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(II) 跑馬地的秘密： 雨水暫駐地

secret under happy valley:
rainwater exodus

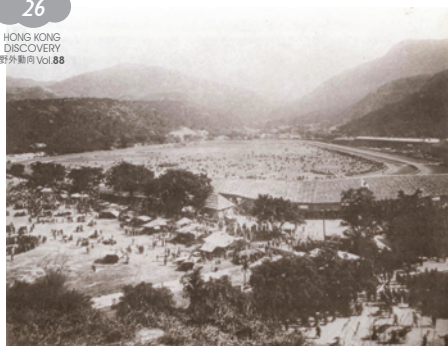
鳴謝 Acknowledgement: 渠務署 Drainage Services Department

你對跑馬地有甚麼感覺？從前，它是屬於富人的「快活谷」；現在，它除了是升斗市民觀看賽馬、踢波跑步的康樂場地，還保護香港島心臟地區免受水浸威脅——秘密在於，原來跑馬地是香港島的「盆地」，渠務署利用這個特點，在跑馬地地下挖出一個雨水貯存池，剛於二零一五年雨季啟用。

What is Happy Valley to you? It was then a playground for the rich; and now recreation hub for the common folks. Few know that this valley basin has a bulwark to keep the heart of Hong Kong Island out of floods. The Drainage Services Department (DSD) hollowed out its bottom for temporary rainwater storage - this is how it works from the rainy season of 2015.

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HONG KONG
DISCOVERY
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給大城市治水 The Big Plan

香港「治水」，殊不容易。作為太平洋沿岸雨量最高的城市之一，香港土地還有六成是天然坡地。本來，天然空曠的自然環境是高蒸發、高滲透、低徑流，亦即土地和山體可以自行吸收和排走雨水。可是香港城市發展密集，道路、建築物覆蓋了天然地表，連山坡也鋪滿建築。若暴雨來臨，海水水位上漲加上從山上瀉下的大量雨水，便會造成市區水浸危機，若加上天文大潮或颱風則更嚴重。香港島的上環曾是香港惡名昭著的水浸黑點，因為它是最早開發的地區之一，舊填海區比新填海區的海拔較低，形成一個低窪盆地。一九九七年，旺角彌敦道曾受嚴重水浸之災。九十年代初，河水泛濫亦令新界北部平原的低窪地區經常水浸。

亞熱帶濕潤 Humid subtropical
八丈島 Hachijojima, 日本 Japan
3,073.4 mm

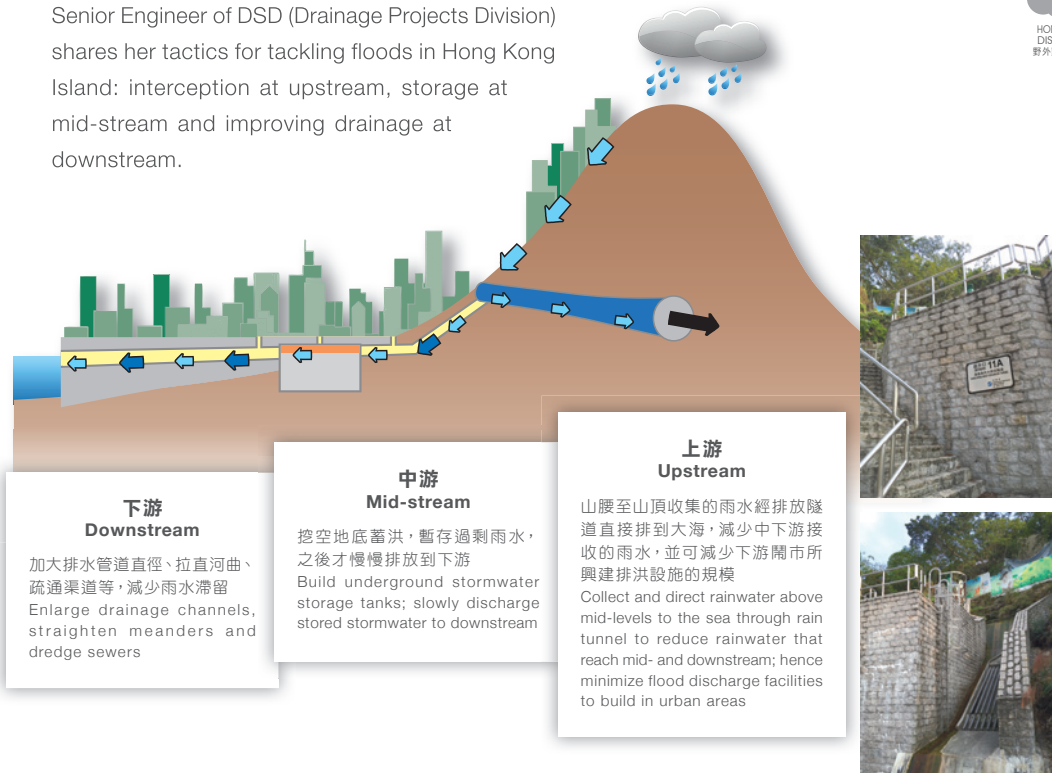
熱帶草原 Tropical savanna
金邊 Phnom Penh, 柬埔寨 Cambodia
1,635.6 mm

溫帶半乾旱 Temperate steppe
烏蘭巴托 Ulaanbaatar, 蒙古 Mongolia
216.4 mm

It isn't easy for Hong Kong, one of the rainiest cities along the Pacific coast, to control floods - 60% of the city's natural terrains are slopes. A primitive, open environment should be highly evaporative, permeable and with less surface runoff, so that the earth and hills can naturally drain away rain. Yet when the terrain is densely studded with concrete buildings and pavements, the land surface cannot absorb much rainwater or let it evaporate. Rising sea level plus runoff from mountains under rainstorm can easily flood urban areas. Flood worsens during high astronomical tide and typhoons. Sheung Wan, the earliest developed area of Hong Kong, was once a notorious "flooding blackspot" since its oldest reclaimed lands are much lower than the newer ones. In 1997 Nathan Road in Mong Kok suffered from severe flooding. And in the early 1990s, the northern New Territories plains were extremely flood-prone due to overflowing rivers.

法國大文豪雨果亦言：「下水道是城市的良心。」，解除水浸威脅才能讓市民安居樂業。「工程好玩之處是解決問題，雖然設計上或施工上也許很複雜，但解決問題的基本還是靠簡單的思維便可。」渠務署排水工程部高級工程師鄭雅思這樣認為。所以，對付港島水浸問題，渠務署採取的是聽來簡單的「防洪三招」：上游截流、中游蓄洪、下游加快排放，三管齊下。

Victor Hugo remarked, "The sewer is the conscience of the city." Reliable drainage is essential for everything to converge and confront. "Engineering is about solving problem and it's fun. It might be difficult to design or construct, but the key approach is to keep it simple." Ellen Cheng, Senior Engineer of DSD (Drainage Projects Division) shares her tactics for tackling floods in Hong Kong Island: interception at upstream, storage at mid-stream and improving drainage at downstream.



香港渠務小史

Brief history of Hong Kong drainage

香港的渠道最初是「雨污合流」，但隨著城市發展，污水量越來越大，不宜直接排到自然水體，於是政府在二十世紀初開始採取「雨污分流」，雨水渠和污水渠分別處理洪水和污水，以改善社會環境。

In early days of Hong Kong rainwater and sewage were discharged in the same set of channels. As sewage increased with urban development, it made no sense to discharge untreated sewage into water bodies. Since early 20th century the government had started to build separate systems for rainwater and sewage.

一九八八年，政府首次開展大型的「全港土地排水及防洪策略研究」，隨即在一九八九年成立渠務署。一九九四年的「雨水排放整體計劃」按照上述研究的成果，把香港劃分為八個集水區，針對各區面對的不同排水問題籌劃和興建有效的排洪設施。傳統上，治理洪水的主要方法是疏浚及擴闊渠道，近年則傾向採用「截流」和「蓄洪」兩個手法，減少工程對鬧市的滋擾。

In 1988 the government commissioned the Land Drainage and Flood Control Strategy Study, and set up Drainage Services Department in 1989. The Drainage Master Plan was drawn up in 1994 which divides the whole territory into 8 parts, each with its resolution and drainage facility for its drainage problems. Conventional flood treatment include dredging and enlarging channels. In recent years "interception" and "stormwater storage" are applied to reduce impact to crowded urban areas.

起蓄洪池 原來不易 The Big Obstacles

「跑馬地地下蓄洪計劃」是香港繼大坑東及上環後第三個蓄洪計劃。在二零零零年，港島多處如黃泥涌道發生嚴重水浸後，已知香港島需要更有效的排洪策略。跑馬地是唯一可行的興建蓄洪池地點，除了因為是區內最低點，有利收集雨水，其上亦不是密集發展地區。「不過管理馬場的香港賽馬會，對工程有不少疑慮，例如會否影響賽馬賽事的進行。」到了二零零八年一場世紀大暴雨，令整個跑馬地馬場頓成一個大「湖泊」，治水刻不容緩，蓄洪計劃終於在二零一二年正式動工。

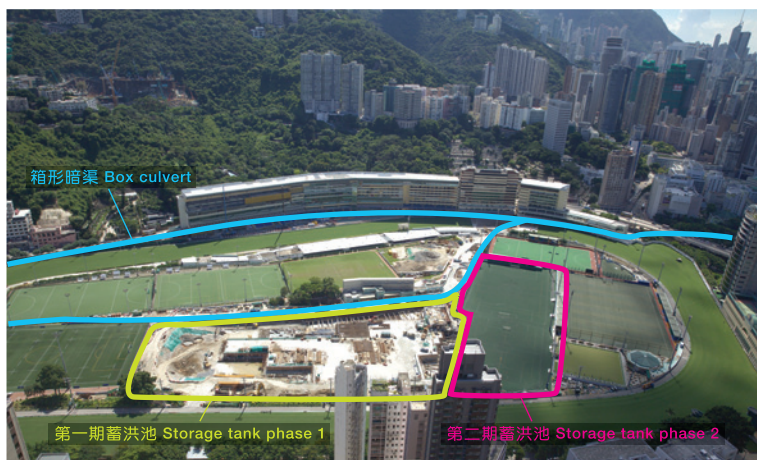


濕潤大陸性 Humid continental
阿菲永卡拉希薩爾 Afyonkarahisar, 土耳其 Turkey
398.6 mm

溫帶海洋性 Temperate oceanic
卑爾根 Bergen, 挪威 Norway
2,250 mm

苔原 Polar tundra
努克 Nuuk, 格陵蘭 Greenland
756 mm

The Happy Valley Underground Stormwater Storage Scheme (HVUSSS) is the third storage scheme following Tai Hang Tung and Sheung Wan. Flooding in various places on Hong Kong Island (including Wong Nai Chung Road in Happy Valley) in 2000 called the need for better flooding solutions. Happy Valley Racecourse was the only possible option for building stormwater storage tank, for it is the lowest point of the district and has no populous developments above. “Yet the Hong Kong Jockey Club (owner of the racecourse) was dubious of the project, especially of the impact on horse-racing fixtures.” So it came to that nasty rainstorm in 2008 which turned the whole racecourse to a shallow lake. The HVUSSS project was kicked off in 2012.



在表面空曠的馬場挖地下池看似不難？實情是困難重重。「工地簡直處於敏感地帶，圍繞馬場的有大量民居、學校、醫院、教堂，上面又有必須保持運作的馬場和球場、跑步徑。」於是，署方需要跟所有受影響方和區議員緊密溝通，甚至了解鄰近學校的考試時間，在該期間避免施工。不過最緊張工程的還是馬會。「星期三夜馬、星期日日馬舉行時和下雨天我們都不能開工。整個星期三下午都需用作清場，因為觀看賽馬需要清晰的視野，連馬腳都要看到，因此場內所有工程機械都要降低高度或撤走。」除了人，還有馬兒的感受需要照顧。「馬兒對環境敏感，所有帆布要收起，以免風吹造成聲響把牠們嚇到；也不能讓牠們看見反光的東西，色彩鮮豔的圍版也不行，有許多限制。」渠務署工程師梁爵麟補充。不過鄭雅思說，由於溝通充分，整個跟馬會合作的過程其實非常愉快。

How hard is it to hollow out the underground of an open space? “Very! Our project site is right underneath an operating racecourse and other sports facilities, surrounded by residential buildings, schools, hospitals and churches.” A lot of liaising were in place, for instance meetings with district councillors, avoiding work during school exam periods. Still the Jockey Club was persnickety over project details. “Work halted on Wednesday nights and Sundays for horse racing, and on rainy days as well. Wednesday afternoons were saved for site clearance - lowering or evacuating all machineries for clear vision down to the hoofs from the spectators’ stand.” Horses are taken care of too. “They are very sensitive to the surroundings. Canvas must be packed up to avoid frightening the horse from crackling of the canvas as winds blow. We also refrain from using reflective materials and colourful hoardings.” Added DSD Engineer Cheuk-lun Leung. After all they had a very happy cooperation with the Jockey Club, explained Ellen.



蓄洪池採淺缸設計，只高三米，減少使用水泵抽水機會，節省能源。
A shallow tank of 3-metre high means less water to be pumped out, in order to save power.

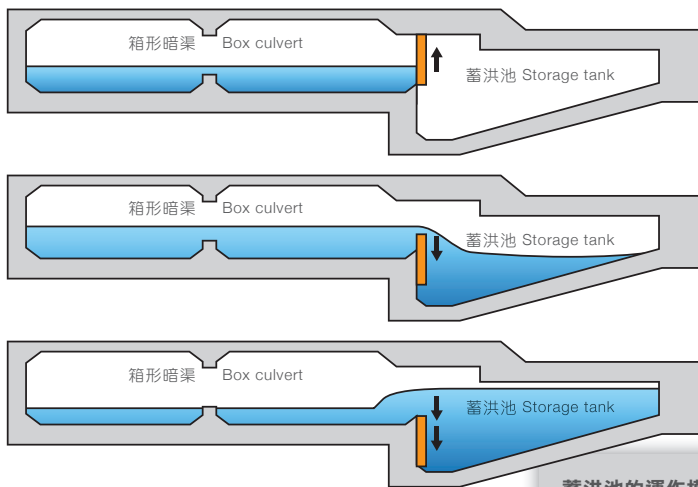
雨水地下城 The Big Tank

在跑馬地遊樂場踢球的「波友」，未必想到現在在他們腳下，有一個容量達二十四個標準泳池（六萬立方米）的大水缸。跑馬地蓄洪計劃包括興建蓄洪池、與之連接的箱形暗渠（方形的大容量雨水渠）、靜水池、泵房和風扇房。當雨量不大，雨水可以直接經暗渠排走；但當雨一直下，四個水位感應器（安裝於跑馬地上下游、蓄洪池內和天文台設於鯉魚涌的潮汐站）均感應到洪水上漲，智能水閘和蓄洪池便會自動開始運作（見右頁圖）。「這也是個環保的設計，因為如沒有智能水閘阻擋，即使下游管道還有空間容納雨水，平時雨水也會自然流入蓄洪池，佔據了池內空間，須多挖二萬立方米的蓄洪池空間來應付需求，亦會增加了興建時耗用的能源。」

Football and rugby players on Happy Valley Recreation Ground may not be aware of a gargantuan tank, as large as 24 standard-sized swimming pools (60,000m³), under their feet. HVUOSS comprises such tank, connecting box culverts, a stiling basin, a pump house and a fan room. Rainwater normally escapes only through the box culverts. With certain amount of rainfall the 4 water level sensors (at up- and downstream of Happy Valley, inside the tank, and at HKO's tide gauge at Quarry Bay) will issue an alert, the movable weirs and the tank then come into usage (see next page). "This is environmentally friendly - without these controllable weirs, rainwater would flow into and fill up a portion of the tank space, even when downstream channels can still receive water. That would require 20,000m³ more of tank space to meet actual need and much more energy in construction."

為了減少工程期間須關閉的球場數目，蓄洪池分二期興建，到二零一八年全面落实後，預計可抵禦「五十年一遇」暴雨，長遠保護灣仔、銅鑼灣、及跑馬地共一百三十公頃地方免受水浸之苦。

HVUOSS comes in two phases so that fewer ball courts have to be closed during the project. It will ultimately be completed in 2018, enabling 130 hectares of areas in Wan Chai, Causeway Bay and Happy Valley to withstand rainstorms of a 50-year return period.



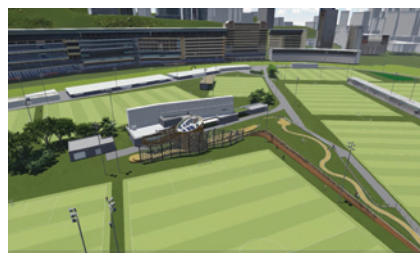
蓄洪池的運作模式：在一般情況下，蓄洪池會空置，所有雨水經暗渠排走；暴雨時，水閘下降，雨水流到蓄洪池貯存；到暴雨過後，水閘降得更低，以便自然排走約三分之二池水，餘下三分之一開動水泵抽走，這也是個省電的設計。

How it works: The tank is normally empty and all rainwater exit via the box culverts. In a rainstorm, the movable weirs lower to let in rainwater. After rainstorm, they lower more so that 2/3 of stored rainwater escape freely from box culvert. Only the rest 1/3 water needs to be pumped out - an energy-saving design.

蓄洪以外的收穫 The Green Mind

為了改善社區雨水問題而大興土木，但若稍一不慎，可能會對環境造成得不償失的影響，渠務署也考慮到這一點。「工地之內及周圍都有不少美麗珍貴的樹木，我們邀請了樹木專家詹志勇教授協助制定工程期間保護樹木的方案，例如安裝儀器監察工程有否令樹木震動、保持樹木根部濕潤。」最特別的是，工程最後加入了一個小型的水源回收重用系統，這是原本計劃中沒有的。「我們另外在蓄洪池旁興建了一個水缸，收集這裡豐富的地下水和灌溉球場後滴下的水，經簡單處理後再次用於灌溉。我們也密切監察跑馬地這裡收集的雨水水質，研究將來實行更大規模雨水集蓄的可行性。」雖然香港仍然未能大規模重用雨水資源，但在這裡總算踏前了一步。

It is a shame if a huge project for the community's sake do more harm than good to the environment. "There are beautiful and precious trees around the project site. We invited 'tree expert' Professor C.Y. Jim to monitor tree conditions during the project, such as installing devices to detect if the construction had shaken any trees, and feed moisture to tree roots." Another surprise is a water recycling system which wasn't in the initial plan. "We built a smaller tank next to the big one to collect groundwater and irrigation water from the ball courts above. They are used for irrigation again after simple treatment. Moreover, we are examining the quality of rainwater collected in this site, for further studies of rainwater harvesting possibilities." This can be a good start to probe applying larger rainwater harvesting systems in Hong Kong.



綠化之後，泵房頂會興建一座假山，鋪上真草，讓市民居高臨下欣賞球賽。更加有趣的是，渠務署受康文署之託，將在工程外「順道」加建新的大型更衣室供市民使用。

An artificial hill with real grass will cover up the pump house. People may watch ball games up here. Commissioned by the LCSD, DSD will also build a new changing room within the project site.

丹麥哥本哈根其中一個小社區聖基特，由於位於海岸邊，突如其來的大雨很容易將社區淹沒。二零一一年，哥本哈根因大雨和洪水驟漲發生嚴重水災，損失達超過十億歐元，聖基特亦不能倖免。丹麥政府於是決心整頓該區，特別的是它捨棄傳統興建地下排水道的方式，而是把大街小巷設計成洪水來襲時的「運河」、公園則變成有效的蓄水池，當暴風雨降臨，整個地區會化成一個美麗的水城。這項城市改造設計並不把洪水視為「猛獸」，而是大自然的一部分。

St. Kjeld, a small coastal community of Copenhagen, is flood-prone during cloudbursts. It was flooded with the rest of Copenhagen in 2011 that caused a loss of over 1 billion euros. The Danish government then rectifies the district's floodwater solution - not by the traditional sub-drains but turns streets and lanes into temporary "canals" under rain, and the park into a potential water tank. When storm strikes again, the community would become a canal town rather than a disaster-hit area. The design of this engineering project considers flood part of nature and wisely copes with it.

渠務署和其他政府部門如何合作，解決雨水問題？

How does DSD work with various departments to deal with rainwater treatment?

向水務署收集引水道和集水區的資料，計算可能會有多少雨水由引水道溢流到下游排水系統；亦與天文台定期商討降雨量、潮水值和氣候變化的資訊，以分析排水設施的防洪能力；並與路政署、食物環境衛生署和民政事務總署檢討水浸事故和執行預防措施。The Water Supplies Department (WSD) provides details of catchwater and catchment areas for DSD to calculate amount of rainwater that may spill over from catchwater to the downstream channels. It discusses regularly with HKO about rainfall amount, tide height and climate change to evaluate flood control capacity. It also joins hands with Highways Department, Food and Environmental Hygiene Department and Home Affairs Department on analyzing and preventing flooding.

香港大規模推行雨水集蓄，可行嗎？

Is it possible to harvest rainwater in Hong Kong in a large scale?

經現有市區雨水渠收集的雨水，其實已被建築物表面和路面上的污物所污染，例如車輛廢氣、鳥糞等等，如需重用，必須經過處理或興建額外的收集系統，渠務署研究後認為未能符合成本效益。該署會與水務署繼續研究如何重用珍貴水資源，例如在渠務工程範圍先推行小型集蓄，將荔枝角雨水排放隧道收集的雨水在淨化後用作灌溉公園、沖廁和洗街便是一例。

Rainwater collected from the existing culverts in urban areas contain pollutants from buildings and roads, such as vehicle emissions and bird droppings. It must be treated or collected through separate systems to be reused, and is not cost effective according to DSD's studies. DSD and WSD continue to look for ways to recycle precious water resources, for instance small-scale rainwater harvesting. Rainwater collected from Lai Chi Kok Drainage Tunnel is now used for irrigation in the park, toilet flushing and cleaning roads.



在繁忙的香港及九龍市區以外，渠務署怎樣為新界鄉郊解決水浸煩惱？

Apart from Hong Kong Island and Kowloon, what about flooding in the rural New Territories?

除了擴闊河道外，渠務署在低窪村落推行「鄉村防洪計劃」，先在村落四周築起基堤，再為村落興建蓄洪池和雨水泵房，將儲起的雨水泵至村外的排水道。

Other than widening river channels, "village flood pumping scheme" is applied at low-lying villages: bunds are constructed around villages, and smaller stormwater storage tanks and pump houses are built within the village. Stored water is discharged outside the bunds.

根據保安局的《天災應變計劃》，當新界北部水浸特別報告發出，新界北渠務部緊急控制中心便會啟動，渠務署人員會當值，隨時準備出動疏通淤塞的河渠。

The Contingency Plan for Natural Disasters of the Security Bureau provides that when the Special Announcement on Flooding in the northern New Territories is issued, the DSD Mainland North Region Emergency Control Centre will be activated, stationed by DSD staff who are ready to clear blocked drains.

資料來源 Source: 渠務署 Drainage Services Department

苔原 Polar tundra
楚格峰 Zugspitze, 德國 Germany
2,004 mm

溫帶海洋性 Temperate oceanic
日內瓦 Geneva, 瑞士 Switzerland
822 mm

地中海 Mediterranean
巴倫西亞 Valencia, 西班牙 Spain
44.2 mm