For discussion **PWSC(2015-16)59**
(date to be confirmed)

ITEM FOR PUBLIC WORKS SUBCOMMITTEE OF FINANCE COMMITTEE

HEAD 704 – DRAINAGE
Environmental Protection – Sewerage and sewage treatment
381DS – Construction of additional sewage rising main and rehabilitation of the existing sewage rising main between Tung Chung and Siu Ho Wan

Members are invited to recommend to the Finance Committee the upgrading of **381DS** to Category A at an estimated cost of $1,942.1 million in money-of-the-day prices.

PROBLEM

There is an urgent need to provide an alternative sewage rising main to the existing one between Tung Chung and Siu Ho Wan.

PROPOSAL

2. The Director of Drainage Services, with the support of the Secretary for the Environment, proposes to upgrade **381DS** to Category A at an estimated cost of $1,942.1 million in money-of-the-day (MOD) prices for the construction of an additional sewage rising main and the rehabilitation of the existing sewage rising main between Tung Chung and Siu Ho Wan.

/ **PROJECT** …..

PROJECT SCOPE AND NATURE

3. The proposed scope of works under the project comprises –

(a) construction of an additional sewage rising main of about 6.5 kilometres (km) with diameter of 1 200 millimetres (mm) from the Tung Chung sewage pumping station (TCSPS) to the Siu Ho Wan sewage treatment works (SHWSTW);

(b) construction of the associated connection works for the additional sewage rising main;

(c) rehabilitation of the existing sewage rising main with diameter of 1 200 mm; and

(d) ancillary works including ground investigation and monitoring works.

A site plan is at Enclosure 1.

4. Subject to funding approval of the Finance Committee, we plan to commence construction of the proposed works in the third quarter of 2016 for commissioning the new sewage rising main in mid-2023 and completing the rehabilitation of the existing rising main by end 2025.

JUSTIFICATION

5. The existing sewage rising main between Tung Chung and Siu Ho Wan is the only pipe for conveying sewage collected from Tung Chung Town and Airport Island to the SHWSTW. It has been in operation under pressure for 20 years. Given the need of its operation round the clock, it is not possible to shut down the rising main or divert the sewage away for carrying out inspection or maintenance works. It is thus not possible to ascertain the structural or serviceable condition of the existing sewage rising main.

/ 6. …..

6. However, the existing trunk sewer upstream of the TCSPS had shown signs of serious corrosion, due to ageing as well as the unexpected high hydrogen sulphide level in the sewage. Details on the issue of high hydrogen sulphide level as requested by the Legislative Council Panel on Environmental Affairs (EA Panel) are set out in Enclosure 2. As the situation encountered by the upstream trunk sewer is also applicable to the sewage rising main between Tung Chung and Siu Ho Wan, the rising main will likely experience a similar corrosion problem, giving rise to a growing risk of structural failure.

7. The existing sewage rising main, if bursts, will cause spillage of raw sewage onto Cheung Tung Road and the adjacent North Lantau Highway. This would create severe disruption to road traffic and affect the transportation of airport users and goods, and therefore the operation of the Hong Kong International Airport (HKIA). The spillage might also cause detrimental environmental impacts to the nearby coastal water.

8. In addition, both the population intake for the planned housing development of Tung Chung New Town Extension and the commissioning of the three-runway system of the HKIA are scheduled to take place in late 2023. They will increase the projected sewage flow to about 76 500 cubic metres (m^3) per day in 2023, exceeding the maximum capacity of the existing sewage rising main of 60 000 m^3 per day, and the projected sewage flow will increase further with continued population growth[1]. We need to construct the proposed additional sewage rising main with a capacity of 60 000 m^3 per day[2] to meet the projected sewage flow in 2038. Details on the design capacity of the rising mains and relevant components of the sewerage system as requested by the EA Panel are shown in Enclosure 3.

/ 9. …..

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[1] The existing population of Tung Chung New Town (TCNT) is about 80 000 people and the current passenger number of the HKIA is 68 million per year. The latest planned population for the TCNT, including both the proposed Tung Chung East and Tung Chung West extension areas, is 165 800 people while the passenger number of the HKIA is projected to reach 83 million per year in 2023. The population and passenger number will increase to 268 400 and 126 million respectively with full occupation of the private residential and public housing developments in Tung Chung and full expansion of the HKIA into a three-runway system in 2038.

[2] Under normal pressure. If operated under elevated pressure on a short-term basis, the capacity could increase to 120 000 m^3 per day.

9. We have carefully considered four different alignment options for the proposed rising main and concluded that the only feasible option is to put the rising main underneath the carriageway of Cheung Tung Road. Details of the four options considered as requested by the EA Panel are set out in Enclosure 4.

10. Upon the completion and operation of the proposed sewage rising main, the existing main can be temporarily decommissioned for rehabilitation. After the completion of the rehabilitation works, the overall operation and reliability of the sewerage system will be greatly enhanced.

FINANCIAL IMPLICATIONS

11. We estimate the capital cost of the proposed works to be $1,942.1 million in MOD prices (please see paragraph 12 below), broken down as follows –

			$ million	
(a)	Construction of an additional rising main		666.0	
(b)	Associated connection works		17.0	
(c)	Rehabilitation of the existing rising main		359.7	
(d)	Ancillary works		5.1	
(e)	Environmental mitigation measures		17.3	
(f)	Consultant's fees for		9.7	
	(i) contract administration	2.6		
	(ii) management of residential site staff	7.1		
(g)	Remuneration of residential site staff		153.8	
(h)	Contingencies		111.7	
	Sub-total		1,340.3	(in September 2015 prices)
(i)	Provision for price adjustment		601.8	
	Total		1,942.1	(in MOD prices)

/ A …..

A breakdown of the estimates for the consultants' fees and resident site staff costs by man-months is at Enclosure 5.

12. Subject to funding approval, we will phase the expenditure as follows –

Year	$ million (Sept 2015)	Price adjustment factor	$ million (MOD)
2016 – 2017	25.0	1.05875	26.5
2017 – 2018	65.0	1.12228	72.9
2018 – 2019	95.0	1.18961	113.0
2019 – 2020	135.0	1.26099	170.2
2020 – 2021	160.0	1.32719	212.4
2021 – 2022	160.0	1.39355	223.0
2022 – 2023	150.0	1.46323	219.5
2023 – 2024	105.0	1.53639	161.3
2024 – 2025	170.0	1.60745	273.3
2025 – 2026	200.0	1.67978	336.0
2026 – 2027	52.0	1.75537	91.3
2027 – 2028	23.3	1.83436	42.7
	1,340.3		1,942.1

13. We have derived the MOD estimate on the basis of the Government's latest set of assumptions on the trend rate of change in the prices of public sector building and construction output for the period from 2016 to 2028. We will deliver the works under two contracts, one for the construction of an additional sewage rising main and the other for the rehabilitation of the existing sewage rising main. Both contracts will adopt the format of New Engineering Contract – Option D "target contract with bill of quantities" with mechanism of gain share/pain share for sharing of risk between the Government and contractor and providing incentives for achieving cost savings.

/ 14. …..

14. We estimate the additional annual recurrent expenditure arising from the project to be $2.4 million. Based on the current level of expenditure on operation and day-to-day maintenance of sewerage facilities, the proposed works will lead to an increase in the recurrent cost of providing sewage services by about 0.14% which will be taken into consideration when determining the sewage charge and trade effluent surcharge rates in future.

PUBLIC CONSULTATION

15. We consulted the Tourism, Agriculture, Fisheries and Environmental Hygiene Committee of the Islands District Council (IsDC) on 30 September 2013, the Mui Wo Rural Committee on 14 November 2013 and the Traffic and Transport Committee of the IsDC on 19 January 2015. All the above committees supported the proposed works.

16. We consulted the EA Panel on 21 December 2015 on the proposed works. The EA Panel supported submitting the funding proposal to Public Works Subcommittee for consideration. Supplementary information as requested by the EA Panel is set out in Enclosures 2 to 4 in addition to Footnote 1 above.

ENVIRONMENTAL IMPLICATIONS

17. The proposed works are not designated projects under the Environmental Impact Assessment Ordinance (Cap.499). Drainage Services Department completed an Environmental Review for the proposed works in September 2014. It was concluded that, with the timely implementation of appropriate mitigation measures as mentioned in the following paragraphs, the proposed works would not have long-term adverse environmental impacts.

/ 18. …..

18. For short-term environmental impacts during construction, we will control noise, dust, and site run-off to levels within the established standards and guidelines through implementation of environmental mitigation measures, such as the use of silenced construction equipment and noise barriers to reduce noise generation, water-spraying to reduce emission of fugitive dust, and proper treatment of site run-off before discharge. We will also carry out regular site inspections to ensure that these recommended mitigation measures and good site practices will be properly implemented on site. We have included in paragraph 11(e) a sum of $17.3 million (in September 2015 prices) in the project estimate for implementation of the environmental mitigation measures.

19. At the planning and design stages, we have considered ways to reduce the generation of construction waste (e.g. to design the alignment of the proposed sewage rising main in such a manner that excavation and modification of existing structures will be minimised) where possible. In addition, we will require the contractor to reuse inert construction waste (e.g. excavated soil) on site or in other suitable construction sites as far as possible, in order to minimise the need for disposal of inert construction waste at public fill reception facilities (PFRF)[3]. We will also encourage the contractor to maximise the use of recycled or recyclable inert construction waste, and the use of non-timber formwork to further reduce the generation of construction waste.

20. At the construction stage, the contractor is required to submit for approval a plan setting out the waste management measures, which will include appropriate mitigation measures to avoid, reduce, reuse and recycle inert construction waste. We will ensure that the day-to-day operations on site comply with the approved plan. We will require the contractor to separate inert and non-inert construction waste on site for disposal at appropriate facilities. We will control the disposal of inert and non-inert construction waste at PFRF and landfills respectively through a trip-ticket system.

/ 21. …..

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[3] PFRF are specified in Schedule 4 of the Waste Disposal (Charges for Disposal of Construction Waste) Regulation. Disposal of inert construction waste in PFRF requires a licence issued by the Director of Civil Engineering and Development.

21. We estimate that the proposed works will generate 208 000 tonnes of construction waste. Of these, we will reuse 128 000 tonnes (62%) of the inert construction waste on site and deliver another 77 000 tonnes (37%) to PFRF for subsequent reuse. We will dispose of the remaining 3 000 tonnes (1%) of non-inert construction waste at landfills. The total costs of accommodating construction waste at PFRF and landfill sites are estimated to be about $2.5 million for the proposed works (based on a unit charge rate of $27 per tonne for disposal at PFRF and $125 per tonne at landfills as stipulated in the Waste Disposal (Charges for Disposal of Construction Waste) Regulation).

HERITAGE IMPLICATIONS

22. The proposed works will not affect any heritage site, i.e. all declared monuments, proposed monuments, graded historic sites or buildings, sites of archaeological interest and government historic sites identified by the Antiquities and Monuments Office.

LAND ACQUISITION

23. The proposed works do not require any land acquisition.

BACKGROUND INFORMATION

24. In September 2011, we upgraded **381DS** to Category B.

25. In October 2012, we engaged consultants to undertake site investigation, surveys, impact assessments and detailed design for the proposed works. The total estimated cost was $17.3 million. We charged this amount to block allocation **Subhead 4100DX** "Drainage works, studies and investigations for items in Category D of the Public Works Programme". We have substantially completed the detailed design for the proposed works.

/ 26. …..

26. Of the 1 229 trees within the project boundary, 1 200 trees will be preserved. The proposed works will involve the felling of 26 trees and transplanting of 3 trees. All the trees to be felled and transplanted are not important trees[4]. We will incorporate planting of 52 trees as part of the project.

27. We estimate that the proposed works will create about 420 jobs (340 for labourers and another 80 for professional/technical staff), providing a total employment of 21 000 man-months.

Environment Bureau
February 2016

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[4] "Important trees" refer to trees in the Register of Old and Valuable Trees, or any other trees that meet one or more of the following criteria –

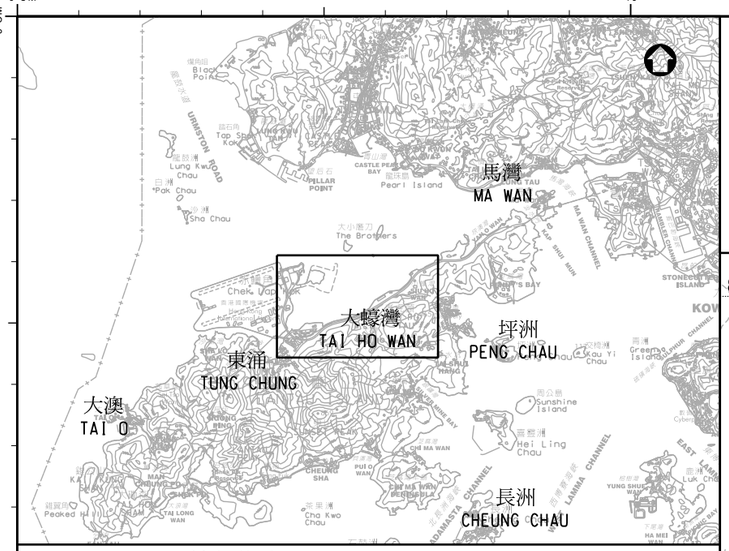
(a) trees of 100 years old or above;

(b) trees of cultural, historical or memorable significance e.g. Fung Shui trees, trees as landmark of monastery or heritage monument, and trees in memory of important persons or event;

(c) trees of precious or rare species;

(d) trees of outstanding form (taking account of overall tree sizes, shape and any special features) e.g. trees with curtain like aerial roots, trees growing in unusual habitat; or

(e) trees with trunk diameter equal or exceeding 1.0 metre (m) (measured at 1.3 m above ground level), or with height/canopy spread equal or exceeding 25 m.



位置圖 LOCATION PLAN
比例 SCALE 1:300000

圖例 LEGEND ：

擬建造的1200mm直徑加壓污水管
PROPOSED CONSTRUCTION OF 1200mm DIA. SEWAGE RISING MAIN

擬復修的現有1200mm直徑加壓污水管
PROPOSED REHABILITATION OF THE EXISTING 1200mm DIA. SEWAGE RISING MAIN

812 000 E
814 000 E
816 000 E
818 000 N
820 000 N

小蠔灣污水處理廠
SIU HO WAN SEWAGE TREATMENT WORKS

小蠔灣
SIU HO WAN

北大嶼山公路
NORTH LANTAU HIGHWAY

翔東路
CHEUNG TUNG ROAD

東涌污水泵房
TUNG CHUNG SEWAGE PUMPING STATION

富東邨
FU TUNG ESTATE

東涌
TUNG CHUNG

大蠔灣
TAI HO WAN

北大嶼郊野公園擴展部
LANTAU NORTH (EXTENSION) COUNTRY PARK

版 no.	日期 date	修改項目 description	簡簽 initial
A	15 DEC 2015	GENERAL REVISION	SIGNED Ir K.S. NG E/CM14

圖則名稱 drawing title

工務計劃項目第4381DS號 -
在東涌及小蠔灣之間增建一條加壓污水管及修復現有加壓污水管

PWP ITEM No.4381DS -
CONSTRUCTION OF ADDITIONAL SEWAGE RISING MAIN AND REHABILITATION OF THE EXISTING SEWAGE RISING MAIN BETWEEN TUNG CHUNG AND SIU HO WAN

繪畫 drawn	SIGNED K. S. LEUNG	日期 date 15 OCT 2015
核對 checked	SIGNED Ir K. S. NG	日期 date 15 OCT 2015
批核 approved	SIGNED Ir W. F. WONG	日期 date 15 OCT 2015
部門 office	顧問工程管理部 CONSULTANTS MANAGEMENT DIVISION	

圖則編號 drawing no. DCM/2015/014A

比例 scale 1:20000 OR AS SHOWN

香港特別行政區政府渠務署
DRAINAGE SERVICES DEPARTMENT
GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

381DS – Construction of additional sewage rising main and rehabilitation of the existing sewage rising main between Tung Chung and Siu Ho Wan

Problem of Hydrogen Sulphide and Remediation Measures Taken

Sewage contains high levels of organic pollutants and bacteria. Seawater, which is commonly used for toilet flushing in Hong Kong, contains high levels of sulphate. Inside sewers and rising mains, bacteria will grow on the surface of pipes and use sulphate to oxidize the organic pollutants. With this natural bacterial activity, sulphate is gradually converted into hydrogen sulphide (H_2S). As it takes time for sewage to pass through sewers and reach sewage treatment works, the longer the hydraulic retention time inside a sewer, the more H_2S will be formed. High levels of H_2S will speed up the corrosion of sewers.

2. Drainage Services Department (DSD) detected high level of H_2S in the sewage at the Tung Chung sewage pumping station (TCSPS) and Siu Ho Wan sewage treatment works (SHWSTW) in 2004. Subsequent investigations revealed that sewage generated from the Hong Kong International Airport (HKIA) contributed to the H_2S, mainly due to the prolonged retention time inside the sewerage system on Airport Island. DSD then closely liaised with the Airport Authority Hong Kong for implementing remedial actions to reduce the H_2S levels of the sewage generated on Airport Island. These remedial actions include –

(a) Sequential replacement of all sewers, including cement lined rising mains and concrete gravity pipes, on Airport Island by high density polyethylene (HDPE) pipes. As HDPE has a much smoother surface than cement and concrete, the growth of bacteria on the surface of pipes would be reduced which in turn reduced H_2S generation.

(b) Addition of calcium nitrate at critical locations, such as the HKIA pumping stations, to suppress the conversion of sulphate into H_2S and enhance the conversion of H_2S back to sulphate.

/ (c) …..

(c) Construction of a new sewage treatment plant, namely a Membrane Biological Reactor, to treat the greywater (e.g. kitchen, laundry and washing basin wastewater generated in the airport) to improve the quality of the sewage effluent and to facilitate further reuse of treated greywater for water saving.

(d) Relocation of the discharge point of the treated effluent in (c) above to flush the raw sewage and reduce the hydraulic retention time of sewage to reduce H_2S formation.

(e) Setting up of a monitoring system to check the level of H_2S in the sewage generated from Airport Island regularly.

3. In parallel, DSD also added an oxygen injection facility at the TCSPS to suppress the formation of H_2S in the rising main between the TCSPS and the SHWSTW. Since the completion of the above measures in 2011, the level of H_2S in the system has been reduced to an acceptable level.

381DS – Construction of additional sewage rising main and rehabilitation of the existing sewage rising main between Tung Chung and Siu Ho Wan

Sewage Conveyance and Treatment Capacity of the Rising Main, Pumping Station and Sewage Treatment Works

Most of the critical sewage rising mains laid in recent years in Hong Kong are provided in pair running alongside each other, with both mains using as duty rather than one as duty and the other as standby, since twin pipes operation mode can maintain the pumping pressure at normal level which would help to save long-term power cost. In addition, septicity in the standby pipe would pose operational and maintenance problems. Should one of the duty mains be taken out of operation for maintenance, the remaining one would then operate under elevated pressure to deliver a higher quantity of flow at a higher velocity on a short-term basis.

2. As the existing sewage rising main is assessed to be in a deteriorating condition with serious corrosion problem, it is not appropriate to further increase the operating pressure of the rising main to cope with the increasing sewage flow because this will further increase the risk of pipe bursting. The capacity of the sewage rising mains (RM) before and after completion of project are set out below –

	Operating under normal pressure		Operating under elevated pressure on short-term basis	
	Design capacity (m^3/day)	Pipe pressure (bar)	Design capacity (m^3/day)	Pipe pressure (bar)
Before project completion:				
Existing single pipe RM	60 000	3.3	Not advisable in view of the deteriorating condition of the existing RM	
After project completion:				
Additional pipe RM	60 000	3.3	120 000	6.6
Rehabilitated pipe RM	60 000	3.3	120 000	6.6

Note: "Bar" is a unit of pressure measurement. 1 bar is equal to 1 atmospheric pressure. At 1 bar, water/sewage can be pumped up by 10.2 meters.

/ 3. …..

3. The capacity of the Tung Chung sewage pumping station and Siu Ho Wan sewage treatment works are set out below –

	Design capacity (m^3/day)
Tung Chung sewage pumping station	120 000
Siu Ho Wan sewage treatment works	180 000

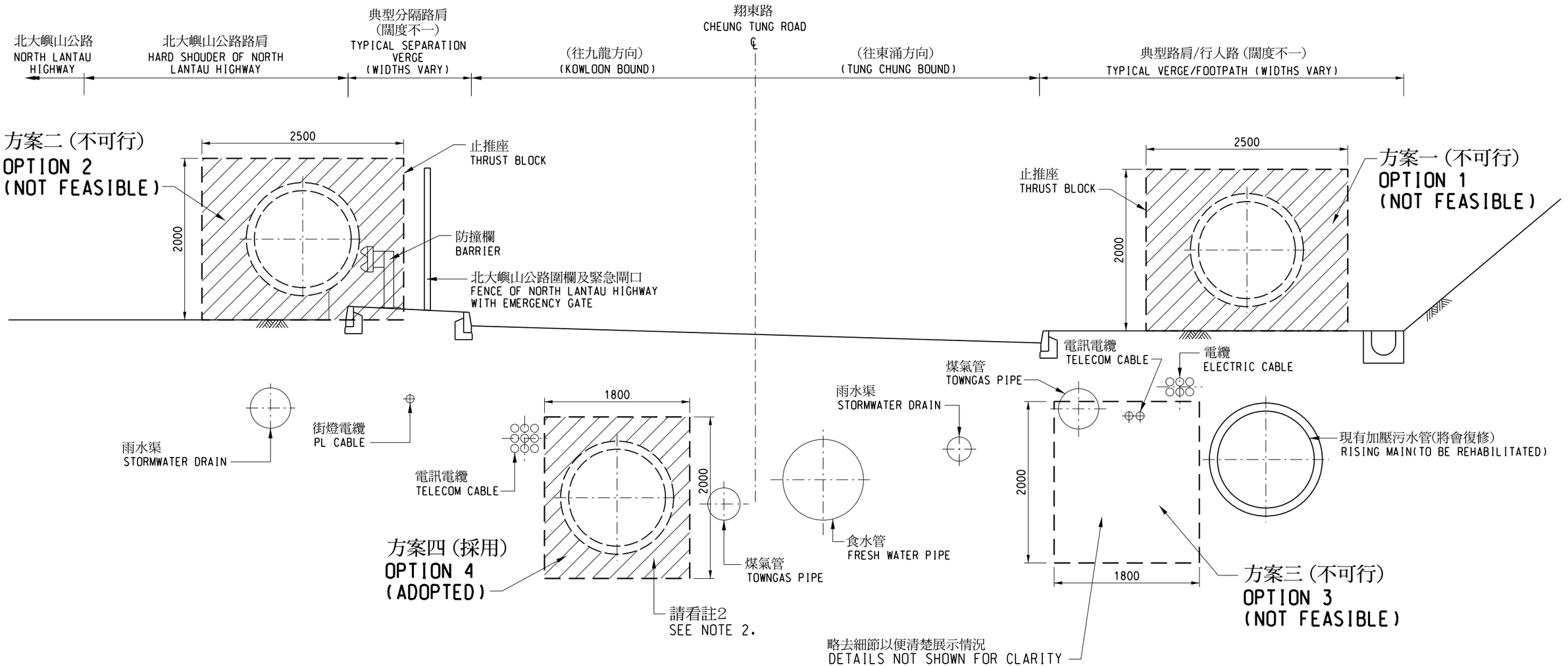
381DS – Construction of additional sewage rising main and rehabilitation of the existing sewage rising main between Tung Chung and Siu Ho Wan

Comparison of Alternative Alignment Designs and Construction Methods of the Sewage Rising Main

Technical Considerations	Feasibility
Option 1 - The sewage rising main to be laid above-ground along the verge adjacent to the Tung Chung bound traffic lane of Cheung Tung Road	
(a) The proposed rising main together with the associated concrete thrust blocks and plinths would obstruct the rehabilitation of the existing 1 200 millimetres (mm) diameter sewage rising main and the maintenance of rehabilitated rising main and other existing underground utilities. (b) The proposed rising main which is exposed above ground will be more susceptible to damage due to vehicle collision as the proposed rising main would be placed close to the edge of the carriageway.	Not feasible
Option 2 - The sewage rising main to be laid above-ground along the verge/hard shoulder of the North Lantau Highway, which is adjacent to the Kowloon bound traffic lane of Cheung Tung Road	
(a) Most of the verges between Cheung Tung Road and North Lantau Highway are not wide enough to accommodate the proposed rising main and the associated concrete thrust blocks and plinths. In addition, several sections indeed have no verge to separate Chung Tung Road and North Lantau Highway, except the fence and crash barrier. As such, the exposed sewage rising main would inevitably occupy part of the hard shoulder. Since the hard shoulder is part of the carriageway which is designed for serving the expressway as an emergency lane during traffic incident /accident or maintenance, the proposed sewage rising main would be against the design purpose of hard shoulder and affect traffic safety. (b) Locating the proposed rising main together with the concrete thrust blocks and plinths on the verge/hard shoulder will obstruct the maintenance of underground utilities.	Not feasible

Technical Considerations	Feasibility
(c) The proposed rising main will physically block off the traffic diversion emergency openings between the North Lantau Highway and Cheung Tung Road, rendering the emergency diversion option of Transport Department's contingency traffic plan inoperable. (d) The proposed rising main which is exposed above ground will be susceptible to damage due to vehicle collision. (e) Transport Department and Highways Department do not support this option due to its adverse impact on the operation of the expressway.	
Option 3 - The sewage rising main to be laid underground along the verge adjacent to the Tung Chung bound traffic lane of Cheung Tung Road	
(a) The verge of Cheung Tung Road has been congested with many underground utility services. There is no sufficient space to accommodate another 1 200 mm diameter pipe.	Not feasible
Option 4 - The sewage rising main to be buried along the Kowloon bound traffic lane of Cheung Tung Road	
(a) No insurmountable technical issues. (b) Due consideration has been made to reduce traffic impact during construction by using the pipe jacking method or locating the proposed rising main on the verges of the existing or re-aligned Cheung Tung Road. As a result, about 1.5 kilometres (km) out of the 5.5 km long proposed rising main to be laid along Cheung Tung Road will not cause any traffic impact.	Feasible and adopted in the current design

A sketch illustrating the construction methods of the alternative alignment designs is at Sketch 1.



典型切面圖 TYPICAL SECTION

比例 SCALE 1:50

註 NOTES:

1. 所有量度以毫米為單位
   ALL DIMENSIONS ARE IN MILLIMETRES
2. 由於有被動土壓力的幫助,地下止推座相對細小
   WITH THE PASSIVE EARTH PRESSURE, THE SIZE OF UNDERGROUND THRUST BLOCK IS RELATIVELY SMALLER

版 no.	日期 date	修改項目 description	簡簽 initial

圖則名稱 drawing title

在東涌及小蠔灣之間增建一條加壓污水管及修復現有加壓污水管
- 不同加壓污水管設計方案圖
CONSTRUCTION OF ADDITIONAL SEWAGE RISING MAIN AND REHABILITATION OF THE EXISTING SEWAGE RISING MAIN BETWEEN TUNG CHUNG AND SIU HO WAN
- SCHEMATIC DRAWING OF ALTERNATIVE SEWAGE RISING MAIN DESIGNS

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批核 approved: Ir W. F. WONG	日期 date	
部門 office: 顧問工程管理部 CONSULTANTS MANAGEMENT DIVISION		

香港特別行政區政府渠務署
DRAINAGE SERVICES DEPARTMENT
GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

381DS – Construction of additional sewage rising main and rehabilitation of the existing sewage rising main between Tung Chung and Siu Ho Wan

Breakdown of estimates for consultants' fees and resident site staff costs (in September 2015 prices)

			Estimated man-months	Average MPS* salary point	Multiplier (Note 1)	Estimated fee ($ million)
(a)	Consultants' fees for contract administration (Note 2)	Professional	-	-	-	2.0
		Technical	-	-	-	0.6
					Sub-total	2.6
(b)	Resident site staff (RSS) costs (Note 3)	Professional	496	38	1.6	58.9
		Technical	2 500	14	1.6	102.0
					Sub-total	160.9
	Comprising –					
	(i) Consultants' fees for management of RSS				7.1	
	(ii) Remuneration of RSS				153.8	
					Total	**163.5**

* MPS = Master Pay Scale

Notes

1. A multiplier of 1.6 is applied to the average MPS salary point to estimate the cost of RSS supplied by the consultants (as at now, MPS salary point 38 = $74,210 per month and MPS salary point 14 = $25,505 per month).

2. The consultants' staff cost for contract administration is calculated in accordance with the existing consultancy agreement for the design and construction of the project. The construction phase of the assignment will only be executed subject to Finance Committee's approval to upgrade **381DS** to Category A.

3. The actual man-months and actual costs will only be known after the completion of the construction works.