Task Force on Water-land Interface

For discussion
on 24 October 2016

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Harbour Area Treatment Scheme Stage 2A

PURPOSE

This paper provides an overview of the Harbour Area Treatment Scheme Stage 2A project and its benefits to Victoria Harbour.

WHAT IS HARBOUR AREA TREATMENT SCHEME (HATS)?

2. To improve the water quality of Victoria Harbour, the Harbour Area Treatment Scheme (HATS), formerly known as Strategic Sewage Disposal Scheme, was launched in late 1980's and was implemented in stages to provide treatment for the sewage collected from the urban areas on both sides of the Harbour. Stage 1 and Stage 2A of this world-class environmental infrastructure project are now in operation.

Figure 1 – HATS Timeline

3. HATS Stage 1 costs $8.2 billion and comprised the construction of Stonecutters Island Sewage Treatment Works (SCISTW) and 23.6km of deep tunnels for treating sewage collected from Kowloon, Kwai Tsing, Tseung Kwan O and north-eastern Hong Kong Island. The project commenced in 1994 and was commissioned in December 2001 providing treatment to 75% of sewage from both sides of the Harbour.

4. Figure 2 shows the SCISTW in 2001 and was widely recognised as one of the largest and most efficient Chemically Enhanced Primary Treatment (CEPT) plants in the world with a design capacity of 1.7 million cubic metres per day.

Figure 2 – Stonecutters Island Sewage Treatment Works in 2001

5. HATS Stage 2A provides treatment to the remaining 25% of sewage from the northern and south-western parts of Hong Kong Island. The works include:-

- Upgrade 8 preliminary treatment works (PTW) in northern and south-western parts of Hong Kong Island
- Construct 21km long of deep sewage tunnels to SCISTW
- Upgrade SCISTW and add disinfection facilities

6. Stage 2A commenced in 2009 and was commissioned in end 2015. It costs $17.5 billion and together with Stage 1, HATS can treat 2.45 million cubic metres sewage per day, equivalent to the volume of 1,000 nos. standard Olympic swimming pools per day. The full commissioning of HATS helps to enable the sustainable development of the harbour area and also allows the public to better enjoy Victoria Harbour with improved water quality.

Figure 3 – HATS Overall Scheme

BENEFITS OF HATS

7. Upon the commissioning of HATS 1 and Stage 2A, it stops sewage from being directly discharged into Victoria Harbour and southwestern parts of Hong Kong Island by means of proper

collection and treatment, hence greatly improved the water quality of the Harbour:

- Remove 70% of Biochemical Oxygen Demand (BOD), 80% of Suspended Solids (SS) and over 99% of E.coli from sewage before discharge
- Increase Dissolved Oxygen (DO) of the Harbour by 13%
- HATS stage 1 reduced the E.*coli* level in the Harbour by 50%, and HATS stage 2A further reduced the E.*coli* level by 75%

8. Besides, the commissioning of HATS also helps to maintain a healthier marine environment whilst meeting future development needs. With an improved water quality, the cross-harbour swimming race was resumed since 2011. Tsuen Wan beaches which were closed in the past are all re-opened.

Figure 4 – Resumption of Cross-Harbour Swimming Race

IMPLEMENTATION OF HATS STAGE 2A

How is the sewage treated in HATS 2A?

9. HATS Stage 2A collects sewage from catchments located at the northern and southwestern parts of Hong Kong Island. The

sewage within these catchment areas is first collected by the 8 newly upgraded Preliminary Treatment Works (PTWs) along the coast for preliminary treatment, i.e. with only screening and degritting, and then it is conveyed to SCISTW via the deep sewage tunnels. Sewage will receive Chemically Enhanced Primary Treatment (CEPT) at SCISTW and finally undergoes disinfection to remove over 99% *E. Coli.* in sewage. The treated effluent is then discharged to Western part of Victoria Harbour.

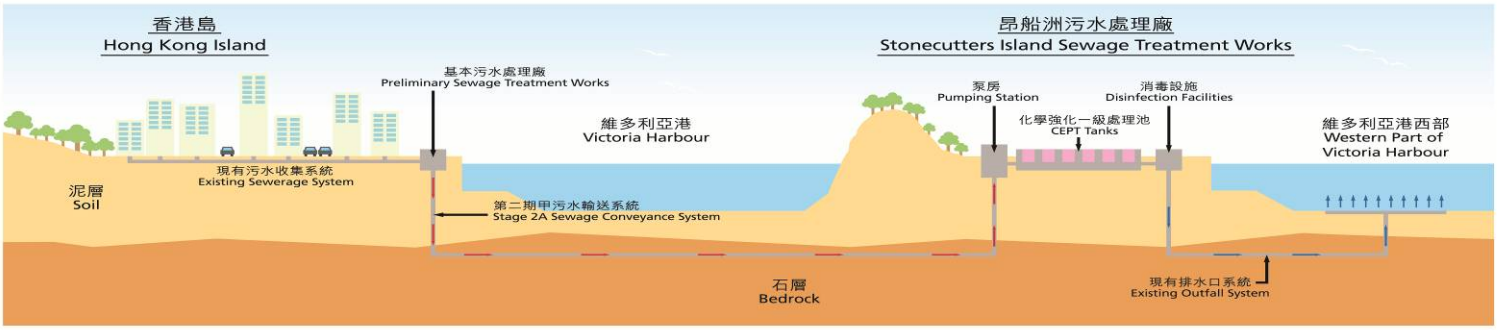

Figure 5 – Sewage treatment under HATS 2A

Sewage Conveyance System

10. A network of 21 km long deep tunnels was constructed as the sewage conveyance system to collect and convey sewage from the eight PTWs to the SCISTW. Figure 6 shows the alignment of the deep tunnels and the locations of the 8 PTWs.

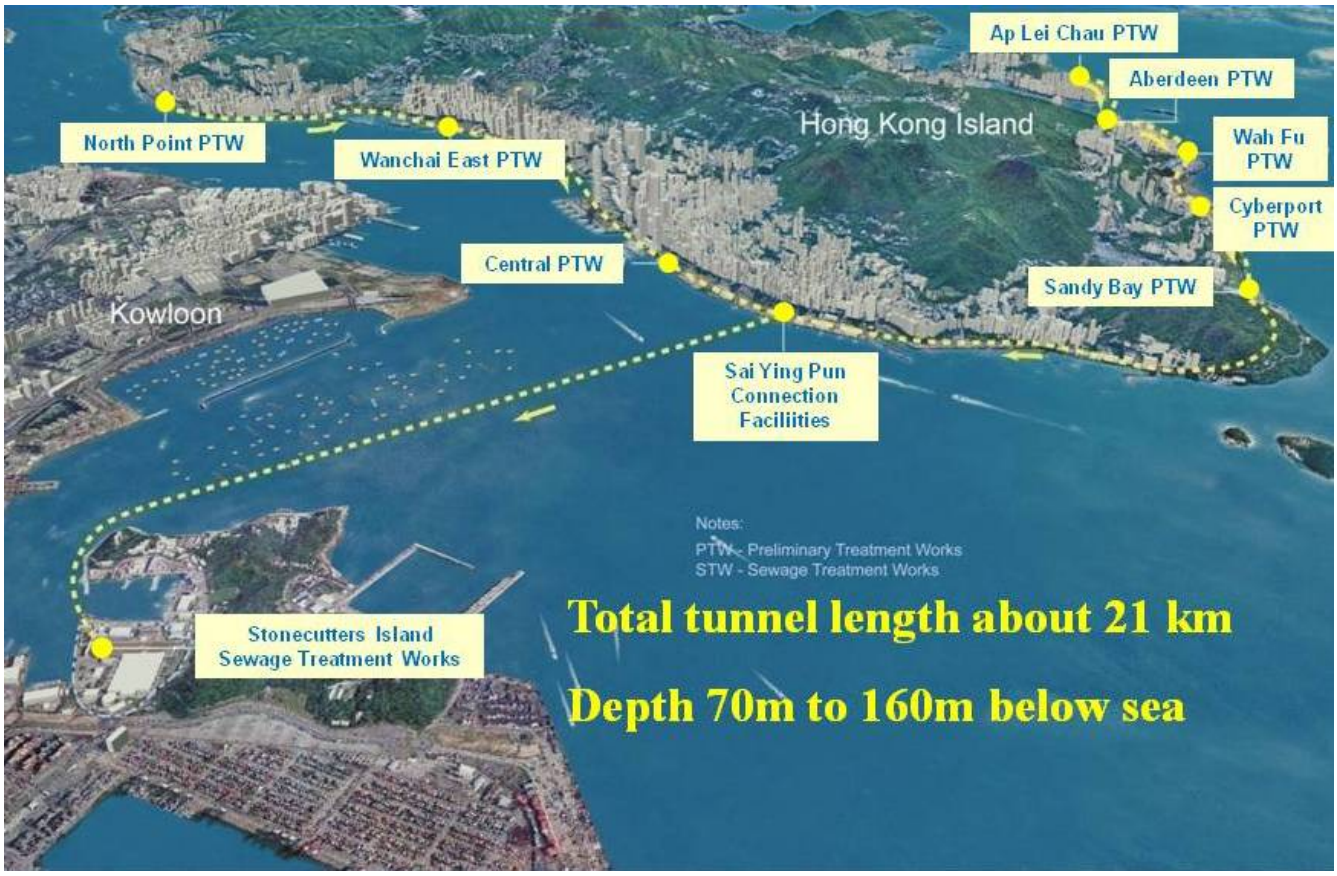

Figure 6 – Alignment of the Deep Tunnels under HATS Stage 2A

11. At the planning stage, various options for the design of the conveyance systems, such as deep tunnel, shallow tunnel or open cut method of construction were investigated. In order to minimize the disruption to the public, possible conflicts with utilities and building foundations, MTR tunnels, programme risks and constraints on future development, the deep tunnel option was finally adopted. The tunnels were constructed in hard rock with 30m rock cover. The depths of the tunnels range from about 70m to 160m below sea level with the deepest section at the upstream end at North Point.

12. Critical review had also been conducted on the tunnel construction method. It was considered that drill and blast method would effectively and efficiently limit groundwater inflows, which could be under very high pressure up to 16 bar in HATS's case, by

pre-excavation grouting. It also allowed maximum flexibility for installing different kinds of temporary ground supports to stabilize difficult geological conditions such as fault zones and fractured ground.

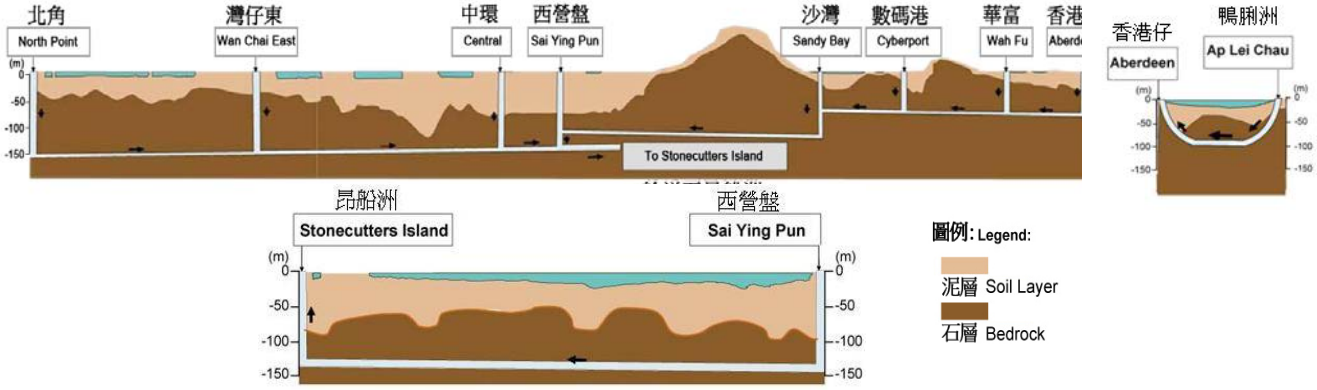

Figure 7 – Vertical Profile of Deep Tunnels

Upgrading of SCISTW

13. The SCISTW was upgraded with a new main pumping station (MPS), eight new sedimentation tanks, an effluent tunnel and disinfection facilities. The upgrading also includes the provision of covers and deodourization units (DOU) to all CEPT tanks. SCISTW is the World's largest CEPT plant.

<u>New Main Pumping Station (MPS2)</u>

14. MPS2 is one of the World's largest underground sewage pumping stations. The MPS2 is circular in shape, with an internal diameter of 55m and depth of 40m. 8 sets of mega size sewage pumps have been installed inside MPS2. Each pump has a capacity of 4m^3/s. The combined design capacity of the 8 pumps can fill up a standard swimming pool in about 1 minute.

Figure 8 – New Main Pumping Station

Figure 9 – Pump No.7 inside MPS2

Sedimentation Tanks

15. The sewage entering the system is pumped to the sedimentation tanks at which ferric chloride is added for CEPT. SCISTW adopts a space-saving, double-tray sedimentation tanks design to reduce its footprint. The total footprint of SCISTW is only 10 ha (about half of the size of Victoria Park) but can serve up to 5.7 million people.

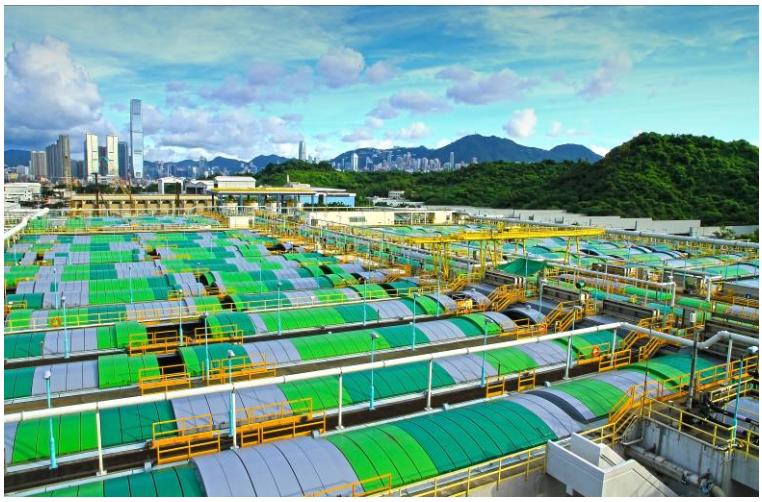

Figure 10 – CEPT in SCISTW

Dedicated sludge transport facilities

16. Sludge treatment is an important feature of a CEPT plant. Under HATS Stage 2A, two dedicated marine vessels were built (namely "Clean Harbour 1" and "Clean Harbour 2"). Sludge is first dewatered, stored in silos, unloaded into containers and transported via the two dedicated marine vessels from the treatment works to the Western New Territories (WENT) landfill reception area, where the sludge cake is taken to be incinerated at the T-Park (sludge treatment facility at Tuen Mun Nim Wan). A system using a gantry crane on the vessel was adopted to maximise the lay-down and manoeuvring areas at the SCISTW. A key environmental benefit for marine transportation of sludge is that it minimises land-based traffic and potential odour nuisance.

Figure 11 – Clean Harbour 1

Disinfection Facilities

17. The effluent tunnel and disinfection facilities are an integral system under HATS Stage 2A. Disinfection is by means of chlorination. The scheme, as shown in Figure 12, comprises an 8.5m diameter and 880m long effluent tunnel at 90m below ground to convey the effluent from the SCISTW to the submarine outfall and at the same time provides sufficient retention time for disinfection to reduce over 99% of *E. Coli.* The effluent then undergoes a dechlorination process to neutralize the residual chlorine, before discharging to the waters southwest of Stonecutters Island.

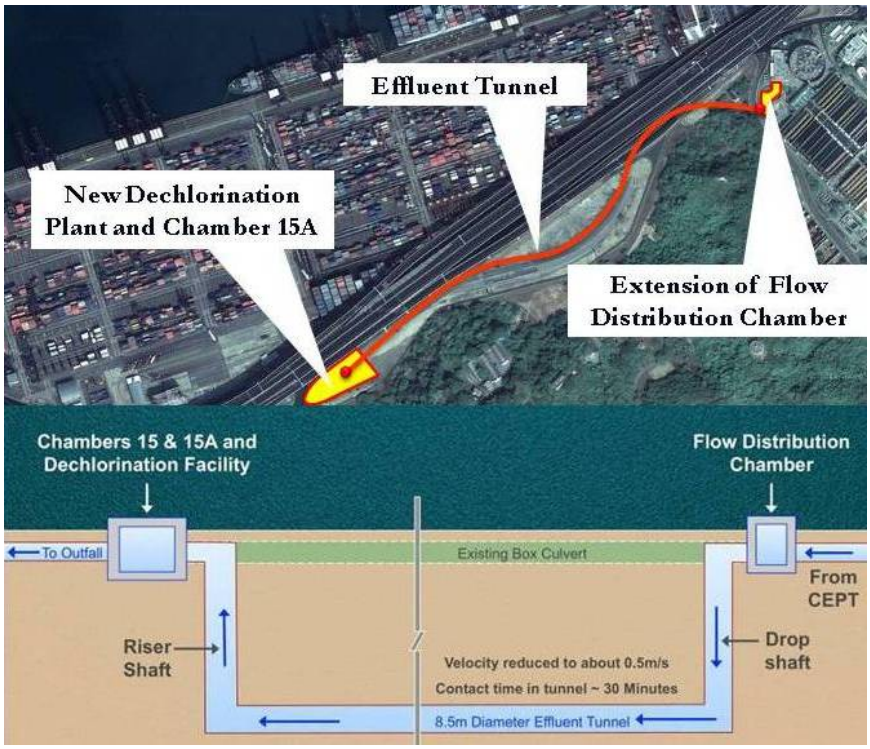

Figure 12 – Effluent Tunnel and Disinfection Facilities

Odour Control Enhancement

18. Odour control is always given a high priority in the operation of a sewage treatment works. Opportunity was hence taken to enhance odour control during the upgrading of SCISTW. All potentially odorous facilities at SCISTW, including the pumping stations, sludge dewatering buildings, sludge cake silos, sedimentation tanks, etc. are enclosed to ensure that the odour is contained inside the facilities. The odorous gas inside the enclosures is extracted and ducted to designated deodourization facilities to undergo treatment before discharge.

Figure 13 – Odour Control Enhancement

Greening and Beautification under HATS Stage 2A

19. In addition to providing a cleaner Victoria Harbour under the HATS Stage 2A, it also endeavours to include substantial greening and beautification measures despite the congested sites of the SCISTW and the PTWs to enhance the living environment for our neighbours. These include vertical and roof greening, and a well-considered outlook of the facilities to allow a better blend with the environment.

Figure 14 – Photomontage for the Future SCISTW upon completion of the Upgrading Works

Figure 15 – Photomontage of upgraded Wan Chai PTW

CONCLUSION

20. HATS is a major initiative of the Government to provide a cleaner Victoria Harbour. It intercepts, conveys and treats all sewage from both sides of the Harbour in an efficient, effective and environmentally sustainable manner. The full commissioning of HATS helps to enable the sustainable development of the harbour areas and also allows the public to better enjoy Victoria Harbour with improved water quality.

Drainage Services Department
October 2016