Enclosure 1

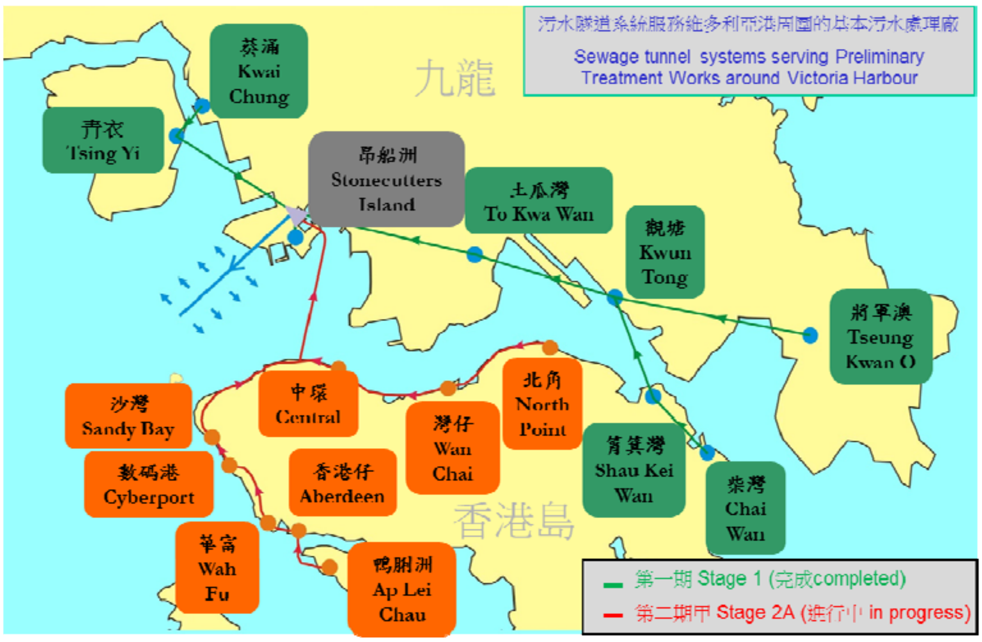
Harbour Area Treatment Scheme

<u>Background</u>

The Harbour Area Treatment Scheme (HATS) involves the implementation of an integrated sewerage system for collecting and treating sewage generated around the Victoria Harbour in an efficient, effective and environmentally sustainable manner.

2. Construction of HATS Stage 1 commenced in early 1995 and was completed in 2001. Sewage generated from Tsuen Wan, Kwai Tsing, Tseung Kwan O, Kowloon and north-eastern Hong Kong Island is collected for treatment at the Stonecutters Island Sewage Treatment Works (SCISTW). HATS Stage 1 now collects 1.4 million cubic metres (m^3) of sewage each day (representing about 75% of the total sewage generated from the harbour catchment) to the SCISTW via deep tunnels for centralised treatment before disposal. The SCISTW is one of the most efficient chemical treatment plants in the world, removing 70% of the organic pollutants, 80% of the suspended solids and 50% of *E.coli*. This has resulted in significant improvement in the marine environment.

3. The remaining 450,000 m^3 of sewage currently generated within the areas from North Point to Ap Lei Chau which is not handled by HATS Stage 1 (i.e. the remaining 25%) would be collected and transferred to the expanded SCISTW for centralised treatment under Stage 2A. For HATS Stage 2B, an underground biological treatment facility is proposed at a site adjacent to the existing SCISTW.



Current state of water quality of Victoria Harbour

4. For the Victoria Harbour Water Control Zone, the compliance rate with the relevant Water Quality Objectives (WQOs) in 2013 was 83%. Non-compliance was mainly found with regard to the Total Inorganic Nitrogen (TIN) and Dissolved Oxygen objectives at some monitoring stations. The TIN compliance rate of the Victoria Harbour WCZ was 60% in 2013. This could be due to a higher background TIN level under the influence of Pearl River discharge (as reflected in the increase in TIN levels at many stations in the north-western and southern waters of Hong Kong), the year-to-year normal range of fluctuation of the discharge from surface run-offs, and the untreated sewage discharged from the four preliminary treatment works (PTW) located between North Point and Central. After the commissioning of HATS Stage 2A, the pollution load to Victoria Harbour will be further reduced when sewage from the above mentioned PTWs is collected for treatment at the SCISTW.

5 The DO compliance rate of the Victoria Harbour WCZ was 90% in 2013. The DO level in a water body can be affected by organic pollution as well as natural factors such as temperature [1] and stratification [2] of the water column. Since the monitoring data, on the basis of parameters such as organic nitrogen and 5-day Biochemical Oxygen Demand, did not show any obvious sign of an increase in organic pollution in the harbour waters in 2013, the 10% non-compliance rate with the DO objective was likely related to the occasional hot weather experienced during the summer months.

Water quality improvements of implementing HATS

6. After commissioning HATS Stage 2A, the bulk of Victoria Harbour will comply with the applicable WQOs such as Dissolved Oxygen (DO) and Un-ionised Ammonia (UIA).

WQOs	HATS Stage 1	HATS Stage 2A
DO	Increased by10%	Further increased by 3%
UIA	Reduced by 31%	Further reduced by 12%
TIN	Reduced by16%	Further reduced by 7%

7. The additional benefits brought about by the implementation of HATS Stage 2B to the water quality of Victoria Harbour are that the level of

1 Solubility of oxygen in water is affected nonlinearly by temperature, and decreases considerably in warm water.

2 In summer, surface run-offs and river outflow increase significantly as a result of heavy rainfall. When the marine water body receives fresh water input from these sources, salinity difference between the upper layer and lower layer of the water body will lead to stratification of the water column. Stratification discourages mixing which in turn affects replenishment of DO in the water body.

DO would be marginally improved and the level of un-ionised ammonia would be reduced. However the level of total inorganic nitrogen would be increased due to the nitrification process of biological treatment.

8. The improvement will mainly be found in the western part of Victoria Harbour / around the HATS outfall area, away from the coastal waters and hence will not result in an obvious improvement of the quality of coastal waters. The residual pollution discharges into the urban coastal waters, i.e. those not collected by our sewerage system due to various factors such as drain misconnections, polluted surface run-offs from streets, etc., and the odour and visual impacts caused by near shore pollution to our urban coastal waters still remain.

Findings and Recommendations of HATS Stage 2B Review

9. The ultimate sewage flow [3] adopted for the design of HATS Stage 2A was 2.44 million m^3/day [4], which is significantly less than the 2.80 million m^3/day sewage flow estimated in 2004 for post 2016 [5]. The HATS Stage 2B Review reveals that the ultimate sewage flow is 2.29 million m^3/day post 2031 [6]. Using the latest population forecast by the Planning Department [7], the projected sewage flow in the HATS catchment in 2036 would be 2.05 million m^3/day. In this regard, HATS Stage 2A has already provided adequate capacity to handle the projected sewage flow well beyond 2036. After commissioning HATS Stage 2A, the bulk of Victoria Harbour will be in compliance with the WQOs, except the water bodies near the SCISTW outfall and the near shore waters. Upgrading the SCISTW treatment level from CEPT to biological treatment will further improve water quality for a couple of the parameters such as unionized ammonia, but it will not result in an observable improvement of the water quality of the bulk of Victoria Harbour. On the other hand, it will cause an increase in total inorganic nitrogen [8], albeit the increase should result in little visual effects on

---

3 Sewage flow is a function of population and economic activity and is made up of flows from housing, industry, commercial activities, schools and other sources.

4 The estimate was made based on the "Year 2030 Planning Data for HATS" provided by the Planning Department with corresponding population forecast of 5.23 million.

5 Post 2016 refers to an unspecified future date reflecting full development of the sewage catchments according to outline zoning plans and land use factors at that time, and has been established as the design horizon for HATS. The corresponding forecast population was 6.27 million.

6 The estimate was made based on the year 2031 population forecast of 5.15 million within the HATS catchment in the 2009-based Territorial Population and Employment Data Matrices (TPEDM), the latest available at the time, plus 5%.

7 The 2011-based TPEDM. The year 2036 population forecast within the HATS catchment is about 4.75 million.

8 The increase in total inorganic nitrogen (TIN) results from the nitrification process in HATS Stage 2B. Scientific research has shown that the TIN level is not a determining factor of the occurrence of red tides. Instead, the implementation of HATS Stage 2B would reduce the phosphorous level in the receiving water and reduce the probability of red tides.

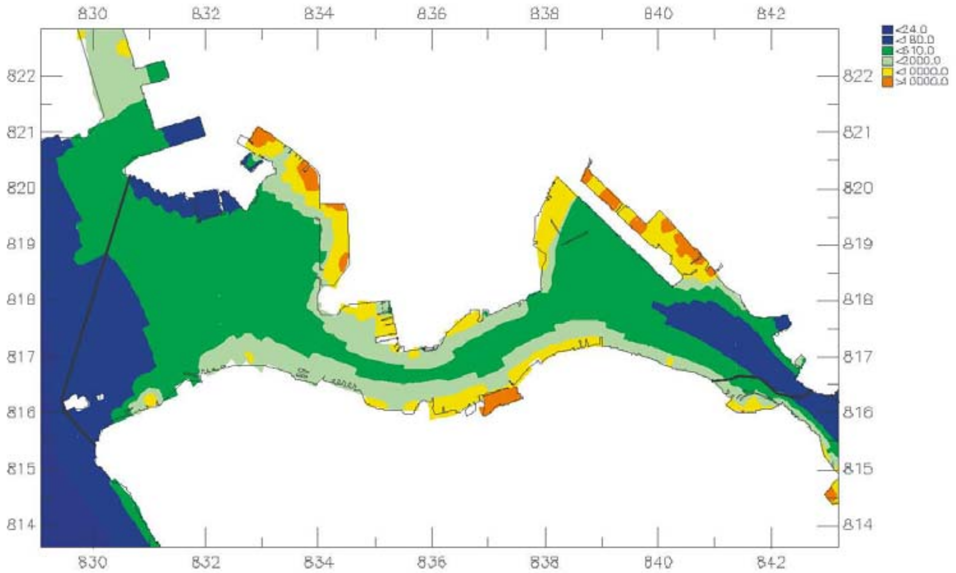
the water quality. The HATS Stage 2B Review thus concludes that in terms of WQO compliance, the implementation of HATS Stage 2B at this stage is not critical.

10. Implementation of HATS Stage 2B which is meant to provide a more advanced level of treatment of sewage collected, however, will not resolve these near shore water quality problems caused by residual pollution discharges from a number of activities in densely populated urban areas into the coastal waters. These discharges originate from various pollution sources, including overland polluted storm water flow and wastewater from mis-connections. **Annex 1** presents in graphical form a preliminary prediction of *E.coli* levels of HATS Stages 2A at ultimate flow, as well as with HATS Stage 2B ultimate flow [9]. The near shore pollution indeed has masked the scene. The difference in near shore *E.coli* levels with HATS Stage 2B is so small that it is not readily observable by comparing the results in graphical form. On the other hand, implementation of HATS Stage 2B will require substantial investment both in terms of capital and operating costs. The estimated 15-year lifecycle cost will range from $41Bn to $44Bn, depending on the sewage treatment technology [10] to be adopted.

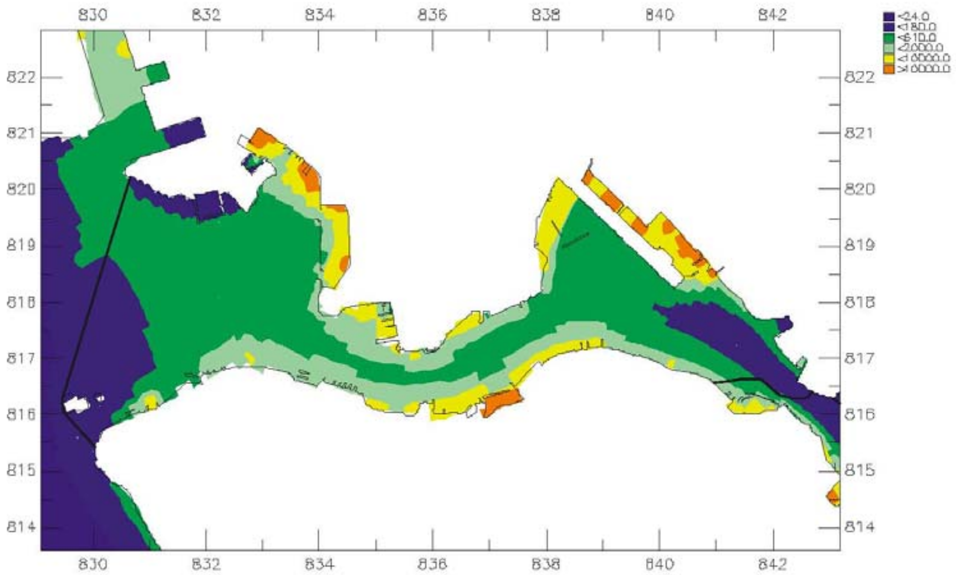
9 Ultimate flow refers to when the concerned sewage treatment works reach the design treatment capacity. Based on latest available population forecast, it would be beyond 2036.

10 The estimates are at 2012 price level. The range of capital and annual operation costs are $22Bn to $30Bn and $1.2Bn to $1.8Bn respectively. The treatment technologies studied under the HATS 2B Review included biological aerated filter, membrane bioreactor and moving bed bioreactor.

***E. coli* level in no./100ml (Annual Geometric Mean Depth Averaged)**
– HATS Stage 2B Review Study



Prediction at Ultimate Flow of HATS Stage 2A



Prediction at Ultimate Flow of Late Phase of HATS Stage 2B

Enclosure 2

Objective indicators for monitoring Victoria Harbour

The removal of aesthetic and odour problems is our target in enhancing quality of the coastal waters. While improvement in aesthetic and, to an even greater extent, odour problems would be difficult to quantify, we will draw reference from relevant indicators of water pollution. For example:

(a) *E.coli.*： *E.coli* level is a common bacterial indicator of water pollution and is counted for compliance with the Water Quality Objective (WQO) for bathing beaches and secondary contact recreation subzones. Though there is no known scientific literature or report to directly link the foul odour detected in environmental water samples with high levels of E.coli, if organic matter such as sewage is discharged into the storm drain system, the anaerobic decomposition of the organic sediments under anoxic (e.g. no-oxygen) condition may generate hydrogen sulphide and hence bad smell, which may be released through openings and manholes of the storm drains, and culvert outlets at the waterfront when the sediments are exposed to air under low tide condition. And, the levels of E.coli in near shore water can indicate whether the “source” of the odour problem detected in a certain area is sewage-related.

(b) Acid Volatile Sulphide (AVS)： To assess whether sea-bed sediment is causing odour, we need to monitor water quality (e.g. water depth, tidal patterns, the level of dissolved oxygen and biochemical oxygen demand, temperature, pH values and other nutrient parameters) and sediment conditions (such as pH values, total organic matters, AVS and other nutrients parameters). If sediments containing organic matters and lots of AVS are found under anoxic condition, and situated in water bodies with unfavourable circumstances (including low dissolved oxygen levels, stagnant water and shallow water), hydrogen sulphide formed by sediments is likely to be released to the air, thus causing odour problems.