



淨化海港計劃第一期 Harbour Area Treatment Scheme Stage I

淨化海港計劃（前稱「策略性污水排放計劃」）是政府為改善維多利亞港水質而推行的一項大型計劃。計劃的第一期包括興建全長23.6公里的深層隧道輸送系統，將每日約130萬立方米的污水，從九龍及港島東北部輸送到昂船洲處理及排放。

「淨化海港計劃」第一期的深層隧道系統已於2001年12月竣工，這不僅是「淨化海港計劃」的一個重要里程碑，亦標誌著香港在工程方面的卓越成就。這些隧道是現時世界上最深的污水隧道，其長度約為地下鐵路港島線長度的兩倍。當整套第一期系統在2002年初經全面測試和啟用後，維港附近大部分人口密集地區產生的污水將會經過妥善處理後才排放出海。該計劃的第一期系統預計能為350萬市民提供所需服務。

The Harbour Area Treatment Scheme (HATS), formerly known as the Strategic Sewage Disposal Scheme (SSDS), is a major Government initiative to improve the water quality in Victoria Harbour. HATS Stage I consists of a 23.6km-long tunnel conveyance system for transferring 1.3 million cubic metres of sewage each day, from Kowloon and the northeastern part of Hong Kong Island, to Stonecutters Island for treatment and dispersion.

Completion of the HATS Stage I deep tunnel system in December 2001 is not only a major milestone in the HATS project, but also represents one of the most remarkable engineering achievements ever carried out in Hong Kong. These tunnels are the world's deepest sewage tunnels and have a length of about twice that of the Mass Transit Railway line on Hong Kong Island. When the entire Stage I system is fully tested and commissioned in early 2002, sewage from the most densely populated areas around the Harbour will receive proper treatment before disposal. Stage I of the Scheme is designed to serve a population of 3.5 million people.



渠務署
Drainage
Services
Department

“我們的抱負” 建立達致國際水平的雨水和污水排放系統，及污水處理設施，以保障市民的健康和安全。
“Our Vision” to develop and maintain world-class drainage and sewerage systems, and sewage treatment and disposal facilities to keep our community healthy and safe

第一期工程於1994年4月展開，當中涉及非常專門的工程技術。全部工程共分成15項工程合約進行，讓本地及海外具備有關專門技術的承建商均可參與。昂船洲化學強化一級污水處理廠已於1997年5月建成並投入服務，處理西北九龍地區的污水。因成效顯著，該廠被譽為世界上採用化學強化一級污水處理程序最具效率的設施之一。

Construction of the Stage I works, which demanded a high degree of engineering expertise, commenced in April 1994. Works were packaged into 15 works contracts to enable participation of both local and overseas contractors with the required specialist skills. The chemically enhanced primary treatment (CEPT) plant at Stonecutters Island was completed and put into operation for treating sewage flows from the North West Kowloon areas in May 1997. It has since shown excellent performance, being recognised as one of the world's most efficient facilities that adopt the CEPT process.



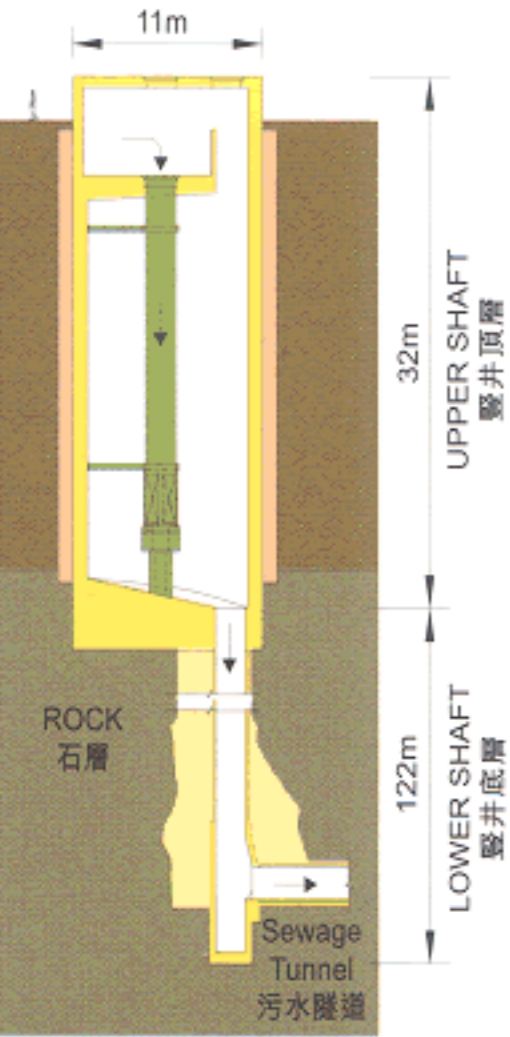
第一期計劃污水集水區
Stage I Catchment

Shau Kei Wan on Hong Kong Island, is first directed to 7 preliminary treatment works (PTWs) all located along the harbour front. These PTWs, in existence for many years, have been modernised under the HATS to provide a high standard of performance in removing grit and large solids before the sewage enters the deep tunnels. A great deal of effort and co-ordination was needed during the upgrading process to ensure the proper functioning of these PTWs at all times.

輸送污水往昂船洲 **Conveying Sewage to Stonecutters Island**

污水由基本污水處理廠內的豎井進入污水隧道，並被輸送往昂船洲處理。選用深層隧道輸送系統，除了可選擇最短的路線外，更重要的是要減低施工期間對公眾、環境、交通、現有公用設施、運輸系統及建築物所造成的影響和滋擾。

Sewage is conveyed through a series of shafts and tunnels from the PTWs to Stonecutters Island for treatment. The deep tunnel conveyance system was adopted to allow the shortest route to be chosen and, more importantly, to minimise the disturbance and nuisance to the public, the environment, traffic, existing utilities, transport systems and buildings during construction.



傾卸豎井切面圖
Typical Dropshaft Section

收集污水 **Collecting Sewage**

第一期的污水集水區在九龍方面由將軍澳伸延至青衣，香港島則由柴灣伸延至筲箕灣。集水區內的污水會先被輸送到7個沿岸的基本污水處理廠。這些使用多年的廠房，已在「淨化海港計劃」下完成改善工程，以提高其在污水排入深層隧道前把砂礫及較大固體去除的效能。在施工期間，我們投入了大量的協調工作，以確保這些基本污水處理廠能於改善工程進行的同時維持正常運作。

Raw sewage from the Stage I catchment, which extends from Tseung Kwan O to Tsing Yi in Kowloon and from Chai Wan to



位於柴灣的現代化基本污水處理廠
Modernised PTW at Chai Wan



已完成的豎井
Inside of Finished Shaft



在狹窄的隧道鑽挖機空間工作
Working around TBM



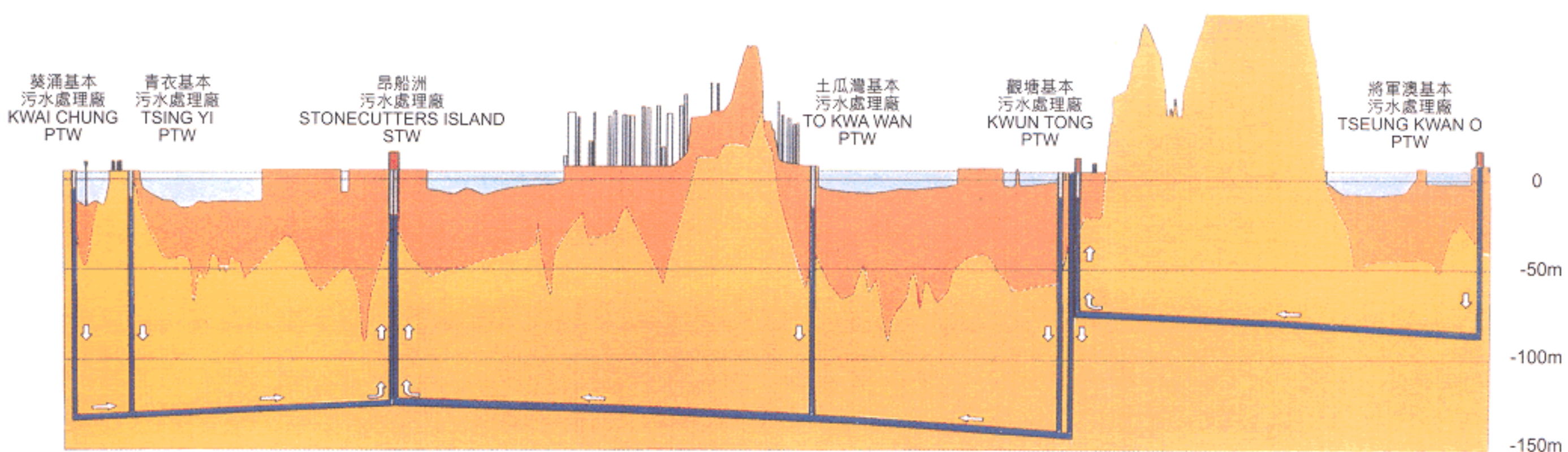
清洗完成後的隧道
Cleaning Completed Tunnel



第一期隧道示意圖 Layout of Stage I Tunnels

全長23.6公里，直徑介乎1.2米至3.5米之間的污水輸送隧道現已完成。這些隧道建於地底下深達150米(大約相等於50層高的大廈)的石層中，並由不少於30米的石層覆蓋著。除了葵涌至青衣之間一段較短的隧道以爆破方法挖掘外，其他的隧道均以隧道鑽挖機挖掘而成。挖掘完成後的豎井及隧道均以混凝土鋪上襯層，以提高系統的水力效率，同時避免污水中的沉積物在隧道內積聚。

A total of 23.6km of sewage tunnels, with diameters ranging from 1.2m to 3.5m, have been formed at depths of up to 150m (about equal to the height of a 50-storey building). There is a minimum of 30m of sound rock above the tunnel crown. The tunnels were excavated using hard rock tunnel boring machines, except for the short length between Kwai Chung and Tsing Yi where the drill and blast method was employed. The finished shafts and tunnels have been fully lined with concrete to enhance hydraulic efficiency of the system and at the same time prevent progressive deposition of sediments within the tunnels during operation.



沿隧道路線的切面圖 Longitudinal Section along Tunnels

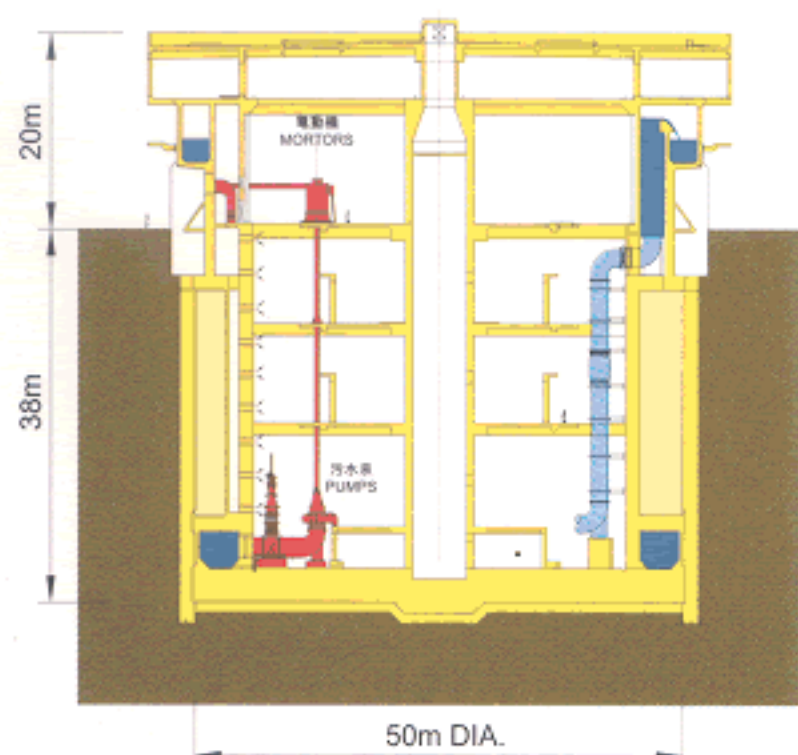
建造這些隧道的工程極富挑戰性。其中以貫穿多個斷層帶及橫過九龍半島的市區、地下鐵路系統(共經過6個位置)、東區海底隧道及葵涌貨櫃碼頭地底的隧道挖掘工程最為艱巨。所有的困難現已成功克服，而整個污水隧道輸送系統亦於2001年12月完成，並逐步進行測試，投入服務。



貫穿隧道的隧道鑽挖機
Breakthrough of Tunnel by TBM

Construction of these tunnels proved to be a challenging task. Exceptional efforts were required in cutting through various sections of faulted ground and traversing under the built-up areas of the Kowloon peninsula, the MTRC underground railways (crossed at six locations), the Eastern Harbour Crossing, and Kwai Chung Container Terminals. All these challenges were successfully overcome and by December 2001 the entire tunnel conveyance system was completed and being progressively tested and commissioned.

抽出深層隧道內的污水 Lifting Sewage from Deep Tunnels



昂船洲主泵房切面圖
Section through SCIMPS

當污水被輸送到昂船洲後，會經由昂船洲主泵房從深層隧道抽往地面。該泵房內徑為50米，深入地底超逾38米，是世界上最大的地下污水泵房之一。建造這個主泵房時需要在隔膜牆內進行深層的挖掘工程。位於泵房底層的8台巨型抽水機，由變速摩打驅動，每一台抽水機的抽水量為每秒8立方米，負責把隧道內的污水抽往污水處理廠的入水口。抽水機的摩打機及控制室則設於主泵房的圓形上蓋層建築物內，建築物採用玻璃幕牆設計，以提高外觀的質素。主泵房並裝有一套自動控制系統，用以管理整套第一期系統（包括上述的7個基本污水處理廠）及以俱能源效益的方式控制抽水機的運作。

When sewage arrives at Stonecutters Island, it is lifted from the deep tunnels to the surface via the Stonecutters Island Main Pumping Station (SCIMPS) which is one of the world's largest underground sewage pumping stations. The pumping station has an internal diameter of 50 metres and is more than 38 metres below ground. Construction of this facility involved deep excavation within a diaphragm wall. Eight massive pumps, each with a capacity of eight cubic metres per second and driven by variable speed drives, are located at the bottom of the pumping station to lift sewage from the tunnels to the inlets of the sewage treatment works. The pump motors and control room are located in the superstructure, which is a circular building with external curtain wall glazing to provide a high quality finish. An automated control system has been installed in the pumping station to control the entire Stage I system, including the seven PTWs, and to operate the pumps in an energy-efficient manner.

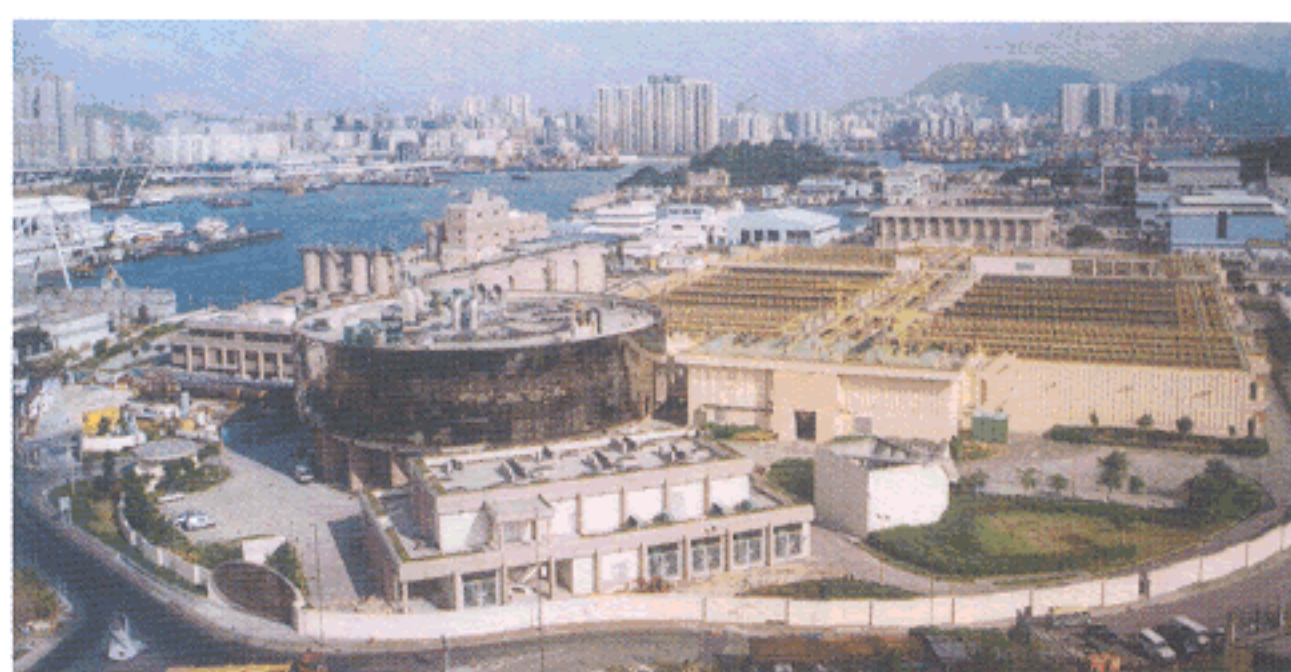


泵房外觀 Exterior View

抽水機 The Pumps



昂船洲污水處理廠 - 一九九六年的地盤情況
SCISTW - Construction Activities in 1996

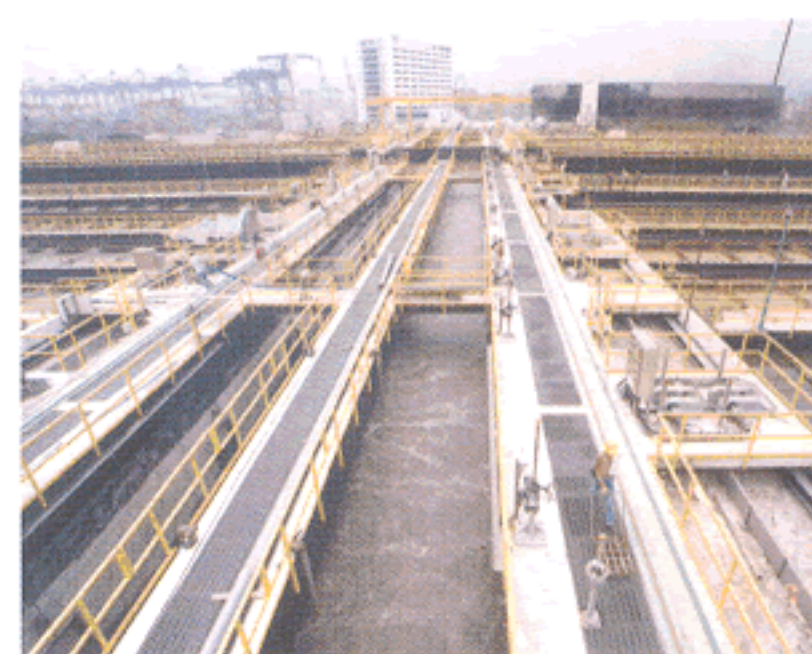


一九九七年五月啟用後的昂船洲處理廠
Commissioned SCISTW in May 1997

處理污水 Treating Sewage

污水被送回地面後，會在昂船洲污水處理廠進行處理，該廠建於昂船洲一幅大約 10.6 公頃的填海土地上，已於 1997 年 5 月完成。昂船洲污水處理廠每日能處理多達 170 萬立方米的污水，是現時世界上最大的化學強化一級污水處理廠。該廠採用最先進的技術和設備，並應用節省空間的雙層沉澱池設計。施工期間，由於多達 10 個承建商需在有限的工地範圍內同時進行各項有關工程，統籌及協調的工作非常繁重。昂船洲污水處理廠落成啟用後，一直處理著西北九龍地區的污水，成效理想，被本地及國際著名專家譽為世界上最具效率的化學強化一級污水處理廠之一。

Sewage entering the system receives treatment at the Stonecutters Island Sewage Treatment Works (SCISTW), which was built on 10.6 hectares of reclaimed land and commissioned in May 1997. SCISTW, with a design capacity for treating 1.7 million cubic metres of sewage per day, is the largest chemically enhanced primary treatment plant in the world. It features space-saving, double-tray sedimentation tanks and employs the latest technology and equipment available. During construction, concurrent activities had to be carried out by up to 10 contractors within the confines of the site, demanding extensive coordination efforts. Since its opening, the plant has been treating sewage flows from the North West Kowloon areas with excellent performance results and is acclaimed by local and international experts as one of the world's most efficient CEPT plants.



運作中的沉澱池
Sedimentation Tanks in Operation

棄置污泥 Disposal of Sludge



運送污泥塊往堆填區棄置
Disposal of Sludge Cakes to Landfill

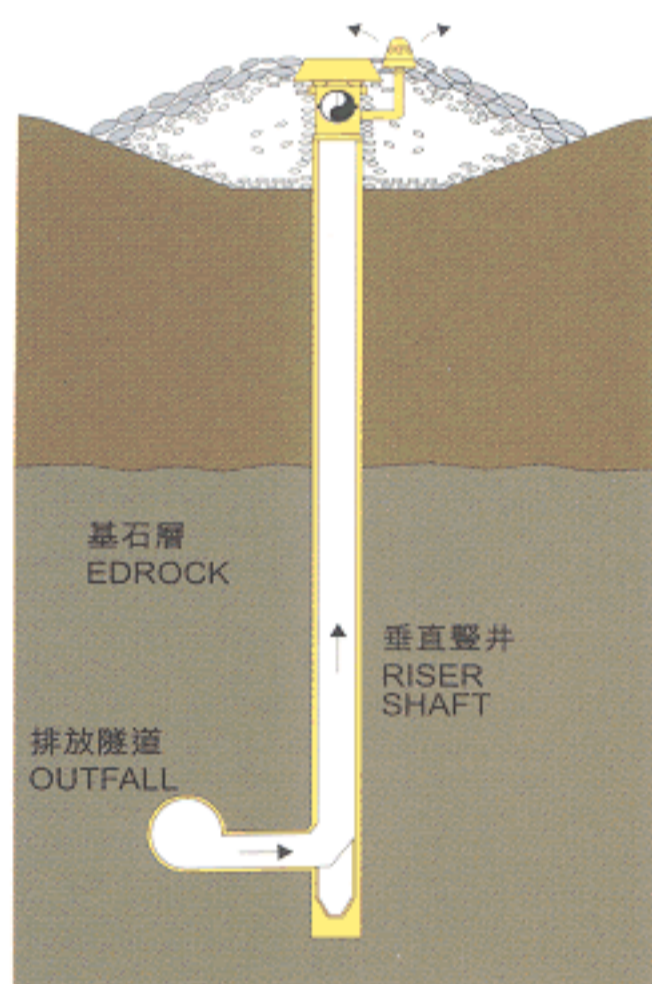
來自沉澱池的污泥漿會被送往毗鄰的污泥處理設施進行處理。這些污泥漿在加進聚合物後，會被泵入離心機，進行脫水，使成污泥塊。當「淨化海港計劃」第一期全面啟用後，每日產生及運往堆填區的脫水污泥約為600噸。污泥處理設施已加設了除臭設備，並使用密封容器，以盡量減少在處理、裝卸及運送污泥期間對公眾造成的滋擾。

The slurry sludge drawn from the sedimentation tanks is delivered to the adjacent sludge treatment facilities. It is first conditioned with polymer and then pumped into centrifuges where the water content is significantly reduced to produce solid sludge cakes.

Upon full commissioning of HATS Stage I, about 600 tonnes of dewatered sludge will be produced and transported to landfill sites every day. Odour control facilities have been incorporated and sealed containers are used to minimise nuisance to the public throughout the treatment, handling and transportation process.

排放經處理的污水 Discharging Treated Effluent

經處理的污水會由一條長約1.7公里的隧道排放至昂船洲西南面對開的水域，途經北航道下約100米深的地底。該隧道是第一期隧道中最大的一條，利用隧道鑽挖機於地質惡劣的岩土中挖掘而成。它以預製混凝土組件作襯層，內徑為5米，並經兩條直徑3.25米的垂直管道，連接至一條長1.2公里橫放於海床的擴散器管道。為保護擴散器管道不受錨泊損壞，管道周圍放置了一層石塊護面，並於每個擴散器頂部加上保護圓罩。經處理的污水利用擴散器管道上的24個擴散器排入海水裡稀釋。排放管道啟用至今運作良好。



排放隧道及垂直管道切面圖
Outfall Tunnel and Riser Pipe

Treated effluent from SCISTW is discharged to the waters southwest of Stonecutters Island along a 1.7km long tunnel, which passes under the Northern Fairway at a depth of about 100m. The tunnel is the largest of the Stage I tunnels and was excavated by tunnel boring machine through difficult ground



擴散器保護罩
Protective Dome

conditions. It is lined with precast concrete segments, to give a finished diameter of 5 m, and is connected to two 3.25m diameter riser pipes and a 1.2km diffuser pipeline laid in a pre-dredged trench on the seabed. To protect the diffuser pipeline from damage by ship anchors, a layer of rock armour was placed around it and each diffuser head was covered by a protective dome. The effluent is dispersed into the tidal stream through 24 diffusers installed along the diffuser pipeline. Since commissioning, the outfall has been operating satisfactorily.



垂直管道的安裝工程
Construction of Riser Pipe

效益和未來路向 Benefits and Way Forward

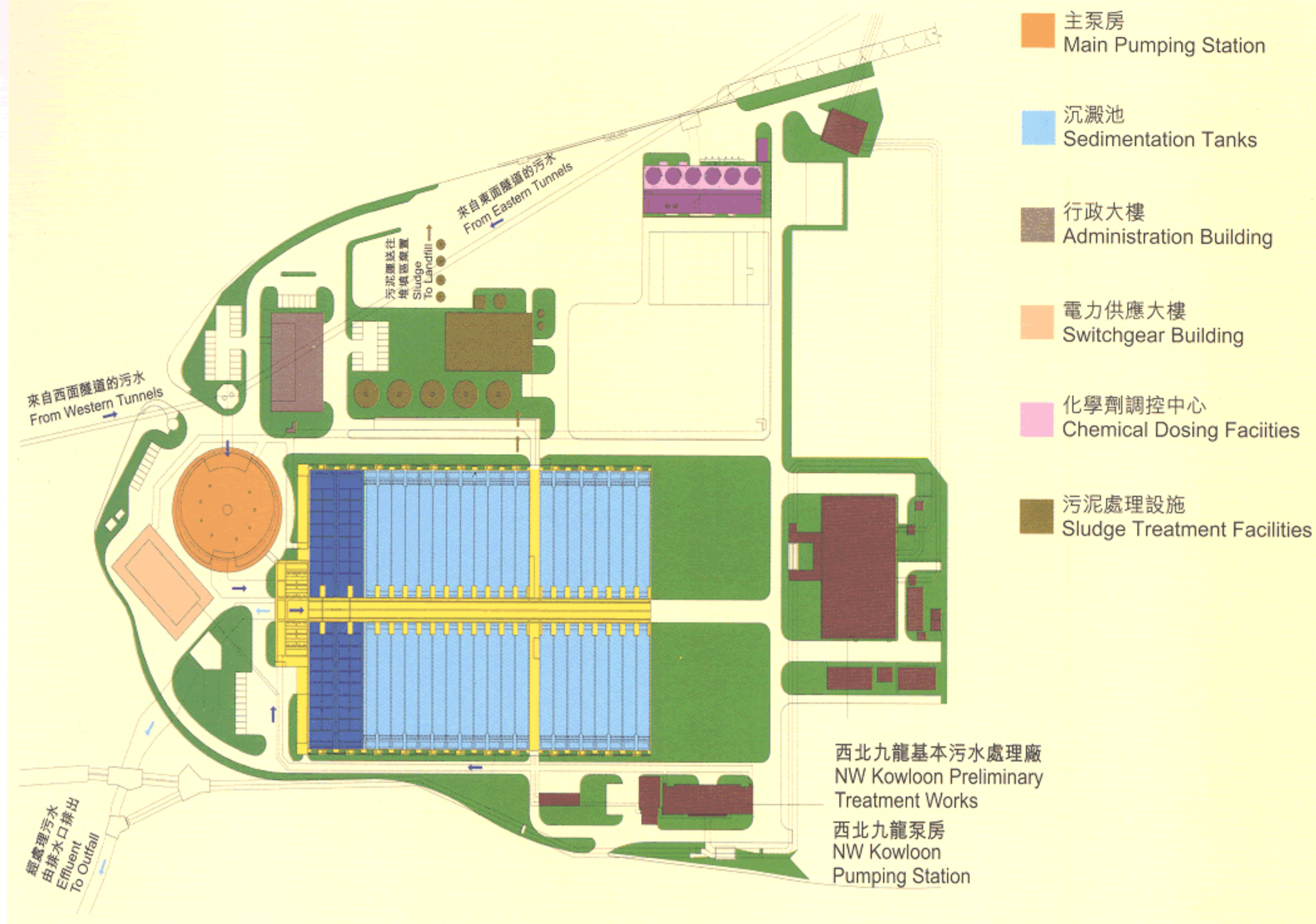
當「淨化海港計劃」第一期系統於2002年初全面啟用後，約七成由維多利亞港內人口密集市區所產生的污水將得到妥善處理，使維多利亞港的水質得到大大改善。

政府現正按照國際專家小組於2000年的建議進行一系列的試驗和研究，以釐定「淨化海港計劃」餘下各期的路向。當整項計劃完成後，所有於維港兩岸主要市區產生的污水均會得到妥善處理，從而長遠改善維港的水質。

Upon the full commissioning of the HATS Stage I by early 2002, some 70% of the raw sewage from the densely-populated areas around Victoria Harbour will receive proper treatment, bringing substantial improvement to the water quality of the Harbour.

The Government is now implementing a programme of trials and studies, recommended by the International Review Panel in 2000, to assist in formulating the way forward for further stages of HATS. Upon completion of the entire Scheme, all sewage generated from the main urban areas on both sides of the Harbour will receive adequate treatment and long-term improvement to the water quality of the Harbour will ensue.

昂船洲污水處理廠 Stonecutters Island Sewage Treatment Works



「淨化海港計劃」第一期 - 便覽

預計服務人口：350 萬

污水處理量：

每日 170 萬立方米污水

估計整項工程最終造價：約 82 億港元

施工期：1994 年 4 月至 2001 年 12 月

基本污水處理廠：

7 個經全面改善的基本污水處理廠位於柴灣、筲箕灣、將軍澳、觀塘、土瓜灣、葵涌及青衣

昂船洲污水主泵房的抽水量：

每秒 31.25 立方米

豎井/隧道：

10 個豎井，深達 150 米，直徑介乎 1.8 米至 7.3 米

隧道全長 23.6 公里，深達 150 米，直徑介乎 1.2 米至 3.5 米

昂船洲污水處理廠

38 個雙層沉澱池（總處理量每秒 39.75 立方米）

8 個絮凝池

化學劑量：氯化鐵及聚合物

（最高劑量：每公升 40 毫克）

8 台離心機（每日可處理 900 噸的污泥塊，

脫水率達 37%）

第一期排放管道

隧道長 1.7 公里，直徑 5.0 米

擴散管道長 1.2 公里，直徑介乎 1.5 米至 2.5 米，擴散器 24 個

隧道鑽挖機挖掘率：

平均每日 8 米，最高每日 37 米

挖掘出來的總廢土量：552,300 立方米

所用的混凝土總量：389,600 立方米

HATS Stage I - Facts at a glance

Projected population served: 3.5 million

Treatment Capacity:

1.7 million cubic metres of sewage per day

Estimated Final Project Cost: HK\$8.2 billion

Construction Period: April 1994 to December 2001

Preliminary Treatment Works: Major upgrading of seven existing PTWs located at Chai Wan, Shau Kei Wan, Tseung Kwan O, Kwun Tong, To Kwa Wan, Kwai Chung and Tsing Yi

Pumping Capacity of Stonecutters Island Main Pumping Station: 31.25 cubic metres per second

Shafts/Tunnels:

10 shafts up to 150m deep, diameters 1.8m - 7.3m

23.6km long tunnels at depths up to 150m, diameters 1.2m - 3.5m

Stonecutters Island STW:

38 double-tray sedimentation tanks (total capacity: 39.75 m³/s)

8 flocculation tanks

Chemical dosing: ferric chloride and polymer

(max dosing rate: 40 mg/L)

Eight centrifuges (total capacity: 900 tonnes/day of sludge cake at 37% dryness)

Stage I Outfall:

1.7km long, 5.0m diameter tunnel

1.2km long, 1.5m - 2.5m diameter diffuser pipeline with 24 diffusers

Tunnel Boring Machine Excavation Rate:

Average 8 m/day, maximum 37 m/day

Total Material excavated: 552,300 cubic metres

Total Concrete used: 389,600 cubic metres

Project Management:



策略性污水排放計劃部及機電工程部
Strategic Sewage Disposal Scheme
Division and Electrical & Mechanical
Projects Division

Project Design and
Construction Management:

