

CHAPTER 5

Water Supplies Department

<h4>Mainlaying works</h4>

**Audit Commission
Hong Kong
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This audit review has been 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 have been accepted by the Government of the Hong Kong Special Administrative Region.

The Report is available on our website at <http://www.info.gov.hk/aud/>

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MAINLAYING WORKS

Contents

	Paragraph
PART 1: INTRODUCTION	1.1 – 1.2
Implementation of mainlaying works	1.3
Audit review	1.4 – 1.5
PART 2: CONTRACT OVERRUNS	2.1
Mainlaying contracts	2.2
Contract period overruns	2.3
<i>Audit observations</i>	2.4 – 2.5
<i>Audit recommendations</i>	2.6
Response from the Administration	2.7
PART 3: CONTRACT A — REALIGNMENT OF WATER MAINS	3.1 – 3.3
Investigation of proposed alignment in the design stage	3.4 – 3.6
Substantial realignment in the construction stage	3.7 – 3.13
<i>Audit observations</i>	3.14 – 3.21
<i>Audit recommendations</i>	3.22
Response from the Administration	3.23
PART 4: CONTRACT B — DELAY DUE TO ADDITIONAL WORKS	4.1 – 4.4
Late additional connection works	4.5

	Paragraph
Substantial increase in quantities of bends	4.6 – 4.11
Works carried out within restricted hours	4.12 – 4.16
<i>Audit observations</i>	4.17 – 4.22
<i>Audit recommendations</i>	4.23 – 4.24
Response from the Administration	4.25 – 4.26
PART 5: CONTRACT C — DELAY IN GIVING SITE POSSESSION	5.1 – 5.4
Drainage Services Department sewerage works concurrent with those of Contract C	5.5 – 5.8
Delay in completion of Section I	5.9 – 5.12
Delay in completion of Section II	5.13 – 5.19
<i>Audit observations</i>	5.20 – 5.22
<i>Audit recommendations</i>	5.23 – 5.24
Response from the Administration	5.25 – 5.26
PART 6: SUPPLY OF TREATED WATER TO REMOTE VILLAGES	6.1
Water supply schemes for remote villages	6.2 – 6.7
Per capita capital cost	6.8 – 6.9
Population size	6.10 – 6.12
Water consumption	6.13
<i>Audit observations</i>	6.14 – 6.19
<i>Audit recommendations</i>	6.20
Response from the Administration	6.21

	Page
Appendices	
A : Extension of time granted for the works sections of Contract B	39
B : Delay in works at the Hung Hom Road and Tai Wan Road junction	40
C : Delay in works at the Hung Hom Road and Hok Yuen Street junction	41
D : Delay in works at the Pau Chung Street and Mau Tau Kok Road junction	42
E : Water consumption of remote villages	43 – 44
F : Geographical location of remote villages with low water consumption	45
G : Chronology of key events	46 – 47
H : Acronyms and abbreviations	48

PART 1: INTRODUCTION

1.1 This PART describes the background and the objectives of the audit.

1.2 **Background.** Hong Kong's water supplies are provided through 5,600 km of fresh water mains and 1,400 km of salt water mains. The Water Supplies Department (WSD) undertakes waterworks projects to provide a stable and reliable water supply. The majority of waterworks projects involve the laying of water mains (i.e. mainlaying — Note 1) to supply water to new developments and to upkeep the supply and distribution networks (Note 2). In 2003-04, the estimated expenditure on mainlaying works is about \$510 million.

Implementation of mainlaying works

1.3 The New Works Branch of the WSD carries out mainlaying works projects. The Branch comprises the Project Planning Unit, the Design, Construction, Consultants Management and Project Management Divisions. The functions and duties include the following:

- (a) **Project Planning Unit.** The Project Planning Unit plans the general requirements for and the timing of new projects;
- (b) **Design Division.** The Design Division carries out investigation studies and detailed design of the works (Note 3). It reviews water main alignments, investigates ground conditions, and carries out traffic, drainage and environmental impact assessments. After completing detailed design, the Design Division prepares the contract documents and initiates the tendering procedures;

Note 1: *There are also other waterworks projects, such as the construction of water treatment works and pumping stations.*

Note 2: *In July 1997, a WSD consultant, after completing an Underground Asset Management Study, recommended that, to upkeep the supply and distribution networks, there was a need to replace and rehabilitate some 3,050 km of aged water mains over a period of 20 years. The estimated cost of the programme was \$9.7 billion at 1996 prices. Stage I of the programme commenced in December 2000.*

Note 3: *In some mainlaying projects, the WSD employs consultants to carry out investigation study and design, and to supervise the construction works.*

- (c) ***Construction Division.*** The Construction Division supervises works contracts. Upon substantial completion, it hands over the works to relevant operational regions;
- (d) ***Consultants Management Division.*** The Consultants Management Division administers consultancy agreements, and checks and advises on the acceptability of consultants' technical proposals, designs and related work; and
- (e) ***Project Management Division.*** The Project Management Division formulates and implements project management procedures to enable the delivery of projects within time limit and budget.

Audit review

1.4 The Audit Commission (Audit) recently carried out a review of the mainlaying works of the WSD. The review focused on the following areas:

- (a) the implementation of the WSD's mainlaying projects (see PART 2 to PART 5);
and
- (b) the supply of treated water to remote villages (see PART 6).

1.5 The audit has found that there is scope for improvement in project implementation and contract administration of mainlaying works.

PART 2: CONTRACT OVERRUNS

2.1 This PART examines mainlaying contracts of the WSD completed in the last four years.

Mainlaying contracts

2.2 From 1 September 1999 to 31 August 2003, the WSD certified the completion of 29 capital works contracts with substantial mainlaying works (hereinafter referred to as mainlaying contracts).

Contract period overruns

2.3 Audit examined the contract period overruns of these 29 mainlaying contracts (Note 4). Audit found that a high percentage (45%) of the contracts overran by more than six months. Of the 29 contracts, for those with contract sums of more than \$15 million, the percentage of contracts with overruns of more than six months was even higher (63%). The details are shown in Table 1.

Note 4: *Audit also examined the cost overruns of these 29 contracts. Audit noted that the causes giving rise to major cost overruns of these contracts were similar to those of contract period overruns which are covered in detail in this Report. As such, a separate review of cost overruns is considered unnecessary.*

Table 1
Mainlaying contracts with contract period overruns

	Mainlaying contracts					
	Original contract sum \$15 million (Note 1)		Original contract sum > \$15 million (Note 2)		Total	
	No.	(%)	No.	(%)	No.	(%)
With contract overrun (Note 3):						
(a) 3 months	3	23%	5	31%	8	28%
(b) >3 months and 6 months	3	23%	0	—	3	10%
(c) >6 months and 12 months	2	15%	4	25%	6	21%
(d) >12 months	1	8%	6	38%	7	24%
	9	69%	15	94%	24	83%
Without contract overrun:	4	31%	1	6%	5	17%
Total	<u>13</u>	<u>100%</u>	<u>16</u>	<u>100%</u>	<u>29</u>	<u>100%</u>

Source: WSD records

Note 1: The original contract sums of these 13 contracts ranged from \$4 million to \$10.4 million. In the Public Works Programme, projects of not more than \$15 million are not subject to separate approval by the Public Works Subcommittee. As such, these WSD contracts are placed in a separate category.

Note 2: The original contract sums of these 16 contracts ranged from \$27.8 million to \$213.5 million.

Note 3: Contract period overruns due to inclement weather were excluded from the analysis.

Audit observations

2.4 In this review, Audit selected three of the seven mainlaying contracts with contract overruns of more than 12 months for in-depth examination (see Table 1). The three mainlaying contracts (hereinafter referred to as **Contract A**, **Contract B** and **Contract C**) overran by 17 months, 17 months and 14 months respectively. The WSD granted extensions of time (EOTs) and paid prolongation costs to the contractors, as shown in Table 2.

Table 2
Extension of time granted and
prolongation cost paid in Contracts A, B and C

Contract	Description of works	Original contract sum	Original contract period	EOT granted (Note 1)	Prolongation cost paid/ assessed	Final payment certificate date
		(\$ million)	(day)	(day)	(\$ million)	
Contract A	Laying of 3.3 km of fresh water mains in diameter of 1400 mm from Yuen Long to Kam Tin River	55.7	480	599	13.99	13.9.2002
Contract B	Laying of 8 km of salt water mains in diameters from 400 mm to 1200 mm in Tsuen Wan and Kwai Chung	136.6	730	534	4.38 (Note 2)	Not yet issued (Note 3)
Contract C	Laying of 4.3 km of fresh water mains and 0.7 km of salt water mains in diameters from 250 mm to 900 mm in Kowloon South and Kowloon Central	42.6	670	436	8.44	25.6.2003
Total					26.81	

Source: WSD records

Note 1: The EOTs granted included 57 days, 4 days and 7 days due to inclement weather for Contracts A, B and C respectively.

Note 2: The consultant of Contract B has assessed a prolongation cost of \$4.38 million. As at the end of the audit in February 2004, the assessment had yet to be agreed with the contractor.

Note 3: As at February 2004, the WSD had not yet issued the final payment certificate.

2.5 The audit has found that there is room for improvement in project implementation and contract administration. The details are described in PART 3 to PART 5 of this Report.

Audit recommendations

2.6 As delays in mainlaying works would invariably result in claims and the payment of prolongation costs to contractors and would cause inconvenience to the public, Audit has *recommended* that the Director of Water Supplies should:

- (a) **critically review the procedures for the management of mainlaying contracts to avoid overruns;**
- (b) **identify contracts with slow progress and take early management action to minimise overruns in the contracts; and**
- (c) **in managing mainlaying contracts, consider setting measurable performance targets so as to ensure that the works are completed within the contract periods.**

Response from the Administration

2.7 The **Director of Water Supplies** agrees with the audit recommendations mentioned in paragraph 2.6. He will strengthen the time management and procedures for mainlaying contracts stipulated in the WSD Project Administration Manual. He has said that:

- (a) mainlaying works by nature involve some uncertainties as progress is dependent on underground conditions which cannot be fully established before the works commence; and
- (b) mainlaying contracts are more susceptible to variations to suit sub-surface conditions, thus resulting in delay.

PART 3: CONTRACT A — REALIGNMENT OF WATER MAINS

3.1 This PART examines the delay in the completion of Contract A.

3.2 **Contract A works.** Contract A included the laying of about 3.3 km of fresh water mains of 1400 mm in diameter along Castle Peak Road, from Yuen Long to Kam Tin River. The contractor (hereinafter referred to as Contractor A) commenced the works on 25 November 1996. The original contract period was 480 days. The works were scheduled to be completed on 19 March 1998. In the event, the works were substantially completed on 8 November 1999.

3.3 The WSD granted an EOT of 599 days (of which 57 days were due to inclement weather) and paid a prolongation cost of \$13.99 million to Contractor A. The WSD also paid \$3.42 million to Contractor A due to price fluctuation during the extended contract period.

Investigation of proposed alignment in the design stage

3.4 The WSD investigated and finalised the alignment and size of the water mains of Contract A in the design stage. According to the WSD's Civil Engineering Design Manual (hereinafter referred to as the Design Manual), during the design stage, it is necessary to ascertain the ground conditions for mainlaying works, particularly the availability of space, the rock content and the ground water level, by means of inspection pits (Note 5) along the proposed alignment.

3.5 According to the Design Manual, the design engineers should ensure that sufficient inspection pits are dug to ascertain underground conditions before the alignment is finalised. In general, one inspection pit should be dug:

- (a) for every 100 m of pipeline inside a carriageway; or
- (b) for every 200 m of pipeline inside a cycle track or a footpath.

This is considered to be the minimum requirement for simple cases. More inspection pits should be dug where utilities or changes in ground nature are expected. The design engineers should also arrange to excavate additional inspection pits when information received from utility companies and others suggests that there may be insufficient space for the proposed pipeline.

Note 5: *The WSD usually uses its term contractors to excavate inspection pits in the design stage.*

3.6 The inspection pit records only present the information of some particular spots along the alignment. In order to obtain an accurate interpretation of the inspection pit records, the Design Manual requires the design engineers to:

- (a) walk along the proposed pipe route as far as practicable;
- (b) discuss with colleagues who are working or have worked on nearby sites; and
- (c) conduct more desk studies, such as reviewing other site investigation reports in the vicinity of the site.

Substantial realignment in the construction stage

3.7 Since the commencement of Contract A in November 1996, the progress of the works had been slow. In the first eight months (i.e. the first half) of the contract period, less than 100 m (3%) of the 3,300 m water mains were laid. The delay was mainly due to the existence of underground utilities, the lack of working space, and close proximity to trees (Note 6), which prevented the water mains from being laid along the proposed alignment. In a section of the water mains, the original alignment was obstructed by a large number of high voltage power cables that emerged from a nearby power substation. As a result, the water mains had to be realigned because diverting the power cables would involve substantial works.

3.8 ***70% of the original alignment redesigned.*** At a progress meeting held in July 1997 (i.e. at the end of the first half of the contract period) with Contractor A, the WSD expected that a substantial realignment of the water mains would be needed. As it transpired, approximately 70% of the original alignment was redesigned and the pipe size in some sections was revised. This significantly affected the progress of the works. The original and the revised alignment of the water mains are shown in Figure 1 on the centre pages.

3.9 ***Internal technical review of Contract A.*** In August 1997, the WSD carried out an internal technical review of Contract A. The technical review report of September 1997 said that:

- (a) the investigation works had not been very productive since about 70% of the proposed route would have to be realigned; and
- (b) the proposed pipeline was large and required a trench of at least 2 m in width. Such a trench was not readily available along the proposed route.

Note 6: *The Design Manual specifies that pipes should not be laid nearer than 2 m from tree trunks.*

3.10 As shown in Table 3 below, by March 1998 (i.e. the end of the original contract period), less than 850 m (26%) of the water mains had been laid. In May 1998, the WSD fully identified the realignment. However, due to technical problems and traffic restrictions, Contractor A could not proceed with the works of some of the realigned sections. The problems were not fully resolved until May 1999 (see Table 3). The works were only substantially completed in November 1999 (i.e. a delay of 19 months of which 2 months were due to inclement weather).

Table 3
Progress of Contract A

Progress of mainlaying as at	Length of water mains pending laying due to			Length ready for laying	Length laid		Total length
	realignment to be identified	technical problem	traffic restriction		in metres	as % of total length	
(a)	(b)	(c)	(d)	(e)	(f)	(g) = $\frac{(f)}{(h)} \cdot 100\%$	(h) = (b)+(c)+(d)+(e)+(f)
	(m)	(m)	(m)	(m)	(m)	(%)	(m)
January 1998	1,681	475	411	237	482	14.7%	3,286
March 1998 (Note)	90	1,185	459	693	832	25.5%	3,259
May 1998	0	43	461	1,741	1,058	32.0%	3,303
August 1998	0	163	450	1,474	1,194	36.4%	3,281
January 1999	0	65	140	952	2,190	65.4%	3,347
May 1999	0	0	0	464	2,914	86.3%	3,378
August 1999	0	0	0	49	3,320	98.5%	3,369
November 1999	0	0	0	0	3,369	100.0%	3,369

Source: WSD records

Note: Contractor A commenced the works on 25 November 1996. The original contract completion date was 19 March 1998.

3.11 *Inaccurate utility records.* At the time of tender, the WSD supplied the tenderers with drawings such as fitting schedules and utilities plans for tendering purposes. Contractor A expected that these schedules and plans had a certain degree of accuracy for the works to be planned and carried out without major problems. However, it turned out that there were major problems in ascertaining the exact location and number of utilities in many sections of the pipeline. During construction, many inspection pits were excavated to locate the underground utilities. The quantity provided in Contract A for excavating inspection pits was 270 cubic metres. However, due to the inaccurate utility records, the final quantity was 1,600 cubic metres.

3.12 *Joint Utilities Policy Group for improvement of utility records.* In June 2002, a Working Group under the Joint Utilities Policy Group of government departments (namely the WSD, the Drainage Services Department (DSD) and the Highways Department) and major utility companies issued a Practice Guideline for As-built Records of Underground Utilities. The objective of the Practice Guideline is to establish an agreed accuracy standard and level of details for as-built records of underground utilities (Note 7).

3.13 The Practice Guideline does not cover the as-built records of underground utilities installed before its issue in June 2002, except in so far as the utility is:

- (a) altered; or
- (b) located in the course of other works or repairs after the issue of the Practice Guideline.

According to the Practice Guideline, if underground utilities are found exposed during the works, the road-opening utility operator should inform the other utility operators if he is adamant that there is a mismatch between the actual and the recorded position of the exposed utilities. It is the responsibility of the owner of the exposed utilities to attend promptly and update his as-built records. The road-opening utility operator has no obligation to withhold excavation activities to await the attendance of the owner of the exposed utilities.

Audit observations

Inadequate investigation of underground conditions

3.14 Audit shares the concern of the WSD's internal technical review that the site investigation for Contract A works was not very productive because 70% of the proposed

Note 7: *According to the Practice Guideline, the standards should be treated as the minimum requirements.*

route had to be realigned. The WSD only excavated 18 inspection pits in the design stage (nearly the minimum for simple cases as specified in the Design Manual — see para. 3.5). In the construction stage, Contractor A had to excavate another 67 inspection pits. **Audit considers that the WSD should strengthen its quality control procedures to ensure that a thorough site investigation is carried out prior to finalising the alignment and size of water mains. This is particularly important for laying large diameter water mains in utility-congested areas.**

Realignment not fully identified until after end of original contract period

3.15 The WSD took a long time in realigning the pipeline. **Audit considers that the WSD should have taken early action to identify an alternative alignment, taking into account any technical problems and traffic restrictions, so that any design problems relating to the realignment could have been resolved as soon as possible.**

Inaccurate utility records

3.16 The Practice Guideline issued in June 2002 states that the as-built records of the underground utilities exposed in road-opening works should be updated, if there is a mismatch between the actual and the recorded position of these utilities. However, the success of this arrangement depends very much on the initiative and cooperation of the road-opening utility operator and the owner of the exposed utilities. **Audit considers that appropriate measures should be introduced such that underground utilities exposed in road-opening works are surveyed and the records are updated, if there is a mismatch between the actual and the recorded position of the utilities.**

3.17 Upon Audit's enquiry, the Highways Department advised that the industry had all along been fully aware of the importance of the accuracy and completeness of utility records. The issue was first brought up to the Joint Utilities Policy Group in February 2001 and a working group was subsequently set up to formulate the Practice Guideline. The Highways Department would join effort with utility operators to alert each other when certain utility installations were found to be in positions different from the records during the course of the works. In this regard, Audit notes that the Joint Utilities Policy Group is considering introducing a monitoring system to keep track of the effectiveness of implementing the Practice Guideline, particularly on the updating of existing utility records.

Design-and-build form of contract for mainlaying projects

3.18 To the Employer, a major advantage of a design-and-build form of contract is its single-point responsibility characteristics. This means that a single main contractor is employed to take ultimate responsibility for both the design and the construction of the works. If implemented successfully, a design-and-build contract would have greater cost

and time certainty compared to that of a conventional contract. Furthermore, in a design-and-build contract, the risk of the contractor making claims can also be minimised because the responsibility and risk for the design are on the contractor.

3.19 The main stages of works of a mainlaying project include investigation, design and construction. The laying of water mains, particularly large diameter water mains, in utility-congested areas often involves a lot of uncertainties. The uncertainties can be reduced if adequate investigation has been carried out before the construction stage. The need for realigning the water mains and the delay in Contract A were mainly due to inadequate investigation. If Contractor A had been engaged in the investigation and design works, he would have had to take ultimate responsibility for any delay caused by changes in alignments due to underground utilities obstructions or insufficient design.

3.20 For mainlaying contracts awarded before 2000, the WSD supplied the pipe materials to contractors. However, in some contracts, the contractors claimed EOT and prolongation cost due to the late delivery of pipe materials by the WSD. In 2000, to minimise such risk, the WSD commenced a “supply and lay” arrangement for the pipe materials. Under such an arrangement, the contractors are responsible for supplying the pipe materials and the WSD is no longer responsible for delay caused by the late delivery of materials.

3.21 **Audit considers that the WSD should, similar to the adoption of the “supply and lay” arrangement for the pipe materials, consider the use of the design-and-build form of contract for mainlaying projects (Note 8), particularly those involving the laying of large diameter water mains in utility-congested areas.**

Audit recommendations

3.22 **Audit has recommended that the Director of Water Supplies should:**

- (a) **strengthen the WSD quality control procedures to ensure that a thorough site investigation is carried out prior to finalising the alignment and size of water mains. This is particularly important for laying large diameter water mains in areas:**
 - (i) **with congested underground utilities;**
 - (ii) **where there is limited working space; and**

Note 8: *The design-and-build contractor should be engaged to carry out investigation, design and construction of the mainlaying works.*

- (iii) **where realignment works affect other contractors;**
- (b) **where a water main has to be realigned during construction, take early action to identify an alternative alignment so that any problems can be resolved as soon as possible; and**
- (c) **consider the use of the design-and-build form of contract for mainlaying projects, particularly those involving the laying of large diameter water mains in utility-congested areas.**

Response from the Administration

3.23 The **Director of Water Supplies** agrees with the audit recommendations mentioned in paragraph 3.22. He concurs that more thorough site investigation during the design stage may reduce the extent of delay. He has said that:

- (a) the Design Manual has laid down general guidelines for site investigation. The WSD will make more use of non-destructive means to locate underground utilities, and will introduce a checking system by senior professionals to ensure that adequate site investigation will be carried out before the detailed design;
- (b) in mainlaying works, much time is lost when the need for realignment is confirmed because by then, a lot of time and efforts would have been spent to find out a solution to follow the original alignment. Owing to the substantial realignment in Contract A, considerable time was taken to explore alternative routes and to arrange for the inspection pits to identify the alternative alignment. It was also necessary to circulate the alternative alignment to the utility operators and other relevant authorities for agreement in obtaining the excavation permits. The WSD will strengthen the project administration procedures and time management;
- (c) following the directive of the Joint Utilities Policy Group, the WSD has issued internal guidelines on the updating of water mains record plans and the checking of accuracy of other utilities; and
- (d) the WSD was aware of the contract overrun problem in mainlaying contracts. For water mains replacement and rehabilitation projects, the WSD has adopted an alternative form of contract through the use of works orders to better control the works programme and manage events. For the laying of large diameter water mains in utility-congested areas, the WSD will also try out the design-and-build form of contract with a view to containing contract overruns.

PART 4: CONTRACT B — DELAY DUE TO ADDITIONAL WORKS

4.1 This PART examines the delay in the completion of Contract B.

4.2 **Contract B works.** Contract B included the laying of about 8 km of salt water mains of 400 mm to 1200 mm in diameter in Tsuen Wan and Kwai Chung. A consultant (hereinafter referred to as Consultant B) carried out the design, tendering, and supervision of the works.

4.3 **Extension of time.** The original contract period of Contract B was 730 days. The contractor (hereinafter referred to as Contractor B) commenced the works on 21 April 1998. The works were scheduled to be completed on 19 April 2000. In the event, the works were substantially completed on 5 October 2001, i.e. a delay of 17 months. Contract B comprised eight sections of works (hereinafter referred to as Sections W1 to W8). Each section of works, apart from Section W2, experienced a different extent of delay. The EOTs granted to Contractor B for the different sections are given in Appendix A. Section W3 experienced the longest delay and was granted an EOT of 534 days (of which 4 days were due to inclement weather). The completion date of Contract B was thus extended by 534 days. Consultant B considered that, of the EOTs granted for the different sections, only those relating to the issue of variation orders were entitled to prolongation cost. Consultant B assessed that a prolongation cost of \$4.38 million should be awarded to Contractor B (Note 9).

4.4 **Major causes of delay.** There were many causes of delay which resulted in the granting of EOTs (see Appendix A). The major causes are as follows (Note 10):

- (a) late additional connection works;
- (b) a substantial increase in the quantities of bends due to changes in the alignment;
- (c) additional locations for works carried out within restricted hours;

Note 9: *As at the end of the audit in February 2004, the assessment of the prolongation cost had yet to be agreed with Contractor B.*

Note 10: *For items (a) and (d), and some minor items (see items (iii) to (v) in the note to Appendix A), the EOTs were entitled to prolongation cost as variation orders were issued (see para. 4.3). For items (b), (c) and (e), the EOTs were not entitled to prolongation cost as no variation orders were issued.*

- (d) changes in the alignment due to congested underground utilities; and
- (e) delay in giving Contractor B site possession due to works carried out by other contractors.

This PART focuses on the issues relating to items (a) to (c). The details are given in paragraphs 4.5 to 4.16. The issues relating to items (d) and (e) are similar to those covered in PART 3 and PART 5 respectively and are therefore not covered in this PART.

Late additional connection works

4.5 Contract B, which commenced in April 1998, was scheduled to be completed in April 2000. During the extended contract period, in June 2000, on request from its operational regions, the WSD instructed Consultant B to order additional connections from the water mains at Sections W3, W5, W7 and W8 to the existing water mains. The additional connections were required for transferring services from the existing salt water mains, which were earmarked for de-commissioning, to the new pipelines. Consultant B considered that the additional connection works disrupted Contractor B's progress as they added works out of sequence. Accordingly, Consultant B granted EOTs (Note 11) to Contractor B. As the late additional works were instructed by variation orders, Consultant B assessed that a prolongation cost of \$2.1 million (see Note 10 to para. 4.4) should be paid to Contractor B.

Substantial increase in quantities of bends

4.6 *Special Condition of Contract.* According to a Special Condition of Contract of Contract B, if in the opinion of the Engineer the cause of delay was due to a substantial increase in the quantity of any item of work included in the contract (Note 12) *not* resulting from a variation ordered, then the Engineer should within a reasonable time consider whether the contractor was fairly entitled to an EOT. This Special Condition of Contract has been incorporated in the General Conditions of Contract for Civil Engineering Works.

Note 11: *Consultant B granted EOTs of 123 days, 58 days and 126 days to Contractor B for Sections W3, W5 and W7 respectively (see Appendix A).*

Note 12: *A Contract means the Articles of Agreement, the Tender and the acceptance thereof by the Employer, the Drawings, the General Conditions of Contract, the Special Conditions of Contract, the Specification, and the priced Bills of Quantities (BQ).*

4.7 Contractor B claimed that he had been instructed to install a larger quantity of bends than that shown on the Drawings. The increase in quantities was mainly due to the realignment. The installation of the additional bends caused delay to the works. Table 4 shows that the total number of bends installed was more than that shown on the Drawings.

Table 4

Bends installed under Contract B

Section	No. of bends installed (Note 1)	No. of bends shown on the Drawings (Note 1)	Percentage increase	No. of bends stated in the BQ (Note 2)
	(a)	(b)	$(c) = \frac{(a) - (b)}{(b)} \cdot 100\%$	(d)
	(No.)	(No.)	(%)	(No.)
W1	18	8	125%	66
W3	51	17	200%	76
W5	67	32	109%	42
W8	54	5	980%	47
Total	190	62	206%	231

Source: WSD records

Note 1: The bends were of diameters from 450 mm to 900 mm.

Note 2: The bends were of diameters from 150 mm to 1200 mm.

4.8 **Consultant B's EOT assessment.** The installation of the additional bends required additional time for trench excavation, erection of formwork, fabrication and installation of the bends, and the casting of concrete. Consultant B recommended that EOTs should be granted for Sections W1, W3, W5 and W8.

4.9 **WSD's views on the EOT assessment.** The WSD had different views on Consultant B's EOT assessment. The WSD considered that even though there were big increases in the quantities of the bends as compared to the quantities taken off from the Drawings, this did not constitute "*a substantial increase in the quantities of the items of work included in the contract*" as referred to in the Special Condition of Contract. The WSD said that:

- (a) the contract consisted of not only the Drawings but also included the Bills of Quantities (BQ — Note 13) and the Specification; and
- (b) the Specification specified that the alignment of the pipeline might need adjustment to suit site conditions. The quantities as taken off from the Drawings might vary depending on the site conditions. Accordingly, the WSD presumed that the quantities listed in the BQ should have been suitably drawn up to allow for the increase in the quantities of bends. (The quantities of bends stated in the BQ and the quantities installed are shown in Table 4.)

4.10 **Contract Advisor's comments.** Owing to the difference in views between Consultant B and the WSD, in July 2002, the WSD sought its Contract Advisor's views. The Contract Advisor said that:

- (a) in general, the Drawings and Specification stipulated the quantities of the works required and the BQ were for pricing purposes;
- (b) if the Drawings and Specification were clear, the quantities ascertained from such documents should be used as the baseline for assessing the substantial increase in quantities; and
- (c) the BQ would come into play when the quantities could not be ascertained from the Drawings and Specification, or when the quantities so ascertained were ambiguous. Under such circumstances, the assessment had to be based on the BQ quantities.

4.11 Notwithstanding the above comments, the Contract Advisor considered that:

- (a) if Contractor B had programmed his works based on the information on the Drawings and Consultant B, being the Engineer, gave his consent to such a

Note 13: *The BQ section of a contract is a list of items describing the works to be performed and the quantities estimated. Tenderers are required to price each BQ item. The BQ section allows a comparison of tender prices, provides a means of valuing the works and forms the basis for valuing variations of works. Normally, the BQ quantities are directly measured from the designed details given on the Drawings.*

programme, it would not be fair to say that Contractor B should have allowed more time for the anticipated extra quantity of bends; and

- (b) the case as stated in (a) above would not be applied, if the note in the Drawings or the Specification expressly stated or explicitly implied that Contractor B should programme his works according to the BQ quantities.

The WSD, taking into consideration the Contract Advisor's views, agreed with Consultant B's assessment for granting EOTs (Note 14) to Contractor B. As the installation of the additional bends was only related to the instructions given on site but not ordered as variation orders, Consultant B considered that Contractor B should not be entitled to prolongation cost (see Note 10 to para. 4.4).

Works carried out within restricted hours

4.12 ***Particular Specification.*** The Particular Specification of Contract B required that works at *four specified locations* should be carried out within restricted hours. The restricted hours were defined as between 7 p.m. and 7 a.m. on weekdays or at any time on General Holidays.

4.13 ***Works within restricted hours at ten additional locations.*** During the construction stage, the Transport Department/the Hong Kong Police Force (Police) required that the works at *ten more locations*, in addition to the four locations specified in Contract B, should be carried out within restricted hours.

4.14 ***Consultant B's EOT assessment.*** Consultant B considered that the works within restricted hours at the ten additional locations were additional requirements. The laying of water mains within the restricted hours would take a longer time than that within normal working hours because the contractor had to install and remove the temporary traffic arrangements every night. Therefore, Consultant B recommended that EOTs should be granted to Contractor B for Sections W5, W7 and W8.

4.15 ***Assessment of the cost of the additional works.*** The cost of the works at the additional locations was evaluated using the BQ rates for works within restricted hours. Consultant B assessed that an additional cost of \$3.82 million should be paid to Contractor B.

Note 14: *Consultant B granted EOTs of 3 days, 138 days, 113 days and 114 days to Contractor B for Sections W1, W3, W5 and W8 respectively (see Appendix A).*

4.16 The WSD agreed with Consultant B's assessment of the additional cost of \$3.82 million and the granting of EOTs (Note 15) to Contractor B. As the works were not ordered as variation orders, Consultant B considered that Contractor B should not be entitled to prolongation cost (see Note 10 to para. 4.4).

Audit observations

Late additional connection works

4.17 The additional connection works disrupted Contractor B's progress of works by adding works out of sequence. Consultant B granted EOTs and assessed that a prolongation cost of \$2.1 million should be paid to Contractor B. Upon Audit's enquiry, the WSD advised that the additional connections were ordered to meet operational requirements which were only apparent at the late stage of the works. The WSD said that instead of ordering the additional connection works under Contract B, an alternative arrangement would be to have the works carried out by another contractor, but that would involve repeated road-openings.

4.18 The WSD informed Audit that it would strengthen the project administration procedures to require its officers to consider the merits and demerits of different options before ordering additional works identified after the award of a contract.

Substantial increase in quantities of bends

4.19 For the laying of water mains (particularly large diameter water mains) in utility-congested areas, the alignment might have to be adjusted during construction to suit site conditions. A note on the Drawings of Contract B clearly stated that the locations of the water mains and pipe fittings were indicative only and that the exact locations were to be determined on site. This indicated that the number of bends (a type of pipe fittings) could not be ascertained from the Drawings of Contract B.

4.20 **To avoid claims, Audit considers that for items of work the quantities of which cannot be ascertained from the Drawings (such as the number of bends), the WSD should clearly state on the Drawings that contractors should not programme and price these items of work according to the indicative quantities shown on the Drawings. Instead, contractors should be asked to programme and price these items of work according to the BQ quantities.**

Note 15: *Consultant B granted EOTs of 34 days, 24 days and 217 days to Contractor B for Sections W5, W7 and W8 respectively (see Appendix A).*

Works carried out within restricted hours

4.21 Contract B stipulated that the works at *four specified locations* should be carried out within the restricted hours. During the construction stage, the Transport Department/Police required that the works at *ten more locations* had to be carried out within the restricted hours, and Contractor B was granted EOTs and an additional cost of \$3.82 million.

4.22 **To minimise claims for EOT and prolongation cost arising from works carried out within restricted hours, Audit considers that the WSD should strengthen consultation with the Transport Department/Police to ensure that all such restricted-hour locations are identified before tendering. The WSD should also consider improving the contractual provisions of mainlaying contracts, such as by incorporating provisional items, so as to allow for the addition of more restricted-hour locations subsequently found necessary.**

Audit recommendations

4.23 **Audit has recommended that the Director of Water Supplies should:**

- (a) **to avoid claims, for items of work the quantities of which cannot be ascertained from the Drawings (such as the number of bends), clearly state on the Drawings that the contractor should programme and price these items of work based on the quantities given in the BQ, and not on the indicative quantities shown on the Drawings; and**
- (b) **with a view to minimising claims for EOT and prolongation cost arising from works carried out within restricted hours:**
 - (i) **strengthen consultation with the Transport Department/Police to ensure that all locations which require works to be carried out within the restricted hours are identified before tendering; and**
 - (ii) **consider improving the contractual provisions of mainlaying contracts, such as by incorporating provisional items, so as to allow for the addition of more restricted-hour locations subsequently found necessary.**

4.24 **Audit has recommended that the Secretary for the Environment, Transport and Works should consider notifying all works departments (e.g. by promulgating Environment, Transport and Works Bureau Technical Circulars (Works)) of the audit recommendations mentioned in paragraph 4.23, so that they may also be aware of possible areas of improvement in their project implementation and contract administration.**

Response from the Administration

4.25 The **Director of Water Supplies** agrees with the audit recommendations mentioned in paragraph 4.23. He has said that:

- (a) the WSD recognises that there was a discrepancy between the Drawings and the BQ of Contract B. The WSD concurs that such discrepancy should best be addressed when the contract documents were being prepared; and

- (b) there was a fairly long time gap between the consultation process in the design stage and the actual construction. Although traffic assessment was carried out in the consultation process, traffic conditions might have changed during construction. The WSD will cut short the time gap between design consultation and construction in order to reduce the chance of changes owing to the traffic conditions. The WSD will also carefully consider the merits of incorporating provisional items in the BQ to cater for such changes.

4.26 The **Secretary for the Environment, Transport and Works** welcomes the audit recommendation mentioned in paragraph 4.24. She will duly consider notifying works departments of the audit recommendations mentioned in paragraph 4.23.

PART 5: CONTRACT C — DELAY IN GIVING SITE POSSESSION

5.1 This PART examines the delay in the completion of Contract C.

5.2 **Contract C works.** Contract C included the laying of about 4.3 km of fresh water mains and 0.7 km of salt water mains of 250 mm to 900 mm in diameter (hereinafter referred to as DN250 to DN900) in Kowloon South and Kowloon Central. The WSD designed and supervised the works. Contract C, which commenced on 27 December 1996, was divided into the following two sections of works according to the geographical location:

- (a) **Section I.** Section I involved the laying of 2.1 km of water mains. It was scheduled to be completed on 26 December 1997. In the event, Section I was substantially completed on 26 July 1999, i.e. a delay of 579 days. The WSD granted an EOT of 540 days (of which 50 days were due to inclement weather and variations) to the contractor (hereinafter referred to as Contractor C — Note 16); and
- (b) **Section II.** Section II involved the laying of 2.9 km of water mains. It was scheduled to be completed on 26 October 1998. In the event, Section II was substantially completed on 10 January 2000, i.e. a delay of 440 days. The WSD granted an EOT of 436 days (of which 7 days were due to inclement weather) to Contractor C (Note 17).

5.3 The EOTs granted for Sections I and II were due to the failure to give possession of site to Contractor C on time. The details are given in paragraphs 5.9 to 5.19. As Section II was completed later than Section I, the completion date of Contract C was extended by 436 days in accordance with the EOT granted for Section II. The WSD paid a prolongation cost of \$8.44 million to Contractor C in respect of the EOT granted (Note 18).

5.4 **Possession of site.** According to Clause 48 of the General Conditions of Contract for Civil Engineering Works, the Employer will from time to time, as the works proceed, give to the contractor possession of such further part of the site as may be required. This is to enable the Contractor to proceed with construction of the works with

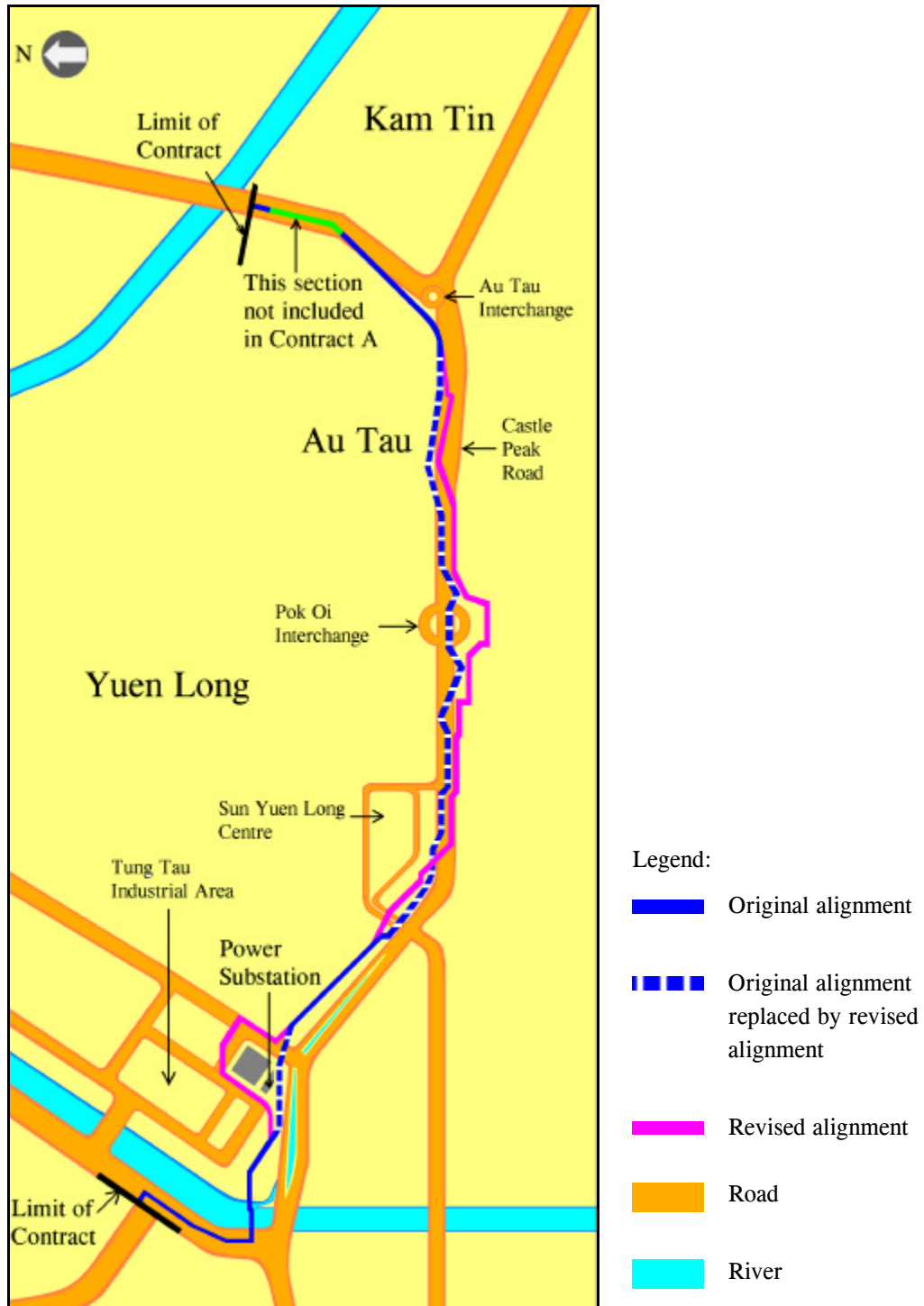
Note 16: *Contractor C was responsible for another 39 days of delay and liquidated damages were deducted.*

Note 17: *Contractor C was responsible for another four days of delay and liquidated damages were deducted.*

Note 18: *As Section II was completed later than Section I, there was no prolongation cost granted for Section I.*

Figure 1

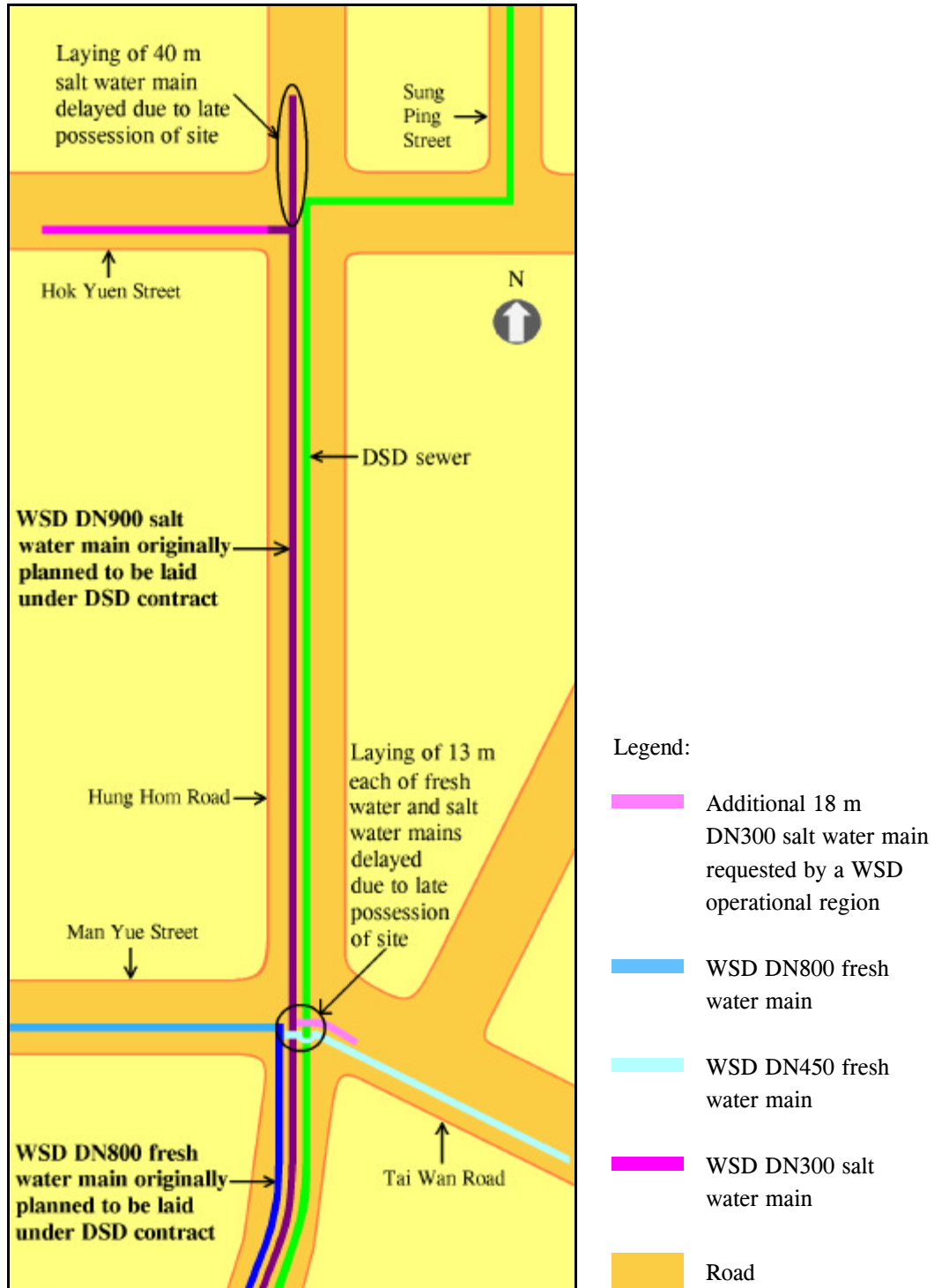
The original and the revised alignment of water mains in Contract A
(para. 3.8 refers)



Source: WSD records

Figure 2

Part of fresh water and salt water mains originally planned to be laid under the DSD contract (paras. 5.6 and 5.9 refer)



Source: WSD records

due despatch in accordance with his programme. If the Engineer is of the opinion that the progress of the works has been materially affected by the failure of the Employer to give possession of the site, then the Engineer shall ascertain any additional cost incurred, and shall certify the cost accordingly.

Drainage Services Department sewerage works concurrent with those of Contract C

5.5 During the early construction stage of Contract C, the DSD was also laying sewers along Hung Hom Road under a DSD contract. The DSD works were originally scheduled to be commenced in October 1995 and be completed by mid-1997. In the event, the DSD contract commenced in December 1995 due to a delay in obtaining funding approval. It was completed in early 1999.

Entrustment of mainlaying works to DSD not implemented

5.6 During the planning of the works, the WSD proposed at a meeting with the DSD in March 1995, that its mainlaying works and the DSD sewerage works along Hung Hom Road should be coordinated. The DSD had no objection in principle to incorporate the fresh water and salt water mainlaying works in the DSD contract, as this would minimise traffic disruption and enhance project coordination. The Director of Water Supplies endorsed the proposed entrustment. The alignment of the section of fresh water and salt water mains planned to be laid under the DSD contract is shown in Figure 2 on the centre pages.

5.7 ***Delay in obtaining funding for WSD works.*** The DSD intended to invite tenders for its sewerage contract in July 1995, and requested the WSD to provide by 8 May 1995 the details of the proposed entrustment works. However, on 12 July 1995, the WSD informed the DSD that funding for the laying of its fresh water mains had not yet been approved (Note 19), and that the WSD would not entrust the fresh water and salt water mainlaying works to the DSD. The funding for the laying of the fresh water mains was subsequently approved on 29 July 1995.

5.8 ***Delay in obtaining funding for DSD works.*** There was also a delay in obtaining funding for the DSD sewerage works. Funding was approved on 29 July 1995 (i.e. the same day of funding approval for the fresh water mains). The DSD invited tenders for its contract on 13 October 1995, instead of in July 1995. However, after obtaining

Note 19: *At that time, the WSD only obtained funding (approved on 27 January 1995) for the laying of the salt water mains.*

funding for the fresh water mains, the WSD did not pursue further the entrustment to the DSD contract. The WSD and the DSD agreed to coordinate the works of their separate contractors along Hung Hom Road.

Delay in completion of Section I

5.9 Section I of Contract C required the laying of a section of DN450 fresh water main along Tai Wan Road, and 18 m of DN300 salt water main (Note 20) at the junction of Hung Hom Road and Tai Wan Road (see Figure 2 on the centre pages).

5.10 *Delay in giving site possession.* The WSD was not able to give to Contractor C timely possession of the site to complete the 13 m of fresh water main and 13 m of salt water main at the junction of Hung Hom Road and Tai Wan Road. The main reason was that part of the southbound slow lane of Hung Hom Road at the junction with Tai Wan Road was occupied by the DSD contractor. The Police did not permit Contractor C to carry out road-opening works at this junction simultaneously with the DSD works.

5.11 The sequence of major events of the delay in completing the mainlaying works at the Hung Hom Road and Tai Wan Road junction is given in Appendix B.

5.12 The WSD granted an EOT of 490 days to Contractor C due to the delay in giving site possession (Note 21), and another 50 days for inclement weather and variations (i.e. a total EOT of 540 days). Section I was completed on 26 July 1999.

Delay in completion of Section II

5.13 There was also delay in giving site possession to Contractor C for two portions of works of Section II:

- (a) the first portion was related to the laying of a 40 m DN900 salt water main at the junction of Hung Hom Road and Hok Yuen Street (see paras. 5.14 to 5.16); and

Note 20: *In November 1997, an operational region of the WSD requested the laying of an additional 18 m of DN300 salt water main under Contract C so as to extend salt water supply to nearby developments.*

Note 21: *The EOT included 57 days for completing the works after the site was made available to Contractor C.*

- (b) the second portion was related to the laying of a 10 m DN450 fresh water main at the junction of Pau Chung Street and Ma Tau Kok Road (see paras. 5.17 to 5.19).

Delay in works at the junction of Hung Hom Road and Hok Yuen Street

5.14 Section II of Contract C required the laying of a salt water main at the junction of Hung Hom Road and Hok Yuen Street. The completion of the works was delayed because:

- (a) the WSD was not able to give to Contractor C timely possession of the site at the junction; and
- (b) there was a change in the construction method (from trenching to pipe-jacking) to avoid underground utilities.

5.15 The sequence of major events of the delay in completing the works at the Hung Hom Road and Hok Yuen Street junction is given in Appendix C.

5.16 The WSD granted an EOT of 226 days (Note 22) to Contractor C for completing the salt water main at the junction. The completion of Section II was extended to 17 June 1999 (Note 23).

Delay in works at the junction of Pau Chung Street and Mau Tau Kok Road

5.17 Section II of Contract C required the laying of 240 m DN450 fresh water main at Pau Chung Street. Owing to the delay in giving possession of the site to Contractor C, and to the realignment of the pipeline, there was a delay in completing 10 m of the water main at the junction of Pau Chung Street and Mau Tau Kok Road.

Note 22: *The EOT included 30 days for the delay in giving site possession, 106 days for the change of construction method, and 90 days for carrying out the construction works.*

Note 23: *The construction works were actually completed on 1 July 1999. The EOT was granted up to 17 June 1999 because Contractor C did not carry out site works for 14 days during the construction period.*

5.18 The sequence of major events of the delay in completing the works at the Pau Chung Street and Mau Tau Kok Road junction is given in Appendix D.

5.19 The WSD granted an EOT of 203 days (Note 24) to Contractor C for completing the fresh water main at the junction. The completion date of Section II was further revised from 17 June 1999 (see para. 5.16) to 10 January 2000. The WSD paid a prolongation cost of \$8.44 million to Contractor C for the EOT of 429 days (i.e. 203 days plus 226 days — see para. 5.16) granted (Note 25).

Audit observations

Need to review procedures for entrustment of works

5.20 The delay in completing Contract C could have been minimised if the related works were entrusted to the concurrent DSD sewerage contract. **Audit considers that the WSD should have pursued its proposal for entrusting the mainlaying works along Hung Hom Road to the DSD contract, after obtaining funding for its fresh water mains on 29 July 1995.** As it transpired, the funding for the DSD sewerage works was also obtained on the same date. Even if the funding for the mainlaying works had not been obtained before July 1995, the WSD could still have arranged with the DSD to incorporate the mainlaying works as a provisional item in the DSD contract.

5.21 In March 1995, when the WSD design team proposed to entrust the mainlaying works to the DSD, the Director of Water Supplies' approval was obtained in accordance with the WSD departmental instructions. However, when the design team later decided not to proceed with the entrustment, there was no requirement that the design team should formally report back to the Director.

Remedial action needed to deal with delay in giving site possession

5.22 The failure to give site possession to Contractor C on time caused delay in completing Sections I and II. There was delay because other contractors occupied the sites longer than originally planned. **Audit considers that the WSD should review its project administration procedures to ensure that remedial action is promptly taken to deal with delay in giving possession of sites to contractors.**

Note 24: *The EOT included 104 days for the delay in giving site possession, and 99 days for the construction works.*

Note 25: *An EOT of seven days was also granted for inclement weather.*

Audit recommendations

- 5.23 **Audit has *recommended* that the Director of Water Supplies should:**
- (a) **critically review and update the WSD project administration procedures to ensure that, if there is a delay in obtaining funding for works planned for entrustment, appropriate follow-up action is taken to deal with the entrustment;**
 - (b) **stipulate in the WSD departmental instructions the procedures to be followed for cancelling entrustments of works which the Director of Water Supplies has approved; and**
 - (c) **take remedial actions to deal with delay in completing works in situations where possession of sites cannot be timely given to contractors due to delays caused by other parties. The remedial actions may include:**
 - (i) **entrusting the outstanding works to the other parties; or**
 - (ii) **deleting the outstanding works from the contracts, and employing term contractors to carry out the works upon possession of the sites.**

5.24 **Audit has *recommended* that the Secretary for the Environment, Transport and Works should consider notifying all works departments (e.g. by promulgating Environment, Transport and Works Bureau Technical Circulars (Works)) of the audit recommendations mentioned in paragraph 5.23, so that they may also be aware of possible areas of improvement in their project implementation and contract administration.**

Response from the Administration

5.25 **The Director of Water Supplies agrees with the audit recommendations mentioned in paragraph 5.23. He has said that:**

- (a) **the WSD will enhance the project administration procedures involving works carried out in conjunction with other parties to mitigate delay in similar situations. For Contract C, as the WSD was unable to confirm availability of funds by the deadline set by the DSD, the design was drawn up without the entrustment arrangement, and the entrustment proposal was not incorporated in the Public Works Subcommittee paper. Although fundings for the WSD and the DSD projects were eventually approved at the same time, the WSD subsequently agreed with the DSD to coordinate the works on site instead of entrustment;**

- (b) for contracts where the situation warrants, the WSD will delete the outstanding works for subsequent execution by another party. The decision will be made on a case-by-case basis. In Contract C, the WSD was keen to commission the works as early as possible to meet supply requirements. In the circumstances, deleting the works in question would not have helped to achieve the target; and
- (c) for Contract C, since the cause of delay associated with the non-possession of site was relatively straightforward, it was used for assessing the EOT. However, there were other concurrent causes of delay such as realignments, change in the method of construction and delay in obtaining excavation permits due to conflict with other contracts.

5.26 The **Secretary for the Environment, Transport and Works** welcomes the audit recommendation mentioned in paragraph 5.24. She will duly consider notifying works departments of the audit recommendations mentioned in paragraph 5.23.

PART 6: SUPPLY OF TREATED WATER TO REMOTE VILLAGES

6.1 This PART examines the efforts in supplying treated water to remote villages in the New Territories.

Water supply schemes for remote villages

6.2 In 1982, the WSD, with the support of the then City and New Territories Administration (now the Home Affairs Department — HAD), started a 5-year programme for improving water supply to villages in the New Territories that were reasonably close to existing distribution systems. When the 5-year programme was prepared, about 175 villages were identified as being so remote that the provision of water supply would be either uneconomic or technically difficult. In December 1985, the HAD approached the WSD, saying that there had been major development in the provision of infrastructure, including water supply systems, which might make it feasible to extend treated water supply to the villages.

6.3 *Preliminary appraisal and feasibility study.* In November 1986, the WSD completed a preliminary study, in which the remote villages were grouped into clusters according to their geographical locations. The WSD investigated water supply schemes to these village clusters and evaluated their technical and economic feasibility. The WSD assessed the per capita capital cost of each scheme and determined the most economical supply scheme.

6.4 *Initial economically justifiable water supply schemes.* The preliminary study in 1986 identified about 90 villages (Note 26) for which extending treated water supply was considered technically feasible and economically justifiable. The WSD considered that supplying water to the remaining 60 (i.e. 175 – 90 – 25) or so villages was technically difficult and not economically justifiable. However, the WSD would consider supplying water to additional remote villages if the HAD put forward special justifications. In 1987, the WSD included the water supply schemes for the 90 villages in the Public Works Programme (PWP) for implementation in the order of priority agreed with the HAD.

6.5 *Water supply schemes for other remote villages.* By the mid-1990s, when the works for the initial water supply schemes were at an advanced stage, the WSD and the HAD progressively sought support from the Works Bureau (now the Environment, Transport and Works Bureau) for supplying treated water to the remaining 60 or so villages.

Note 26: *To supply treated water to another 25 villages would require no major improvement works, as these villages could have a metered water supply following the completion of nearby schemes.*

6.6 ***Joint effort of the WSD and the HAD.*** Throughout the detailed planning of the water supply schemes, the WSD liaised closely with the HAD to determine the priority. The HAD updated the population figures of the villages and assessed the quality of the local source of water, while the WSD considered the technical feasibility of the schemes.

6.7 ***Current position.*** The funding for implementing the water supply schemes (Note 27) was about \$420 million. The position is as follows:

- (a) 127 remote villages have been supplied with treated water; and
- (b) 16 remote villages have yet to be supplied with treated water, as the related works are still being carried out.

Since March 2003, the plan to supply treated water to another 19 remote villages has been deferred, because the estimated average per capita capital cost of supply was at a high level of \$455,000. The WSD considered that the supply to the 19 remote villages should be postponed until there was development near the villages, or when new circumstances warranted reconsideration.

Per capita capital cost

6.8 Audit examined the Public Works Subcommittee (PWSC) papers of different PWP items for the funding of the water supply schemes. Each PWP item covered a number of water supply schemes. Audit noted that the information provided in the PWSC papers included the estimated capital cost of each of the water supply schemes, and the total population of the villages of all the water supply schemes. However, the following information was *not* provided:

- (a) the per capita capital cost of each water supply scheme; and
- (b) the population of the villages of each water supply scheme.

Therefore, the per capita capital cost of an individual water supply scheme cannot be ascertained from the PWSC papers.

Per capita capital cost of water supply scheme

6.9 Audit obtained from the WSD population figures of the remote villages of the latest three PWP items, namely 250WF, 239WF and 204WF (such population figures were not provided in the PWSC papers). Audit calculated the per capita capital cost of each of the water supply schemes. Table 5 below shows that the per capita capital cost of some of the water supply schemes was significantly higher than that of the PWP item.

Note 27: *Over the years, of the original list of 175 remote villages, some villages have been removed from the list as they have been cleared or deserted, while other villages not previously identified have been added to the list.*

Table 5
Per capita capital cost of water supply scheme

PWP item no.	Per capita capital cost for each PWP item (Note 1)	Water supply scheme			Per capita capital cost of the water supply scheme
		Scheme no.	Approved cost estimate	Population figure	
(a)	(b)	(c)	(d)	(e)	(f) = (d) / (e)
	(\$)		(\$ million)		(\$)
250WF	16,560	36D	7.01	1,250	5,608
		49	17.83	250	71,320
			<u>24.84</u>	<u>1,500</u>	
239WF (Note 2)	121,556	8	54.10	290	186,552
		46	14.82	50	296,400
		47	26.87	510	52,686
		55	13.61	50	272,200
			<u>109.40</u>	<u>900</u>	
204WF (Note 2)	66,316	23A	2.24	35	64,000
		40	32.33	455	71,055
		50	15.83	270	58,630
			<u>50.40</u>	<u>760</u>	

Source: WSD records

Note 1: Audit calculated the per capita capital cost for the PWP item by referring to the approved cost estimate and the population as provided in the respective PWSC papers.

Note 2: Upon Audit's enquiry, the WSD said that for PWP item 239WF, Scheme nos. 8, 46 and 47 would be served under one extended system, and for PWP item 204WF, Scheme nos. 23A and 40 would be served under another extended system. In these cases, a meaningful per capita capital cost would be the total cost shared by the total population to be served.

Population size

6.10 The population of the remote villages is a major factor for assessing the justification for the water supply schemes. The HAD obtained the population figures of the villages from the liaison network of the District Offices, including records kept by the Rural Committees and the village representatives. In view of the rapid development of the new towns and the high mobility of a young population, the HAD reckoned that there were practical difficulties in obtaining accurate population figures. In some instances, the HAD liaison staff said that they were not able to verify the figures given by the village representatives.

Different basis of determining the population figures

6.11 Audit examined the population figures used by the WSD for implementing water supply schemes for villages under PWP items 250WF, 239WF and 204WF. Table 6 shows that, other than the usual inhabitants, the population figures of some villages also included:

- (a) part-time residents (e.g. those returning for holidays); and
- (b) persons with indigenous villager status but not residing in the villages.

Table 6

Different basis of determining the population figures

Village (Note)	Population figure used in preparing the PWSC paper	Latest population figure advised by HAD	Remarks
<i>(A) Under PWP item 250WF (funding approved on 12.5.2000)</i>			
(i) Ngau Kwu Long	450	150	In March 1999, the HAD advised the WSD that the population figures of Ngau Kwu Long, Pak Mong and Tai Ho were 450, 600 and 200 respectively. They were the potential population if all the family members returned to the villages in the festive seasons. Later, also in March 1999, the HAD clarified that the usual numbers of inhabitants should be 150, 100 and 150 respectively.
(ii) Pak Mong	600	100	
(iii) Tai Ho	200	150	
	<u>1,250</u>	<u>400</u>	
(iv) Kau Sai	250	60	In September 1993, the HAD advised the WSD that Kau Sai had a population of 257. In March 1999, the HAD advised that the population was 60 (i.e. excluding those living in the urban area or abroad).
<i>(B) Under PWP item 239WF (funding approved on 25.5.2001)</i>			
(i) Mong Tung Wan	50	46	In May 1997, the HAD advised the WSD that Mong Tung Wan had a population of 60, a drug rehabilitation centre with 50 inmates and a youth hostel. In February 2001, the HAD advised that the population was 10 and that the drug rehabilitation centre could accommodate 36 persons.

Table 6 (Cont'd)

Village (Note)	Population figure used in preparing the PWSC paper	Latest population figure advised by HAD	Remarks
<i>(C) Under PWP item 204WF (funding approved on 23.11.2001)</i>			
(i) To Kwa Peng	35	4	In March 1999, the HAD advised the WSD that To Kwa Peng had a population of 35. In October 2000, the HAD advised that the population was 4.
(ii) Tai Long	400	10	In September 1993, the HAD advised the WSD that Tai Long had a population of 400. In October 2000, the HAD advised that the population of 400 was the sum of the Tai Long's villagers living throughout the territory. The HAD clarified that the number of inhabitants normally residing in Tai Long was only 10. In November 2000, the Lands Department informed the WSD that, according to the information provided by the village representatives, 370 indigenous villagers would be eligible for small house grants for the next ten years in the area.

Source: WSD records

Note: As at the end of the audit in February 2004, the water supply schemes for To Kwa Peng and Tai Long were still under construction.

Higher per capita capital cost if the latest population figures used

6.12 In most of the cases listed in Table 6, the latest population figures advised by the HAD were not used by the WSD in preparing the PWSC papers. Table 7 shows that the per capita capital costs of the water supply schemes would have been higher, if the latest population figures advised by the HAD had been used.

Table 7

Per capita capital cost using different population figures

Calculation of per capita capital cost

Water supply scheme no.	Village	Approved cost estimate	Population figure used in preparing the PWSC paper	Per capita capital cost	Latest population figure advised by HAD (Note 1)	Per capita capital cost
(a)	(b)	(c)	(d)	(e) = (c) ÷ (d)	(f)	(g) = (c) ÷ (f)
		(\$ million)		(\$)		(\$)
(A) Under PWP item 250WF						
36D	Ngau Kwu Long Pak Mong Tai Ho	7.01	1,250	5,608	400	17,525
49	Kau Sai	17.83	250	71,320	60	297,167
(B) Under PWP item 239WF						
55	Mong Tung Wan	13.61	50	272,200	46	295,870
(C) Under PWP item 204WF						
23A	To Kwa Peng	2.24	35	64,000	4	560,000
40	Tai Long (Note 2) Ham Tin Sai Wan	32.33	455	71,055	66	489,849

Source: WSD records

Note 1: See also the Remarks column of Table 6.

Note 2: Scheme no. 40 included three villages. For Tai Long, the population figure used by the WSD was 400, while the latest population figure advised by the HAD was 10 (see Table 6).

Water consumption

6.13 Audit examined the water consumption of some remote villages. As shown in Appendix E, for these villages:

- (a) the number of water accounts was relatively few compared to the population figure; and
- (b) the water consumption was relatively low compared to the water demand assessed by the WSD.

Some villages did not even have any water accounts. Therefore, there was no record of water consumption. The geographical locations of the remote villages are shown in Appendix F.

Audit observations

Per capita capital cost of water supply scheme not presented in PWSC papers

6.14 As mentioned in paragraph 6.8, it was not possible to ascertain from the PWSC papers the per capita capital cost of the individual water supply scheme. However, upon further analysis, Audit noted that the per capita capital cost of some of the water supply schemes was significantly higher than that of the PWP item (see para. 6.9).

6.15 Audit considers that the WSD should have included adequate information in the PWSC papers to bring to the attention of the PWSC members the per capita capital cost of the individual water supply scheme.

Different basis of determining the population figures

6.16 The WSD used population figures of different basis for implementing the water supply schemes. However, the basis on which the population figures were derived was not disclosed in the PWSC papers. For some villages, the population figures included part-time residents and persons with indigenous villager status but not residing in the villages. Such larger population figures, as compared to the latest population figures advised by the HAD, tended to understate the per capita capital costs of the water supply schemes. This could be misleading for assessing the justification for the schemes (Note 28).

Note 28: *In June 2000, as requested by the Financial Services and the Treasury Bureau, the WSD excluded from the population figures those residents returning for holidays and those who would return to live in the villages after retirement, when considering the water supply for 19 remote villages (see para. 6.7).*

6.17 **Audit considers that the WSD should critically assess the population figures before using them for justifying the water supply schemes. The WSD should also disclose in the PWSC papers the basis on which the population figures are derived.**

Low water consumption

6.18 As mentioned in paragraph 6.13, some remote villages had very low water consumption. Some of these villages did not even have any water accounts. The low water consumption may be due to the following reasons:

- (a) the population figures used for the water supply schemes had been overstated;
- (b) the villagers chose not to use treated water, but continued to rely on stream water, which is free of charge; and/or
- (c) illegal tapping from the treated water supply system.

6.19 **Audit considers that the WSD should carry out a post-implementation review of the water supply schemes to ascertain the reasons for the low water consumption.**

Audit recommendations

6.20 **Audit has recommended that the Director of Water Supplies should:**

- (a) **in implementing water supply schemes for remote villages:**
 - (i) **critically assess the population figures used for justifying the water supply schemes;**
 - (ii) **disclose in the PWSC papers the basis on which the population figures are derived; and**
 - (iii) **include adequate information in the PWSC papers to bring to the attention of the PWSC members the per capita capital cost of individual water supply schemes; and**
- (b) **carry out a post-implementation review of the water supply schemes to ascertain the reasons for the low consumption of treated water in some villages so that:**

- (i) **necessary remedial actions can be taken; and**
- (ii) **lessons can be learnt for planning future schemes.**

Response from the Administration

6.21 The **Director of Water Supplies** agrees with the audit recommendations mentioned in paragraph 6.20. He has said that:

- (a) in planning and designing the water system extensions, the WSD has always taken into account the current population, other potential users and known or planned developments. The marginal cost for a system with a slightly larger capacity is very small. However, the cost to enlarge a system is significant;
- (b) for future PWSC submissions, the WSD will improve the presentation to give a fuller picture on the per capita capital cost; and
- (c) the WSD will carry out a post-implementation review of the water supply schemes. As part of the WSD system planning, the post-implementation reviews are conducted for the supply network to keep track of operational performance and demand build-up.

Extension of time granted for the works sections of Contract B

Section	Causes	EOT granted (day)
W1	(a) Increase in quantities of bends	3
	(b) Others (Note)	4
		<u>7</u>
W2	(a) Nil	<u>0</u>
W3	(a) Additional connection works	123
	(b) Increase in quantities of bends	138
	(c) Others (Note)	273
		<u>534</u>
W4	(a) Others (Note)	<u>7</u>
W5	(a) Additional connection works	58
	(b) Increase in quantities of bends	113
	(c) Works carried out within restricted hours	34
	(d) Others (Note)	88
		<u>293</u>
W6	(a) Others (Note)	<u>487</u>
W7	(a) Additional connection works	126
	(b) Works carried out within restricted hours	24
	(c) Others (Note)	106
		<u>256</u>
W8	(a) Increase in quantities of bends	114
	(b) Works carried out within restricted hours	217
	(c) Others (Note)	43
		<u>374</u>

Source: WSD records

Note: Others included either one or more of the following causes:

- (i) change of alignment due to congested underground utilities;
- (ii) delay in giving site possession;
- (iii) revised construction method;
- (iv) bursting of water main; and
- (v) typhoon signals Nos. 8 and 10.

Appendix B
(para. 5.11 refers)

Delay in works at the Hung Hom Road and Tai Wan Road junction

Date	Events
(a) December 1997	<p>Contractor C completed laying water mains along Tai Wan Road, except for a 13 m fresh water main and another 13 m salt water main at the junction of Hung Hom Road and Tai Wan Road.</p> <p>As the DSD contractor was occupying the Hung Hom Road's southbound slow lane, the WSD was not able to proceed with the works at the middle and fast lanes of the junction. The DSD contractor planned to complete his works by February 1998.</p>
(b) 26 December 1997	<p>This was the original completion date of Section I.</p>
(c) March 1998	<p>Contractor C still could not take possession of the site. The DSD contractor had not completed his works and had made no commitment on the completion date.</p>
(d) April 1999	<p>The DSD contractor was still occupying the junction. The WSD instructed Contractor C to defer the outstanding works, and give priority to Section II.</p>
(e) 14 April 1999	<p>The DSD contractor handed over the road junction.</p>
(f) 24 April 1999	<p>The WSD gave Contractor C possession of the road junction site. Contractor C commenced the outstanding works on the same day.</p>
(g) 26 July 1999	<p>Contractor C completed the outstanding works, and the WSD certified that Section I was substantially completed.</p>

Source: WSD records

Appendix C
(para. 5.15 refers)

Delay in works at the Hung Hom Road and Hok Yuen Street junction

Date	Events
(a) 26 January 1998	Contractor C partially completed the mainlaying works except for a 40 m water main at the junction of Hung Hom Road and Hok Yuen Street. As agreed, Contractor C handed over the road junction to the DSD contractor.
(b) February to December 1998	The DSD contractor occupied the road junction for his sewerage works.
(c) 3 December 1998	The DSD handed over the road junction. On 8.12.1998, Contractor C started pipe trench excavation for the laying of the 40 m water main. The excavation revealed that the pipe route was fully occupied by underground utilities (20 m in width and 2.8 m in depth). The works were delayed.
(d) February 1999	The WSD instructed Contractor C to lower part of the pipeline to avoid the utilities. As a result, a section of a straight pipe had to be cut off and relaid.
(e) March 1999	The WSD asked Contractor C to prepare for the removal of the section of the laid pipe, the construction of pipe-jacking/receiving pits and the detailed design of the pipe-jacking works. The WSD noted that the DSD had constructed a section of sewer in the vicinity also by the pipe-jacking method.
(f) April 1999	The WSD issued a variation order instructing Contractor C to lay the salt water main by the pipe-jacking method.
(g) 1 July 1999	Contractor C completed the outstanding works.

Source: WSD records

Appendix D
(para. 5.18 refers)

Delay in works at the Pau Chung Street and Mau Tau Kok Road junction

Date	Events
(a) February 1998	The Housing Society informed the Transport Department that works for installing traffic control signals at the junction of Pau Chung Street and Mau Tau Kok Road would begin on 2.3.1998 and complete by 15.6.1998.
(b) March 1998	The Housing Society's contractor commenced the works on 11.3.1998 and provided the WSD with details of the works.
(c) August 1998	The WSD originally planned to commence laying the DN450 fresh water main along Pau Chung Street on 25.8.1998.
(d) September 1998	The WSD noted that the Housing Society's contractor was still occupying the junction. The WSD would commence the mainlaying works in two months' time.
(e) October 1998	Contractor C commenced laying the fresh water main along Pau Chung Street.
(f) June 1999	The Housing Society's contractor was still occupying the junction. Contractor C completed most of the mainlaying works along Pau Chung Street, except for the 10 m long pipeline at the junction.
(g) August 1999	The Housing Society's contractor handed over the junction. Contractor C immediately commenced the works on 3.8.1999. However, due to the restricted space available for turning long vehicles at the junction, the 10 m fresh water main had to be realigned.
(h) September 1999	Contractor C commenced the mainlaying works at the junction.
(i) 10 January 2000	Contractor C completed the mainlaying works at the junction.

Source: WSD records

Appendix E
(para. 6.13 refers)

Water consumption of remote villages

Village	Planned		Actual		Actual consumption compared to demand assessment $(f) = \frac{(e)}{(c)} \times 100\%$ (%)
	Population figure	Water demand assessment (Note 1) (cubic metres/ billing period)	No. of water accounts	Water consumption (Note 2) (cubic metres/ billing period)	
(a)	(b)	(c)	(d)	(e)	(f)
(A) North District					
<i>Scheme no. 6</i>					
Pak Fu Shan	80	2,400	4	322	13.4%
Mor Lou Lau	100	3,000	12	412	13.7%
Lin Ma Hang	150	4,500	0	0	0%
	<u>330</u>	<u>9,900</u>	<u>16</u>	<u>734</u>	<u>7.4%</u>
Others (Note 3)	—	—	4	14	—
	<u>330</u>	<u>9,900</u>	<u>20</u>	<u>748</u>	<u>7.6%</u>
(B) Sai Kung District					
<i>Scheme no. 28</i>					
Yim Tin Tsai	428	12,840	0	0	0%
	428	12,840	0	0	0%
Others (Note 3)	—	—	3	732	—
	<u>428</u>	<u>12,840</u>	<u>3</u>	<u>732</u>	<u>5.7%</u>
<i>Scheme no. 48</i>					
Leung Shuen Wan	1,000	30,000	0	0	0%
Pak A	96	2,880	9	23	0.8%
Pak Lap	185	5,550	0	0	0%
Tung A	175	5,250	10	354	6.7%
Sha Kiu	130	3,900	8	713	18.3%
	<u>1,586</u>	<u>47,580</u>	<u>27</u>	<u>1,090</u>	<u>2.3%</u>
Others (Note 3)	—	—	8	2,927	—
	<u>1,586</u>	<u>47,580</u>	<u>35</u>	<u>4,017</u>	<u>8.4%</u>

Appendix E
(Cont'd)
(para. 6.13 refers)

Village	Planned		Actual		Actual consumption compared to demand assessment $(f) = \frac{(e)}{(c)} \times 100\%$ (%)
	Population figure	Water demand assessment (Note 1)	No. of water accounts	Water consumption (Note 2)	
(a)	(b)	(c)	(d)	(e)	(f)
		(cubic metres/ billing period)		(cubic metres/ billing period)	(%)
(C) Lantau Island					
<i>Scheme no. 36D</i>					
Ngau Kwu Long	450	13,500	0	0	0%
Pak Mong	600	18,000	0	0	0%
Tai Ho	200	6,000	0	0	0%
	1,250	37,500	0	0	0%
<i>Scheme no. 41A</i>					
Tai Long Wan Tsuen	100	3,000	0	0	0%
<i>Scheme no. 52</i>					
Lai Chi Yuen	100	3,000	9	260	8.7%
Wan Tsai	50	1,500	12	148	9.9%
	150	4,500	21	408	9.1%

Source: WSD records

Note 1: The WSD assessed that the water demand of each villager in a four-month billing period was 30 cubic metres.

Note 2: Audit examined the water consumption of the individual water accounts for the latest three billing periods prior to November 2003. The billing period with the highest water consumption was used in the analysis.

Note 3: This included one or more of the following: (i) public toilets, (ii) a temple, and (iii) a water sports centre. There was no water demand assessment for these facilities.

Geographical location of remote villages with low water consumption



Source: WSD records

Water supply scheme no.	Villages
6	Pak Fu Shan, Mor Lou Lau, Lin Ma Hang
28	Yim Tin Tsai
36D	Ngau Kwu Long, Pak Mong, Tai Ho
41A	Tai Long Wan Tsuen
48	Leung Shuen Wan, Pak A, Pak Lap, Tung A, Sha Kiu
52	Lai Chi Yuen, Wan Tsai

Appendix G

Chronology of key events

Contract A

November 1996	Contractor A commenced the works.
July 1997	At a progress meeting with Contractor A, the WSD expected that a substantial realignment of the water mains would be needed.
September 1997	The WSD issued a technical review report of Contract A. The report said that the investigation works had not been very productive.
March 1998	This was the original contract completion date.
May 1998	The realignment of the water mains was fully identified.
May 1999	The technical problems and traffic restrictions on the realigned sections were fully resolved.
November 1999	The works were substantially completed.
September 2002	The WSD issued the final payment certificate.

Contract B

April 1998	Contractor B commenced the works.
November 1999	The WSD operational regions identified additional connection requirements for the new salt water mains.
April 2000	This was the original contract completion date.
June 2000	On request of the WSD operational regions, the WSD instructed the consultant to order additional connections.
October 2001	The works were substantially completed.

Appendix G
(Cont'd)

Contract C

March 1995	The WSD proposed, and the DSD agreed, to incorporate the concerned fresh water and salt water mainlaying works in the DSD contract.
Mid-July 1995	The WSD informed the DSD that funding for the laying of its fresh water mains had not yet been approved. The WSD would not entrust the laying of the fresh water and salt water mains to the DSD.
End-July 1995	The funding for the laying of the fresh water mains was approved. The funding for the DSD sewerage works was also approved on the same day.
December 1996	Contractor C commenced the works.
December 1997	This was the original completion date of Section I.
October 1998	This was the original completion date of Section II.
July 1999	Section I was substantially completed.
January 2000	Section II was substantially completed. The whole of the works were also substantially completed.
June 2003	The WSD issued the final payment certificate.

Supply of treated water to remote villages

December 1985	The HAD approached the WSD saying that there had been major development in the water supply systems which might make it feasible to extend treated water supply to some remote villages.
1987	The WSD included the initial economically justifiable water supply schemes for about 90 villages in the PWP.
Mid-1990s	The WSD and the HAD progressively sought support from the Works Bureau (now the Environment, Transport and Works Bureau) for supplying water to another 60 or so remote villages.
March 2003	The original plan to supply treated water to the last batch of 19 remote villages was deferred due to the high average per capita capital cost.

Acronyms and abbreviations

Audit	Audit Commission
BQ	Bills of Quantities
DSD	Drainage Services Department
EOT	Extension of time
HAD	Home Affairs Department
Police	Hong Kong Police Force
PWP	Public Works Programme
PWSC	Public Works Subcommittee
WSD	Water Supplies Department