

HARBOUR AREA TREATMENT SCHEME

STAGE 2A

Executive Summary

1. The Harbour Area Treatment Scheme (HATS) is one of the most important environmental protection programmes undertaken in Hong Kong to improve the water quality of Victoria Harbour (hereinafter referred to as the harbour). HATS is an integrated sewerage system for collecting and treating sewage generated from the harbour catchment in an efficient, effective and environmentally sustainable manner. A three-phase implementation strategy is adopted for HATS (i.e. Stages 1, 2A and 2B). HATS Stages 1 and 2A were commissioned in December 2001 and December 2015 respectively, and all sewage generated from the harbour catchment is transferred to the Stonecutters Island Sewage Treatment Works (SCISTW) for centralised chemically-enhanced primary treatment (CEPT) and disinfection before discharging into the harbour. For HATS Stage 2B, there is no firm plan for implementation at present. The Drainage Services Department (DSD) is responsible for the design, construction and operation of HATS. The Environmental Protection Department (EPD) is responsible for planning HATS and monitoring the marine water quality. The Environment Bureau (ENB) is responsible for overseeing the provision of sewerage and sewage treatment services by DSD and EPD.

2. Between December 2005 and April 2010, the Finance Committee (FC) of the Legislative Council and the Secretary for Financial Services and the Treasury (under delegated authority from FC) approved funding of \$17,591.7 million in total for the investigations, detailed design and construction of HATS Stage 2A. The construction of HATS Stage 2A commenced in April 2008 and was implemented through awarding 14 works contracts (Contracts A to N). The design and construction supervision work of HATS Stage 2A were conducted under Consultancy X (for Contracts A to C by Consultant X) and Consultancy Y (for Contracts D to N by Consultant Y). After the substantial completion of the main works, HATS Stage 2A was commissioned in December 2015, which was one year later than the target commissioning date stated in the FC funding papers. As of July 2019, the Government had incurred \$16,868.7 million for HATS Stage 2A. According to ENB and EPD, after the commissioning of HATS Stage 2A, the water quality of the harbour has shown further improvement. The Audit Commission

Executive Summary

(Audit) has recently conducted a review to examine the Government's work in managing the implementation of HATS Stage 2A.

Construction of sewage conveyance system

3. The sewage conveyance system (SCS) under HATS Stage 2A comprises a network of: (a) vertical shafts for collecting sewage from the existing eight preliminary treatment works (PTWs) at the northern and south-western parts of Hong Kong Island; and (b) deep sewage tunnels for conveying the collected sewage to SCISTW. Contracts A to C (which had been completed with accounts finalised at a total final contract sum of \$7,151 million) covered the construction of SCS (paras. 1.5, 2.2 and 2.3).

4. *Works items in tenderers' design were omitted in the Bills of Quantities (BQ).* Audit examination revealed that works items (involving temporary works) in tenderers' design were omitted in the respective BQ of Contracts A and B. In the course of subsequent contract administration of Contracts A and B, omissions of BQ items were claimed by the pertinent contractors and assessed by Consultant X, leading to payments of \$188.8 million to Contractor A and \$177.4 million to Contractor B for carrying out the works of the related omitted items. According to DSD, while a Technical Circular (prevailing at the time of tender invitations for Contracts A and B in December 2008) required that a tenderer's design should be priced as a lump sum item included in BQ, it was only applicable to permanent works but not "works of a short limited lifespan or temporary in nature" (which were subsequently included in the latest version of the Technical Circular in 2014). In Audit's view, in implementing a works project in future, DSD needs to include works items in a tenderer's design as a lump sum item in BQ (paras. 2.9 to 2.11).

5. *Need to critically check the completeness of BQ items.* According to Contract A, for the purposes of measurement of excavation in shafts, three types of excavated materials were defined in contract clauses and separate items should be provided in BQ for different types of excavated materials. However, under BQ of Contract A, items were provided for two of the three types of excavated materials. Consultant X assessed that the remaining type of excavated material was omitted in BQ. In the event, DSD paid \$68.5 million to Contractor A for carrying out the works of the omitted items. According to DSD, since November 2015, it has required an independent checking of BQ of its works contracts. In Audit's view, in implementing

Executive Summary

a works project in future, DSD needs to continue to make efforts to strengthen checking of BQ for ensuring the completeness and accuracy of BQ (paras. 2.13 to 2.16).

6. *Scope for better ascertaining the presence of government structures in the vicinity of the works sites before inviting tenders.* Audit examination revealed that, under Contract B, some government structures (an existing trunk sewer and an abandoned underground reinforced concrete structure of DSD) in the vicinity of the works sites for constructing a shaft were identified after contract award. Audit noted that: (a) at the design stage, Consultant X requested as-built drawings of structures near the shaft locations from DSD. However, DSD was unable to provide as-built drawings showing that the abovementioned underground structures existed at the works sites; and (b) after Contractor B encountered the underground reinforced concrete structure, Consultant X tried to obtain the then as-built drawings of that structure from DSD again and discovered that such drawings were kept in the records of DSD. In the event, extensions of time (EOTs) ranging from 95 to 411.5 days were granted for completion of various sections of works under Contract B, leading to prolongation costs of \$323.3 million. In this connection, for Contracts I, L and M, Audit also noted similar issues relating to variations to the works due to the identification of government structures in the vicinity of the works sites after contract awards, resulting in significant prolongation costs and EOTs granted (paras. 2.20 and 2.21).

7. *Scope for enhancing pre-tender site investigations.* The works under Contract C, covering the construction of deep sewage tunnels by a relatively new construction method at that time, commenced in August 2009 and were completed in May 2014, about 33 months (1,004 days) later than the original completion date of August 2011 (of which 130 days were due to inclement weather). Audit noted that the delays were mainly due to adverse ground conditions undetected in pre-tender site investigations, leading to granting of EOTs of 741 days for completing each of two sections of works under Contract C (para. 2.24).

Expansion and upgrading of Stonecutters Island Sewage Treatment Works

8. SCISTW (constructed under HATS Stage 1) was expanded and upgraded under HATS Stage 2A to increase its design daily treatment capacity and to provide

Executive Summary

disinfection facilities. DSD awarded eight works contracts (Contracts D to K) for the related works. Except Contract K which was awarded in July 2019 with scheduled contract completion date of May 2021, all the other seven works contracts (Contracts D to J) had been completed with a total expenditure of \$6,286.8 million as of July 2019 (paras. 3.2 and 3.3).

9. ***Need to draw on the experience gained in design changes of deodourisation (DO) facilities.*** Under Contract H, Contractor H was required to construct DO facilities at SCISTW. There were design changes of DO facilities during the construction stage of Contract H, including: (a) construction of double door enclosure systems for two buildings for handling sludge to enable better odour control; and (b) approval of Contractor H's cost saving design for reducing odour loading from the two buildings and issuing a variation order (VO) which included constructing two additional DO units adopting a more environmentally friendly DO system for serving the two buildings (with an estimated saving of about \$49.5 million for recurrent cost over the design life of 15 years). According to DSD, the DO design was progressively made more cost effective. Audit considers that DSD needs to draw on the experience gained in design changes of DO facilities at SCISTW to further improve the design of DO facilities for sewage treatment works in future (paras. 3.8 to 3.11).

10. ***Need to continue to make efforts to monitor the odour situation and tackle the odour issue at SCISTW.*** To ensure no adverse air quality impact to the air sensitive receivers, in December 2014, DSD engaged Consultant Y to conduct an odour study for enhancing the odour management at SCISTW. In July 2017, the odour study was completed. Consultant Y found that certain odour sources at SCISTW had emitted high hydrogen sulphide (often highlighted as the indication of odour from sewage treatment works) levels as compared to the specified design requirements of the DO facilities and proposed further enhancement works to the existing DO facilities at SCISTW to cater for the worst case scenario. As it transpired, in July 2019, DSD awarded Contract K at a contract sum of \$169 million for carrying out further odour reduction measures at SCISTW with a view to mitigating potential odour nuisance to the surrounding air sensitive receivers in future. Audit noted that odour emission from SCISTW was the main environmental concern during the operation phase and odour issue was complicated due to its dynamic and transient nature. In Audit's view, DSD needs to continue to make efforts to monitor the odour situation and tackle the odour issue at SCISTW (paras. 3.7, 3.12 to 3.15 and 3.17).

Executive Summary

11. *Scope for better assessing the ground conditions of existing structures before inviting tenders.* The Dilution Water Pumping Station (DWPS), an underground reinforced concrete structure built under HATS Stage 1 to serve the CEPT process, was a key facility of SCISTW resting on reclaimed fill materials without any piling support and there was little provision in the DWPS design to accommodate excessive settlement. During the construction stage of Contract F, DWPS had undergone more-than-expected settlement. In order to safeguard DWPS from further settlement and to provide long term stability and integrity of DWPS, Consultant Y issued a VO (later valued at a cost of \$9.5 million) to Contractor F for carrying out permanent stabilisation works for DWPS. In Audit's view, in implementing a works project in future, DSD and its consultants need to take further measures to better assess the ground conditions of existing structures before inviting tenders with a view to further mitigating the impact of construction works causing settlement of such structures as far as practicable (paras. 3.21 to 3.24).

12. *Scope for better ascertaining the presence of underground utilities and buried underground structures in the vicinity of the works sites.* After the commencement of Contract G, DSD conducted a comprehensive review of the original design of the Centrate Pipe Return System and then modified the design so as to further enhance its functionality and performance with due regard to the site constraints and the evolving operation needs. Notwithstanding that examination of all available site records for existing underground utilities and structures had been conducted at the design stage and site constraints had been considered when modifying the design of the system, during the excavation works, Contractor G encountered various uncharted underground utilities including cable ducts and other unforeseeable underground obstructions (e.g. sheet piles) which caused delay to the progress of works. In the event, EOTs of 88 days were granted for completion of a section of works, leading to prolongation costs of \$16.4 million. Audit considers that, in implementing a works project in future, there is scope for better ascertaining the presence of underground utilities and structures in the vicinity of the works sites (paras. 3.25 and 3.26).

Upgrading of preliminary treatment works

13. Sewage is preliminarily treated at PTWs to remove large solids and grits to avoid deposition in the deep sewage tunnels and to protect downstream facilities from damage or blockage. The existing eight PTWs at the northern and south-western parts of Hong Kong Island were upgraded to cater for the technical requirements of HATS Stage 2A as well as future development and population growth of the

Executive Summary

respective districts. Contracts L to N (which had been completed with a total expenditure of \$1,546.2 million as of July 2019) covered mainly the upgrading works for the eight PTWs (paras. 4.2 and 4.3).

14. *Delays in handover of works sites and completed civil works.* Before carrying out the upgrading works at PTWs under Contracts L and M, certain portions of works sites or completed civil works were required to be handed over from contractors responsible for the construction works of SCS under Contracts A to C. The late handover of works sites and completed civil works (partly due to inclement weather) from Contractor A to Contractor L and the late handover of works sites (partly due to inclement weather) from Contractors B and C to Contractor M consequentially resulted in: (a) EOTs ranging from 196 to 496 days for completing three sections of works and prolongation costs totalling \$56.2 million granted under Contract L; and (b) EOTs of 272 and 542 days respectively for completing two sections of works and prolongation costs totalling \$56.4 million granted under Contract M (para. 4.5).

15. *Need to notify appropriate higher-rank approving officer of the reasons for cost increase of contract variations as appropriate.* According to DSD's Technical Circular, after a proposed variation has been approved by an approving officer, if it is anticipated that the estimated net value of the proposed variation will for reasons other than change in scope increase to the extent of exceeding the approval limit of that approving officer, then the appropriate higher-rank approving officer shall be notified with explanations of such increase as soon as it is known. As far as could be ascertained, for 5 VOs under Contract L (with an estimated cost of less than \$0.3 million each and issued by Consultant Y within its financial authority), the up-to-date costs as of July 2019 exceeded the estimated costs by 130% to 969%. Audit noted that the up-to-date costs for the 5 VOs exceeded the financial authority (i.e. \$0.3 million) of Consultant Y. However, DSD had no documentation showing that the appropriate higher-rank approving officer had been notified of reasons for the cost increase of the 5 VOs (paras. 4.12 to 4.14).

Executive Summary

Audit recommendations

16. Audit recommendations are made in the respective sections of this Audit Report. Only the key ones are highlighted in this Executive Summary. Audit has *recommended* that the Director of Drainage Services should:

Construction of SCS

- (a) in implementing a works project in future:
 - (i) include works items in a tenderer's design as a lump sum item in BQ (para. 2.17(a));
 - (ii) continue to make efforts to strengthen checking of BQ for ensuring the completeness and accuracy of BQ (para. 2.17(b)); and
 - (iii) better ascertain the presence of government structures in the vicinity of the works sites before inviting tenders (para. 2.31(a));
- (b) when implementing a works contract involving tunnelling works in future, further enhance pre-tender site investigations with a view to providing better information on site conditions as far as practicable (para. 2.31(b));

Expansion and upgrading of SCISTW

- (c) draw on the experience gained in design changes of DO facilities at SCISTW to further improve the design of DO facilities for sewage treatment works in future (para. 3.18(a));
- (d) continue to make efforts to monitor the odour situation and tackle the odour issue at SCISTW (para. 3.18(b));
- (e) in implementing a works project in future:

Executive Summary

- (i) **take further measures to better assess the ground conditions of existing structures before inviting tenders (para. 3.27(a)); and**
- (ii) **better ascertain the presence of underground utilities and buried underground structures in the vicinity of the works sites (para. 3.27(b));**

Upgrading of PTWs

- (f) **in implementing a multi-contract works project in future, consider taking further measures as appropriate to better minimise the impact arising from delays in handover of works sites and completed civil works between the contractors (para. 4.9); and**
- (g) **in implementing a works project in future, take measures to ensure compliance with the requirements relating to notifying the appropriate higher-rank approving officer with explanations of cost increase of contract variations (para. 4.16).**

Response from the Government

17. The Director of Drainage Services agrees with the audit recommendations.