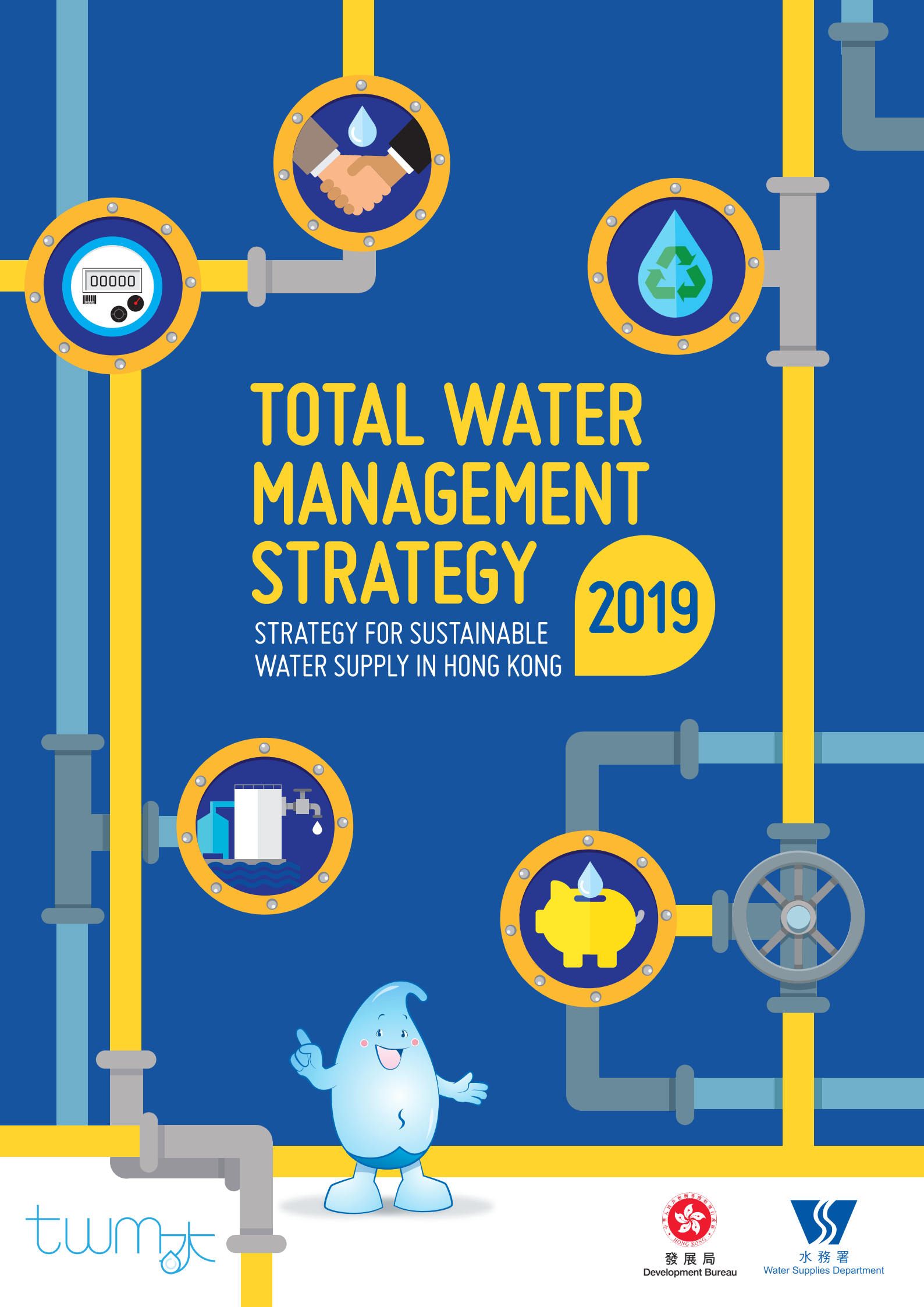

TOTAL WATER MANAGEMENT STRATEGY 2019

STRATEGY FOR SUSTAINABLE WATER SUPPLY IN HONG KONG

twm水

發展局
Development Bureau

水務署
Water Supplies Department

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August 2019

EXECUTIVE SUMMARY

The Total Water Management Strategy (the Strategy) promulgated by the Water Supplies Department in 2008 has mapped out the strategy for sustainable use of water to ensure water security and support the development in Hong Kong. The Strategy puts an emphasis on containing the growth of water demand through promoting water conservation and exploiting new water resources.

The Strategy focuses on two major areas, namely water demand management and water supply management. The major initiatives are enhancing public education on water conservation, promoting the use of water-saving devices, enhancing water leakage control, extending the use of seawater for toilet flushing, strengthening the protection of water resources and actively exploiting new water resources.

We completed a review (The Review) on the Strategy in 2019. The Review confirmed that major initiatives in both water demand and water supply management under the Strategy have achieved their respective milestones. The Review updated the forecast of water demand and supply methodologies and projections up to 2040 taking into account impacts of climate change. After evaluation of water management options using multiple criteria (viz. resilience, economics and sustainability), the updated Strategy (namely Strategy 2019) adopts a two-pronged approach, with emphasis on containing fresh water demand growth and building resilience in the fresh water supply catering for extreme effects of climate change with diversified water resources. The key initiatives of containing fresh water demand include further promotion of water conservation, water loss management and expansion of use of lower grade water for non-potable purposes. It is anticipated that with implementation of the updated water demand management initiatives, the annual fresh water consumption will be maintained at around current level. The construction of the first stage of the desalination plant in Tseung Kwan O is the measure to build resilience in fresh water supply. In summary, with the implementation of the water demand management initiatives, the projected reliable fresh water supply of the current water supply arrangement will be able to meet the forecast fresh water demand up to 2040 and enhanced with resilience. Moreover, the Review also considered a list of backup options in case of worse-than-expected scenarios. In face of unpredictable impacts of climate change and any unforeseen circumstances, we will continuously monitor the water demand and supply situation. The Government invites the public to join hands with us in implementing Total Water Management to ensure sustainable use of precious water resources in Hong Kong.

1 INTRODUCTION

In 2008, we promulgated the Strategy which is an integrated and multi-sectoral approach to achieve sustainability in water resources management. The Strategy focused on containing growth of water demand through conservation whilst strengthening water supply management of Hong Kong through developing new water resources. After its implementation for some years, we engaged consultants to carry out a review on the Strategy in order to:

- **Ascertain the effectiveness of the Strategy**
- **Extend the water demand and supply forecast up to 2040**
- **Formulate, evaluate and recommend the strategic options for meeting the forecasted water demand and supply**
- **Update the Strategy**

Completed / On-going Major Initiatives

The Review confirmed the achievement of a number of major initiatives of both water demand and water supply management under the Strategy, including enhancing public education on water conservation, promoting the use of water-saving devices, enhancing water leakage control, extending the use of seawater for toilet flushing, strengthening the protection of water resources and actively exploiting new water resources.

Water Demand Management	Water Supply Management
With our sustained publicity and public education programmes, people are now more aware of the importance of water conservation as revealed by the public opinion survey in 2015/16 [refer to FAQ 1].	We have been developing seawater desalination. We have completed a feasibility study of desalination in Hong Kong and are implementing the first stage of desalination plant in Tseung Kwan O for anticipated completion in 2023.
A voluntary Water Efficiency Labelling Scheme (WELS) [refer to FAQ 2] was successfully launched in phases since 2009. WELS currently covers six major plumbing fixtures and devices including showers for bathing, water taps, washing machines, urinal equipment, flow controllers and water closets.[1] We have also subsequently required the use of products of certain water efficiency grade(s) in new plumbing installations [refer to FAQ 3] since 1 February 2017 with one year grace period for prescribed types of plumbing fixtures and devices under WELS namely showers for bathing, water taps and urinal equipment.	We have been actively pursuing water reclamation as an alternative water source. We are implementing the infrastructure in north-eastern part of New Territories including Sheung Shui and Fanling, and preparing the legislation for supply of reclaimed water with a view to starting supply of reclaimed water from 2022 to those areas where fresh water is still being used for flushing.
The Replacement and Rehabilitation (R&R) of Water Mains Programme was substantially completed by 2015. About 3,000 kilometres of aged water mains have been replaced and rehabilitated. It has resulted in great reduction in the number of water mains bursts from the peak of about 2,500 in 2000 to around 100 in 2018 and the leakage rate in government water mains from about 25% in 2000 to about 15% in 2018.	We are going to implement a district-based grey water recycling system at the Anderson Road Quarry development site to collect grey water in the development and treat the grey water for supply to the development for flushing and other non-potable uses. The construction of the grey water treatment plant will commence soon in 2020 for commissioning to match with the population intake of the development.
With the improvement of the water supply network achieved by R&R and riding on the technological advancement of sensors, telemetry, network management software and data analysis in recent years, we are implementing Water Intelligent Network (WIN)[2] for monitoring the water loss of the fresh water distribution network for follow up action. The WIN strategy was formulated in 2014 and the associated works for its progressive establishment are in progress.	We have been providing ample protection of our water resources including stringent control of developments in the water gathering grounds and proper maintenance of catchwaters in order to safeguard the quality and quantity of local water resources.
We have extended the coverage of the seawater supply network for flushing from below 80% to 85% of the population for further reduction of fresh water demand.	The Drainage Services Department (DSD) is implementing the Inter-reservoirs transfer scheme which serves dual purposes of reducing flood risk in Lai Chi Kok area and increasing local yield. The project is anticipated to be completed by 2022.

COMPLETED/ON-GOING MAJOR INITIATIVES

2006

Installation of master meters mandated in all new developments with two or more building blocks

2009

Voluntary WELS launched

Installation of water saving devices in Government premises and schools started

2011

"Water: Learn & Conserve" Teaching Kit for Liberal Studies in Secondary School published

2012

Temporary Water Resources Education Centre opened

2013

"Let's Save 10L Water" Campaign launched

2014

Formulation of Water Intelligent Network (WIN)

Distribution of flow controllers to domestic households under the "Let's Save 10L Water" Campaign and application of e-Bill Services

Installation of flow controllers at Public Rental Housing Estates commenced

2015

Feasibility study for Tseung Kwan O desalination plant completed

Replacement and Rehabilitation of Water Mains Programme substantially completed

"Cherish Water Campus" Integrated Education Programme (IEP) – Primary School launched

2016

Water Conservation Week 2016

Best Practice Guidelines for Water Usage in Catering and Hotel Industries published

2017

Investigation and design for the grey water treatment plant at Anderson Road Quarry Development Site started

Infrastructure works related to supply of reclaimed water in north-western part of NT started

Mandatory WELS Stage 1 implemented

2018

Tendering of the first stage of Tseung Kwan O desalination plant project

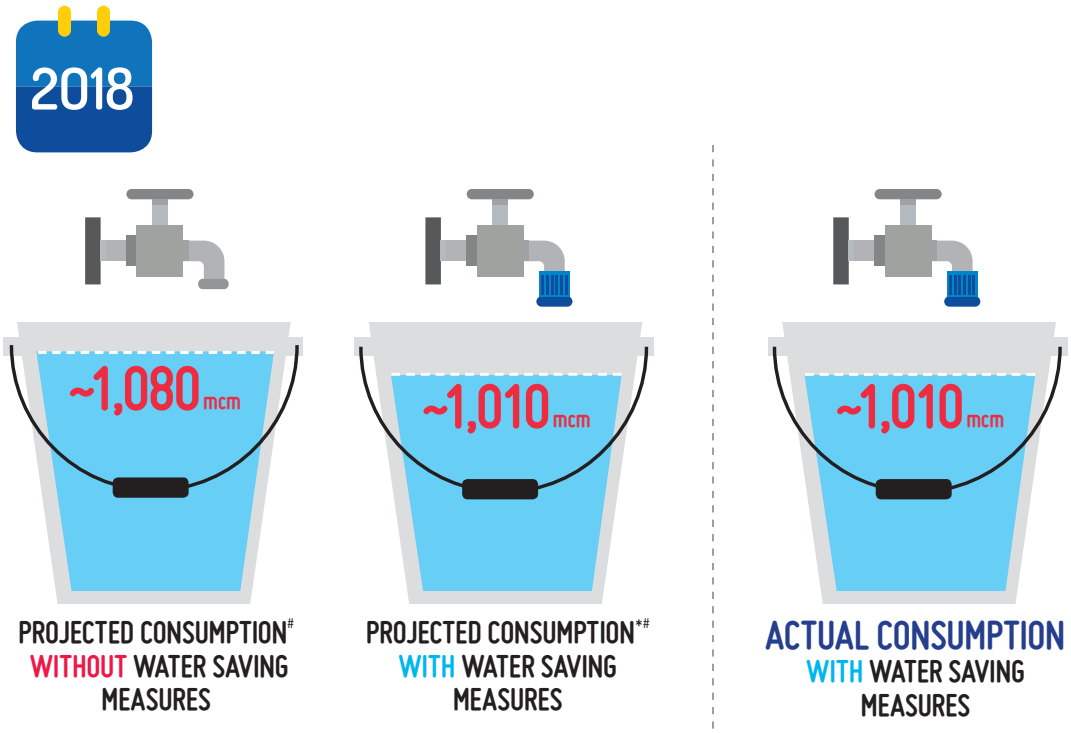
"Cherish Water Ambassador" launched

"Cherish Water Campus" IEP – Kindergarten launched

Promising Performance in Containing Growth of Water Consumption

The effectiveness of the Strategy can be broadly reflected by two key performance indicators (KPI): (1) the total fresh water consumption and (2) the change of average fresh water per capita consumption (pcc). After implementation of the Strategy, the total fresh water consumption in Hong Kong has been successfully contained at the level of around 1,000 million cubic metres (mcm) over the past ten years notwithstanding with a continuous growth of population at a rate of 0.7% per annum which is on par with the anticipated consumption after the implementation of the water demand management measures projected under the Strategy. As regards the fresh water pcc[3], the 10-year average has dropped from 140 to 133 m^3 per capita per year after implementation of the Strategy. The above KPI demonstrated the overall effectiveness of the Strategy.

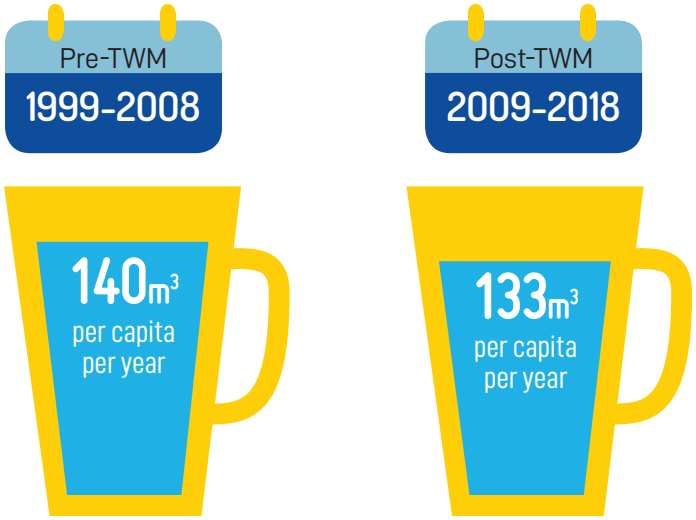
ANNUAL FRESH WATER CONSUMPTION



\# Adjusted according to actual population

* Estimate of water saving adjusted according to actual development programme of new development areas

YEARLY AVERAGE OF FRESH WATER PER CAPITA CONSUMPTION



Domestic Fresh Water Consumption

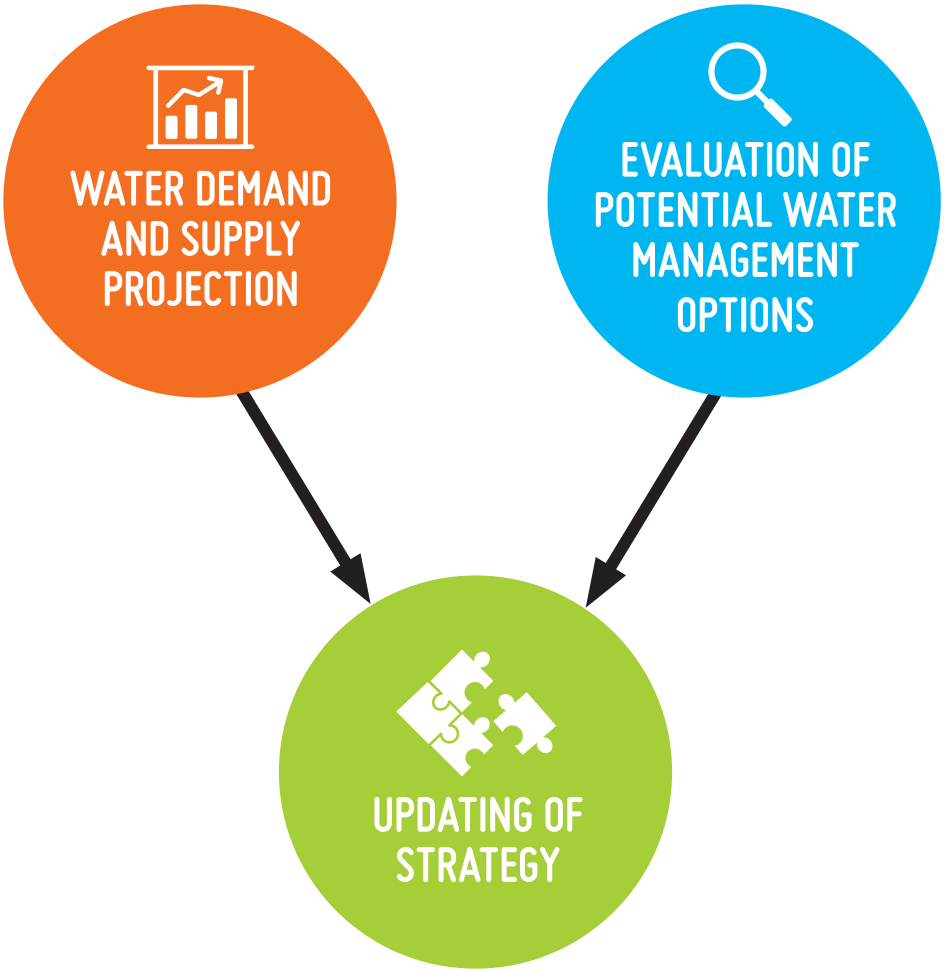
Zooming into the level at domestic household, we observed a mild rising trend of domestic fresh water pcc in recent years which rebounds from the lowest 129 litres in 2010/11 to 135 litres in 2017/18. The increase in domestic fresh water pcc could be attributed to various possible factors including the decreasing trend[4] of average domestic household size[5], raising awareness of public health and hygiene, as well as upgrading quality of living in Hong Kong[6] etc. Nevertheless, with the adoption of seawater for flushing which has effectively reduced fresh water consumption in households, the domestic fresh water pcc in Hong Kong is in fact lower than some other international cities of advanced economies[7].

1. We conduct periodic review of the Scheme Documents for these plumbing fixtures and devices.
2. Under WIN, the fresh water distribution network will be divided into about 2,400 discrete District Metering Areas (DMAs) of manageable size with monitoring and sensing equipment installed in each DMA for continuous monitoring of its water loss.
3. The Strategy has been implemented for about 10 years. As the pcc of each year would fluctuate, the 10-year average pcc before and after implementation of the Strategy are compared to evaluate its effectiveness.
4. Average domestic household size of 3 in 2008 decreased to 2.8 in 2018.
5. Pcc in certain daily living activities, e.g. home cleaning and cooking, can be reduced for a larger household size due to more efficient use of water compared to same number of people living in multiple households (i.e. smaller household size).
6. Upgrading quality of living in Hong Kong increases pcc due to greater enjoyment in showers (longer time and larger frequency), home and car cleanliness, etc.
7. According to a study carried out by the University of Hong Kong in 2015, the domestic fresh water pcc (litre per capita per day) in 2011 was 128.9 for Hong Kong, while the domestic pcc of other cities were: 214.5 for Beijing; 222 for Taipei; 174 for Shenzhen; 153 for Singapore; and 218.9 for Sydney. These cities use fresh water for flushing.

2 STRATEGY REVIEW

The Strategy, which was promulgated in 2008, has been overall effective. However, in face of contemporary challenges of population and economic growth, climate change as well as keen competition in the Pearl River Delta on water resources, the Review updated the forecast methodologies of water demand and supply and projections up to 2040 and sought for new water management initiatives and adjustments to the existing measures if necessary for ensuring the long-term sustainability of water supply in Hong Kong.

METHODOLOGY OF STRATEGY REVIEW

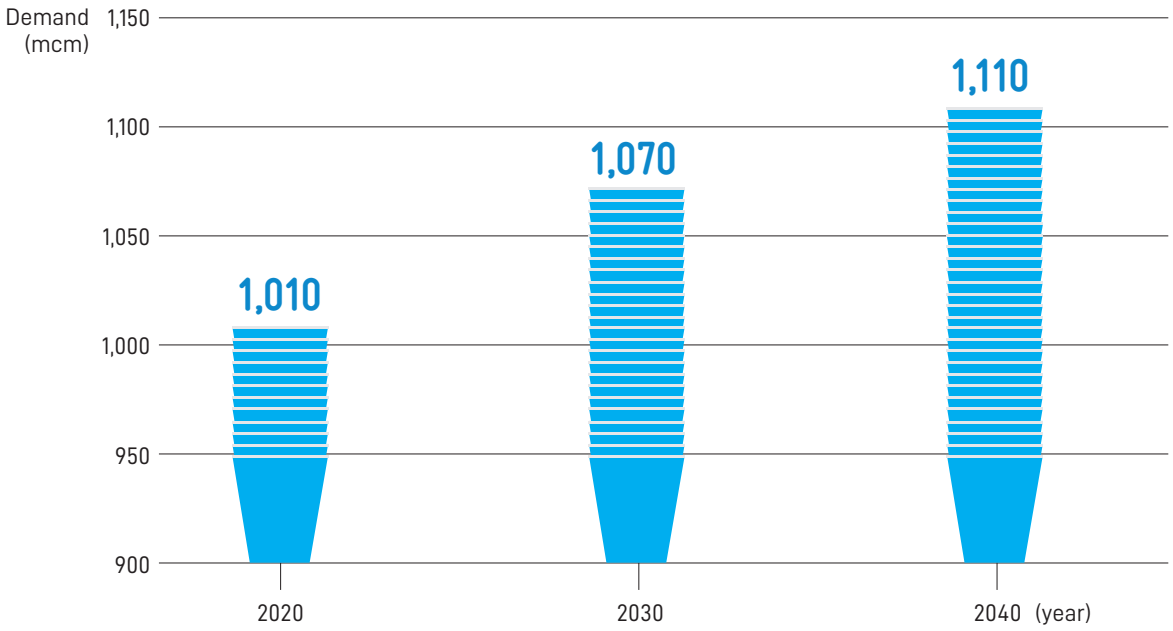


Water Demand and Supply Projections

Water Demand Projection

The water demand projection [refer to FAQ 4] is estimated based on the baseline population projection [refer to FAQ 5] of 8.2 million by 2040 provided by the Census and Statistics Department. Under this expected population growth scenario, the annual fresh water demand is projected to increase to 1,110 mcm in 2040, in the absence of water demand management measures.

DEMAND FORECAST PROJECTION



Projection of Local Water Supply

Local yield is the rainwater collected from water gathering grounds in Hong Kong. The water supply projection of our local yield is based on the projected rainfall under the scenario analysis of different national emission reduction scenarios in relation to the pledges agreed at the Paris Climate Conference in 2015. If all the national emission reduction pledges materialise, the medium-low and medium-high scenarios of greenhouse gas concentration scenarios would be more likely to happen with corresponding impact on the global climate [refer to FAQ 6]. Under these scenarios, the mean of annual rainfall in Hong Kong in the next couple of decades is likely to be slightly lower than the average annual rainfall during the period of 1986-

2005. However, given that there are also some experts expressing uncertainty in achievement of the reduction pledges eventually, a prudent approach is adopted to consider the plausible extreme climate change effect by including all climate change scenarios in an envelope to cater for the lower bound of the projected effect on annual rainfall[8] in the evaluation of climate change effect on local yield.

The consultants have developed a yield model [refer to FAQ 7] to forecast the local yield from our water gathering grounds. Under the projected mean rainfall of the medium-low and medium-high climate change scenarios, the reliable local water supply[9] will remain more or less the same as the historical long-term average. However, under the lower bound of the envelope of projected effect on annual rainfall of all climate change scenarios, the reliable local water supply may decrease by about 50mcm.

Evaluation of Potential Water Management Options

Having projected the water demand and supply in the future, we need to implement water management measures to ensure sustainability of water supply in Hong Kong. In the following paragraphs, an evaluation for selecting and prioritising the potential options of water management measures is introduced.

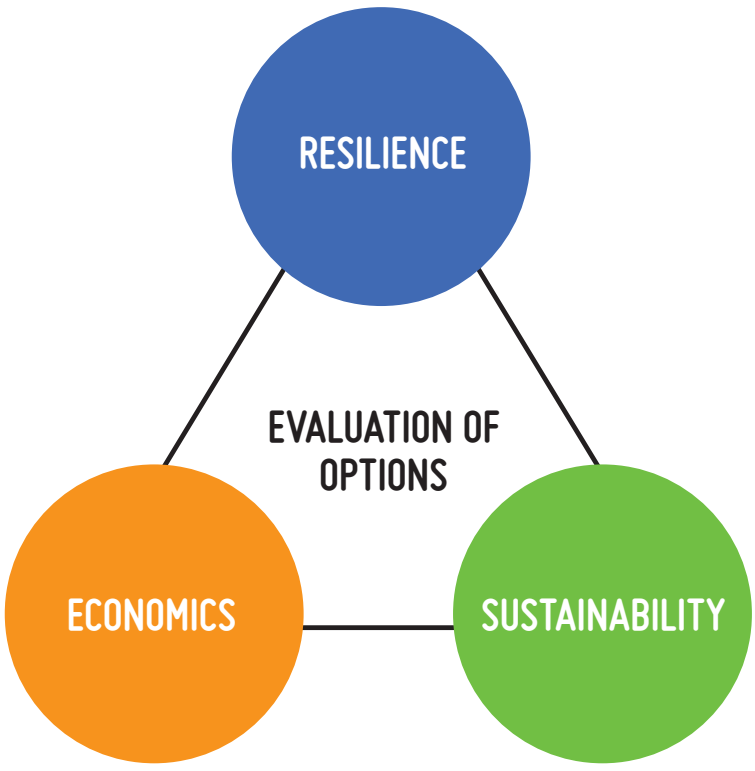
Defining Supply Baseline

To proceed, we need to set the scene for the evaluation by establishing a supply baseline. The consultants have adopted the current water supply portfolio of three water taps, namely the local yield, Dongjiang water imported from the Guangdong Province and seawater for flushing, as the baseline. International experts from the consultants considered that the current fresh water supply arrangement (i.e. local yield together with guaranteed Dongjiang water supply with a ceiling of 820 mcm per annum) should be reasonably set as the baseline condition and it is an optimal arrangement which has secured water supply reliability of 99% for Hong Kong, such that water supply can be maintained round-the-clock even under extreme drought condition with a return period of one in 100 years. The current water supply system in Hong Kong has the infrastructures for water transfer and treatment built in place already to cater for Dongjiang water supply ceiling of 820 mcm per annum. Reduction of the supply ceiling will lower the utilisation of the existing system

and on the other hand require additional investment in implementation of other water supply facilities to make up the reduced Dongjiang water supply and such proposal is thus not cost-effective. On the contrary, further increase in Dongjiang water supply ceiling will mean additional charges for purchasing that quantity of water above the current supply ceiling and additional investment in infrastructures for transfer and treatment of the increased Dongjiang water quantity. The cost-effectiveness for the increase in Dongjiang water supply ceiling need to be evaluated in comparison with other water supply management options.

Multi-Criteria Evaluation

The Review has carefully evaluated the water demand and water supply management options using an approach named "Multi-Criteria Evaluation" [refer to FAQ 8]. First, against the backdrop of the existing supply arrangement of Dongjiang water supply together with local yield as the baseline, the consultants identified options in water demand and water supply management and shortlisted a number of options on the basis of technical viability, land requirement, environmental impact, etc. A panel of international experts of the consultants evaluated and scored the shortlisted options under the three sets of criteria: **resilience, economics and sustainability**. Based on the combined score of each shortlisted option, a prioritised list of the shortlisted options is drawn up. In reviewing the Strategy, we have engaged the Advisory Committee on Water Supplies [refer to FAQ 9] and stakeholders, and have also taken into consideration the views collected.




Supply Management Options
Demand Management Options
First stage of the Tseung Kwan O Desalination Plant
Reactivation of mothballed water treatment works on Hong Kong Island
Second stage of the Tseung Kwan O Desalination Plant
Increase of Dongjiang water supply
Other desalination plants
Expansion of storage capacity by constructing a reservoir at high level in the Plover Cove Reservoir
Expansion of the water gathering ground of High Island Reservoir
Expansion of the water gathering ground of Plover Cove Reservoir
Water loss management
Strengthening promotion of water conservation
Expansion of use of lower grade water for non-potable uses
SHORTLISTED WATER MANAGEMENT OPTIONS

Updating of Strategy

Based on the prioritised water management options, the updated Strategy (Strategy 2019) will adopt a two-pronged approach with emphasis put on **containing fresh water demand growth** and **building resilience in the fresh water supply with diversified water resources**, which is considered to be the most effective strategy.

As revealed in the Review, under the medium-low and medium-high greenhouse gas concentration scenarios with mean annual rainfall and the expected population growth scenario, the current water supply will be able to meet the forecast water demand when measures to contain the demand growth are implemented. We will therefore continue to implement the water demand management measures of water conservation, water loss management and expansion of the use of lower grade water (i.e. seawater and recycled water) for non-potable purposes.

We have also worked out the water supply management measure for building resilience in the fresh water supply to cater for the lower bound of the envelope of projected effect on local annual rainfall (and hence substantially reduced local yield) due to climate change, i.e. the first stage of desalination plant in Tseung Kwan O (TKO) to be commissioned in 2023 to supply desalinated water.

Furthermore, a list of backup options is recommended in case the situation had deviated from the present projections due to reasons such as higher-than-expected population growth [refer to FAQ 10], worse-than-projected impact of climate change on rainfall or less-than-anticipated effect of containing water demand growth.

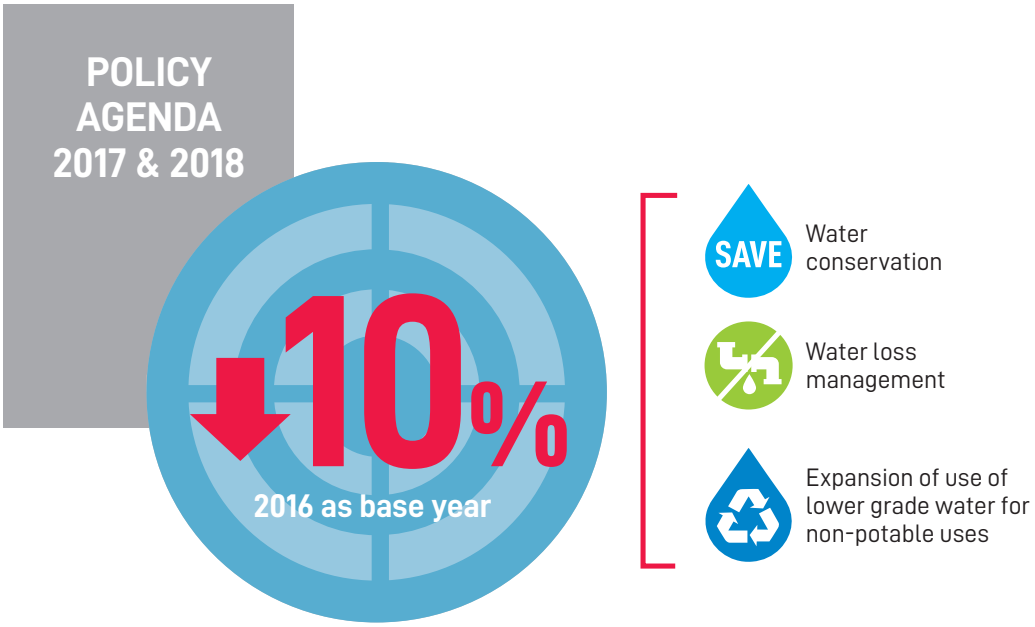
8. Projected effect on annual rainfall refers to the projected annual rainfall anomaly of Hong Kong relative to the average of 1986-2005 under different greenhouse gas concentration scenarios by the Hong Kong Observatory.
9. Reliable local water supply refers to the contribution of local yield and reservoir storage under extreme drought condition with a return period of one in 100 years.


Building resilience in water supply
Backup options
Containing fresh water demand growth
First stage of the Tseung Kwan O Desalination Plant
Reactivation of mothballed water treatment works on Hong Kong Island
Second stage of the Tseung Kwan O Desalination Plant
Increase of Dongjiang water supply
Other desalination plants
Expansion of storage capacity by constructing a reservoir at high level in the Plover Cove Reservoir
Expansion of the water gathering ground of High Island Reservoir
Expansion of the water gathering ground of Plover Cove Reservoir
SAVE
Strengthening promotion of water conservation
Water loss management
Expansion of use of lower grade water for non-potable uses
PRIORITISED WATER MANAGEMENT MEASURES

3 CONTAINING FRESH WATER DEMAND GROWTH

It is the outcome of the "Multi-Criteria Evaluation" that containing fresh water demand growth will be the prioritised water management measure. Moreover, as pledged in the Policy Agenda 2017 and 2018, the Government's goal is to reduce the average fresh water pcc by 10% by 2030 at the earliest, using 2016 as the base year. We will take forward three main initiatives to achieve this goal, namely, **water conservation**, **water loss management** and **expansion of use of lower grade water for non-potable purposes**.

TARGET REDUCTION IN PER CAPITA FRESH WATER CONSUMPTION

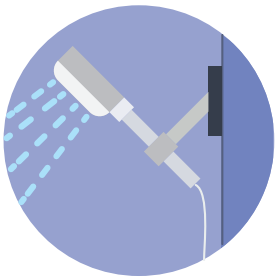


Strengthening Promotion of Water Conservation

Water Efficiency Labelling Scheme (WELS)

We have taken gradual steps to migrate WELS for plumbing fixtures and devices from voluntary participation to mandatory implementation in two stages. In Stage 1, it is mandatory to use products of certain water efficiency grade(s) in new plumbing installations for prescribed types of plumbing fixtures and devices under WELS. Starting from February 2018, water efficient products registered under WELS for the types of plumbing fixtures and devices namely showers for bathing, water taps and urinal equipment are required to be used in all plumbing works that require permission from the Water Authority in kitchens in domestic premises and bathrooms and toilets in all premises. In Stage 2, we plan to implement mandatory WELS for the designated types of plumbing fixtures and devices that WELS label is to be affixed to either the products or their packages on sale in the retail market via amendments to the Waterworks Ordinance and Waterworks Regulations.

VOLUNTARY WATER EFFICIENCY LABELLING SCHEME (WELS)

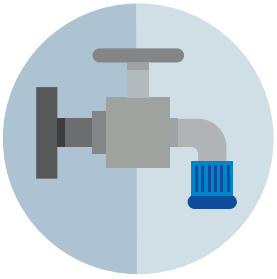


Showers for Bathing

Water Taps

Urinal Equipment

Washing Machines



Flow Controllers

Water Closets

Automatic Meter Reading

Innovation and technology are key elements in the Strategy 2019. We will use smart technology to facilitate water conservation. We have planned to implement Automatic Meter Reading (AMR) in appropriate, new public and private developments and aim to install about 460,000 smart water meters in the next ten years. In addition to enabling automatic reading of water meters, AMR can provide customers with timely water consumption data and related information. The use of AMR can raise customers' awareness about water conservation and alert them of abnormal water consumption which may be caused by leakage in water mains inside their premises. Customers could then take early rectification action accordingly.

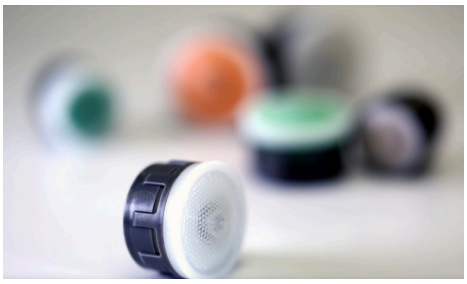
Strengthening of Public Education

We will strengthen the culture of water conservation through proactive promotion, education and engagement with the community. We will step up publicity and public education programmes in collaboration with non-government organisations, and strengthen engagement of younger generation. Our school education programmes have already covered secondary and primary schools as well as kindergartens. Since the 2015/16 school year, we have launched "Cherish Water Campus" Integrated Education Programme ("IEP"), which targeted at primary school students. The programme aimed at broadening students' knowledge about water resources, and raising their awareness of water conservation and water sustainability via integrating theory with practice, such as school water audit, home water audit and education camp on water conservation. To further extend IEP to pre-primary levels, we have also launched the pilot IEP for kindergartens in the 2017/18 school year and fully launched the programme to all kindergartens in the 2018/19 school year. We have also launched a Cherish Water Ambassador Scheme for youngsters in secondary schools and tertiary institutions in 2018. An array of events is tailor-made for the Ambassadors, including Water Treatment Works Guided Tour, short film production workshop and training camp including sharing session with film experts and directors, video competition and in-school promotional activities. All these will educate the Ambassadors the importance of cherishing water resources, fulfilling and publicising the habits of cherishing water. A water resources education centre

will be commissioned in Tin Shui Wai in late 2019 to enhance public understanding about water resources and water conservation. A territory-wide public activity, "Let's Save 10L Water" Campaign, is launched since 2014 to encourage the public to pledge to save 10 litres of water every day and implement water-saving practices in daily lives.

Enhancement of Water Use Efficiency

For businesses and industries, we will continue to promote the "Best Practice Guidelines on Water Usage" to high water consumption industries including catering and hotel sectors in order to enhance water efficiency. We have also been continuing the installation works of water saving devices (such as water taps, showers for bathing, etc.) in suitable government venues and schools in phases since 2009. Moreover, we will complete the installation of flow controllers at public rental housing estates by 2022 to help reduce domestic fresh water consumption. In addition, we are planning to extend the installation to private housing estates and schools. We continue to distribute free water flow controllers to the domestic households via the "Let's Save 10L Water" Campaign and application for e-Bill service.



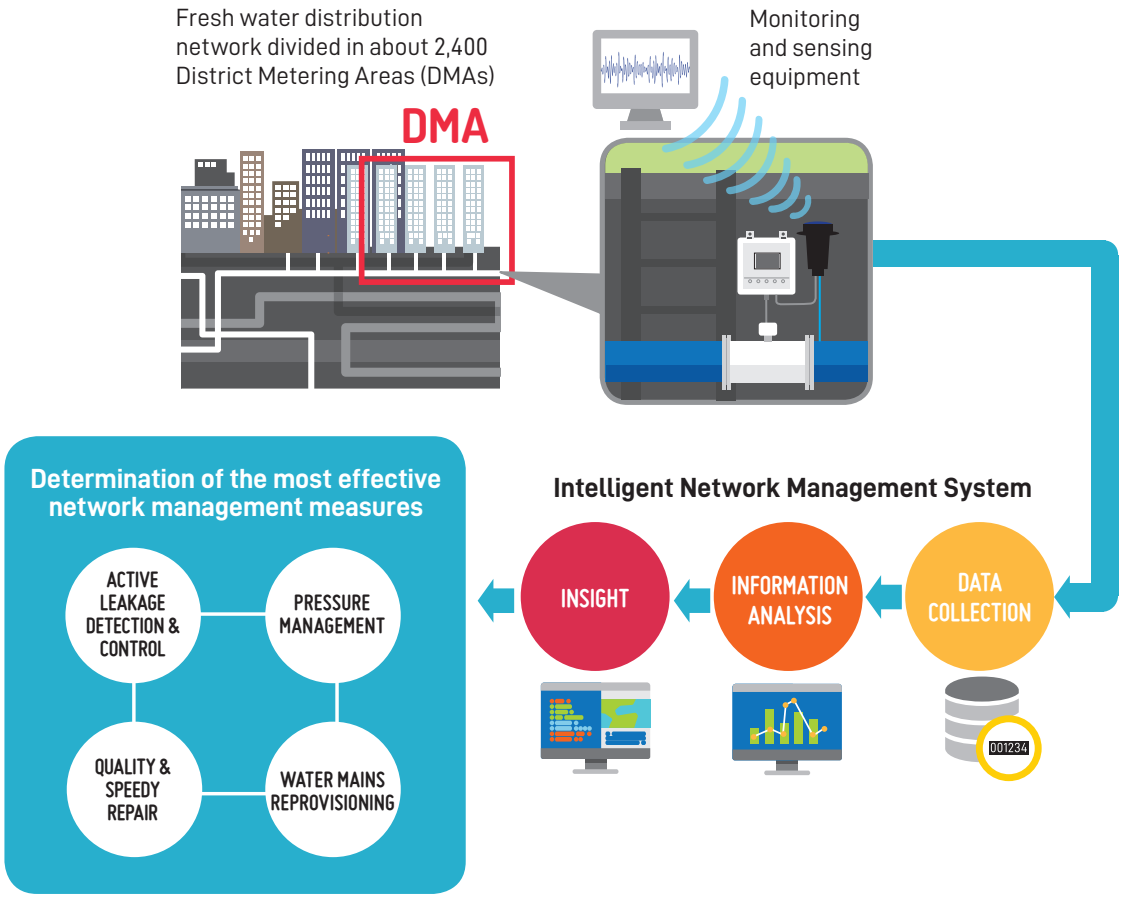
Water Loss Management

The hilly terrain as well as vibration and disturbances to underground water mains brought by frequent roadworks, busy traffic and congested underground utilities in the city cause higher risks of leakages [refer to FAQ 11] from the water mains in Hong Kong. We are taking steps to reduce water loss due to leakages from both government and private water mains through various measures. We have set a target of reducing leakage rate of government water mains from about 15% in 2017 to below 10% by 2030.

Water Intelligent Network (WIN)

We are progressively establishing the Water Intelligent Network (WIN). Under WIN, the fresh water distribution network will be divided into about 2,400 District Metering Areas (DMAs) within which monitoring and sensing equipment will be installed. The essence of WIN is to divide the vast fresh water distribution network in the territory into discrete DMAs of manageable size for continuous monitoring of their water loss so as to prioritise them for taking effective network management actions including (a) active leakage detection and control; (b) pressure management to reduce the water supply pressure in the network; (c) quality and speedy repairs to water main leaks and bursts; and (d) reprovisioning of aged water mains which are beyond economical repair. The vast amount of data collected from these DMAs will be analysed with a new Water Intelligent Network Management System which is anticipated to be commissioned in 2020. Besides, in order to enhance the leakage detection work of our water mains, we are exploring various advanced technologies in leakage detection of water mains.

HOW WATER INTELLIGENT NETWORK (WIN) WORKS



Underground Asset Management

Having drawn on the latest international best practices, we are implementing a strategy for underground asset management of water mains through an optimal balance of cost (including social cost), risk and service levels. Under the underground asset management strategy, we will determine if improvement works are required for each water main in the supply network and prioritise the improvement works on a risk-based approach [refer to FAQ 12].

Reduction of Private Water Main Leakage

Currently, leakage from private water mains accounts for about 8% of total fresh water consumption in Hong Kong. We will tackle private water main leakage on multiple fronts. First, installation of master meters has been mandated in all new developments with two or more building blocks since 2006. We are also installing master meters in existing developments with an aim to achieving completion of master meter installation for all large housing estates (exceeding 1,000 flats) by 2023. Master meters can help us better monitor water loss of the developments and facilitate our follow up action with suspected leakage in their private communal water mains. Second, we will provide property owners and building management agents with technical advice and support to detect leakage and make subsequent repair to their private communal water mains. In this connection, we will render assistance to the market to develop expertise in leakage detection including personnel and contractors with recognised qualifications. Third, we will step up enforcement through the existing Waterworks Ordinance against water loss in private communal water mains and are exploring options to tackle the water loss problem in private communal water mains through legislative amendments.

Expansion of Use of Lower Grade Water

Seawater for flushing has been introduced in Hong Kong since the late 1950's. Up till now, Hong Kong is one of the few places extensively applying seawater for flushing. The use of such a sustainable water resource continues to play an important role in Hong Kong's water resource management. Currently, a total of 280 mcm per annum of seawater is supplied, conserving an equivalent amount of fresh water which is about 20% of the total water consumption in Hong Kong.

We target at expanding the network coverage of using lower grade water for flushing from 85% of the total population to 90% in the long run in order to further reduce the fresh water demand for flushing. Lower grade water refers to seawater and recycled water. Recycled water comprising reclaimed water (produced by further processing treated sewage effluent), treated grey water[10] and harvested rainwater is suitable for non-potable purposes. The implementation plan of using recycled water is as follows:

- The Shek Wu Hui Sewage Treatment Works will be upgraded into an Effluent Polishing Plant (EPP) by adopting tertiary treatment. We will further process the tertiary treated effluent from the EPP to produce reclaimed water for supply to the northeast New Territories, including Sheung Shui and Fanling currently being supplied with fresh water for flushing, in phases starting from 2022 onwards. We will further extend the supply of reclaimed water to Kwu Tung North and Fanling North New Development Areas in accordance with their development programmes.

- The existing developments in Tung Chung are currently supplied with fresh water for flushing. The seawater flushing systems to the existing Tung Chung New Town and Tung Chung New Town Extension are being implemented in phases for target commissioning in end 2023.

- Construction of a district-based grey water recycling system at the Anderson Road Quarry development site will commence in 2020 with a view to collecting grey water in the development and treating the grey water for supply to the development for flushing and other non-potable purposes to match with population intake of the development.

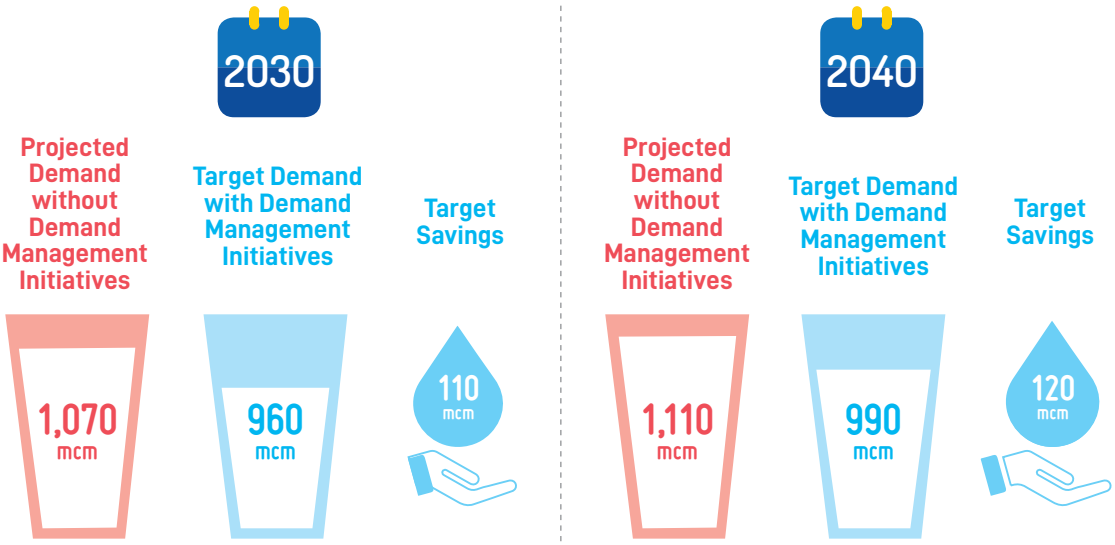
- With a view to further reducing the use of fresh water for flushing, we will continue to review the extension of supply of lower grade water to other new development areas and those areas still being supplied with fresh water for flushing and other non-potable purposes [refer to FAQ 13] to save the precious fresh water resources.

We have also been promoting the use of recycled water for non-potable uses in government buildings as well as private buildings. In line with the Government's policy on green buildings, works departments would as far as practicable, install rainwater harvesting or grey water recycling systems in government buildings in public works projects. By mid-2019, new buildings of about 100 government projects have been installed with rainwater harvesting or grey water recycling systems. We have also been working with the Hong Kong Green Building Council to promote adoption of recycled water in private buildings through the Building Environmental Assessment Method (BEAM) Plus. Buildings with grey water recycling system or rainwater harvesting system will be eligible for credits under BEAM Plus to encourage private developers to provide these facilities in lieu of using fresh water for non-potable uses.

Future Water Demand

With the continued implementation of the above demand management measures in respect of water conservation, water loss management and expansion of use of lower grade water for non-potable purposes, it is anticipated that the growth of fresh water demand will be contained and maintained at the level of around 1,000 mcm per annum.

FUTURE WATER DEMAND



10. Grey water is collected from baths, wash-basins, kitchen sinks, etc. and can be treated for non-potable uses.

4 BUILDING RESILIENCE IN FRESH WATER SUPPLY

Hong Kong's water supply is indispensable to the people's livelihood and supports the sustainable development of the society. To enhance the ability of the fresh water supply system to adapt to climate change, the Review has evaluated the possible impact on the system under the effect of climate change and recommended building resilience in the fresh water supply as a water supply management initiative.

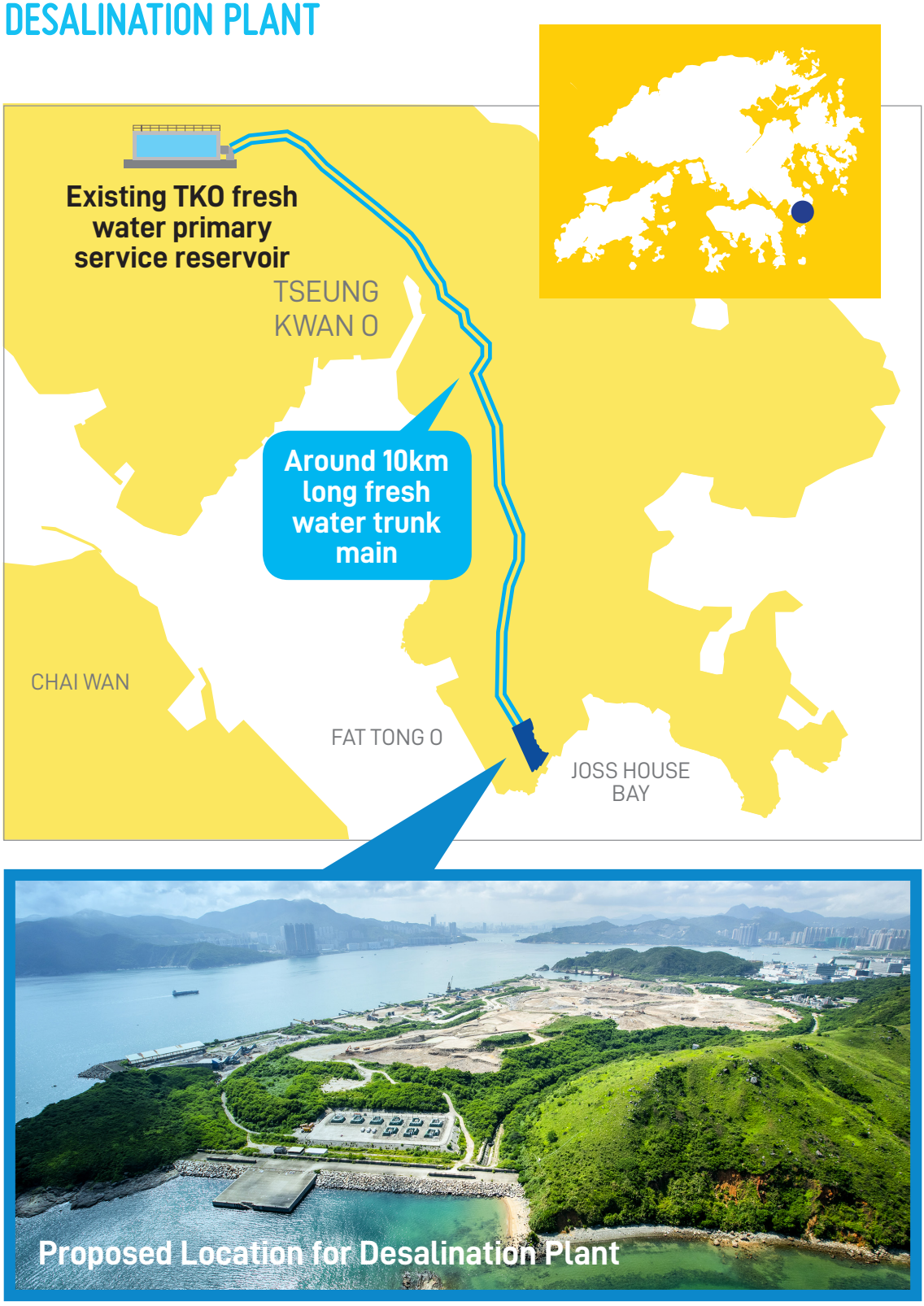
Under the climate change effect on mean rainfall of the medium-low and medium-high greenhouse gas concentration scenarios, the current supply arrangement with local yield, Dongjiang water and seawater for flushing will be able to cope with the demand up to 2040 if the target of demand management measures, i.e. reducing the average fresh water pcc by 10%, is achieved.

In view of the possibility that the local yield may decrease substantially due to climate change, the Strategy 2019 recommends to build resilience in our fresh water supply. To cater for the lower bound of the envelope of projected effect on local annual rainfall due to climate change, we are building resilience in our fresh water supply through the first stage desalination plant in TKO.

Desalination

Desalination is a strategic water resource which is not susceptible to impact of climate change. We will take forward the construction of the first stage of the TKO desalination plant which aims to commence operation in 2023 with a capacity of producing 50 mcm of fresh water per annum with provision for future expansion to the ultimate capacity of 100 mcm per annum. The desalination plant will adopt the latest technology of reverse osmosis, which has been confirmed with a previous pilot study to be effective in producing potable water complying with the Hong Kong Drinking Water Standards under local conditions. First stage of the desalination plant will meet around 5% of total fresh water consumption in Hong Kong.

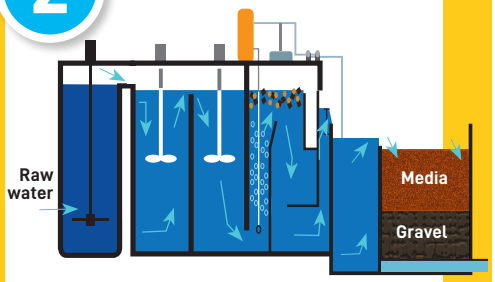
LOCATION OF TSEUNG KWAN O DESALINATION PLANT



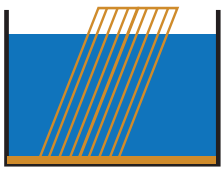
CLEAN, SAFE AND PROVEN DESALINATION TECHNOLOGY USING REVERSE OSMOSIS

1 SEAWATER INTAKE

2 PRE-TREATMENT FACILITIES



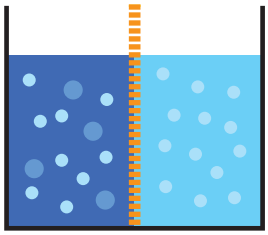
Pre-treatment facilities



Screening

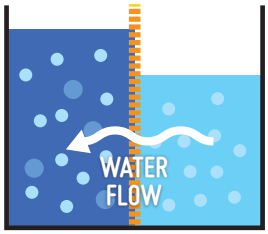
3 REVERSE OSMOSIS FACILITIES

Principle of Reverse Osmosis



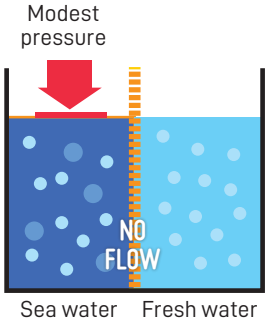
1

Seawater and fresh water with same volume are seperated by a semi-permeable membrane in a container



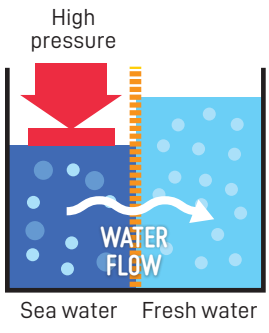
2

Natural Osmosis
Under normal osmosis, water diffuses from less concentrated solution through the membrane to achieve osmotic equilibrium



3

At Osmotic Equilibrium
Modest pressure is applied to sea water side so that fresh water cannot pass through the membrane



4

Reverse Osmosis
is the process of forcing water from concentrated solution to less concentrated solution through the membrane under high pressure. The membrane allows fresh water to pass through while it retains salts and other impurities.

Semi-permeable membrane
Dissolved salt ions
Water molecules

4 BRINE CONCENTRATE OUTFALL BY DIFFUSER

5 POST-TREATMENT FACILITIES

6 TREATED WATER PUMPING STATION

7 FRESH WATER TRUNK MAIN

5 ADDITIONAL LOCAL YIELD

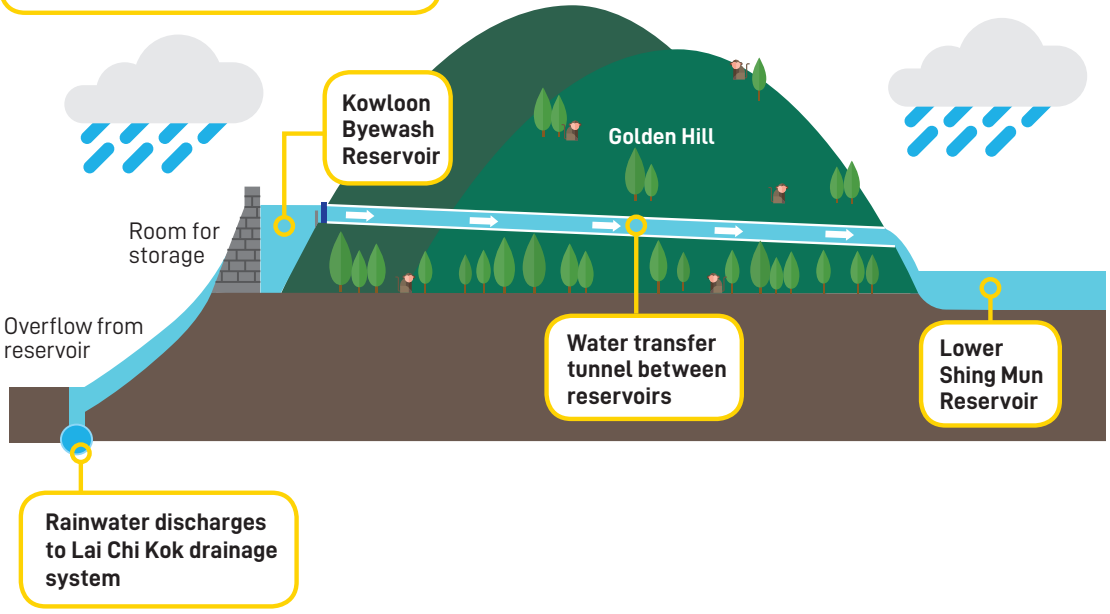
Inter-Reservoirs Transfer Scheme (IRTS)

DSD is implementing the Inter-Reservoirs Transfer Scheme (IRTS) project that builds a 2.8 km long water tunnel to connect Kowloon Byewash Reservoir and Lower Shing Mun Reservoir. The scheme serves dual purposes of reducing flood risk in Lai Chi Kok area and increasing the local yield. On one hand, it will substantially reduce the discharge of rainwater into the drainage system of Lai Chi Kok area; and on the other hand, the rainwater collected in Kowloon Byewash Reservoir can be diverted to Lower Shing Mun Reservoir to reduce overflow from the former reservoir and increase the yield of the latter reservoir. On its completion by around 2022, the IRTS is estimated to increase average local yield of around 3.4 mcm per annum, providing extra buffer of local fresh water resources.

HOW IRTS WORKS

Diverts rainwater collected in Kowloon Byewash Reservoir to Lower Shing Mun Reservoir to reduce overflow from the former reservoir thus increases local yield, at the same time reduces discharge of rainwater to Lai Chi Kok drainage system.

Serves dual purpose of reducing flood risks in Lai Chi Kok area and collect additional average yield of 3.4 mcm per annum



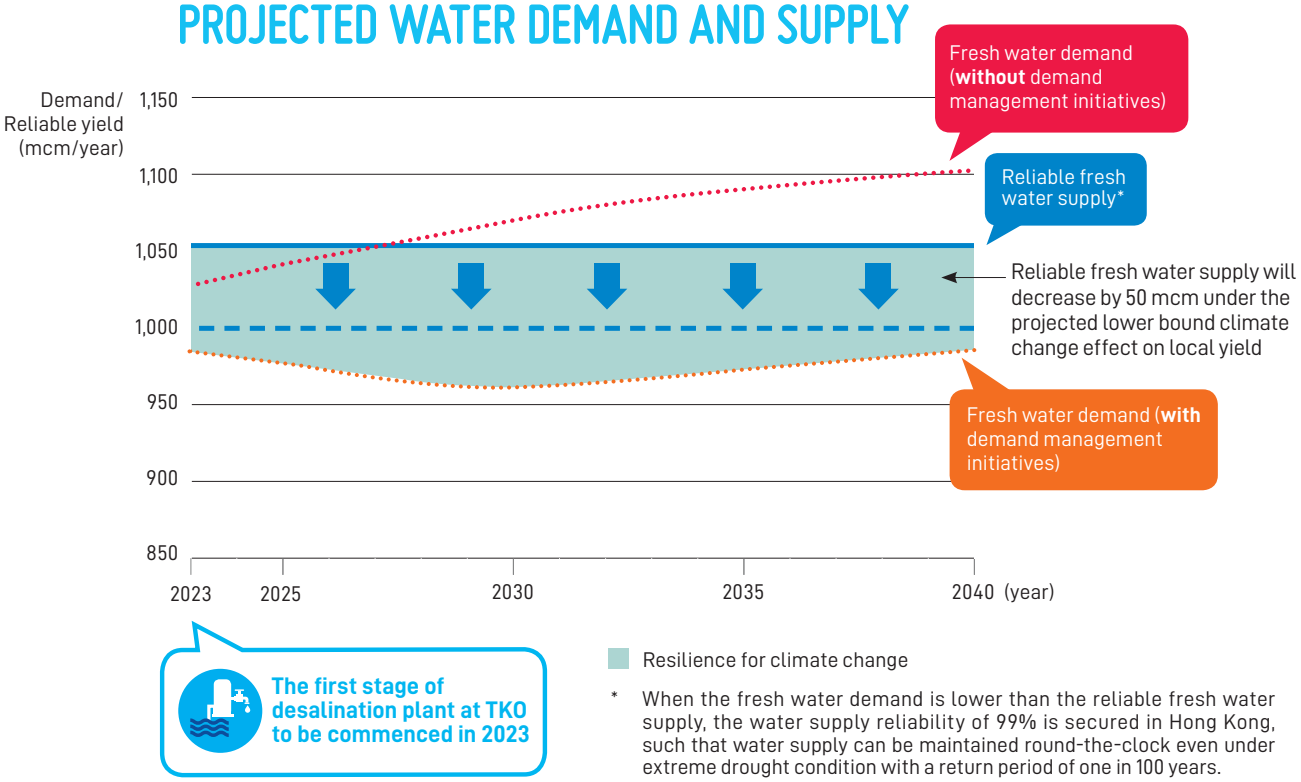
6 OUTLOOK OF DIVERSIFICATION OF WATER RESOURCES IN FUTURE

Following the recommended two-pronged approach under the Strategy 2019 by containing the growth of fresh water demand and building resilience of the fresh water supply, the future fresh water resources in Hong Kong will comprise the following.

Dongjiang water [refer to FAQ 14] with water supply ceiling of 820 mcm per annum	**~ 60% - 80%** depending on the amount of local yield
Local yield	**~ 15% - 35%**
Desalinated water [refer to FAQ 15] up to 50 mcm per annum	**~ 5%**

Besides, while the above fresh water resources will account for about 75% of the total water consumption in Hong Kong, the lower grade water (namely seawater and recycled water) for non-potable uses will account for the remaining 25% in the Strategy 2019.

PROJECTED WATER DEMAND AND SUPPLY



* When the fresh water demand is lower than the reliable fresh water supply, the water supply reliability of 99% is secured in Hong Kong, such that water supply can be maintained round-the-clock even under extreme drought condition with a return period of one in 100 years.

7 PLANNING FOR WORSE SCENARIOS

Capabilities to Tackle Worse-than-Expected Situation

As mentioned, if the situation had deviated from the present projections due to reasons such as higher-than-expected population growth, worse-than-projected impact of climate change on rainfall or less-than-anticipated effect of containing water demand growth, we still have the capabilities to overcome by implementation of a list of backup options that have been formulated in the Review. The backup options include implementation of second stage of TKO desalination plant, reactivation of mothballed water treatment works on Hong Kong Island[11], expansion of storage capacity of the Plover Cove Reservoir and water gathering grounds[12], implementation of other desalination plants[13], and increase of Dongjiang water supply.

Due to the considerations[14] of the cost-effectiveness, environmental impact, energy consumption etc. in the multi-criteria evaluation, the above backup options were not accorded with priorities in the Strategy 2019.

OVERVIEW

CONTAINING FRESH WATER DEMAND GROWTH	**Water loss management**
	Expansion of use of lower grade water for non-potable uses
	Strengthening promotion of water conservation
BUILDING RESILIENCE IN WATER SUPPLY	**First stage of the Tseung Kwan O Desalination Plant**
ADDITIONAL LOCAL YIELD	Inter-Reservoirs Transfer Scheme (by the Drainage Services Department)
BACKUP OPTIONS	Second stage of the Tseung Kwan O Desalination Plant
	Reactivation of mothballed water treatment works on Hong Kong Island
	Expansion of storage capacity by constructing a reservoir at high level in the Plover Cove Reservoir
	Expansion of the water gathering ground of Plover Cove Reservoir
	Expansion of the water gathering ground of High Island Reservoir
	Other desalination plants
	Increase of Dongjiang water supply

Continuous Monitoring and Review

In order to ensure that the people of Hong Kong will continue to enjoy adequate and reliable water supply, the Government is implementing the water demand and water supply management measures of the Strategy 2019. We can never afford complacency, however, in face of unpredictable impacts of climate change and unforeseen circumstances. We will therefore continuously monitor the water demand and supply situation. If the situation had deviated from the present projections, we will implement the appropriate backup options as necessary.

11. Reactivate the mothballed Eastern Water Treatment Works (WTW) and Aberdeen WTW so as to fully utilise the local yield captured from the Tai Tam Group of Reservoirs and Aberdeen Group of Reservoirs respectively.
12. Construction of a reservoir at high level in the Plover Cove Reservoir is proposed to increase the water storage capacity. In addition, expansion of water gathering grounds of Plover Cove Reservoir and High Island Reservoir will increase the yield of these reservoirs.
13. Desalination plants other than the first and second stages of the TKO desalination plant.
14. Expansion of storage capacity of the Plover Cove Reservoir by constructing a high level reservoir and expansion of water gathering grounds will impact on Country Parks and ecology; reactivation of mothballed Water Treatment Works on Hong Kong Island will involve substantial uprating works but only treat a moderate amount of fresh water; implementation of other desalination plants will increase significantly energy consumption and the running cost will also be high.

8 YOUR PARTICIPATION CREATES SYNERGIES

It is our unchanged goal to provide reliable water supply and ensure water sustainability. Synergies created by the collaboration between the Government and public are indispensable to overcome the acute challenges ahead and lead us to success. We invite you to join hands with us in the delivery of a host of measures for better management of our precious water resources and sustainability of water supply.

Save Every Drop of Water

Every drop of fresh water is precious resource on the Earth. You and your family can save water at home, in restaurants and workplace. Just a little change to our daily habits can help a lot. Let us think before turning on the water taps. You can also install water saving devices such as flow controller for water taps and showers for bathing, water-efficient water taps and showers for bathing, washing machines, or water-efficient water closets (such as those with dual flush function) that are registered under WELS at home. You can save water and your bill at the same time.

We would invite every family to join "**Let's Save 10L Water**" Campaign. Since 2014, we have been promoting the Campaign to encourage households to save water. All households that pledge to save 10L of water per capita every day will be given for free a pair of flow controllers for installation at water taps to conserve water at home. Please join this Campaign and visit **www.waterconservation.hk**. The Campaign 2.0 is planned to launch in 2019, aiming to widen the spectrum of beneficial parties through various programmes, encouraging different stakeholders in the community to put water conservation into practice.

Foreign domestic helpers can also contribute to the Campaign. If you have foreign domestic helpers at home, you can teach them how to save water. Please watch our promotional videos at **www.wsd.gov.hk/fdh**.

WATER SAVING TIPS AT HOME

If you have foreign domestic helpers at home, you can teach them how to save water.

Water saving tips for employers and helpers can be found in our videos: **www.wsd.gov.hk/fdh**

WATER SAVING TIPS WHEN DINING OUT

Use the same plate to take food for several times if it is clean

Do not replace bone plates and dining utensils unnecessarily

Only request for water when needed

Ask waiter to take away the unnecessary clean dining utensils

In a restaurant, be a water efficient customer!

Proactive Water Leakage Management

Leakage from the water mains at your home or office or communal area of your housing estate can waste a lot of water, sometimes with little of your knowledge. Property owners and building management agents have duties and incentives to repair and keep good maintenance of these private water mains to avoid leakage.

It is important for everyone to check your water mains at home for any leakage from time to time. Please engage licensed plumbers to fix any water mains problem as quickly as possible.

You can also help detect leakage from water mains in communal area of your housing estate. If you identify any suspected leakage in water mains in communal area of your housing estate, please report to the building management agent or WSD Enquiry Hotline at telephone number 2824 5000.

Education of Young Generation

"Save a Droplet, Save the World." Let us promote this important message to our young generation. Parents and teachers can educate your children and students the importance of using precious water resource wisely. You can encourage your family, children and friends to participate in water conservation campaigns and education programmes.

Teachers can use our education programme materials of the Cherish Water Campus to teach students in kindergartens and primary schools how to conserve water at schools and home. For secondary school, teachers can use the materials prepared by us for Liberal Studies for students to discuss and express their view on water related topics.

We have launched a Cherish Water Ambassador Scheme to promote water conservation among the younger generation. Please encourage your children, students and young friends at secondary schools or tertiary institutions to become ambassadors of water conservation.

If you have any idea to promote water conservation, we welcome very much a partnership with you. Together, we can foster a stronger culture of using water wisely in Hong Kong.

FREQUENTLY ASKED QUESTIONS (FAQs)

1. Are Hong Kong people aware of the importance of water conservation?

We conducted Domestic Water Consumption Survey in 2015/16 to identify the domestic water consumption patterns and gauge the public awareness of and response to water conservation education. From the survey, 98.2% of the interviewees have implemented one or more water conservation measures (e.g. taking shower instead of bath, shortening the showering time and reducing the flow of shower for bathing and water tap, etc.) which indicates that people are now more aware of the importance of water conservation.

2. How were the grading tiers of WELS established?

We engaged consultants to review overseas technical standards of water saving devices, for example, those of Australia, New Zealand, Singapore, United Kingdom and the United States of America (USA) in order to develop the technical standards, including the water efficiency grading system, the test parameters and testing methodology for Hong Kong context.

3. How were the required water efficiency grades of prescribed types of plumbing fixtures and devices under WELS in new plumbing installations determined?

Assessment criteria comprising water saving performance, suitability for application and availability in local market were considered in determining the mandatory water efficiency grades. The business impacts on the stakeholders were also considered.

4. How is the water demand projection carried out?

The water demand model has been developed by the consultants to forecast the water demand till year 2040.

The water demand model takes into account different factors, including future territorial population, employment structure, economic growth, planned and latest known development proposals of relevant government departments, quasi-government bodies and the private sector, meteorology, etc. The statistical information was mostly sourced from the Planning Department.

5. What is the population forecast data adopted in the Review?

The water demand projection is based on the Territorial Population and Employment Data Matrix (TPEDM) compiled by the Planning Department and the population projections from the Census and Statistics Department (C&SD). C&SD has compiled three sets of population growth projections, being the baseline, high and low population projections. The Review adopts the baseline population projection as the expected population growth scenario, as C&SD considers that the assumptions in the baseline population projection are most likely to be realised at the time of compilation.

6. What are climate change scenarios and why the medium-low and medium-high scenarios are adopted in the Review to assess the impact on local yield?

Under the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), four scenarios of greenhouse gas concentration, which are Representative Concentration Pathway (RCP) 2.6 (low), RCP 4.5 (medium-low), RCP 6.0 (medium-high) and RCP8.5 (high) in the order of increasing concentration, are employed by the Hong Kong Observatory (HKO) to make climate projections for Hong Kong such as changes in annual temperature, annual rainfall anomaly (see Table 1) and mean sea level etc.

In 2015, more than 190 governments pledged at the Paris Climate Conference to reduce carbon emissions with a view to lowering greenhouse gas concentration and decelerating global warming. If all the national emission reduction pledges agreed at the conference eventually materialised, the medium-low and medium-high scenarios of greenhouse gas concentration would more likely happen with corresponding impact on the global climate (Ref: **https://www.hko.gov.hk/climate_change/climate_change_e.pdf**). The implication of these likely climate change scenarios is that the average annual rainfall will decrease but the volatility of rainfalls will increase over the next couple of decades. Nevertheless, the Review also considers the plausible extreme climate change effect by including all climate change scenarios in an envelope to cater for the lower bound of the projected annual rainfall anomaly in the evaluation of climate change effect on local yield.

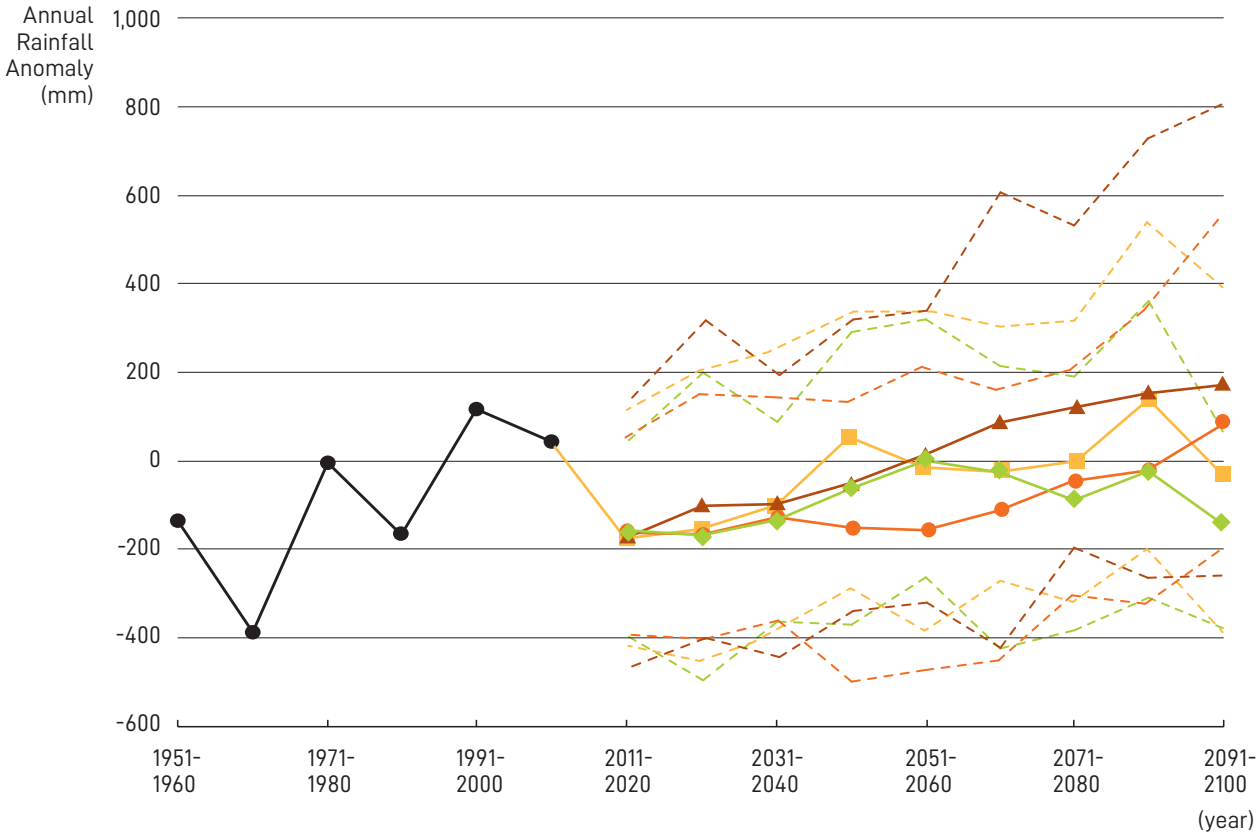
Projected annual rainfall anomaly of Hong Kong relative to the average of 1986-2005 in millimetres under different greenhouse gas concentration scenarios

Table 1

	RCP2.6 Low		RCP4.5 Medium-low		RCP6.0 Medium-high		RCP8.5 High	
DECADE	MEAN	LIKELY RANGE	MEAN	LIKELY RANGE	MEAN	LIKELY RANGE	MEAN	LIKELY RANGE
2011 - 2020	-160	-401 to +43	-168	-418 to +115	-167	-400 to +49	-175	-468 to +142
2021 - 2030	-171	-501 to +198	-150	-448 to +206	-171	-410 to +149	-103	-404 to +317
2031 - 2040	-135	-366 to +85	-93	-385 to +251	-130	-364 to +142	-99	-447 to +193
2041 - 2050	-60	-373 to +291	56	-283 to +334	-155	-517 to +131	-50	-343 to +319

Source: The Hong Kong Observatory

Graphical Presentation of Table 1



Observed

Mean value of low greenhouse gas concentration scenario

Likely range of projection results of low greenhouse gas concentration scenario

Mean value of medium-low greenhouse gas concentration scenario

Likely range of projection results of medium-low greenhouse gas concentration scenario

Mean value of medium-high greenhouse gas concentration scenario

Likely range of projection results of medium-high greenhouse gas concentration scenario

Mean value of high greenhouse gas concentration scenario

Likely range of projection results of high greenhouse gas concentration scenario

7. How does the yield model forecast the local yield?

The yield model adopts the watershed balance method, taking into account statistical data including the change in water level of reservoirs, transfer between reservoirs and outflow and the spillway overflow from reservoirs to forecast the local yield under rainfall of different climate change scenarios.

8. What is "Multi-Criteria Evaluation"?

Under the "Multi-Criteria Evaluation", the water demand and water supply management options are evaluated and scored by a panel of international experts of the consultants based on the following three main sets of criteria.

RESILIENCY	It refers to the degree of dependency on future uncertainties and extent of contribution to the diversity of water resources.
ECONOMICS	It refers to capital and recurrent costs, and life-cycle unit cost of an option and the extent to which it can be implemented progressively.
SUSTAINABILITY	It refers to environmental impacts such as air quality, marine water quality, biodiversity and atmospheric pollution through greenhouse gas emissions of an option.

9. What is the Advisory Committee on Water Supplies?

The Advisory Committee on Water Supplies is an independent body to keep under review and to advise the Government on matters relating to water supplies, including water resources, network management, regulation and control of inside service, water conservation and other operational matters. It comprises members from the public including academics, district councillors, green advocates, professionals, trades and officials from related government departments and bureaux. For further details about the Committee, please visit: **https://www.wsd.gov.hk/acws/en/welcome/index.html**

10. What is the higher than expected population?

As mentioned in the answer to FAQ 5, C&SD has compiled three sets of population growth projections, being the baseline, high and low population projections. While the baseline population projection has been adopted in the Review as the basis, the high population projection of about 9 million by C&SD is still a possible scenario.

11. Why is the risk of water main leakage higher in Hong Kong?

Hong Kong has a hilly terrain. In order to supply water to buildings at high altitude, the water pressure of the water supply networks in Hong Kong is higher than many other cities. Besides, frequent roadworks, busy traffic and congested underground utilities in the city cause a lot of vibration and disturbances to the underground water mains making them more prone to leakage.

12. What is the risk-based approach for the improvement works of water mains?

We assess the risk of water mains on the basis of both the probability and the consequence of failures. To assess the probability of failures of water mains, consideration will be given to the materials and ages of water mains, the past failure records of water mains, etc. To assess the consequence of failures of water mains, consideration will be given to the estimated extent and criticality of customers (e.g. hospitals) affected, the impact on traffic, etc.

13. Will use of recycled water be expanded to potable use for further saving of fresh water?

The use of recycled water has been increasingly practised throughout the world, including the USA, Australia, Singapore, etc. The common uses of recycled water in urban areas of the USA and Australia are for irrigation of green areas, e.g. parks, golf courses, sports fields, greenbelts, etc., while recycled water in Singapore is mainly supplied for industrial uses. At present, very few places* in the world use recycled water for direct potable use because most of the people do not accept drinking recycled water. It is worthwhile to note that the Government conducted a public consultation on supply of recycled water in Hong Kong in 2018 which revealed that majority of the views received are positive and supportive to the supply of recycled water for non-potable uses only.

* Examples of places using recycled water for direct potable use are Windhoek in Namibia and Beaufort West in South Africa etc. There are also examples using recycled water for indirect potable use, such as Singapore where a certain amount (about 2% of the total daily potable water consumption) of "NEWater" (i.e. recycled water produced from treated effluent of sewage treatment works) is injected into fresh water impounding reservoirs and the mixed water is treated by water treatment plants before supplying for potable use.

14. With the Dongjiang water still forming the major portion of Hong Kong water supply, are there any risks in reliance on Dongjiang water which is susceptible to climate change?

The annual supply ceiling of 820 mcm under the current supply agreement represents only about 3 per cent of the annual mean flow of the main stream of Dongjiang. Furthermore, there are three large reservoirs, namely Xinfengjiang Reservoir, Fengshuba Reservoir, and Baipenzhu Reservoir, in the middle-upper stream of the Dongjiang River Basin with a total storage capacity of 17,060 mcm. The storage in these reservoirs can be utilised to balance the flow of Dongjiang, enabling us to import Dongjiang water up to the annual supply ceiling as stipulated in the current supply agreement. Moreover, the Pearl River Delta Water Resources Allocation Project is being implemented to divert water from Xijiang to the eastern part of the Pearl River Delta (including Guangzhou Nansha, Shenzhen and Dongguan) to alleviate the pressure of demand on the Dongjiang water in those areas. At the same time, the Project will have provision of emergency backup to Hong Kong, Panyu, Shunde, etc. to further safeguard the water security of these areas. The risk regarding the security of the Dongjiang water supply to Hong Kong at the supply ceiling of 820 mcm per annum is therefore low.

15. Why don't we build more desalination plants?

The Strategy 2019 including the measures to contain water demand growth and implementation of the first stage of desalination plant in TKO will be able to cope with the projected water demand up to 2040 under the expected population growth scenario with resilience to cope with the impact of climate change. Nonetheless, if the situation had deviated from the present projections due to reasons such as higher-than-expected population growth, worse-than-projected impact of climate change on rainfall or less-than-anticipated effect of containing water demand growth, it would be overcome by implementation of the backup options formulated in the Review. They include the second stage of the TKO desalination plant and other desalination plants which will be evaluated together with other backup options for implementation. In addition, when planning for water supply in individual development areas, we will evaluate desalination and other water sources to identify the suitable one for the development areas taking into account a host of factors including capital investment and operation and maintenance costs which will be affected by the distance between the development area and the coast, as well as the proximity of existing fresh water supply network and facilities, their capacities, etc.

16. Why not raise water tariff to reduce water consumption?

According to a study on water tariff of twelve other major cities[15] around the world conducted by the University of Hong Kong in 2015, there is a lack of price elasticity of water consumption in general, i.e. the effect of a higher water tariff on lowering the water consumption is not significant.

The success of any water conservation programme depends on, inter alia, the support of the public. Therefore, effort should be made to enhance public awareness that water is a precious resource and strengthen their sense of responsibility for cherishing water resources for developing their water conservation habits. We will continue to enhance promotion and education of water conservation through various measures, including the "Water Efficiency Labelling Scheme", education programmes such as "Cherish Water Campus" and "Cherish Water Ambassador", "Let's Save 10L Water" campaign, collaboration with various stakeholders in organising activities to raise public awareness on water conservation, etc.

15. The cities included in the study were Beijing, Guangzhou, Macau, Shenzhen, Taipei, Singapore, Tokyo, London, Los Angeles, New York, Seattle and Sydney.