectively, differing significantly from the “787 m” stated in the tender BQ. In his tender submitted, Contractor D specified a BQ rate of \$95,151/m for 400 mm tunnel linings but nil rates for both 500 mm and 600 mm tunnel linings, resulting in an estimated cost of \$75 million for the tunnel lining works (paras. 3.5 to 3.8).

11. According to in-situ Q-values obtained after tunnel excavation, linings with thickness of 400 mm, 500 mm and 600 mm should have been constructed for tunnel lengths of “2,069 m”, “145 m” and “147 m” respectively. However, during works implementation, Consultant X instructed Contractor D to construct linings with thickness of 400 mm, 500 mm and 600 mm for tunnel lengths of “1,157 m”, “1,036 m” and “168 m” respectively, resulting in a cost of \$110 million. In the event, Contractor D was paid an additional sum of \$43 million for settling his claim that site instructions given to him to construct linings with thickness of 400 mm for less tunnel lengths and 500 mm and 600 mm for more tunnel lengths were at variance with contract requirements. As a result, the final cost of the concrete lining works amounted to \$153 million, which was 104% higher than the original contract estimate of \$75 million. Audit notes that the HyD had not identified the significant differences in tunnel lengths for different lining thickness between those stated in the BQ and those derived from the GI Drawings (see para. 10 above) during its checking of the BQ included in the tender document (paras. 3.10, 3.11, 3.14, 3.15 and 3.18).

12. ***Risk of unreasonably high BQ rate.*** Contractor D’s BQ rate of \$95,151/m for tunnel lining of 400 mm was three times higher than the pre-tender cost estimate of \$22,000/m. However, the HyD and Consultant X had not requested Contractor D to provide reasons for submitting this unreasonably high BQ rate. Furthermore, the HyD had not assessed the financial implications of possible related contract claims and included them in the Tender Assessment Report for submission to the Central Tender Board (para. 3.20).

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Provision of traffic control and surveillance system under Contract E

13. The TCS System is installed at Tsing Yi Section and Sha Tin Section of Route 8 for traffic management by the TD. The TCS System includes closed-circuit television cameras, automatic vehicle detection devices, lane control signals and variable message signs. In October 2004, the HyD awarded Contract E to Contractor E at a lump-sum-fixed price of \$255 million. In the event, Contract E was substantially completed in January 2010, 17 months later than the original target completion date of August 2008, at a final contract sum of \$309.2 million (paras. 4.2 and 4.7).

14. *Long time taken to provide site access to Contractor E.* Tsing Yi Section and Sha Tin Section of Route 8 were implemented under seven civil works contracts, which included constructing facilities related to the installation of the TCS System. The related civil works were to be completed (according to milestone dates specified in the seven works contracts) before providing the completed facilities and site access to Contractor E for carrying out the TCS System installation work. On the other hand, site access dates corresponding to the completion of the seven work contracts were specified in Contract E for Contractor E to gain access to the sites for commencing the system installation work. Owing to longer time taken in completing the related civil works vis-à-vis the original scheduled time under some works contracts, site access to most of the sites were only provided to Contractor E by phases a long time after the site access dates specified in Contract E. In the event, Contractor E was paid a sum of \$52.2 million for settling his claim for additional costs arising from contract modifications and delays in providing site access to him for carrying out the TCS System installation work. Audit notes that the longer time taken in completing civil works under some works contracts had knock-on effects on the subsequent system installation work and had resulted in substantial financial claims (paras. 4.8, 4.9, 4.12 to 4.14, and 4.22).

Audit recommendations

15. **Audit recommendations are provided in the respective sections of this Audit Report. This Executive Summary only highlights the key recommendations. Audit has recommended that the Director of Highways should:**

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- (a) **take measures to ensure that HyD staff and consultants provide separate BQ items for works of different nature in the tender documents of a contract (para. 2.10(a));**

- (b) **in implementing a lump-sum fixed-price contract involving a contractor's design, establish proper control procedures to require the HyD consultant to seek the HyD's comments before instructing the contractor to carry out works which may subsequently constitute works variations involving additional cost which exceeds \$300,000 (para. 2.20);**

- (c) **in implementing a works project in future involving the use of private land as a temporary works area, take measures to ensure that pertinent land-lot owners have been consulted and their concerns have been properly dealt with before including such land in a works contract (para. 2.28);**

- (d) **in implementing a works project in future involving a change in the works procedures on the grounds of traffic considerations, provide the TML Group with the related financial implications of possible contract claims for making informed decisions (para. 2.44);**

- (e) **take measures to ensure that HyD staff and consultants strengthen checking of BQ items to safeguard their completeness and accuracy, and pay particular attention to any unreasonable BQ rates (para. 3.22(a) and (b)); and**

- (f) **in implementing a works project with independent system installations in future, take measures to strengthen the HyD's monitoring of the civil works completion, taking into account the knock-on effects and potential financial claims resulting from any significant delay in providing site access to a system contractor (para. 4.23(b)).**

Response from the Administration

16. The Administration agrees with the audit recommendations.

PART 1: INTRODUCTION

1.1 This PART describes the background to the audit and outlines the audit objectives and scope.

Route 8

1.2 Route 8 is a 27.7 kilometre (km) dual three-lane expressway connecting Sha Tin with North Lantau via Cheung Sha Wan and Tsing Yi, which was implemented by the Highways Department (HyD). It comprises three road sections, namely North Lantau Section, Tsing Yi Section and Sha Tin Section (see Figure 1).

Figure 1

Route 8



Source: HyD records

Note 1: North Lantau Section of Route 8 includes Lantau Link (comprising Tsing Ma Bridge, Ma Wan Viaduct and Kap Shui Mun Bridge) and North Lantau Highway.

Note 2: Sha Tin Section of Route 8 comprises Sha Tin Heights Tunnel and Approaches, Eagle's Nest Tunnel and Lai Chi Kok Viaduct.

Introduction

1.3 North Lantau Section of Route 8 (which is 14.5 km long and comprises Tsing Ma Bridge, Ma Wan Viaduct, Kap Shui Mun Bridge and North Lantau Highway) was constructed from May 1992 to April 1997 to provide a direct road link between Tsing Yi and the Hong Kong International Airport on North Lantau. To cope with the increasing traffic demand, Tsing Yi Section and Sha Tin Section were constructed between April 2002 and November 2009 (see Table 1).

Table 1

Tsing Yi Section and Sha Tin Section of Route 8

Road section	Road length (km)	Major part	Works commenced in	Works completed in
Tsing Yi Section (from Cheung Sha Wan to Tsing Yi — see Figure 2)	7.6	Ngong Shuen Chau (NSC) Viaduct Stonecutters Bridge East Tsing Yi Viaduct Nam Wan Tunnel West Tsing Yi Viaduct	April 2002	November 2009
Sha Tin Section (from Sha Tin to Cheung Sha Wan)	5.6	Sha Tin Heights Tunnel and Approaches Eagle's Nest Tunnel Lai Chi Kok Viaduct	November 2002	December 2007

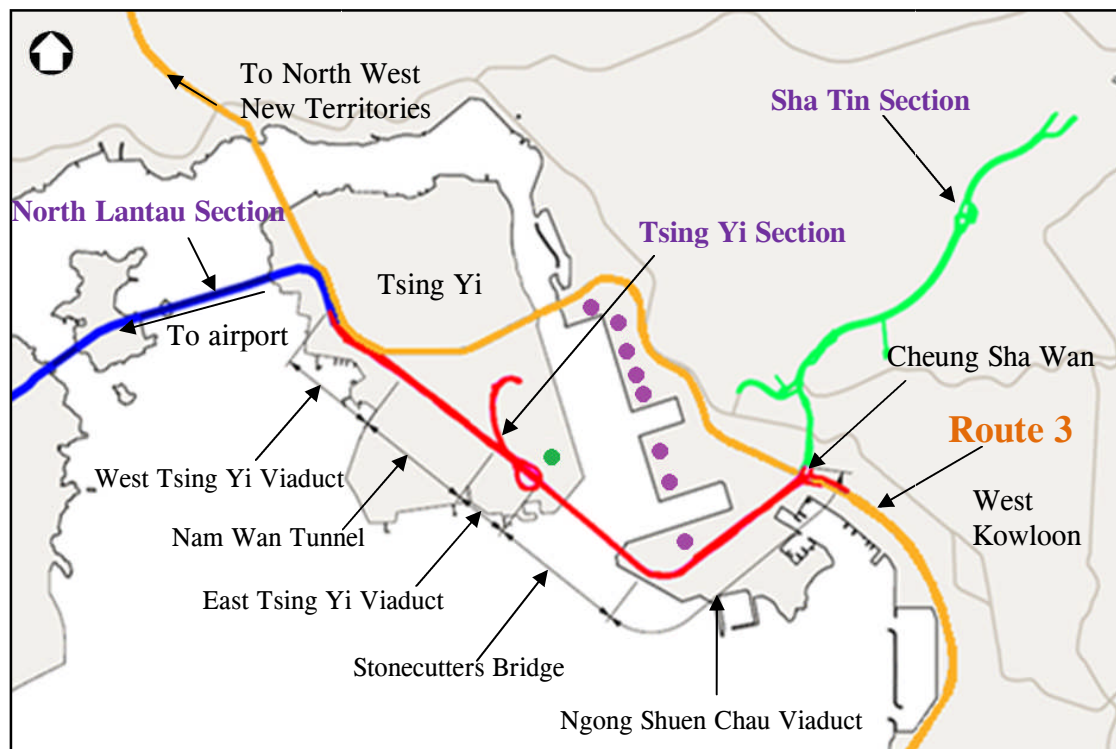
Source: HyD records

Justifications for constructing Tsing Yi Section

1.4 At the time of the opening of the Hong Kong International Airport at Chek Lap Kok in July 1998, North Lantau Section of Route 8 between Tsing Yi and North Lantau had been completed. At that time, Route 3 connecting West Kowloon with North West New Territories via Tsing Yi (see Figure 2) had also been completed and was providing a highway link to the airport on North Lantau via North Lantau Section of Route 8.

Figure 2

Tsing Yi Section of Route 8



Legend: ● Container terminals in Kwai Tsing District
● Container Terminal 9

Source: HyD records

Introduction

1.5 In October 1998, the HyD completed a feasibility study for constructing Tsing Yi Section of Route 8. Based on forecast population growth in Tung Chung, Yuen Long, Tuen Mun and Tin Shui Wai, the study estimated that there would be traffic-demand growth among North West New Territories, Lantau and the urban areas, and the capacity of Route 3 between West Kowloon and Tsing Yi (comprising Tsing Kwai Highway, Cheung Tsing Tunnel and Cheung Tsing Highway) would be saturated by 2006. Therefore, with a view to alleviating the anticipated traffic congestion at Route 3 between West Kowloon and Tsing Yi, the Administration decided to construct Tsing Yi Section of Route 8 to provide an alternative route connecting Lantau Link with West Kowloon Highway at Cheung Sha Wan and provide direct access to Container Terminal 9 and container terminals in Kwai Tsing District without going through the Tsing Yi road network (see Figure 2).

1.6 Between December 1998 and November 2008, the Finance Committee (FC) of the Legislative Council approved funding of \$12,191.7 million for the design and investigation, and the construction of Tsing Yi Section under two projects, namely Projects A and B (see Table 2).

Table 2
Funding approvals for Tsing Yi Section
(December 1998 to November 2008)

Date	Particulars	Amount (\$ million)
Design and investigation		
December 1998	Detail design and investigation	473.5
Construction works		
Project A		
July 2001	Implementing NSC Viaduct	3,650.0 (Note)
Project B		
June 2002	Implementing West Tsing Yi Viaduct, Nam Wan Tunnel, East Tsing Yi Viaduct, Stonecutters Bridge, and associated traffic control and surveillance system (TCS System)	7,468.2
November 2008	Increase in approved project estimate (APE) to meet anticipated contract-price fluctuation payments	600.0
Total		12,191.7

Source: HyD records

Note: The works contract was awarded in April 2002 at \$1,538.7 million. In view of the lower-than-estimated contract price, in 2003, the Financial Services and the Treasury Bureau imposed a ceiling of \$1,946.8 million on the project estimate.

Introduction

1.7 In February 1999 and March 2001, the HyD awarded two consultancies respectively for the design and construction supervision of Tsing Yi Section (see Table 3).

Table 3

Consultancies and contracts for Tsing Yi Section

Consultancy	Consultant	Cost (\$ million)	Responsible for design and construction supervision (see Figure 2)
X (Awarded in February 1999)	X	105	NSC Viaduct (Contract A) East Tsing Yi Viaduct (Contract C) Nam Wan Tunnel and West Tsing Yi Viaduct (Contract D) TCS System (Contract E)
Y (Awarded in March 2001)	X (Note)	52	Stonecutters Bridge (Contract B)

Source: HyD records

Note: After conducting two separate open consultant selection exercises and obtaining approval of the Engineering and Associated Consultants Selection Board, the HyD awarded both Consultancies X and Y to Consultant X.

1.8 Between April 2002 and November 2004, the HyD awarded four works contracts and a TCS System contract to five contractors (see Table 4).

Table 4
Contracts A to E for Tsing Yi Section
(April 2002 to August 2008)

Contract	Works	Commencement date	Original contract completion date	Original contract sum (\$ million)
Works contracts				
A	NSC Viaduct (2.2 km)	10.4.2002	13.11.2006	1,538.7
B	Stonecutters Bridge (1.6 km)	27.4.2004	26.6.2008	2,760.0
C	East Tsing Yi Viaduct (1.1 km)	7.12.2004	6.4.2008	1,011.9
D	Nam Wan Tunnel (1.2 km) and West Tsing Yi Viaduct (1.5 km)	23.4.2003	23.5.2007	1,479.3
TCS System contract				
E	TCS System (Note)	12.10.2004	8.8.2008	255.0
Total				7,044.9

Source: HyD records

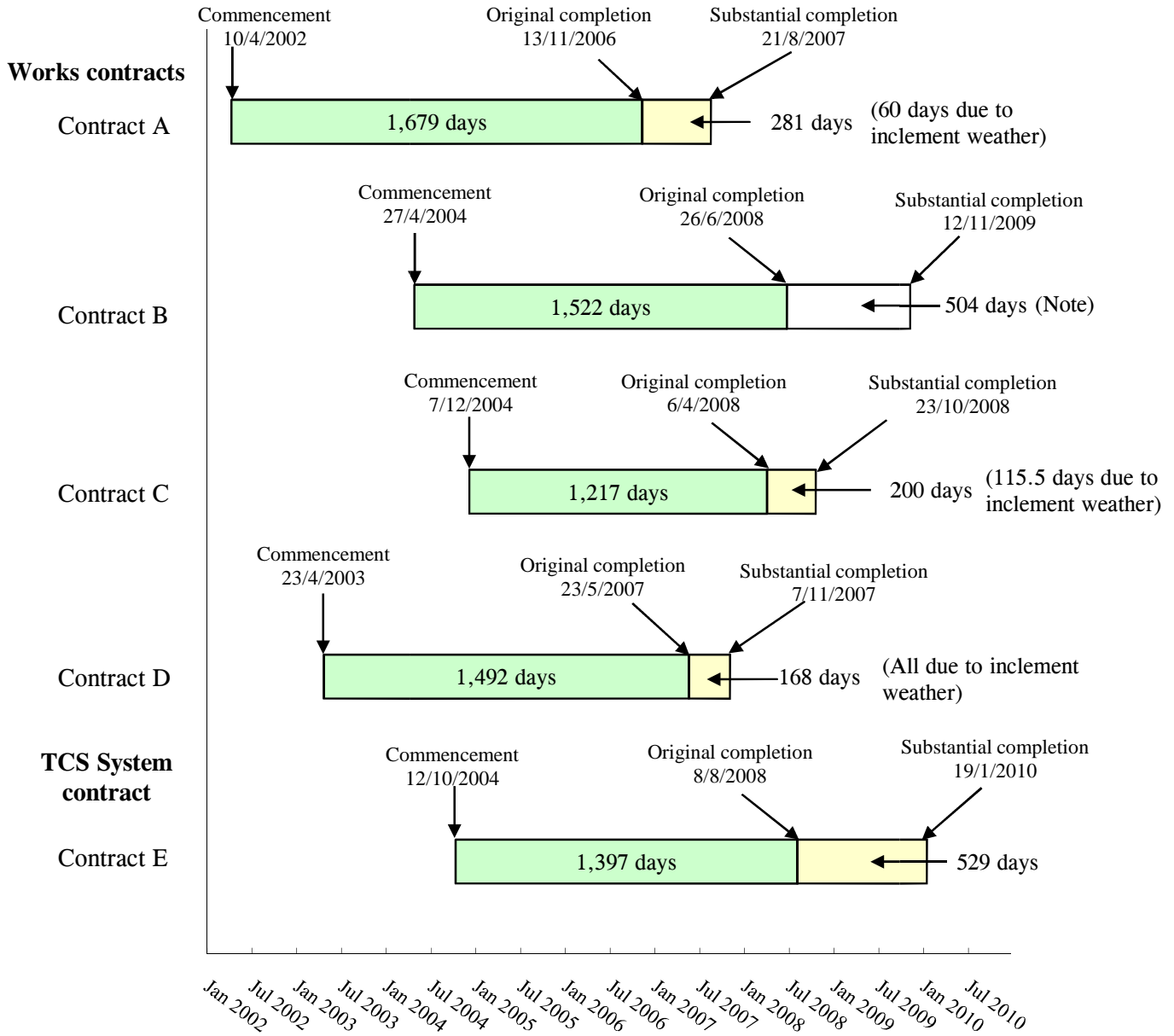
Note: Under Contract E, the TCS System was implemented for both Tsing Yi and Sha Tin Sections and the system cost was to be shared between the two road projects.

Completion of Tsing Yi Section

1.9 Contracts A to D were substantially completed between August 2007 and November 2009 and the TCS System under Contract E was completed in December 2009 (Note 1), where Tsing Yi Section of Route 8 was opened to traffic on 20 December 2009. The time of completion of the five contracts had been extended (see Figure 3), resulting in prolongation costs and delays in relieving the traffic load on Route 3 between Tsing Yi and Cheung Sha Wan. In the event, the Tsing Yi Section was commissioned in December 2009, 16 months later than the original completion date in August 2008. The contractors were granted extensions of time (EOTs) for completion of works due to various reasons, including inclement weather.

Note 1: *The TCS System under Contract E was completed on 19 December 2009. The system underwent an operability test for a month before the substantial contract completion on 19 January 2010.*

Figure 3
Time of completing Contracts A to E
(April 2002 to January 2010)



Original contract period
 EOT granted

Source: HyD records

Note: Contract B was substantially completed in November 2009. As of February 2014, the EOTs and the account of Contract B had not been finalised.

Introduction

Cost of Tsing Yi Section

1.10 As of December 2013:

- (a) \$9,926 million (81.4%) of the APE totalling \$12,191.7 million for Tsing Yi Section had been incurred;
- (b) the accounts of Contracts A, C, D and E had been finalised (see Table 5); and
- (c) the account of Contract B had not been finalised, where the HyD and Contractor B were negotiating over outstanding contract issues.

Of the \$9,926 million in (a) above, \$8,336.1 million (84%) related to expenditures for Tsing Yi Section under Contracts A to E (see Note 4 to Table 5). The remaining \$1,589.9 million (16%) covered the following items:

Item	Amount (\$ million)
Resident site staff costs	1,006.0
Consultancy fees to Consultant X	215.0 (Note)
Project insurance premium	84.0
Other works carried out by government departments	96.0
Miscellaneous costs	188.9
Total	1,589.9

Note: In addition to \$157 million under Consultancies X and Y (see Table 3 in para. 1.7), Consultant X was paid \$58 million for other consultancy services, such as supervising the conduct of site investigations.

Table 5
Contract sums of Contracts A to E
(December 2013)

Contract	Original contract sum (a) (\$ million)	Final/ Up-to-date contract sum (b) (\$ million)	Increase in contract sum (c) = (b) – (a) (\$ million)	Contract sum increase due to price fluctuation adjustment (Note 1) (d) (\$ million)	Increase/ (Decrease) after price fluctuation adjustment (e) = (c) – (d) (\$ million)
A	1,538.7	1,647.7	109.0 (7%)	115.0 (7%)	(6.0)
B	2,760.0	3,669.2 (Note 2)	909.2 (33%)	754.5 (27%)	154.7
C	1,011.9	1,183.6	171.7 (17%)	69.9 (7%)	101.8
D	1,479.3	1,699.4	220.1 (15%)	95.3 (6%)	124.8
E (Note 3)	255.0	309.2	54.2 (21%)	—	54.2
Total	7,044.9	8,509.1 (Note 4)	1,464.2 (21%)	1,034.7 (15%)	429.5

Source: HyD records

Note 1: The original contract sums of Contracts A to D already included provisions for price fluctuation adjustments. These are additional sums to cover excessive price fluctuation adjustments.

Note 2: As of February 2014, the account of Contract B had not been finalised. Hence, this was the up-to-date contract sum.

Note 3: Contract E did not include a provision for price fluctuation adjustments. Furthermore, \$173 million of the final contract sum of \$309.2 million was funded under the works project of Sha Tin Section.

Note 4: Of the \$8,509.1 million, \$8,336.1 million related to Tsing Yi Section and \$173 million related to Sha Tin Section (see Note 3).

Introduction

Audit review

1.11 Tsing Yi Section of Route 8 is one of the major road projects implemented by the HyD. Its objective is to provide an alternative route between Cheung Sha Wan and Tsing Yi, and its timely completion was important for the full commissioning of Route 8. In the event, Tsing Yi Section was completed 16 months later than the original completion date (see para. 1.9).

1.12 The Audit Commission (Audit) has recently conducted a review of the HyD's planning and implementation of Tsing Yi Section. This review mainly covered Contracts A, C, D and E, but not Contract B, because at the time of conducting this review, the account of Contract B had not been finalised. No major audit observations under Contract C were noted (see Appendix A for major cost components).

1.13 The following audit issues relating to Contracts A, D and E were examined:

- (a) additional time and cost under Contract A (PART 2);
- (b) additional cost under Contract D (PART 3); and
- (c) provision of a traffic control and surveillance system under Contract E (PART 4).

Audit has found that there are areas where improvements can be made by the HyD in implementing similar road projects in future, and has made a number of recommendations to address the issues.

Acknowledgement

1.14 Audit would like to acknowledge with gratitude the full cooperation of the staff of the HyD, the Transport Department (TD), the Hong Kong Police Force (HKPF), and the Lands Department (Lands D) during the course of the audit review.

PART 2: ADDITIONAL TIME AND COST UNDER CONTRACT A

2.1 This PART examines the causes of granting EOTs and additional costs to Contractor A under Contract A. The following audit issues were examined:

- (a) omission of a Bills of Quantity (BQ — Note 2) item (paras. 2.4 to 2.11);
- (b) additional piling works (paras. 2.12 to 2.21);
- (c) changes of works areas (paras. 2.22 to 2.29); and
- (d) changes of bridge-deck erection arrangements (paras. 2.30 to 2.46).

Contract A

2.2 Contract A was a remeasurement contract (Note 3) covering the construction of NSC Viaduct (see Photograph 1) and its slip roads, the realignment of Container Port Road South (CPS Road — Note 4) underneath NSC Viaduct on Stonecutters Island, and civil works associated with the TCS System.

Note 2: *Under a remeasurement contract, a BQ, which forms part of the tender documents and subsequently the contract documents after the award of a contract, contains estimated quantities of various works items. A tenderer needs to provide a tender price for the relevant BQ items. For the successful tenderer, the BQ prices would be used for valuing the actual work performed.*

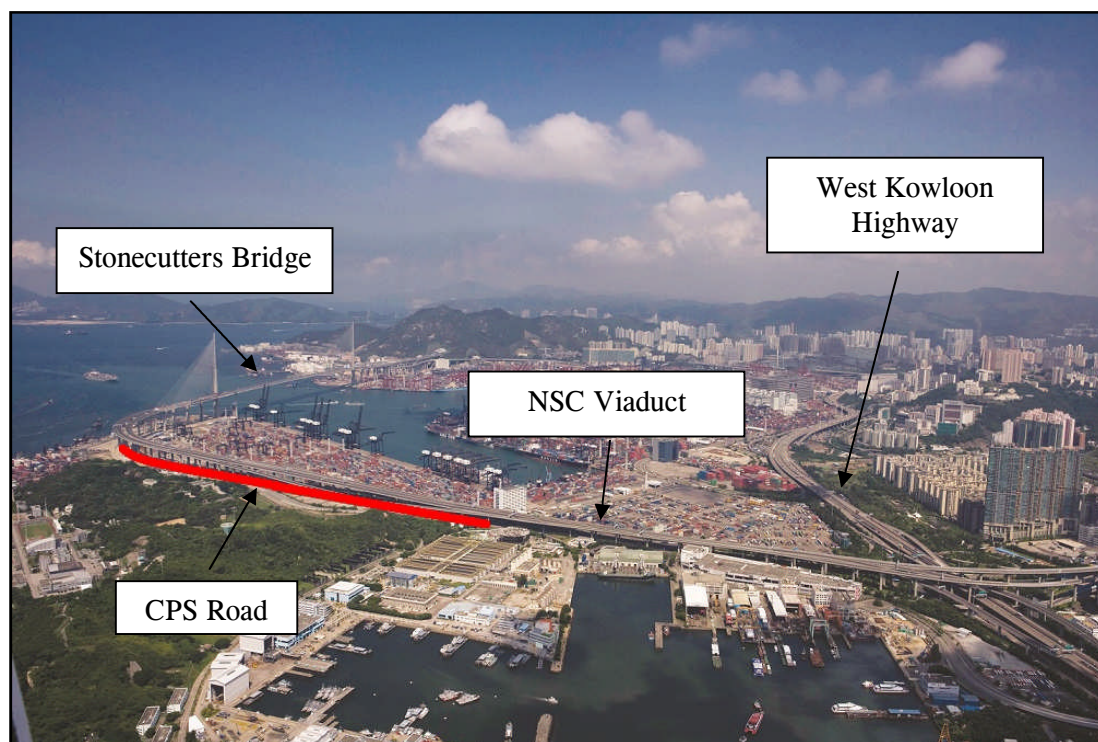
Note 3: *Under a remeasurement contract, the costs of works are based on the actual quantities of works done and the prices of different works items as stated in the BQ of the contract.*

Note 4: *CPS Road originally was a road with some bends (see Figure 4 in para. 2.22). For the purpose of improving land utilisation, CPS Road was re-aligned underneath NSC Viaduct under Contract A.*

Additional time and cost under Contract A

Photograph 1

NSC Viaduct



Source: HyD records

2.3 After conducting a prequalification exercise (Note 5) and a tender exercise, the HyD awarded Contract A to Contractor A in April 2002 at a contract sum of \$1,538.7 million. The works commenced in April 2002 and were scheduled for completion in November 2006. Consultant X was the Engineer responsible for supervising the contract works. In the event, the contract works were substantially completed in August 2007, nine months later than the scheduled completion date (Note 6). Contract A account was finalised in December 2009 and the final contract sum was \$1,647.7 million (see Table 6).

Note 5: *According to Works Branch Technical Circular No. 15/1994, the responsible Government department needed to invite eligible contractors to apply for prequalification assessments for undertaking a works contract of an unusually high value and special technicality. The prequalified contractors would then be invited to submit tenders for the contract.*

Note 6: *Owing to inclement weather, EOTs of 60 days were granted to Contractor A.*

Additional time and cost under Contract A

Table 6
Final contract sum of Contract A
(December 2009)

Particulars	Amount (\$ million)	Amount (\$ million)
1. Contract works completed	443.3	
2. Payment for contract price fluctuation	235.0	
3. Alternative-design works completed under Supplementary Agreement (SA) 1 (Note 1)	851.0	
4. Alternative-design works completed under SA2 (Note 2)	17.6	
Total works completed		1,546.9
Payments for settling contract claims		
5. Claims related to an omitted BQ item (\$32.8 million — see paras. 2.4 to 2.11) and additional piling works (\$12 million — see paras. 2.12 to 2.21) settled under SA3	44.8	
6. Claims related to changes of works areas (see paras. 2.22 to 2.29)	23.8	
7. Claims related to changes of bridge-deck erection arrangements (see paras. 2.30 to 2.46)	17.0	
8. Other claims (Note 3)	15.2	
Total claims		100.8
Final contract sum		1,647.7

Source: HyD records

Note 1: In December 2003, the HyD and Contractor A entered into SA1, under which Contractor A's alternative design and construction of some piles and superstructures of NSC Viaduct at a fixed cost of \$851 million would replace the corresponding contract works of \$876 million, with a saving of \$25 million.

Note 2: In April 2007, the HyD and Contractor A entered into SA2, under which Contractor A's alternative design for waterproofing works for the viaduct bridge-decks at a fixed cost of \$17.6 million would replace the corresponding contract works of \$23.2 million, with a saving of \$5.6 million.

Note 3: Other claims mainly included costs relating to additional traffic management requirements for parapet construction (\$6.8 million) and changes of parapet types (\$3.7 million).

Additional time and cost under Contract A

Omission of a BQ item

2.4 According to Contract A, the following two tests were required to be carried out on completed piles:

- (a) a full-depth coring test (Note 7) on 5% of the completed piles to verify their structural integrity; and
- (b) a proof drilling test (Note 7) on all completed piles to ascertain whether they were founded on bedrock.

2.5 In the BQ of Contract A, a BQ item for the “core test” was included. According to Contractor A:

- (a) the nature of the full-depth coring test and the proof drilling test was different; and
- (b) owing to the omission of a BQ item for the proof drilling test in the BQ, he was unable to include a tender rate for that test although the test was required to be carried out under Contract A.

Hence, Contractor A made a claim for the costs of performing the proof drilling test which had not been specified as a BQ item. On the other hand, Consultant X considered that the full-depth coring test and the proof drilling test were variations of the same type of test and should be paid for under the BQ item for the “core test”.

Contractor A’s claim

2.6 In September 2006, after obtaining legal advice and the Financial Services and the Treasury Bureau (FSTB)’s approval, the HyD and Contractor A entered into SA3 (see item 5 in Table 6), under which Contractor A was paid a settlement sum

Note 7: *Under the full-depth coring test, samples of completed piles are tested at an approved laboratory for ascertaining their strength. Under the proof drilling test, samples of completed piles are inspected on site to ascertain whether they are founded on the bedrock.*

Additional time and cost under Contract A

of \$44.8 million (\$32.8 million related to the missing BQ item on proof drilling test and \$12 million related to additional piling works — see paras. 2.12 to 2.21), and was awarded an EOT of 46 days related to additional piling works.

2.7 In March 2014, the HyD informed Audit that:

- (a) Consultant X did not include a BQ item for the proof drilling test because he considered that the related works should be paid for under the BQ item for the “core test”; and
- (b) subsequent to Contractor A’s claim, separate BQ items for the proof drilling test had been included in Contracts B and C.

Areas for improvement

Works item omitted from BQ

2.8 Audit notes that full-depth coring and proof drilling tests (see para. 2.4 (a) and (b)) are works of different nature in terms of their scope and methodology, and serve different purposes. Therefore, two separate BQ items should have been provided for them. Audit considers that the HyD needs to take measures to ensure that separate BQ items for works of different natures are provided in the tender documents of a contract.

2.9 The proof drilling test should not have been omitted from the BQ of Contract A. After the award of Contract A in April 2002, in the light of a similar Audit finding on omitted BQ items as reported in Chapter 3 of the Director of Audit’s Report No. 53 of October 2009, the Civil Engineering and Development Department amended the Project Administration Handbook for Civil Engineering Works in July 2010 to require works departments to keep omitted items to an absolute minimum through proper preparation of BQs and contract documents, and require the Engineer of a contract to provide the Government with reasons justifying the acceptance of omitted items and the basis of his valuation. Audit considers that the HyD needs to take measures to ensure compliance with this requirement. This would help minimise contract claims and disputes, and enhance competitive tendering.

Audit recommendations

2.10 **Audit has recommended that, in implementing a works project in future, the Director of Highways should take measures to ensure that HyD staff and consultants:**

- (a) **provide separate BQ items for works of different nature in the tender documents of a contract; and**
- (b) **include all works items in the BQ of the contract as far as practicable.**

Response from the Administration

2.11 The Director of Highways agrees with the audit recommendations. He has said that:

- (a) the HyD will remind its staff and consultants to provide separate BQ items for works of different nature where appropriate; and
- (b) the HyD has followed the guidelines in the Project Administration Handbook for Civil Engineering Works promulgated in July 2010 requiring works departments to keep omitted items to an absolute minimum through proper preparation of BQs and contract documents, and require the Engineer of a contract to provide the HyD with reasons justifying the acceptance of omitted items and the basis of his valuation. The HyD has included the requirements in its quality management manual. The HyD will remind its staff and consultants to keep omitted items to an absolute minimum through proper preparation of BQs.

Additional piling works

2.12 In early 2003, Contractor A proposed an alternative viaduct design for NSC Viaduct, which would substitute part of the original works, including some bored piles and support works, superstructures and associated drainage ducts and railing works. Under the alternative design, the number of bored piles to be constructed would be reduced from 585 to 413, and the related BQ cost of works of

Additional time and cost under Contract A

\$876 million under the original design would be replaced by a lump-sum-fixed price of \$851 million (with a saving of \$25 million). In December 2003, the HyD and Contractor A entered into SA1 for implementing the alternative-design works (see item 3 in Table 6).

2.13 According to SA1, Contractor A needed to employ an Independent Checking Engineer (ICE) to check the alternative design and issue check certificates to Consultant X certifying that the works designs were in compliance with the terms and conditions of Contract A. According to Contractor A, the alternative design for the piling works was based on the relevant Government standards and the geological information available. In March 2004, Consultant X approved the check certificate issued by the ICE on the design principles for the pile foundation.

2.14 In April 2004, during the construction stage, in view of some available geological information, Consultant X wrote to Contractor A expressing concerns over the piling works and requested Contractor A to review the piling designs of 96 piles and to resubmit a design certified by the ICE for Consultant X's consent. According to Contractor A:

- (a) to avoid delaying the works, he had continued with the piling works of the 96 piles to founding levels deeper than those certified by the ICE while reviewing the design of the piles to address Consultant X's concern;
- (b) after noting that the rock samples extracted were inferior, Consultant X also issued verbal site instructions requesting him to lower the founding levels of the remaining 317 piles (413 minus 96 piles); and
- (c) the lowering of the founding levels of the piles (see (a) and (b) above) was additional works and he had requested Consultant X to issue a Variation Order (VO) for the works, but Consultant X did not do so.

Contractor A's claim

2.15 Contractor A subsequently made a claim that he had incurred extra time and additional costs for lowering the founding levels of the piles than actually required. In response to the HyD's enquiries, Consultant X said that:

Additional time and cost under Contract A

- (a) he, as the Engineer of Contract A, was required under the contract to satisfy himself that the proposed founding levels of the piling works were adequate;
- (b) it was Contractor A's own decision to revise the founding levels; and
- (c) the cost of the additional piling works was deemed to have been included in the lump-sum-fixed price of SA1, and therefore he did not issue a VO for the works.

2.16 In March 2014, the HyD informed Audit that, according to site records, of the total 413 piles involved under SA1 (see para. 2.12):

- (a) the founding levels of 86 piles were 0.5 m to 11 m deeper than the original certified founding levels; and
- (b) the founding levels of the remaining 327 piles were less than 0.5 m deeper than the original certified founding levels, which were within the usual range of variations for such works.

2.17 After obtaining legal advice, the HyD agreed that the lowering of the founding levels of 86 piles might constitute "deemed" variations. In this connection, Contractor A submitted calculations demonstrating that the original piling design was in line with Contract A requirements. After obtaining the FSTB's approval in July 2006, the HyD negotiated with Contractor A to settle the claim on the issue. In September 2006, the HyD and Contractor A entered into SA3 to settle this claim and another claim (see paras. 2.4 to 2.11), under which Contractor A was awarded a payment of \$12 million and an EOT of 46 days for his claim on additional piling works (see item 5 in Table 6 and para. 2.6).

Areas for improvement

HyD not informed before Contractor A was requested to review the piling design

2.18 Under SA1, Contractor A was responsible for implementing works under the alternative design which was subject to independent checking and certification by an ICE. The alternative design also formed the basis for determining the lump-sum-fixed price of SA1. However, according to Contractor A, Consultant X had requested Contractor A to review the founding levels of 96 piles and verbally commented on the founding levels of 317 piles. According to the HyD, the lowering of the founding levels of 86 piles (see para. 2.17) might constitute “deemed” variations, resulting in a payment of \$12 million and the grant of an EOT of 46 days to Contractor A.

2.19 According to Project Administration Handbook for Civil Engineering Works, for works variations estimated to exceed \$300,000 in value, the Engineer of a consultant-managed contract should seek prior approval from the responsible Government department. In March 2014, the HyD informed Audit that:

- (a) in response to Consultant X’s requests for Contractor A to review the founding levels of the 96 piles, in order to avoid disruption to the works, Contractor A took action to found the piles at deeper levels while conducting the review;
- (b) it was not clear, at the time of executing the piling works, whether Contractor A’s choice to lower the founding levels while conducting the piling review was actually a variation to the requirements under SA1; and
- (c) the HyD only realised that the request for Contractor A to review the piling design and the various verbal comments made by Consultant X on the founding levels should be considered as “deemed” variations after seeking legal advice in the process of negotiation with Contractor A on settling the related claim.

Additional time and cost under Contract A

According to the HyD, Consultant X had not sought the HyD's comments before requesting Contractor A to review the pile founding levels, which subsequently led to an additional contract cost. In Audit's view, for a lump-sum fixed-price contract involving a contractor's design, some of the Engineer's comments relating to such works may have cost implications. The HyD needs to establish proper control procedures to require its consultants to seek its comments before requesting a contractor to take any action which may subsequently constitute works variations involving additional cost which exceeds \$300,000.

Audit recommendation

2.20 **Audit has recommended that the Director of Highways should, in implementing a lump-sum fixed-price contract involving a contractor's design, establish proper control procedures to require the HyD consultant to seek the HyD's comments before instructing the contractor to carry out works which may subsequently constitute works variations involving additional cost which exceeds \$300,000.**

Response from the Administration

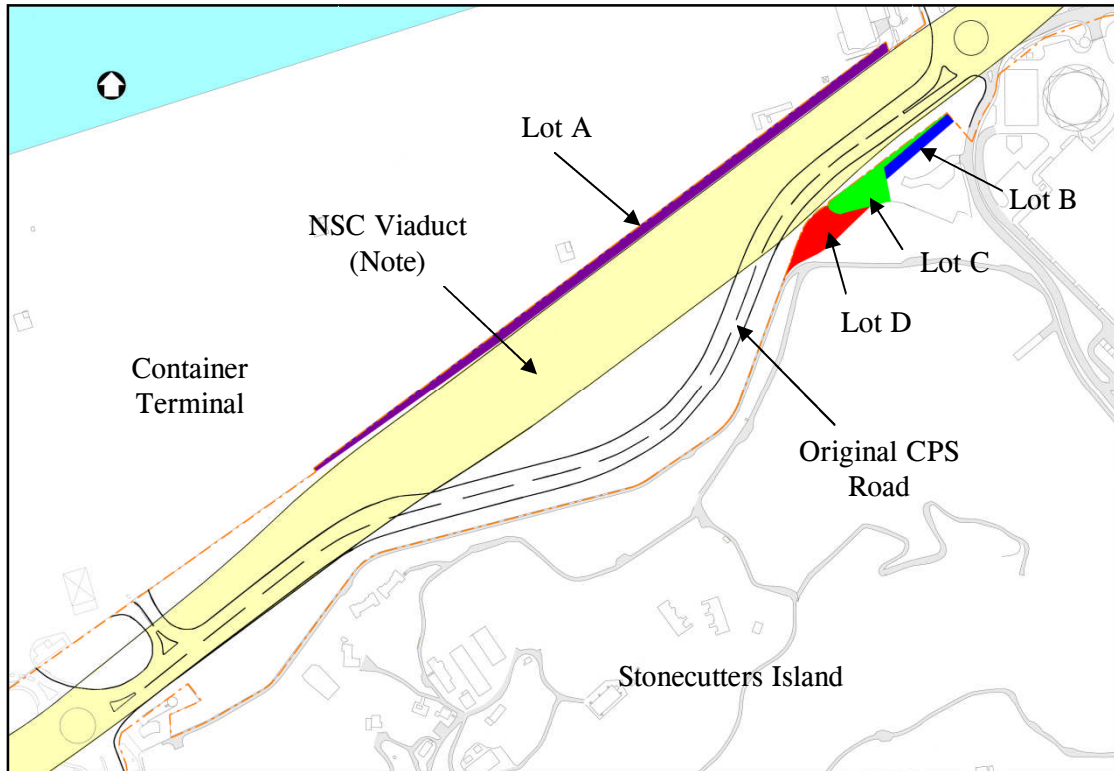
2.21 The Director of Highways agrees with the audit recommendation.






Changes of works areas

Designating private land as a works area

2.22 Under the works design of Contract A, a piece of private land of 4,660 square metres (m²) on Stonecutters Island (Lot A — see Figure 4) owned by a private company (Company A) was earmarked to be used as a works area by Contractor A.

Figure 4
Works areas along CPS Road



- Legend:
-  Works site of Contract A
 -  Lot A of 4,660 m²
 -  Lot B of 450 m²
 -  Lot C of 1,600 m²
 -  Lot D of 1,800 m²

Source: HyD records

Note: Re-aligned CPS Road was constructed underneath NSC Viaduct to replace original CPS Road.

Additional time and cost under Contract A

2.23 In April 2000, the HyD took actions to inform the public and stakeholders of the road scheme for Tsing Yi Section under the Roads (Works, Use and Compensation) Ordinance (Roads Ordinance — Cap. 370), including the proposed designation of Lot A as a works area. A chronology of key events is shown in Table 7.

Table 7

**Chronology of key events of designating private land as a works area
(April 2000 to February 2004)**

Date	Event
April 2000	A notice was published in the gazette regarding the proposed road scheme for Tsing Yi Section under the Roads Ordinance, which included the proposed declaration of Rights of Temporary Occupation (Note 1) of Lot A as a works area. Under the Ordinance, the HyD deposited a copy of the road scheme in the Land Registry, published the gazette notice in one local Chinese and one English newspaper, affixed copies of the plan in prominent places, including a place near the entrance to Lot A, and provided the Kwai Tsing District Council with a copy of the plan.
June 2000	Within 60 days after the notice was first gazetted in April 2000, the HyD did not receive any objections on the designation of Lot A as a works area (Note 2).
September 2000	The road scheme was approved by the Secretary for Transport under the Roads Ordinance.
April 2002	Contract A was awarded in which Lot A was indicated as a works area.
July 2003	Contractor A informed Consultant X that he had planned to use Lot A as a temporary road to divert traffic from CPS Road during the construction of NSC Viaduct.

Additional time and cost under Contract A

Table 7 (Cont'd)

Date	Event
July 2003	The Lands D gazetted a notice for the creation of Rights of Temporary Occupation of Lot A from 1 November 2003 to 31 December 2006, and served the notice on Company A.
August 2003	<p>Company A (which had not raised objections during the gazettal of the road scheme) raised objection to the proposed temporary occupation of Lot A as a works area on the following grounds:</p> <p>(a) it had not been consulted on the proposal since the first notice gazetted in April 2000; and</p> <p>(b) using Lot A as a temporary road with heavy vehicular traffic would adversely affect the facilities located underneath the area, and would seriously interrupt the company's operation thus inducing a substantial financial loss, which would not be adequately covered by compensation provided in the Roads Ordinance (Note 3).</p>
February 2004	After obtaining the consent of the occupiers of Lots B, C and D (see Figure 4), the HyD was allowed to make use of the three land lots to form a temporary road to divert traffic on part of CPS Road during the construction of NSC Viaduct. Consultant X issued a VO to Contractor A on implementing revised Temporary Traffic Arrangements using Lots B, C and D.

Source: HyD records

Note 1: Under the Roads Ordinance, the Secretary for Transport and Housing may declare Rights of Temporary Occupation of a piece of private land for the purpose of carrying out road works.

Note 2: Under the Roads Ordinance, a person may raise objection to proposed works or proposed use of land within 60 days from the publication of a gazette notice.

Note 3: Under the Roads Ordinance, any person having an interest in a piece of land being declared for Rights of Temporary Occupation may claim for compensation, which is the amount of an open market value of the right during the period of easement. In the event of a dispute, the case can be referred to the Lands Tribunal for settlement.

Additional time and cost under Contract A

Contractor A's claim

2.24 The traffic-diversion arrangements on CPS Road took place from April 2004 to November 2006. Between October 2003 and March 2005, Contractor A made claims for EOTs and additional payments on the grounds of the changes in the provision of the works area from Lot A to Lots B, C and D. In the event, Contractor A was granted EOTs of 66 days and additional payments totalling \$23.8 million (see item 6 in Table 6 in para. 2.3) for settling the related claims, including:

- (a) an EOT of 47 days, a prolongation cost of \$10.3 million and an additional payment of \$6.5 million for additional site formation and pavement works owing to the changes in the works area;
- (b) an additional payment of \$2.9 million for the return of one of the alternative works areas to the occupier before completion of the related works, as additional resources were required to be deployed to re-prioritise the works; and
- (c) an EOT of 19 days and a prolongation cost of \$4.1 million for the permanent diversion of two water mains under the temporary road.

Areas for improvement

Inadequate consultation before including private land in contract as a temporary works area

2.25 Audit notes that the HyD complied with the requirements of the Roads Ordinance to gazette the road scheme for Tsing Yi Section in April 2000, including the proposed declaration of Rights of Temporary Occupation of Lot A as a works area. The HyD also affixed copies of the road scheme in prominent places within the areas delineated in the plan (see Table 7 in para. 2.23). However, in August 2003, after the Lands D had gazetted a notice for the creation of Rights of Temporary Occupation of Lot A and served the notice on Company A (the owner of Lot A), the latter raised objection to the proposed temporary occupation of Lot A as a works area. According to Company A, it had not been consulted on the proposed temporary occupation of Lot A, the proposed use of Lot A as a temporary road would adversely affect the underground facilities in the area, and it would suffer a substantial financial loss owing to disruption to the company's business during the

Additional time and cost under Contract A

land occupation period. In the event, the HyD took actions to make use of Lots B, C and D as temporary works areas for the purpose. However, because of the changes in the works area, Contractor A was granted an EOT of 66 days and an additional payment of \$23.8 million.

2.26 According to Company A, it had not been consulted about the proposed designation of Lot A as a temporary works area for Contract A between April 2000 (when the Tsing Yi Section road plan was first gazetted) and July 2003 (when the Lands D served the notice on it about the creation of Rights of Temporary Occupation of Lot A). In Audit's view, had the HyD consulted the owner of Lot A before the award of Contract A in April 2002, it might have chosen other areas (such as Lots B, C and D) instead of Lot A for inclusion in Contract A as the works area, because the owner of Lot A would have informed the HyD about the presence of underground facilities in the area and its financial loss arising from the HyD's temporary use of Lot A as a temporary road. The lack of direct consultation with the private-land owner before including a piece of private land in Contract A as a temporary works area led to subsequent changes in the works area and resulted in additional contract time and payment.

2.27 In this connection, the "Guideline on public consultation and engagement for works projects" issued by the HyD in August 2010 (eight years after the award of Contract A in April 2002) requires HyD staff and consultants to conduct consultation with the pertinent individuals (including private-land owners) through arrangements of the District Offices of the Home Affairs Department during the planning and design stages of a road project. In Audit's view, in implementing a works project in future involving using private land as a temporary works area, the HyD needs to take measures to ensure that pertinent land-lot owners have been consulted and their concerns have been dealt with before including such land in a works contract.

Audit recommendation

2.28 **Audit has recommended that, in implementing a works project in future involving the use of private land as a temporary works area, the Director of Highways should take measures to ensure that pertinent land-lot owners have been consulted and their concerns have been properly dealt with before including such land in a works contract.**

Response from the Administration

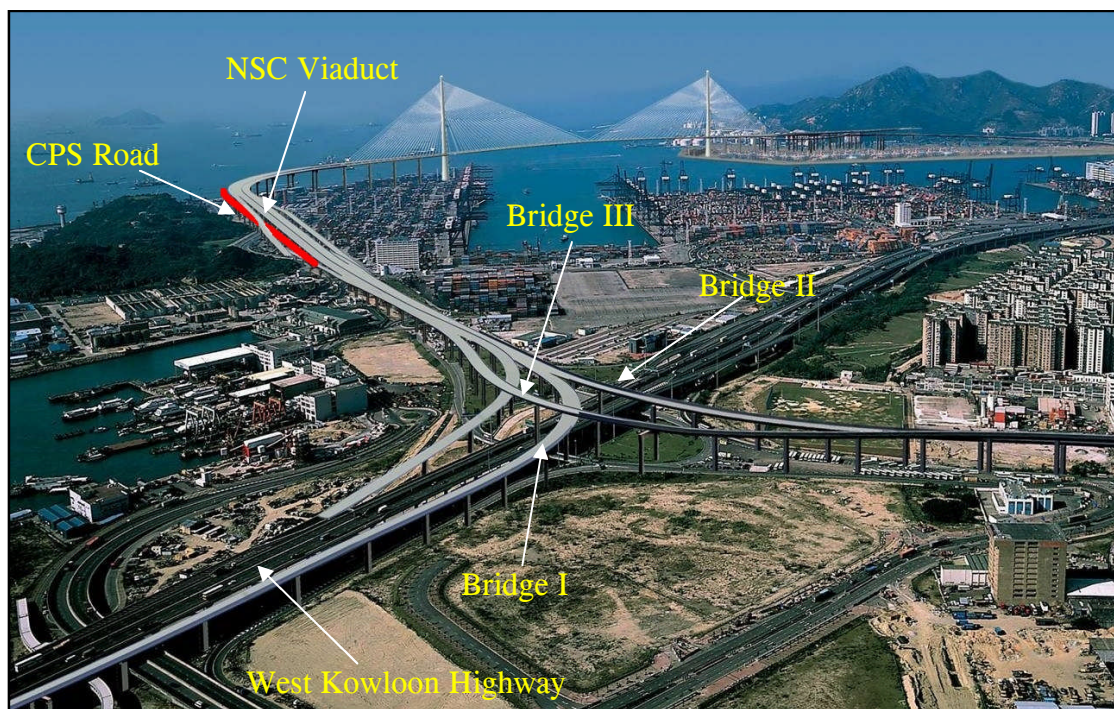
2.29 The Director of Highways agrees with the audit recommendation.

Changes of bridge-deck erection arrangements

2.30 Contract A included the construction of three bridges (namely Bridges I, II and III) which span over West Kowloon Highway linking to the NSC Viaduct (see Figure 5).

Figure 5

Bridges I, II and III



Source: HyD records

Guidelines on Traffic Impact Assessment

2.31 Under the “Guidelines on Traffic Impact Assessment (TIA) and Day-time Ban Requirements for Road Works on Traffic Sensitive Routes” issued by the HyD in July 1995, HyD staff and consultants should, during the planning stage of a road project:

- (a) assess the anticipated traffic implications of carrying out the works; and
- (b) devise appropriate temporary traffic management measures to ameliorate the traffic impact of the road works.

2.32 For a project affecting traffic, during the design stage, the HyD needs to conduct a TIA and submit a TIA report with a proposed temporary traffic management scheme to the relevant parties, including the TD and the HKPF, for comment. During the construction stage, a Traffic Management Liaison Group (TML Group — Note 8) would be set up for the project to review and provide comments on the temporary traffic arrangements proposed by a contractor based on the prevailing/projected traffic conditions and with due consideration of road safety.

Temporary Traffic Management scheme

2.33 In November and December 2000, in the TIA report and Temporary Traffic Management scheme report submitted to the HyD and circulated to the TD and the HKPF, Consultant X proposed that:

- (a) temporary traffic arrangements should be made for the bridge-deck erections for Bridges I, II and III;
- (b) as an option, segments of the decks of Bridges I, II and III might be launched separately;

Note 8: *A TML Group for a road project usually comprises representatives from the TD, the HKPF, the HyD, the Engineer, the Contractor, the relevant District Offices and various public transport operators.*

Additional time and cost under Contract A

- (c) the launching operations of bridge-decks, which would be carried out after mid-night and before 6:30 am, would affect West Kowloon Highway for 39 nights; and
- (d) the actual implementation programme would be developed by the contractor to tie in with his preferred construction method and works programme.

2.34 In May 2002, the TML Group for Contract A was set up. In August 2003, Contractor A informed the TML Group that the erection of the decks of the three bridges would be carried out one after the other in three times (three-time launching scheme) using one launching girder from 10:30 pm to 5:30 am for about 7.5 months with West Kowloon Highway partially closed for traffic for 41 nights and fully closed for 9 nights (totally 50 nights). During the partial and full closure of West Kowloon Highway, vehicular traffic would be diverted to other roads.

2.35 At the TML Group meeting held in December 2003, the TD and the HKPF representatives raised objection to the three-time launching scheme proposed by Contractor A because of the prolonged traffic impact on West Kowloon Highway. They requested Contractor A to explore the viability of reducing the number of bridge-deck erection works from three times to two times (two-time launching scheme). At the same meeting, Contractor A informed the TML Group that the three-time launching scheme would be the best arrangement and beneficial to the overall progress of the project. In response, the TML Group said that, as the Group would dominantly focus on the impacts, disruptions and public safety related to the temporary traffic arrangement scheme, all other contractual issues without jeopardizing public interest were outside the TML Group's jurisdiction.

2.36 At the TML Group meeting held in January 2004, Contractor A submitted and the TML Group agreed in principle to a revised temporary traffic management scheme involving a two-time launching scheme. Under the two-time launching scheme, the bridge-deck erection works for Bridges II and III would be carried out at the same time.

Additional time and cost under Contract A

2.37 In February 2004, Consultant X informed the TD and the HKPF that:

- (a) the proposed two-time launching scheme would cause less inconvenience to the public and road users, because West Kowloon Highway would be partially closed for traffic for 33 nights and fully closed for 8 nights only (totally 41 nights); and
- (b) however, this scheme would cause a one-month delay to the completion of the project, and a similar delay to the completion of the re-aligned CPS Road, which aimed to provide relief to the traffic congestion in container port area.

2.38 At a meeting held in March 2004:

- (a) Consultant X advised the TD and the HKPF that the two-time launching scheme would cause some delays to the completion of Bridges II and III and would defer the commissioning date of the road link between West Kowloon Highway and CPS Road;
- (b) Consultant X also pointed out that according to a study, closure of West Kowloon Highway would result in extra journey time of about three to four minutes for affected vehicles;
- (c) the TD raised reservations on the study results and requested Consultant X to substantiate the study findings; and
- (d) Consultant X advised that two-time launching would require additional resources which might not be readily available in the market, including another rescue team for handling emergencies.

2.39 Between August and October 2004, the bridge-deck erection works for Bridge I were carried out, during which West Kowloon Highway was partially closed for traffic for 22 nights and fully closed for 4 nights (totally 26 nights). At a TML Group meeting held in November 2004, Contractor A proposed and the TML Group agreed that the bridge-deck erection works for Bridges II and III should be carried out separately on the following grounds:

Additional time and cost under Contract A

- (a) the carrying out of bridge-deck erection works for Bridge I had no adverse traffic impact and only a few minor complaints were received; and
- (b) the proposed works arrangement would minimise the interfacing issues with other projects in the vicinity and obviate the complex procedures for carrying out bridge-deck erection works for Bridges II and III at the same time.

2.40 From January to July 2005, bridge-deck erection works for Bridges II and III were carried out separately, during which West Kowloon Highway was partially closed for traffic for 31 nights and fully closed for 24 nights (totally 55 nights).

Contractor A's claim

2.41 In June 2004, Contractor A submitted a claim for additional costs and an EOT arising from the change of the three-time launching scheme to the two-time launching scheme (see para. 2.36) on the grounds that he had incurred additional costs and the progress of works had been affected. After assessing the claims, Contractor A was awarded an EOT of 26 days and an additional payment of \$17 million (see item 7 in Table 6 in para. 2.3), comprising additional expenses of \$11.3 million and prolongation costs of \$5.7 million.

Areas for improvement

Financial implications not provided for informed decision

2.42 In January 2004, in the light of objection of the TD and the HKPF representatives in the TML Group on the three-time launching scheme on the grounds of the forecast prolonged traffic impact on West Kowloon Highway, Contractor A adopted the two-time launching scheme for Bridges I, II and III (see paras. 2.35 to 2.37). At that time, Consultant X informed the TD and the HKPF that the adoption of the two-time launching scheme, instead of the original three-time launching scheme, would cause a one-month delay to the completion of the project, and a similar delay to the completion of the re-aligned CPS Road, but

there was no mention of the additional cost to be incurred. As it transpired, the decision to change the three-time launching scheme to the two-time launching scheme in January 2004 resulted in an EOT of 26 days and an additional payment of \$17 million granted for Contract A (see para. 2.41). In the event, after completion of bridge-deck erection works for Bridge I, the TD and the HKPF representatives agreed with Contractor A in November 2004 that the latter could revert to the original three-time launching scheme (see para. 2.39).

2.43 In Audit's view, the TML Group should have been provided with the financial implications of possible contract claims arising from changing the three-time launching scheme to the two-time launching scheme for making informed decisions. The HyD needs to learn lessons from this incident.

Audit recommendation

2.44 **Audit has *recommended* that, in implementing a works project in future involving a change in the works procedures on the grounds of traffic considerations, the Director of Highways should provide the TML Group with the related financial implications of possible contract claims for making informed decisions.**

Response from the Administration

2.45 The Director of Highways agrees with the audit recommendation. He has said that the HyD will require its staff and consultants to advise members of TML Groups of possible time and cost implications when matters to be considered by these groups may involve risks of contract claims.

2.46 The Commissioner of Police also agrees with the audit recommendation. He has said that the confirmed cost implications of proposed changes to a project should be made known to a TML Group.

PART 3: ADDITIONAL COST UNDER CONTRACT D

3.1 This PART examines the causes of incurring additional cost under Contract D relating to tunnel-lining works (Note 9).

Contract D

3.2 Contract D was a remeasurement contract for the construction of:

- (a) Nam Wan Tunnel (see Figure 2 in para. 1.4 and Photograph 2) which is a twin three-lane tunnel, each of 1.25 km long (Note 10);
- (b) West Tsing Yi Viaduct (see Figure 2) of 1.5 km long; and
- (c) civil works associated with the TCS System.

Note 9: *A tunnel lining is a layer of structure covering the inside surface of a tunnel to uphold the excavated rock face of the tunnel.*

Note 10: *The completed Nam Wan Tunnel was 1.2 km long.*

Photograph 2

Eastern entrance of Nam Wan Tunnel



Source: HyD records

3.3 After conducting a prequalification exercise and a tender exercise, in April 2003, on the recommendation of the Central Tender Board (Note 11) and the approval of the FSTB, the HyD awarded Contract D to Contractor D at a contract sum of \$1,479.3 million. The works commenced in the same month and were scheduled for completion in May 2007. Consultant X was the Engineer supervising the contract works. Owing to inclement weather, EOTs of 168 days were granted to Contractor D. In the event, the contract works were substantially completed in November 2007, 168 days (five and a half months) later than the original scheduled completion date. Contract D account was finalised in August 2010 and the final contract sum was \$1,699.4 million (see Table 8).

Note 11: *In April 2003, the Central Tender Board was chaired by the Permanent Secretary for Financial Services and the Treasury (Treasury) and comprised four members.*

Additional cost under Contract D

Table 8

**Final contract sum of Contract D
(August 2010)**

Particulars	Amount (\$ million)	Amount (\$ million)
1. Contract works completed	1,427.5	
2. Payment for contract price fluctuation	205.3	
3. Alternative-design works completed under SA4 (Note 1)	21.9	
4. Alternative-design works completed under SA5 (Note 2)	1.7	
Total works completed		1,656.4
Payment for settling contract claim		
5. Claim related to tunnel-lining works settled under SA6 (see paras. 3.5 to 3.24)		43.0
Final contract sum		1,699.4

Source: HyD records

Note 1: In September 2005, the HyD and Contractor D entered into SA4, under which Contractor D's alternative design for the construction of some dams for mitigating natural terrain hazards was accepted to replace the original design for implementation, with a saving of \$4.8 million.

Note 2: In May 2007, the HyD and Contractor D entered into SA5, under which Contractor D's alternative design for a viaduct waterproofing system was accepted to replace the original design for implementation, with a saving of \$0.5 million.

3.4 One of the major works items under Contract D was the construction of Nam Wan Tunnel (see para. 3.2(a)) which consisted of twin tunnels each of 1.25 km long with a height of 9.5 metres (m). Cross passages connecting the twin tunnels were provided at 100-m intervals for use during emergencies.

Construction of tunnel linings

3.5 The twin tunnels were excavated through hills by the drill and blast method. Under Contract D, for the purpose of upholding the excavated rock face of the tunnels:

- (a) Contractor D was responsible for constructing concrete linings for the twin tunnels and the cross passages (see Photograph 3); and
- (b) the thickness of the linings was to be determined by referring to the Norwegian Geotechnical Institute “Q-value” System with Q-values measured in-situ on the excavated rock face (In-situ Q-values — Note 12).

Note 12: *Q-value is a rock-condition classification system for use in the design of tunnel lining works, which takes into account the effects of blasting, the influence of underground water pressure and the quality of materials covering the inside surfaces of tunnels. The higher the Q-value, the higher is the rock quality and stability, and the thinner is the tunnel lining required.*

Photograph 3

Tunnel lining works at Nam Wan Tunnel



Source: HyD records

Specifications in tender documents

3.6 The estimated tunnel lengths requiring different tunnel-lining thickness were provided in the tender BQ of Contract D. On the other hand, drawings showing the ground investigation (GI) information (GI Drawings) obtained at the design stage were also provided to tenderers for reference upon request. The GI Drawings showed the estimated Q-values of the rock along various sections of the tunnels which were estimated based on the GI information (estimated Q-values). According to the HyD, the GI Drawings were not tender drawings and were not intended to show the thickness of tunnel linings to be adopted for various sections of the tunnels.

3.7 The estimated tunnel lengths requiring different lining thickness stated in the tender BQ and reflected in the GI Drawings are shown in Table 9:

Table 9

Estimated tunnel lengths requiring different tunnel-lining thickness

Estimated Q-value	Lining thickness required millimetre (mm)	Estimated tunnel length	
		stated in BQ (m)	calculated by Audit based on estimated Q-values in GI Drawings (m)
Larger than 1	400	787	1,855
0.4 to 1	500	787	130
Less than 0.4	600	787	320
Total		2,361	2,305 (Note)

Source: Audit analysis of Contract D's BQ and GI Drawings

Note: The total length of the twin tunnels was 2.5 km (1.25 km × 2). As other protection treatments were required for the tunnel portals, the length of tunnels requiring concrete linings was shorter than 2.5 km. Furthermore, the total tunnel length under the GI drawings was shorter than that under the BQ because the former did not include the length of the cross passages.

As shown in Table 9, the estimated tunnel lengths requiring different lining thickness stated in the BQ differed significantly from those calculated based on the estimated Q-values stated in the GI Drawings.

Additional cost under Contract D

3.8 In the tender submitted by Contractor D, he specified a BQ rate of \$95,151/m for 400 mm tunnel linings but nil rates for both 500 mm and 600 mm tunnel linings (see Table 10).

Table 10
Contractor D's BQ rates for tunnel linings
(November 2002)

	Lining thickness required (mm)	BQ quantity	Contractor D's tender	
		Length (m)	BQ rate (\$/m)	BQ amount (\$)
(a)	400	787	95,151	74,883,837
(b)	500	787	0	0
(c)	600	787	0	0
	Total	2,361	—	74,883,837

Source: HyD records

3.9 In response to Consultant X's enquiry in January 2003, Contractor D indicated that the 500 mm and 600 mm lining works would be implemented free of charge, and the costs of which would be covered in the rates of other works items. Audit notes that Consultant X and the HyD had not assessed the cost implications if the outturn tunnel lengths requiring different lining thickness were similar to those based on the GI Drawings, namely "1,855 m", "130 m" and "320 m" for lining thickness of 400 mm, 500 mm and 600 mm respectively (see Table 9). Contractor D was subsequently awarded Contract D and the tender documents and the BQ rates became part of Contract D.

Consultant X’s Site Instructions during works implementation

3.10 During works implementation from May 2004 to May 2005, Consultant X issued 41 Site Instructions to Contractor D specifying the thickness of the tunnel linings in some tunnel sections. Based on Consultant X’s Site Instructions, the following tunnel linings were constructed:

Tunnel lining thickness (mm)	Tunnel length (m)
400	1,157
500	1,036
600	168
Total	2,361

Disputes over tunnel-lining requirements

Contractor D’s claim

3.11 Subsequently, Consultant X certified the completion of the tunnel lining works at a cost of \$110 million (1,157 m × \$95,151/m — see item (a) in Table 10 in para. 3.8). As the BQ rates of 500 mm and 600 mm lining works were nil, no cost was certified by Consultant X for the related works. In May 2005, Contractor D served a notification on the HyD claiming an additional cost for the tunnel lining works on the following grounds:

- (a) during the tender stage, based on the estimated Q-values at various locations of the tunnels, Contractor D expected that there should be more 400 mm-thick lining works than those stated in the BQ (see Table 9 in para. 3.7). Accordingly, he submitted in his tender an “enhanced” rate for the 400 mm item in the BQ, while the 500 mm and 600 mm items would be constructed free of charge. He considered that this pricing strategy would enable him to submit a lower and more competitive tender price;

Additional cost under Contract D

- (b) also, under Contract D, the only criterion provided for determining the lining thickness levels was the In-situ Q-values. The Site Instructions issued by Consultant X during works implementation (see para. 3.10) had involved a change in the tunnel length requiring different lining thickness, which was at variance with the lining requirements based on the In-situ Q-values; and
- (c) according to Contractor D, the tunnel lengths requiring each of the three types of tunnel lining based on the In-situ Q-values obtained after completing the tunnel excavation works should have been as follows:

Q-value	Tunnel lining thickness (mm)	Tunnel length (m)
Larger than 1	400	2,069
0.4 to 1	500	145
Less than 0.4	600	147
	Total	2,361

Audit notes that Contractor D had been instructed to construct less lengths of 400 mm lining works (of 1,157 m) than those reflected in the in-situ measurement (of 2,069 m).

Independent engineering expert's assessment

3.12 From October 2005 to February 2006, the HyD and Contractor D entered into mediation over the latter's financial claim. In January 2006, the Development Bureau (DEVB — Note 13) appointed an independent engineering expert to assess

Note 13: *Before July 2002, the then Works Bureau was responsible for the policy portfolio of works matters. In July 2003, the then Environment, Transport and Works Bureau was formed to take over the policy portfolio. In July 2007, the Development Bureau was formed to take over the works policy portfolio. For simplicity, the then Works Bureau and the then Environment, Transport and Works Bureau responsible for works matters are referred to as the DEVB in this Audit Report.*

Contractor D's claim. In his report submitted in February 2006, the expert said that:

- (a) the contract drawings did not indicate that the selection of lining thicknesses was dependent on anything other than the In-situ Q-values; and
- (b) work calculations demonstrated that 400 mm linings were structurally adequate in some locations where thicker linings had been instructed through the issue of site instructions, and therefore some instructions were unnecessary.

Consultant X's explanations

3.13 In response to the HyD's enquiry in November 2005, Consultant X said that:

- (a) when estimating the tunnel lengths requiring different lining thickness levels for incorporation into the BQ, other known geological information and features (such as localised areas of poor soil materials and water drainage) had also been considered; and
- (b) therefore, the estimated tunnel lengths provided in the BQ, particularly for the 400 mm item, did not correlate with the estimated tunnel lengths calculated based on the estimated Q-values shown in the GI Drawings.

Claim settlement

3.14 In August 2006, with the approval of the FSTB, the HyD and Contractor D entered into SA6, under which Contractor D was paid a sum of \$43 million to settle the related claim.

Areas for improvement

Cost increase in tunnel lining works

3.15 According to the BQ in Contract D, the cost of the concrete lining works was estimated to be \$75 million (see Table 10 in para. 3.8). As it transpired, the final cost amounted to \$153 million (\$110 million plus \$43 million — see paras. 3.11 and 3.14), which was 104% higher than the original estimate of \$75 million.

Additional cost arising from different tunnel lengths requiring different lining thickness between BQ and GI Drawings

3.16 Audit notes that the estimated tunnel lengths requiring different lining thickness stated in the BQ differed significantly from those calculated based on the estimated Q-values stated in the GI Drawings (see para. 3.7). Subsequent to contract award, Consultant X issued Site Instructions requiring Contractor D to construct thicker linings in some tunnel sections. Table 11 shows the BQ quantities, the quantities derived from the GI Drawings, the actual quantities instructed by Consultant X, and the quantities based on the In-situ Q-values obtained after completing the tunnel excavation works.

Table 11

Estimated and actual quantities of lining works

Tunnel lining thickness	Tunnel length			
	BQ quantity estimated by Consultant X (see Table 9)	Quantity based on estimated Q-values shown in GI Drawings (see Table 9)	Actual quantity instructed by Consultant X (see para. 3.10)	Estimated quantity based on In-situ Q-values (see para. 3.11(c))
(a) (mm)	(b) (m)	(c) (m)	(d) (m)	(e) (m)
400	787	1,855	1,157	2,069
500	787	130	1,036	145
600	787	320	168	147
Total	2,361	2,305 (Note)	2,361	2,361

Source: HyD records

Note: The GI Drawings did not include the length of the cross passages.

3.17 As shown in Table 11, the tunnel lengths requiring different lining thickness based on the estimated Q-values (see column (c)) approximated the tunnel lengths based on the In-situ Q-values (see column (e)). If the tunnel linings had been constructed based on the In-situ Q-values, the tunnel lengths constructed with 400 mm lining would have been about 2,069 m.

3.18 According to Project Administration Handbook for Civil Engineering Works issued by the Civil Engineering and Development Department providing guidance to all works departments, during the pre-tender stage of a works project:

Additional cost under Contract D

- (a) the BQ should be prepared in a way that the quantities should be computed from the tender drawings, unless otherwise stated in the tender documents; and
- (b) the BQ should undergo a checking process to enable its completeness and accuracy and elimination of major errors. This would facilitate competitive tendering.

In this case, Audit notes that the HyD had not identified the significant differences in tunnel lengths requiring lining thickness between those stated in the BQ and those derived from the GI Drawings during its checking of the BQ included in the tender documents.

3.19 In Audit's view, in implementing a works project in the future, the HyD needs to take measures to ensure that HyD staff and consultants strengthen checking of BQ items to safeguard their completeness and accuracy.

Risk of unreasonably high BQ rate

3.20 Audit notes that Contractor D's BQ rate of \$95,151/m for the 400 mm item for tunnel lining works (see para. 3.8) was 333% higher than the pre-tender cost estimate of \$22,000/m. However, the HyD and Consultant X had only requested Contractor D to provide reasons for submitting the unreasonably low BQ rates (nil rates) for the 500 mm and 600 mm items (see para. 3.9), but not for the unreasonably high BQ rate for the 400 mm item. Furthermore, the HyD had not assessed the cost implications of related possible contract claims and included them in the Tender Assessment Report for submission to the Central Tender Board.

3.21 According to Technical Circular (Works) No. 7/2004 issued by the DEVB in April 2004 (promulgated subsequent to the letting of Contract D in April 2003), if a Government department considers that certain rates in a tender are unreasonably high and that there is a risk that the tenderer will take advantage of such rates in future claims, the department should assess the risk that the Government will be exposed to in accepting such a tender. In Audit's view, the HyD needs to take measures to ensure that its staff pay particular attention to any unreasonable BQ rates.

Audit recommendations

3.22 **Audit has recommended that, in conducting a tender exercise for implementing a works project in future, the Director of Highways should take measures to ensure that HyD staff and consultants:**

- (a) **strengthen checking of BQ items to safeguard their completeness and accuracy;**
- (b) **pay particular attention to any unreasonable BQ rates; and**
- (c) **when encountering unreasonable BQ rates, assess the cost implications and the associated risks of financial claims, and include the results of assessment in the tender assessment report for submission to the relevant tender board for consideration.**

Response from the Administration

3.23 **The Director of Highways agrees with the audit recommendations. He has said that:**

- (a) **HyD consultants are responsible for ensuring the completeness and accuracy of BQ items. The HyD will remind them to strengthen such checking; and**
- (b) **the HyD will remind its staff and consultants to be more vigilant in assessing the risks resulting from unreasonably high BQ rates in accordance with DEVB Technical Circular (Works) No. 7/2004 (see para. 3.21).**

3.24 **The Secretary for Financial Services and the Treasury agrees with the audit recommendation in paragraph 3.22(c). He has said that the recommendation is in line with the guideline stated in DEVB Technical Circular (Works) No. 7/2004.**

PART 4: PROVISION OF TRAFFIC CONTROL AND SURVEILLANCE SYSTEM UNDER CONTRACT E

4.1 This PART examines the provision of the TCS System under Contract E for Tsing Yi and Sha Tin Sections of Route 8, focusing on:

- (a) site access for implementing the TCS System (paras. 4.8 to 4.24); and
- (b) implementation of Speed Enforcement Camera (SEC) System (paras. 4.25 to 4.41).

Traffic Control and Surveillance System

4.2 The TCS System is installed at Tsing Yi and Sha Tin Sections of Route 8 for traffic management by the TD. The TCS System includes closed-circuit television cameras, automatic vehicle detection devices (Note 14), lane control signals and variable message signs (see Photograph 4).

Note 14: *The devices are used to detect vehicles exceeding the height limits of the road sections, monitor traffic incidents and collect traffic data.*

Photograph 4

Variable message sign at Sha Tin Section



Source: TD records

4.3 In February and November 1998, when seeking funding for the detailed design of Sha Tin and Tsing Yi Sections respectively from the FC, the HyD said that each of the two road sections would be installed with a TCS System.

4.4 In February and July 1999, the HyD awarded Consultancy X at a cost of \$105 million to Consultant X and another consultancy (Consultancy Z) at a cost of \$50 million to Consultant Z for the design and construction supervision of Tsing Yi and Sha Tin Sections respectively, including the preliminary designs for the TCS Systems for the two road sections.

Provision of traffic control and surveillance system under Contract E

4.5 In early 2000, the TD and the HyD exchanged views on adopting a single TCS System for both Sha Tin and Tsing Yi Sections instead of two TCS Systems. In March 2000, the TD informed the HyD that a single TCS System would save \$12.2 million in capital cost and \$63 million in recurrent cost over the 10-year life cycle of the System.

4.6 In June 2000, the TD and the HyD decided to adopt a single TCS System for the two road sections, and the HyD assigned Consultant X for the preliminary design of the single TCS System, with the main TCS System control centre to be provided at Tsing Yi Section.

Contract E

4.7 After conducting a tender exercise, in October 2004, the HyD awarded Contract E to Contractor E at a lump-sum-fixed price of \$255 million. Contractor E was responsible for the detailed design, installation, and commissioning of the TCS System for Tsing Yi and Sha Tin Sections of Route 8. The works commenced in October 2004 and were scheduled for completion in August 2008. Consultant X was responsible for the preliminary design, civil-works design and supervision of the contract works. In the event, the contract works were substantially completed in January 2010, 17 months later than the original scheduled completion date. Contract E account was finalised in December 2012 and the final contract sum was \$309.2 million (see Table 12).

Provision of traffic control and surveillance system under Contract E

Table 12

**Final contract sum of Contract E
(December 2012)**

Particulars	Amount (\$ million)	Amount (\$ million)
1. Lump-sum-fixed price (A)		255.0
Payments for settling contract claims		
2. Claim related to delays in gaining access to works sites along Tsing Yi Section settled under SA7 (see para. 4.13)	45.5	
3. Claims related to delays in gaining access to works sites along Sha Tin Section (see para. 4.14)	6.7	
4. Claim related to rescheduling of testing work (see para. 4.15)	3.8	
Total claims (B)		56.0
(A) + (B)		311.0
5. Less: cost saving identified in provisional items provided in Contract E		(1.8)
Final contract sum		309.2

Source: HyD records

Site access for implementing the TCS System

4.8 The TCS System for both Tsing Yi and Sha Tin Sections was installed under Contract E. While road works for Tsing Yi Section were undertaken under Contracts A, B, C and D, road works for the Sha Tin Section were under three other works contracts, namely Contracts F, G and H (Note 15).

4.9 The seven works contracts (Contracts A, B, C, D, F, G and H) included constructing facilities related to the installation of the TCS System, such as provisions of ducting, sign gantries, power-supply equipment, and electrical and mechanical (E&M) installations. The related civil works were required to be completed according to milestone completion dates specified in the seven works contracts before providing the completed facilities and site access to Contractor E for carrying out the TCS System installation work. On the other hand, corresponding site access dates were also specified in Contract E for Contractor E to gain access to the sites for commencing the system installation work.

4.10 The works programme of Contract E comprised six sections of works, which were further broken down into 15 sites. To provide contingencies for any delay in completing the related civil works and providing site access and related facilities to Contractor E, the corresponding site access dates specified in Contract E had already provided time gaps of one (Site 14) to six (Site 13) months counting from the scheduled milestone completion dates specified in the seven works contracts (see Appendix B — Note 16).

Note 15: *Contracts F, G and H at a total project cost of about \$6 billion were for the construction and construction supervision of Eagle's Nest Tunnel, Lai Chi Kok Viaduct and Sha Tin Height Tunnel respectively. Contracts F and G were administered by the HyD while Contract H by the Civil Engineering and Development Department.*

Note 16: *According to the HyD, as Contract E was the last contract awarded for the whole Route 8 project, the setting of site access dates had taken into account the programme and progress of the related works contracts (except for Contract C) at the time of inviting tenders for Contract E.*

Provision of traffic control and surveillance system under Contract E

4.11 In the tender documents of Contract E, tenderers were required to indicate in the BQ the amount of compensation per day payable to the contractor for the first 180 days of delay after the specified site possession dates. In the event, Contractor E stated in his tender a compensation of \$1 per day for the first 180 days of delay in site possession, which became a BQ item in Contract E.

Provision of site access to Contractor E

4.12 During the construction of Tsing Yi and Sha Tin Sections, the time of completing the civil works at 15 sites under the civil works contracts was later than the scheduled milestone completion dates, ranging from 16 days (Site 11) to 483 days (Site 15). During works implementation, site access was nonetheless provided to Contractor E for carrying out the TCS System installation work by phases. With the exception of Sites 11 and 12, full site access to most of the sites was provided to Contractor E a long time after the site access dates specified in Contract E. For example, for Site 1, the scheduled site access date was 11 June 2006, but the site access was only provided to Contractor E by phases from 10 April 2006 to 30 November 2007, 537 days after the original scheduled date for providing full site access to Contractor E (see Appendix B).

Claims for delays in gaining full access to works sites

4.13 Contract E was completed in January 2010, 17 months later than the scheduled completion date. In the event, Contractor E submitted claims for an additional cost arising from delays in providing site access to him for carrying out the TCS System installation work. According to Contractor E, he had provided additional resources to address the work-site interfacing problems and rescheduling his work to mitigate work delays to enable timely opening of the road sections. After assessment of Contractor E's claims, in July 2009, the HyD and Contractor E entered into SA7 under which some works items were subdivided into more items with different site access dates in Site 15, and Contractor E was paid an additional sum of \$45.5 million for the contract modifications and delays in providing site access to him along Tsing Yi Section (see item 2 in Table 12 in para. 4.7).

4.14 Furthermore, the HyD also paid \$6.7 million to Contractor E to settle his claims relating to delays in providing site access to him at Sites 1 to 6 along Sha Tin Section (see item 3 in Table 12).

Provision of traffic control and surveillance system under Contract E

4.15 Moreover, owing to a delay in completing the road works, a commissioning test for the TCS System originally scheduled for October 2009 was deferred to December 2009. After assessing Contractor E's claim for the delay, the HyD paid a prolongation cost of \$3.8 million to him (see item 4 in Table 12).

4.16 In March 2014, the HyD informed Audit that:

- (a) under the provisions of Contract E, Contractor E should take due recognition of the restrictive accessibility of the sites in formulating his programme and construction method, and to work with other contractors during the execution of his works. Contractor E should also liaise and coordinate with all parties whose works involved interfacing with the work of Contract E, and agree with them the interfacing arrangements, including timing of interfacing site activities, site access arrangements and working space; and
- (b) the certified substantial completion dates (see column (b) of Appendix B) were the stage achievement dates, by which works under the civil works contracts were completed to a degree such that Contractor E could carry out the TCS System installation work, whilst the contractors for civil works contracts could work in parallel within the same site to complete the remaining civil and E&M works. In the event, programmes for phased handing over of sites were agreed between Contractor E and the various civil works contractors before commencing the TCS System installation work.

4.17 In March 2014, the Civil Engineering and Development Department (which was responsible for administering Contract H) informed Audit that:

- (a) taking into account the extended contract completion dates after the award of EOTs, there were no delays in completing the civil works under Contract H; and
- (b) the site handover dates for Sites 6 and 9, although slightly beyond Contract E's site access dates, were within the timeframe agreed with the HyD.

Provision of traffic control and surveillance system under Contract E

4.18 In March 2014, in response to Audit's observations in paragraph 4.12, Consultant Z (who was the consultant of Contracts F and G) furnished the following views:

- (a) regarding Contract F, the dates shown in column (b) of Appendix B, namely certified substantial completion dates, were the stage achievement dates by which works under the civil works contracts had been completed to a degree such that Contractor E could access the sites to carry out the TCS System installation works, whilst the civil works contractors worked in parallel within the same sites to complete the remaining civil and E&M works; and
- (b) given that the entire site of Contract F covered a length of around 3.6 km of Route 8, both Contractor E and Contractor F were not required, and should not have had sufficient resources, to work along the whole length of such a large site at the same time. Therefore, according to agreements made in the regular interfacing meetings, access to these sites was granted in stages to suit the work programmes of both contractors.

Areas for improvement

Long time taken to provide full site access to Contractor E

4.19 Audit notes that, with the exception of Sites 11 and 12, Contract E was provided with full site access to the other 13 sites by phases, many spanning over a long period of time after the site access dates specified in Contract E. Audit also notes that full site access to most of the sites was provided to Contractor E by phases a long time after the substantial completion of the related civil works (see Appendix B).

4.20 Audit is concerned about the long time taken by the HyD to provide full site access to Contractor E after the scheduled site access dates stated in Contract E, particularly for Sites 1 to 6 and 15, resulting in additional costs totalling \$52.2 million (\$45.5 million plus \$6.7 million — see paras. 4.13 and 4.14). In Audit's view, the HyD needs to take measures to prevent the recurrence of similar incidents in future.

Provision of traffic control and surveillance system under Contract E

Knock-on effects of delays in completing road works

4.21 With a view to mitigating claims relating to any delay in providing site access to Contractor E, the HyD incorporated the following two measures into Contract E:

- (a) provision of time gaps of one to six months between scheduled milestone completion dates specified in the seven works contracts and the site access dates specified in Contract E (see para. 4.10); and
- (b) specified financial compensations for the first 180 days of delay in providing the site access (see para. 4.11).

4.22 However, it transpired that the mitigating measures were not fully effective in preventing claims from Contractor E on the grounds of significant delays in providing site access to him. In Audit's view, in implementing a works project with independent system installations in future, the HyD needs to take measure to strengthen its monitoring of the civil works completion, taking into account the knock-on effects and potential financial claims resulting from any significant delay in providing site access to a system contractor.

Audit recommendations

4.23 **Audit has *recommended* that the Director of Highways should:**

- (a) **take measures to prevent the recurrence of incidents of providing site access to a contractor a long time after the site access date specified in a contract; and**
- (b) **in implementing a works project with independent system installations in future, take measures to strengthen the HyD's monitoring of the civil works completion, taking into account the knock-on effects and potential financial claims resulting from any significant delay in providing site access to a system contractor.**

Response from the Administration

4.24 The Director of Highways agrees with the audit recommendations. He has said that:

- (a) the HyD will take measures to prevent the recurrence of similar incidents of providing site access to a contractor a long time after the site access date specified in a contract in future; and
- (b) the HyD will remind its staff and consultants to strengthen the monitoring of the completion of civil works for timely handing over sites to contractors for system installation.

Implementation of Speed Enforcement Camera System

4.25 An SEC System comprises digital cameras and radar units installed at different locations of a highway. The data captured by an SEC System normally include the registration number of a speeding vehicle, date and time, speed limit in force and location. Control-area operators (authorised by the Commissioner for Transport) and the HKPF make use of vehicle-speed-detection devices for speed enforcement action in government-owned tunnels and control areas (Note 17).

SEC System for Tsing Yi and Sha Tin Sections

4.26 In 2002, Consultant X proposed and the TD agreed to install an SEC System for Tsing Yi and Sha Tin Sections with the following features:

Note 17: *Under the Road Traffic Ordinance (Cap. 374), the Commissioner for Transport and the Commissioner of Police can take prosecution action against speeding offenders. Under the Tsing Sha Control Area Ordinance (Cap. 594), the Tsing Sha Control Area operator is authorised to take speed enforcement action under delegated authority of the Commissioner for Transport.*

Provision of traffic control and surveillance system under Contract E

- (a) the system would comprise 6 sets of digital cameras and radar detectors which would have automated coordination with variable speed limit signs (VSL Signs — Note 18) installed at the gantries along Tsing Yi and Sha Tin Sections; and
- (b) the system would be interfaced with the TCS System where the data captured would be relayed to a work station for processing, storage and retrieval for prosecution purposes.

4.27 At that time, SEC Systems on other roads were not automatically coordinated with VSL Signs and speed limits were generally indicated by fixed traffic signs. The proposed SEC System for Tsing Yi and Sha Tin Sections was the first system in Hong Kong having such new features. The installation of the SEC System was incorporated into Contract E at an estimated cost of \$4.8 million.

4.28 Before inviting tenders for Contract E in March 2004, there were exchanges of views about the incorporation of the new SEC System into Contract E, as follows:

- (a) in September 2002, the Department of Justice (DoJ) informed the TD that the proposed SEC System was acceptable provided that the truth of the produced images would be testified by an expert so that the images could be accepted by the Court as evidence for prosecution actions;
- (b) in August and September 2003, as the SEC System needed to go through a trial and an assessment by an expert, the HyD informed the TD that the application of the proposed SEC System for prosecution actions had not been cleared by the DoJ and it would take a long time to clear the legal issues if new features such as interfacing with the TCS System were required. Therefore, it was inappropriate to incorporate the SEC System into Contract E and there was a risk that the SEC System would become redundant if its use for prosecution purposes could not be fully justified; and

Note 18: *According to the TD, VSL Signs are installed on new strategic roads with variable speed limits (as determined by the road operator or according to pre-set rules) to enhance road safety and efficiency based on the actual road traffic conditions.*

Provision of traffic control and surveillance system under Contract E

- (c) in response to the TD's consultation, the DoJ said that it did not see any special problem with the proposed link between the SEC System and the VSL Signs from a criminal or prosecution perspective on the condition that an expert should testify the truth of images produced through the system.

4.29 In February 2004, after detailed deliberations, the HyD and the TD agreed to adopt a two-stage approach for implementing the SEC System, as follows:

- (a) Stage 1 works would cover civil works (such as ducting, power supply and communication connections), system design and a trial run of the SEC System at one of the 16 planned SEC sites; and
- (b) Stage 2 works would be implemented upon satisfactory completion of Stage 1 works, and would cover the full installation of the SEC System and be included in Contract E as provisional works.

Stages 1 and 2 works were subsequently incorporated into Contract E. According to the TD, the two-stage approach was to safeguard the Government's interest in pursuit of the latest technology at that time, taking into consideration the possible write-off of the SEC equipment.

Abandonment of SEC System under Contract E

4.30 In 2007, an independent SEC Engineer was engaged to carry out a desktop review of the design to resolve certain design problems and identify areas for improvement before conducting the actual trial and producing expert reports for the DoJ's consideration (see para. 4.28(a)). Subsequently, Contractor E was instructed to make some enhancements proposed by the SEC Engineer to the system design.

4.31 In March 2008, Sha Tin Section was opened to traffic. In December 2008, following the DoJ's earlier advice, an expert was engaged to conduct a real-traffic trial run to ascertain the accuracy and proper functioning of the equipment, and to prepare expert reports for submission to the DoJ. Upon completion of the trial run, the expert reports concluded that the proposed SEC System was accurate and reliable in performing its designed functions, and

Provision of traffic control and surveillance system under Contract E

suggested some enhancements to the System. In July 2010, the DoJ approved the expert reports that the System was acceptable for taking prosecution actions, and advised the TD to implement the expert's recommendations on enhancing the SEC System, including the use of the double photo mode, enhancement in encryption with the latest industry standard and provision of real time transfer of law-violation data.

4.32 However, in August 2010, the TD informed the HyD that Stage 2 of the SEC System under Contract E should not be pursued for the following reasons:

- (a) after the TD's assessment, implementing the SEC System enhancements would increase the system cost estimate from \$4.8 million to over \$20 million; and
- (b) even with the considerable amount to be spent on the SEC System enhancements, the System might not resolve some technical difficulties.

In March 2014, the TD informed Audit that the SEC System could not detect the speed of three vehicles on three lanes at the same section of a carriageway at the same time.

Interim measure to detect vehicle speeding

4.33 With the abandonment of the SEC System (see para. 4.32), as an interim measure, the TD instructed the Route 8 operator to make use of a portable speed enforcement camera to carry out the speeding detection work at different locations along Tsing Yi and Sha Tin Sections since the opening of the two roads. According to the TD, the interim measure was not as desirable as an SEC System in terms of operational efficiency and deterrent effects.

4.34 In November 2010, the FSTB approved funding of \$8 million for the TD to develop a new digital SEC System for the two road sections. System equipment would be installed at 14 sites along the tunnel areas. Unlike the SEC System under Contract E, the new SEC System would not have any direct interfaces with the TCS central system. The TD commenced the works in December 2011 by phases, and the works were completed in January 2014.

Provision of traffic control and surveillance system under Contract E

4.35 As of December 2013, \$9.2 million (Note 19) had been spent on the SEC System, but the digital cameras and radar detectors of the SEC System installed on site were not put into use, and some other SEC System equipment was stored in Nam Wan Administration Building near Nam Wan Tunnel without use.

Areas for improvement

4.36 The SEC System for Tsing Yi and Sha Tin Sections was intended for detecting speeding offences and providing information as evidence for prosecution actions. Notwithstanding that \$9.2 million had been spent, the SEC System was eventually abandoned because of the technical difficulties encountered and the anticipated increase in cost from \$4.8 million to over \$20 million for system enhancements. In the event, the TD did not proceed with the Stage 2 works under Contract E and spent another \$8 million to provide an alternative system (which does not have automatic coordination with VSL Signs) in January 2014.

New system arrangements not tested before incorporating into contract

4.37 According to the TD, it had planned to adopt the latest technology in setting out the SEC System requirements, including integrating the system with the TCS System. These arrangements had not been tested and adopted on other roads in Hong Kong at that time. In the event, installation of the system was incorporated into Contract E under a two-stage approach. As it transpired, the TD did not adopt the SEC System for Tsing Yi and Sha Tin Sections after conducting a trial run.

4.38 In March 2014, the TD informed Audit that:

- (a) the total cost of \$9.2 million spent on the trial run for the SEC System was not a waste as the results of the trial had laid a firm foundation for providing clear and useful directions for subsequent projects involving an SEC and VSL Signs, including Central Wanchai Bypass, Tolo Highway,

Note 19: *\$9.2 million comprised \$4.4 million spending on providing the system equipment, supporting networks and installation works, and \$4.8 million on engaging an SEC Engineer and an expert for conducting a desktop review and a trial run.*

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Hong Kong-Zhuhai-Macao Bridge and related projects. All new transport technologies had to be tested before application in Hong Kong, even if the technology had been in use in other countries and cities. In testing any technology, costs would be involved, while success could never be guaranteed. In the majority of cases, it was not pragmatic to conduct independent testing before incorporating a new technology into a works contract. For example, if independent testing were conducted at a purpose-built site, the costs involved in forming and setting up the site would be high. If independent testing were conducted at an existing site with live traffic, this would be more costly than testing at a new road to be constructed under a works contract. This was because, in the former case, it was not only more difficult and costly to erect the installation work on a road with live traffic, it was also necessary to divert the traffic during construction. If the trial was not successful or if a decision was made to cease the trial, the testing installations would have to be dismantled and removed and the affected road section reinstated to the pre-testing condition. The traffic disruption would result in substantial social and economic loss. If off-site independent tests were adopted and the results turned out to be favourable, testing on the highway where the system was to be installed was still necessary as the trial and the report that was subject to legal clearance was site specific;

- (b) in the case of Route 8, any off-site testing ground should be a strategic highway with VSL Signs installed. During the planning stage of Contract E in 2004, the only open highway equipped with VSL Signs that might be suitable for off-site independent testing was Tsing Ma Bridge and its approach roads. As Tsing Ma Bridge and its approach roads were the only road link to the international airport of Hong Kong, it was not acceptable to have them partially closed, and traffic on them disrupted, for a certain period for erecting testing installations and equipment and conducting trial runs. In short, if the technology trial for the Route 8 project were to be revisited, the TD would still need to conduct an on-site trial instead of off-site independent trial. For on-site testing such as the one in Route 8, there were no complications to the works contract as there were no time or monetary claims under Contract E; and
- (c) both the costs of independent testing and on-site testing under a works contract should not be considered as a waste. The introduction of a new technology to the Route 8 project was a first step to an automated speed enforcement system for progressive use and enhancement of road safety in

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all strategic highways with VSL Signs in Hong Kong. A two-stage prudent approach was adopted to try out the SEC System by conducting tests first and exercising a contractual right to continue with or forgo full implementation.

4.39 In Audit's view, in adopting a new technology for law enforcement purposes in future, the TD should conduct independent testing and obtain legal clearance before proposing to a works department to incorporate such a technology into a works contract. This would help minimise abortive work and expenditure, and reduce the risks of lowering the operational efficiency and deterrent effects in carrying out the related law enforcement actions (see para. 4.33). In this connection, Audit notes that, in May 2013, the TD planned to conduct a trial scheme for assessing the feasibility of introducing an Average Speed Camera System (Note 20) at Hong Kong Shenzhen Western Corridor. On this occasion, the TD adopted a good practice to conduct a trial scheme before full system implementation.

Audit recommendation

4.40 **Audit has recommended that, in adopting a new technology for law enforcement purposes in future, the Commissioner for Transport should, as far as practicable, consider conducting independent testing as an alternative to on-site testing and obtain legal clearance before proposing to a works department to incorporate such a technology into a works contract.**

Response from the Administration

4.41 The Commissioner for Transport agrees with the audit recommendation.

Note 20: *The proposed system will calculate the average speed of a vehicle passing through cameras placed at two locations of a road section. If the average speed exceeds the related speed limit, the captured data can be used as evidence for prosecution purposes.*

Final contract sum of Contract C
(August 2013)

Particulars	Amount (\$ million)	Amount (\$ million)
1. Contract works completed	1,030.6	
2. Payment for contract price fluctuation	119.9	
3. Alternative-design works completed under SA8 (Note 1)	11.2	
Total works completed		1,161.7
Payment for settling contract claim		
4. Claim related to additional time taken for excavation works (Note 2)		21.9
Final contract sum		1,183.6

Source: HyD records

Note 1: In April 2008, the HyD and Contractor C entered into a Supplementary Agreement (SA8), under which Contractor C's alternative design for a viaduct waterproofing system was accepted to replace the original design for implementation. The alternative design resulted in a cost saving of \$2.8 million.

Note 2: The claim was related to the construction of East Tsing Yi Viaduct.

Appendix B
(paras. 4.10, 4.12, 4.16(b),
4.18(a) and 4.19 refer)

Provision of site access to Contractor E

Works Section	Site	Works contract	Completion date of works contract			Site access date of Contract E		
			Scheduled milestone (a)	Certified substantial completion (b)	Delay (c) = (b) – (a) (No. of days)	Scheduled (Note) (d)	Actual (e)	Delay in providing full site access (f) = (e) – (d) (No. of days)
1	1	F	30.11.2005	9.4.2006	130	11.6.2006	10.4.2006 – 30.11.2007	0 to 537
	2	F	1.10.2005	9.1.2006	100	12.4.2006	10.1.2006 – 21.11.2006	0 to 223
	3	F	25.3.2006	24.8.2006	152	7.7.2006	11.5.2006 – 5.7.2007	0 to 363
	4	G	1.3.2006	30.11.2006	274	11.6.2006	30.11.2006 – 15.5.2007	172 to 338
	5	G	1.12.2005	20.12.2006	384	11.6.2006	20.12.2006 – 30.7.2007	192 to 414
2	6	H	24.6.2005	15.12.2005	174	26.11.2005	16.2.2006 – 12.3.2007	82 to 471
	7	H	2.10.2005	17.1.2006	107	29.3.2006	6.6.2006 – 27.7.2006	69 to 120
	8	H	2.10.2005	19.1.2006	109	30.3.2006	6.6.2006 – 21.11.2006	68 to 236
3	9	H	2.10.2005	7.1.2006	97	28.12.2005	15.2.2006 – 21.11.2006	49 to 328
4	10	H	2.10.2005	2.12.2005	61	11.12.2005	28.7.2006 – 17.8.2006	229 to 249
5	11	D	15.6.2006	1.7.2006	16	13.9.2006	11.7.2006	0
6	12	D	16.10.2006	15.2.2007	122	7.2.2007	7.2.2007	0
	13	A	14.9.2006	27.6.2007	286	12.4.2007	27.3.2007 – 27.6.2007	0 to 76
	14	C	29.10.2007	15.7.2008	260	12.12.2007	1.2.2008 – 7.8.2008	51 to 239
	15	B	28.12.2007	24.4.2009	483	9.2.2008	21.4.2009 – 14.7.2009	437 to 521

Source: HyD records

Note: Time gaps of one to six months had been provided by the HyD between the scheduled works completion dates (column (a)) and scheduled site possession dates of Contract E (column (d))(see para. 4.10).

Acronyms and abbreviations

APE	Approved project estimate
Audit	Audit Commission
BQ	Bill of Quantity
CPS Road	Container Port Road South
DEVB	Development Bureau
DoJ	Department of Justice
EOT	Extension of time
E&M	Electrical and Mechanical
FC	Finance Committee
FSTB	Financial Services and the Treasury Bureau
GI	Ground Investigation
HKPF	Hong Kong Police Force
HyD	Highways Department
ICE	Independent Checking Engineer
km	Kilometre
Lands D	Lands Department
m	Metre
mm	Millimetre
m ²	Square metre
NSC Viaduct	Ngong Shuen Chau Viaduct
SA	Supplementary Agreement
SEC System	Speed Enforcement Camera System
TCS System	Traffic Control and Surveillance System
TD	Transport Department
TIA	Traffic Impact Assessment
TML Group	Traffic Management Liaison Group
VO	Variation Order
VSL Sign	Variable speed limit Sign