

# Water resource development over the past half-century

## Preface

In just about a hundred years' time, Hong Kong has been successfully transformed from a fishing village into Asia's world city. Such progressive development is inextricably linked with the establishment of a reliable water supply system and its further expansion.

In the 1960s, Hong Kong went through a period of water rationing when water was supplied for only four hours in every four days. Life at that time is probably unimaginable by Hong Kong people today who enjoy an uninterrupted supply of fresh water.

The serious drought had led to the establishment of the Dongjiang Water Supply System which allowed Dongjiang water to be conveyed to Hong Kong against numerous topographical barriers from March 1965 onwards. As a result, Dongjiang water has become a vital source of fresh water supply to Hong Kong, facilitating the rapid development of the city in the recent 50 years.

This year marks the 50<sup>th</sup> anniversary of Dongjiang water supply to Hong Kong. To better understand the memorable history of Dongjiang water supply, as well as the importance of water resource development and protection, let us recapture the precious moments of water supply over the past 50 years.

Hong Kong in the 1960s – the procession to fetch water

Water pipelines in Hong Kong for conveying Dongjiang water

Plover Cove Reservoir – one of the reservoirs for reception of Dongjiang water

## Locations of Reservoirs in Hong Kong in 1960

Tai Lam Chung Reservoir  
Shing Mun Reservoir  
Shek Lei Pui Reservoir  
Kowloon Reservoir  
Kowloon Byewash Reservoir  
Kowloon Reception Reservoir  
Pok Fu Lam Reservoir  
Aberdeen Upper Reservoir  
Aberdeen Lower Reservoir  
Tai Tam Upper Reservoir  
Tai Tam Intermediate Reservoir  
Tai Tam Byewash Reservoir  
Tai Tam Tuk Reservoir  
Wong Nai Chung Reservoir\*

Wong Nai Chung Reservoir ceased operation in 1986 and has been utilised as public open space since then.

Although Hong Kong's total water storage capacity rose to 45 million cubic metres upon the completion of the Tai Lam Chung Reservoir in 1959, the average daily water supply per capita was about 41 litres only, barely sufficient to meet the basic needs. The subsequent drought in 1963-64 even posed a great challenge to Hong Kong which solely relied on rainwater as the main source of water supply.

### **Annual water consumption and population of Hong Kong from 1905-1960**

1905 – 0.71 million cubic metres, population: about 0.3 million  
1935 – 2.7 million cubic metres, population: about 1 million  
1960 – 110 million cubic metres, population: about 3 million

# **A Drop is Priceless at the time of Drought**

## **Severe drought in 1963-64**

### **Not even a drop of water**

In 1963, Hong Kong recorded an annual rainfall of 901 millimetres, far less than its average annual rainfall (the average annual rainfall from 1981-2012 was 2,400 millimetres).

The Government started to implement water rationing measures from 2 May 1963 onwards.

Date	Water rationing measures
	3 hours of water supply per day
	4 hours of water supply in every two days
	4 hours of water supply in every four days
	All water rationing measures were lifted**

\*\* Heavy rainfall brought by typhoon Viola helped put water rationing in Hong Kong to an end.

### **Translation of photo caption**

Information source: Ta Kung Po dated 30 May 1963

Telephone operators of the Waterworks Office were busy attending to public complaints during water rationing in 1963.

The situation was chaotic when water supply was restricted to three hours and members of the public queued up for fresh water on 13 May 1963.

## **Water Conservation Measures adopted by the Government**

To cope with water shortage at that time, the Government actively promoted a culture of water conservation and implemented a number of water conservation measures. Some of these measures may seem unbelievable to people nowadays.

### **Promotion of water conservation**

During the 1963 drought, 29 Kaifong Welfare Associations jointly organised a writing competition on water conservation. With the assistance of the Post Office, participants could mail their articles to the organiser by simply writing the two Chinese characters “慳水” (i.e. “saving water”) on the envelopes. This broke the record for the shortest Chinese postal address in the world. The posted entries were later opened by the organiser on 13 June 1963.

A water conservation leaflet in 1963

A water conservation poster published by the Government in 1963

Winning entries of the water conservation slogan competition organised by the Education Department in 1963

Winner: Do not waste any water as a drop is priceless when you have none.

First Runner-up: Droughts make water conservation a top priority for everyone.

Second Runner-up: Securing water supply by conserving every single drop of water.

### **Water conservation measures adopted by the Government at that time**

- Public swimming pools and bathrooms of public sports stadiums were closed.
- The provision or sale of water by the Marine Department to vessels from other countries was suspended.
- Surgical operations for chronic diseases scheduled in public hospitals were postponed.
- Plastic pipelines were laid along pavements to convey seawater for fire-fighting purpose.
- Regulations were enacted against water wastage.

## **Exploration of New Water Sources by the Government**

### **Delivery of raw water by tankers**

During the severe drought between 1963 and 1964, the Hong Kong Government chartered a fleet of 14 tankers to abstract raw water from Zhujiang (Pearl River) for delivery to Hong Kong with the consent of the Guangdong Provincial Government.

### **Re-opening of water wells**

Following the measures adopted during the 1929 drought, the Government re-opened a number of water wells to provide Hong Kong with an additional supply of 1,800 to 2,300 cubic metres of water per day.

### **Artificial rain-making**

On 31 May 1963, the Hong Kong Government attempted to make artificial rain by deploying two aircrafts of the Auxiliary Air Force to spray dry ice in the sky at an altitude of 7,000 feet to the west of Cheung Chau. Unfortunately, the trial was unsuccessful.

A tanker unloaded raw water at the pier in June 1963 after abstracting water from the Zhujiang Estuary.

Information source: Ta Kung Po dated 27 June 1963

# **Droughts make water conservation a top priority for everyone**

## **Water conservation measures adopted by the public**

### **Water conservation measures initiated by the public**

During water rationing, concerted efforts had been made by different members of the public, ranging from individuals to all trades and professions, to conserve water through the implementation of various measures.

#### **Reduction of individual water use**

- Rural residents made the switch to wheat buns for main meals which required less water to cook.
- Urban residents consumed more canned food to avoid using water for cooking.
- Physical education lessons were cancelled in some schools to avoid creating additional needs for bathing.
- People tried not to wear white clothes which would easily get dirty.
- People ate apples after meals or before bed instead of brushing teeth.
- Disposable paper tableware was used to avoid dish washing.
- Used fresh water was recycled.

#### **“Water token”**

To reduce water consumption, some restaurants offered each of their customers three pieces of “water token” to restrict the times of refilling service for teapots that each customer could enjoy to a maximum of three.

In order to obtain a little bit more water, women frantically did their best to get control of the public tap.

### **Manufacturers of water buckets – the major beneficiary of water rationing**

The sale of water buckets rose drastically as all families and trades needed water buckets for carrying and storing water during water rationing.

### **Religious intercessions for rain**

Several religious organisations invited followers over the territory to join their religious intercessions in order to pray for a good rainfall that could bring an end to the drought.

During the 1963 drought, the Hong Kong Joint Buddhist Association held an intercession for rain.

Water buckets capable of holding 50 gallons of water were the most popular in the market.

The two large water tanks in the squatter area of Diamond Hill, though primitive, were the main sources of water supply for the lower class.

# **Adverse Impacts of Unstable Water Supply on the Development of Society**

## **Public hygiene**

Water shortage under extremely hot weather had led to the spreading of diseases. The first case of cholera in Hong Kong was reported on 28 June 1963 and a total of 115 cases were recorded by the end of that year.

## **Economy**

During the drought period, farmlands and fish ponds dried up, causing severe impact to the agricultural and fisheries industries. The commercial and industrial sectors were also greatly affected. According to the estimation of the Hong Kong and Kowloon Federation of Trade Unions (now the Hong Kong Federation of Trade Unions), a total of 19 trades had reduced or ceased their production, and 200,000 workers had experienced a pay reduction.

## **Translation of photo caption**

Information source: The Kung Sheung Daily News dated 29 June 1963

Information source: Sing Tao Daily News dated 15 October 1963

Information source: The Kung Sheung Daily News dated 31 May 1963

Information source: Sing Tao Daily News dated 12 October 1963

Information source: Sing Tao Daily News dated 5 June 1963



## Dongjiang Water Coming Over the Hills

- 1960 Starting to abstract water from the Shenzhen Reservoir
- 1963 Reaching a consensus on the implementation of the Dongjiang-Shenzhen Water Supply Scheme
- 1965 Supplying water to Hong Kong upon the completion of the Dongjiang-Shenzhen Water Supply Scheme

### **Abstraction of water from the Shenzhen Reservoir in 1960**

As early as in 1960, the Hong Kong Government was well aware that the increasing fresh water demand in Hong Kong could no longer be satisfied by rainfall solely, and the procurement of fresh water from Guangdong Province was the most efficient way for fulfilling the unmet water needs.

On 15 November 1960, the Governments of Guangdong Province and Hong Kong reached an agreement on importing 22.7 million cubic metres per year of raw water from the Shenzhen Reservoir to Hong Kong every year. A pipeline with a diameter of 48 inches (1,200 millimetres) was swiftly constructed subsequently for the delivery of water to Hong Kong from December 1960 onwards.

A large pipeline with a diameter of 48 inches was laid in 1960 for the reception of water from the Shenzhen Reservoir.

The first water supply agreement was signed between the Governments of Guangdong Province and Hong Kong on 15 November 1960.

## **The Dongjiang-Shenzhen Water Supply Scheme in 1963**

In 1963, the Governments of Guangdong Province and Hong Kong held several rounds of discussions and reached a consensus on the implementation of the Dongjiang-Shenzhen Water Supply Scheme. The Scheme was approved by Prime Minister Zhou Enlai and granted a special fund by the Central People's Government for its construction works at the end of the year. Meanwhile, large-scale pumping stations, pipelines and tunnels were constructed in Hong Kong to facilitate the distribution of Dongjiang water to various districts over the territory.

The representative of Hong Kong, Deputy Director of Public Works cum Head of the Waterworks Office, T.O. Morgan, and Head of the Guangdong Province Water Conservancy and Hydro-electric Bureau, Liu Zhaolun, signed the agreement in Guangzhou.

Information source: Ta Kung Po dated 22 April 1964

The design professionals of the Dongjiang-Shenzhen Water Supply Scheme at work. The mission of the team was to complete the design of the Dongjiang-Shenzhen Water Supply Scheme efficiently and effectively, so as to supply water to Hong Kong as early as possible.

In February 1964, the Guangdong Provincial Government deployed substantial manpower and resources to carry out the construction works of the Dongjiang-Shenzhen Water Supply Scheme along an 80-km route from Dongjiang to Shenzhen.

The water supply agreement signed in 1964

The representatives of the Governments of Guangdong Province and Hong Kong signed the agreement.

# A Stream of Clear Southward-flowing Water

## Introduction of the Dongjiang-Shenzhen Water Supply Scheme

### Dongjiang Water Supply Route

#### Translation of descriptions on Map:

Dongguan  
Shenzhen  
Hong Kong  
Dongjiang  
Tonghu  
Changping  
Qingxi  
Fenggang  
Guanlian  
Shenzhen Reservoir  
Taiyuan Pumping Station  
Linhu Pumping Station  
Qiling Pumping Station  
Jinhu Pumping Station  
Muk Wu Pumping Station

Dedicated aqueduct  
Open channel  
Yantian Tunnel  
Connecting pipe between the Shenzhen Reservoir and Muk Wu Pumping Station  
Pumping station

## **Photos of various stages of expansion over the years**

Stage 1 Expansion – Qiling Gate Dam

Stage 2 Expansion – Shangpu Transformer Substation

General view of the Matan Pumping Station upon the completion of Stage 3 Expansion

Initial view of the Shenzhen Reservoir

The Taiyuan Pumping Station, located at Qiantou Town, Dongguan City, Guangdong Province, is the first stop of the Dongjiang-Shenzhen Water Supply Scheme.

For the layout plan underneath Panel 11 & 12, please refer to the marked up JPEG separately enclosed.

# Three Stages of Expansion and One Major Improvement

## Overview on various stages of expansion in the Mainland

Initially, the annual quantity of water supplied to Hong Kong under the Dongjiang-Shenzhen Water Supply Scheme was 68.2 million cubic metres. To tie in with the development of the city, the Hong Kong Government had requested the Guangdong Provincial Government at different times to increase the quantity of Dongjiang water supply. During these stages of expansion, the Guangdong Provincial Government had also taken the opportunities to improve the Dongjiang-Shenzhen Water Supply System.

## Major events and quantities of Dongjiang water supply during various stages of expansion

Nowadays, Dongjiang water is supplied to more than 40 million people living in Hong Kong, Heyuan, Huizhou, Dongguan, Guangzhou, Shenzhen and other cities in the Guangdong Province.

Annual supply quantity (hundred million cubic metres)

Initial Scheme

Stage 1 Expansion

Stage 2 Expansion

Stage 3 Expansion

Improvement works for the Dongjiang-Shenzhen Water Supply Scheme

Bio-nitrification plant

Bio-nitrification of raw water under the Dongjiang-Shenzhen Water Supply Scheme

## **Population of Hong Kong, quantities of Dongjiang water imported and water consumption over the years**

Over the fifty years of supply of Dongjiang water, the population of Hong Kong has doubled from 3.6 million in 1965 to 7.2 million in 2014.

### **Translation of words in the graph:**

Population (million)

Quantity of Dongjiang water imported/Water consumption (hundred million cubic metres)

### **Translation of words in the legend:**

Population (million)

Quantity of Dongjiang water imported (hundred million cubic metres)

Fresh water consumption (hundred million cubic metres)

Present view of the Muk Wu No. 2 Raw Water Pumping Station

## **Infrastructure associated with Dongjiang Water Supply in Hong Kong**

Apart from the constant expansion of the Dongjiang-Shenzhen Water Supply Scheme in the Mainland, the water supply network of Hong Kong has also been enhanced by the construction of associated infrastructure.

### **Principal Water Supply System in Hong Kong**

#### **Plover Cove Reservoir and High Island Reservoir**

During the annual shutdown period of the Dongjiang system (normally in December) for maintenance, water stored in the Plover Cove Reservoir and High Island Reservoir ensures an uninterrupted supply of water in the territory.

Plover Cove Reservoir  
High Island Reservoir

# Joint Efforts to Safeguard the Water

## Measures on water quality taken by the Guangdong Provincial Government

To safeguard the quality of Dongjiang water supplied to Hong Kong, the Guangdong authorities have made continuous efforts to implement a number of water quality improvement works, and to introduce various regulations and administrative measures on the protection of water quality over the years. Some of the water quality improvement works are listed below.

### Improvement works

- Construction of sewage treatment plants along Dongjiang and implementation of sewage interception works
- Relocation of the intake point upstream  
In 1998, the intake point of Dongjiang water was relocated upstream for better water quality.
- Bio-nitrification plant  
To enhance water quality, a bio-nitrification plant was commissioned at the Shenzhen Reservoir in early 1999.
- Dedicated aqueduct  
To further and permanently improve the quality of raw water supplied to Hong Kong, the Guangdong authorities commenced the construction of a dedicated aqueduct from Taiyuan along Dongjiang to the Shenzhen Reservoir in 2000. This dedicated aqueduct was commissioned in 2003.

Outside view of the closed aqueduct at Qiling

Inside view of the closed aqueduct at Jinhu during water suspension for maintenance

- Shima River Sewage Diversion Works  
The Shima River Sewage Diversion Works was completed in June 2003. By making use of a rubber dam, contaminated water from Shima River is deterred from overflowing to Dongjiang near the intake point at the Taiyuan Pumping Station. This can further safeguard the quality of Dongjiang water supplied to Hong Kong.
- Dongjiang River Basin Water Quantity and Quality Monitoring and Control System  
To further safeguard the quality of Dongjiang water, the Guangdong authorities are now implementing the Dongjiang River Basin Water Quantity and Quality Monitoring and Control System.



## **Type II Standard in the Environmental Quality Standards for Surface Water GB 3838-2002**

With the implementation of the above measures, the quality of Dongjiang water supplied to Hong Kong has been in compliance with Type II standard in the Environmental Quality Standards for Surface Water GB 3838-2002 which is the highest national standard for surface water applicable for the abstraction for human consumption.

Dongjiang River Basin Water Quantity and Quality Monitoring and Control System

## **Hong Kong's Efforts in Safeguarding Water Quality**

Once Dongjiang water reaches Hong Kong, its quality is monitored through a comprehensive water quality monitoring programme at the Muk Wu Pumping Station and the water treatment works in Hong Kong. Samples are collected and tested through a series of chemical, physical, bacteriological, biological and radiological examinations.

### **Biosensing Alert System**

In recent years, the Water Supplies Department of Hong Kong has also pioneered the application of Zebrafish to detect abnormalities in raw water. By closely monitoring the behaviour of Zebrafish in raw water, the Department can quickly spot potential water quality problems and take appropriate countermeasures.

Zebrafish plays a vital role in the Biosensing Alert System.

### **Regular release of water quality data on the Internet**

The Water Supplies Department has regularly released the data on the quality of Dongjiang water received at the Muk Wu Pumping Station and the quality of potable water in Hong Kong on its website since August 2000. From 2002 onwards, the frequency of updating the water quality data has been increased from annual to half-yearly intervals.

The Guangdong authorities has also provided data on the quality of Dongjiang water collected at the east bank section of Dongjiang upstream of the intake of Dongjiang water at the Taiyuan Pumping Station since 2001 for release on the website of the Water Supplies Department.

### **Comparison of the quality of Dongjiang water received at the Muk Wu Pumping Station in Hong Kong with GB3838-2002 Type II Standard for Surface Water**

Parameter (unit)  
Monitoring data (10/2013 – 09/2014) average  
GB3838-2002 Type II Standard Value  
Compliance

pH (pH)  
Dissolved Oxygen (mg/L)  
Permanganate Index (mg/L)  
Chemical Oxygen Demand (mg/L)

### **Advisory Committee on Water Resources and Quality of Water Supplies**

The Advisory Committee on Quality of Water Supplies founded in 2000 is an independent body comprising members from the public including academics, district councillors, green advocates, professionals, and officials from related government departments and bureau. Subsequently, the scope of the Advisory Committee has been expanded from 1 April 2012 to cover water resources-related issues in addition to the quality of water supplies in Hong Kong and the Advisory Committee was renamed as the “Advisory Committee on Water Resources and Quality of Water Supplies”.

The Advisory Committee conducts the visit to Dongjiang annually to understand the implementation of mitigation measures against water pollution.

The Advisory Committee visited Dongjiang in October 2014

## **Strong Links between Hong Kong and Guangdong**

The Guangdong Province and Hong Kong maintain close liaison on various issues relating to Dongjiang water supply to Hong Kong through the following established mechanism:

### **Guangdong/Hong Kong Water Supply Business Meeting**

During the meeting, the Guangdong's delegation, led by the Director of Guangdong Water Resources Department, and the Hong Kong's delegation, led by the Secretary for Development, will discuss various issues relating to Dongjiang water supply including water resources protection and water quality monitoring;

### **Guangdong/Hong Kong Water Supply Operation and Management Technical Cooperation Sub-group Meeting**

The meeting is convened once or twice each year to examine water quality monitoring work, as well as to discuss, follow up and take forward measures for reducing pollution of Dongjiang at sources and their implementation apart from other operation and management issues; and

### **Special Panel Meeting on the Protection of Dongjiang Water Quality**

The Special Panel on the Protection of Dongjiang Water Quality under the Expert Group of the Guangdong/Hong Kong Joint Working Group on Sustainable Development and Environmental Protection convenes a meeting once a year to advise on Dongjiang water quality and discuss the strategies, the plans and their effectiveness.

### **Notification Mechanism**

In the event of any major contamination incident affecting the quality of Dongjiang water delivered to Hong Kong, the Guangdong authorities will immediately notify the designated liaison officers of the Water Supplies Department by phone and subsequently supplement with detailed information. If necessary, the Water Supplies Department will cooperate and coordinate with the parties concerned, and take appropriate control measures and corresponding actions so as to ensure the safety of water quality in Hong Kong. The major control measures include:

- immediately stepping up the monitoring of the quality of Dongjiang water at the Muk Wu Pumping Station;
- reducing or suspending the supply of Dongjiang water to Hong Kong when necessary depending on the actual water quality condition;

- discharging all incoming Dongjiang water at the Muk Wu Pumping Station if necessary;
- switching the raw water for water treatment works receiving Dongjiang water to local water sources; and
- collecting more detailed information from the Guangdong authorities so as to formulate further actions required.

The Advisory Committee visited Dongjiang in October 2014

# Close Liaison with Counterparts and Sustainable Water Supply

## Sustainable use of water resources

In 2008, the Total Water Management Strategy was formulated in Hong Kong. The strategy puts emphasis on containing the growth of water demand through promoting water conservation while strengthening water supply management through exploring alternative sources of water supply. It seeks to achieve an optimal balance between water demand and water supply in order to ensure sustainable use of water resources.

In line with the Total Water Management Strategy, the Water Supplies Department has launched a series of educational and promotional activities on water conservation since 2009.

## Recent promotional activities on water conservation

### *Primary and secondary schools*

Water Resources Education Centre

Water: Learn & Conserve - Teaching Kit for Liberal Studies

### *Community*

“Save Water • Cherish the World” Roving Exhibition

Water Saving Tips for Domestic Helpers

Voluntary Water Efficiency Labelling Scheme

## “Let’s Save 10L Water” Campaign

To encourage the public to reduce daily water consumption by 10 litres per capita, both software and hardware measures are implemented to help the public put water conservation into practice.

Software measure: Introducing water saving tips to the public

Hardware measure: Distributing complimentary flow controllers to participating households for promoting the use of water saving devices. Up until now, the number of households being issued with flow controllers has reached over 130,000.

Let’s take part in the “Let’s Save 10L Water” Campaign and commit to saving water resources.

## **Water Conservation Week**

We will hold our major promotional campaign, “Water Conservation Week”, at the Jockey Club Innovation Tower of the Hong Kong Polytechnic University from 20 to 26 November 2015. The event will comprise a host of activities including:

Exhibition on the theme of “Water Supply Time Tunnel”

Forums

Performances

Workshops

Carnival

There will also be events tailor-made for the educational sector, housing estates, as well as stakeholders from hotels and catering industries. See you there!

## **Close Liaison with Counterparts and Sustainable Water Supply**

The Dongjiang-Shenzhen Water Supply Scheme is a waterworks asset of significant importance. Every year, people from different sectors of the community visit the construction site to enhance their understanding of the Scheme. The Scheme has been playing a vital role in maintaining the prosperous development of Hong Kong.

Hong Kong deputies to the National People's Congress visiting the Dongjiang-Shenzhen Water Supply Improvement Works

Students from Hong Kong viewing a model on the Dongjiang-Shenzhen Water Supply Improvement Works

### **Way Forward**

To maintain sustainable water supply, urban and rural areas at the upper stream of the Dongjiang River Basin have been restricted for development in the water gathering grounds since the establishment of the mechanism for the supply of Dongjiang water to Hong Kong. This is a solemn and long-term pledge for the safety of water supply to areas within and outside the Dongjiang River Basin.

While enjoying an ample supply of Dongjiang water, we should not forget the hard time Hong Kong had gone through during water rationing. We should spare no effort in conserving the precious water resources for their sustainable use in the region.