CHAPTER 4

Water Supplies Department

Management of water supply and demand

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MANAGEMENT OF WATER SUPPLY AND DEMAND

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MANAGEMENT OF WATER SUPPLY AND DEMAND

Executive Summary

1. The Water Supplies Department (WSD) is responsible for supplying fresh water and seawater (for flushing) for consumption by Hong Kong's population of seven million for domestic and non-domestic use. In 2013, the WSD supplied 933 million cubic metres (Mm^3) of fresh water, of which 611 Mm^3 (65%) were supplied from Guangdong (GD) Province under Dongjiang Water Supply Agreement (Supply Agreement), and the remaining 322 Mm^3 (35%) were collected from local catchments. In the same year, the WSD supplied 278 Mm^3 of seawater for flushing by 80% of the local population, while the remaining 20% used fresh water for the purpose. In 2013-14, the WSD received $2,556 million water charges. As of December 2014, the WSD administered 2.87 million water accounts, comprising 2.59 million domestic accounts and 0.28 million non-domestic accounts.

2. In 2008, with a view to ensuring sustainable use of water in Hong Kong, the WSD promulgated the Total Water Management (TWM) Strategy which covered five main areas, namely water conservation, active leakage control, extending use of seawater for flushing, using new water resources (including water reclamation) and protection of water resources. The Audit Commission (Audit) has recently conducted a review of the WSD's management of water supply and demand.

Water supply management

3. Under the 2008 TWM Strategy, for the purpose of strengthening its supply management, the WSD has implemented a number of initiatives, including carrying out pilot schemes and studies on using reclaimed water from treated sewage, protecting existing water resources, and developing seawater desalination (para. 2.3).

4. ***Need to expedite using reclaimed water for flushing.*** Under the 2008 TWM Strategy, the WSD had planned to make use of reclaimed water from Shek Wu Hui Sewage Treatment Works, after going through additional treatment processes, for toilet flushing in the Northeast New Territories (NENT) region. According to the WSD, the proposed project would help save 21 Mm^3 of fresh water a year and that the cost of using reclaimed water (at \$3.8 per cubic metre (m^3)) was lower than that of using fresh water (at marginal cost of \$5.6 per m^3) and seawater (at \$10.4 per m^3) for flushing. However, the WSD only commenced planning for the related infrastructure works in 2012 which was targeted for completion by 2022. In Audit's view, the WSD needs to expedite using reclaimed water for flushing. This would save around 3% of fresh water (paras. 2.4 to 2.12).

5. ***Delay in implementing Inter-reservoirs Transfer Scheme (IRTS).*** In 2004, the WSD and the Drainage Services Department (DSD) planned to implement the IRTS which would serve the dual purposes of flood control in the West Kowloon area and generating 2.5 Mm^3 of water a year. Under the IRTS, overflow from the Kowloon Group of Reservoirs (comprising Kowloon Reservoir, Shek Lei Pui Reservoir, Kowloon Reception Reservoir and Kowloon Byewash Reservoir) would be channelled to Lower Shing Mun Reservoir. In 2005, the DSD informed the Panel on Development of the Legislative Council (LegCo) that the construction works for the IRTS would commence in 2010 and was targeted for completion in 2012. However, up to December 2014, the WSD and the DSD had yet to seek funding for carrying out the IRTS construction works. In 2014, the estimated cost of the construction works was \$868 million (paras. 2.13 to 2.17).

6. ***Delay in improving priority catchwater systems.*** A catchwater system comprises catchwater channels which intercept surface water in water gathering ground and carry the water to reservoirs for storage. In October 2008, the Government informed the Panel on Development that the WSD would commence improvement works for four catchwater systems (namely Shing Mun, Beacon Hill, Golden Hill and Tai Lam Chung catchwater systems) by 2011. However, up to December 2014, the WSD had yet to seek funding for carrying out the construction works (paras. 2.18 to 2.22).

7. ***Need to closely monitor the supply of fresh water.*** In June 2012, the LegCo Finance Committee approved funding of $34.3 million for the WSD to carry out a planning and investigation study for the construction of a desalination plant at Tseung Kwan O. According to the WSD, the estimated cost of the desalination plant project was $9.3 billion, which would produce 50 Mm^3 of fresh water a year, accounting for 5% of the total fresh water supply, and the plant capacity could be expanded to produce an ultimate quantity of 100 Mm^3 of fresh water a year. The first stage of the plant is expected to be commissioned in 2020. According to the WSD, the cost of desalinated water would be $12 per m^3, of which $7 per m^3 and $5 per m^3 were operation cost and capital depreciation cost respectively (paras. 2.24 to 2.27).

8. According to information provided to LegCo in May 2012, one of the justifications for constructing the desalination plant was that, based on a risk assessment of water resource adequacy under adverse scenarios (e.g. the occurrence of consecutive droughts and increase in water demand), the water shortage risk after 2020 would increase with a deficit of fresh water resources of up to 39 Mm^3 a year. Audit noted that this estimated water deficit was based on the WSD's Long-term Demand Forecast (2010) and an annual supply of Dongjiang (DJ) water of 820 Mm^3, whereas only 611 Mm^3 of DJ water was actually supplied to Hong Kong in 2013. In the subsequent Long-term Demand Forecast (2013), and again assuming 820 Mm^3 of annual DJ water supply, the estimated water deficit in 2021 would be 33 Mm^3 for the upper-bound water demand and 7 Mm^3 for the lower-bound water demand. Audit notes that, under the Supply Agreement, GD Province has agreed to allocate up to an ultimate annual quantity of 1,100 Mm^3 of fresh water to Hong Kong, albeit the level of charges for the supply in excess of 820 Mm^3 is subject to future negotiation. Therefore, the occurrence of water deficits in future is subject to GD Province not being able to supply an annual quantity of fresh water in excess of 820 Mm^3. In view of the significant capital and recurrent costs of adopting desalination to supply fresh water locally, the WSD needs to closely monitor the supply of fresh water from GD Province and the proposed desalination plant (paras. 2.23, and 2.27 to 2.32).

Water demand management

9. Initiatives to reduce water demand under the 2008 TWM Strategy included retrofitting water-saving devices at government facilities, conducting water-efficiency audits at government departments and extending the use of seawater for flushing (para. 3.3).

10. ***Some government facilities consumed more water after retrofitting with water-saving devices.*** In December 2009, the WSD implemented a pilot scheme on retrofitting water-saving devices at 421 government buildings and schools at a total cost of $104 million. The WSD's review conducted in 2011 found that the water-saving devices would generate an annual saving of $21.43 million and the average payback period of the retrofitting works was 5.1 years. However, Audit examination revealed that, of the 421 government buildings/schools, 119 (28%) had recorded increases in fresh water consumption after being retrofitted with water-saving devices, with increases ranging from 0.4% to more than 100% (paras. 3.9 to 3.14).

11. ***Some Leisure and Cultural Services Department (LCSD) venues consumed more water after implementing related best-practice guidelines.*** In September 2012, after conducting a water-efficiency audit for the LCSD, the WSD issued the best-practice guidelines on water conservation to the LCSD. According to the LCSD and the WSD, after implementing the best-practice guidelines at six parks and five swimming pools, the water consumption at these 11 venues in 2014 had decreased by 7.2% when compared to that in 2011. However, Audit examination revealed that water consumption at 4 of the 11 venues had in fact increased from 2011 to 2014, with increases ranging from 5% to 63% (paras. 3.15 to 3.19).

12. ***Many buildings at Pok Fu Lam not yet connected to seawater supply network.*** Under the 2008 TWM Strategy, for the purpose of converting from using fresh water to seawater for flushing, a seawater supply system at Pok Fu Lam was substantially completed in July 2013. However, as of February 2015, of the total 570 buildings at Pok Fu Lam covered under the seawater supply system, the related conversion works for 378 buildings (66%) had not yet commenced (paras. 3.20 to 3.24).

Implementation of government policy on water charges

13. Under the WSD's tariff structure, fresh water supply for domestic use is charged by adopting a four-tier system. For the first tier, the first 12 m^3 of fresh water should be supplied free of charge for a domestic household in a four-month period, and the related net production cost should be met by the Government. For the second tier, water tariff for the next 31 m^3 of related fresh water consumed should be approximately in line with the net production cost (Note). For the third tier, water tariff for the next 19 m^3 of related fresh water consumed should be approximately in line with the full production cost. Lastly, for the fourth tier, water tariff for the remaining fresh water consumed should be approximately 40% above the third tier (para. 4.3).

14. ***Target rates of return on Average Net Fixed Assets (ANFA) not met since 1998-99.*** Pursuant to the Government's policy, water tariff was set to recover production cost and achieve a target return on ANFA. Since 1996, water charges had not been revised, and the Waterworks Operating Accounts had reported a deficit each year from 1998-99 to 2013-14. Accordingly, the waterworks operation had achieved negative returns on ANFA during the period. Notwithstanding such negative returns, the Government had continued to adopt positive target rates of return on ANFA of 6.5% from 1998-99 to 2011-12 and 3.4% from 2012-13 to 2013-14 (paras. 4.10 to 4.13).

Note: *For the purpose of compiling the Waterworks Operating Accounts, in general, 15% of rates receivable in a year is accounted for as revenue in the Accounts. The net production cost represents the full production cost less the relevant contribution from rates.*

15. ***No disclosure of target return on ANFA included in the unit production cost.*** Audit noted from a LegCo document that the net production cost of fresh water supply in 1994-95 was \$4.86 per m^3. According to the WSD, owing to the need to achieve a target return on ANFA under the Government's policy, the net unit production cost had included such a target return. The net production cost (inclusive of target return on ANFA of \$2.61 per m^3) in 2013-14 was \$10.76 per m^3. Notwithstanding that the net and full unit production costs were significant factors in determining water tariffs (see para. 13), the WSD had not disclosed the amount of the target return on ANFA which had been included in the production costs. The WSD needs to publish in its annual reports the above cost information (paras. 4.14 to 4.20).

16. ***No disclosure of quantity of water supply for calculating unit production cost.*** In April 2014, in relation to the proposed construction of a desalination plant (see para. 7), the WSD informed LegCo that the estimated unit costs of fresh water produced from locally collected fresh water and DJ water were \$4.2 per m^3 and \$8.8 per m^3 respectively, compared to water produced from desalination of \$12 per m^3. Audit noted that these unit costs were calculated based on the total quantity of fresh water supply before treatment (totalled 933 Mm^3 in 2013). However, the WSD had used the lower metered-water quantity (totalled 638 Mm^3 in 2013) to calculate net and full unit production costs for water-tariff setting purposes. The 32% difference ((933 − 638) ÷ 933 × 100%) between the water quantity before treatment and the metered quantity was mainly attributable to water losses due to water mains leakages, water consumed during water treatment processes, unauthorised water consumption and inaccurate metering. In Audit's view, the WSD needs to publish in its annual reports the different bases of calculating unit water production costs (paras. 1.3, 4.21 to 4.23).

Way forward

17. ***High per capita domestic water consumption.*** Audit noted that, despite the implementation of various water-saving initiatives by the WSD in recent years, the daily per capita domestic water consumption had been around 130 litres from 2009 to 2014, which was 18% higher than the world average of 110 litres. Notwithstanding that the WSD has set a target of achieving 10 litres of water saving per capita per day, no target date has been set for achieving this water-saving target (para. 5.5).

Audit recommendations

18. **Audit recommendations are made in the respective sections of this Audit Report. Only the key ones are highlighted in this Executive Summary. Audit has *recommended* that the Government should:**

Water supply management

(a) **expedite actions to:**

(i) **implement the project for supplying reclaimed water for flushing in NENT (para. 2.33(a));**

(ii) **improve the four priority catchwater systems in Shing Mun, Beacon Hill, Golden Hill and Tai Lam Chung (para. 2.33(c)); and**

(iii) **implement the IRTS (para. 2.34);**

(b) **closely monitor the supply of fresh water from GD Province and the proposed desalination plant (para. 2.33(e));**

Water demand management

(c) **conduct a review to ascertain the reasons for water-consumption increases at:**

(i) **119 government buildings and schools after being retrofitted with water-saving devices and take remedial actions where necessary (para. 3.25(c)); and**

(ii) **the four LCSD venues after implementing the related best-practice guidelines (para. 3.26(a));**

(d) **take measures with a view to completing works for supplying seawater for flushing to the remaining 378 buildings at Pok Fu Lam at an early time (para. 3.25(e));**

Implementation of government policy on water charges

(e) **publish information in WSD annual reports showing that:**

(i) **the net and full fresh-water unit production costs have included a target return on ANFA; and**

(ii) **the calculation of the net and full fresh-water unit production costs for charging purposes is based on the quantity of metered fresh water consumed (para. 4.31(a)); and**

Way forward

(f) **consider setting a target date for achieving 10 litres of water saving per capita per day (para. 5.8(a)).**

Response from the Government

19. The Government agrees with the audit recommendations.

PART 1: INTRODUCTION

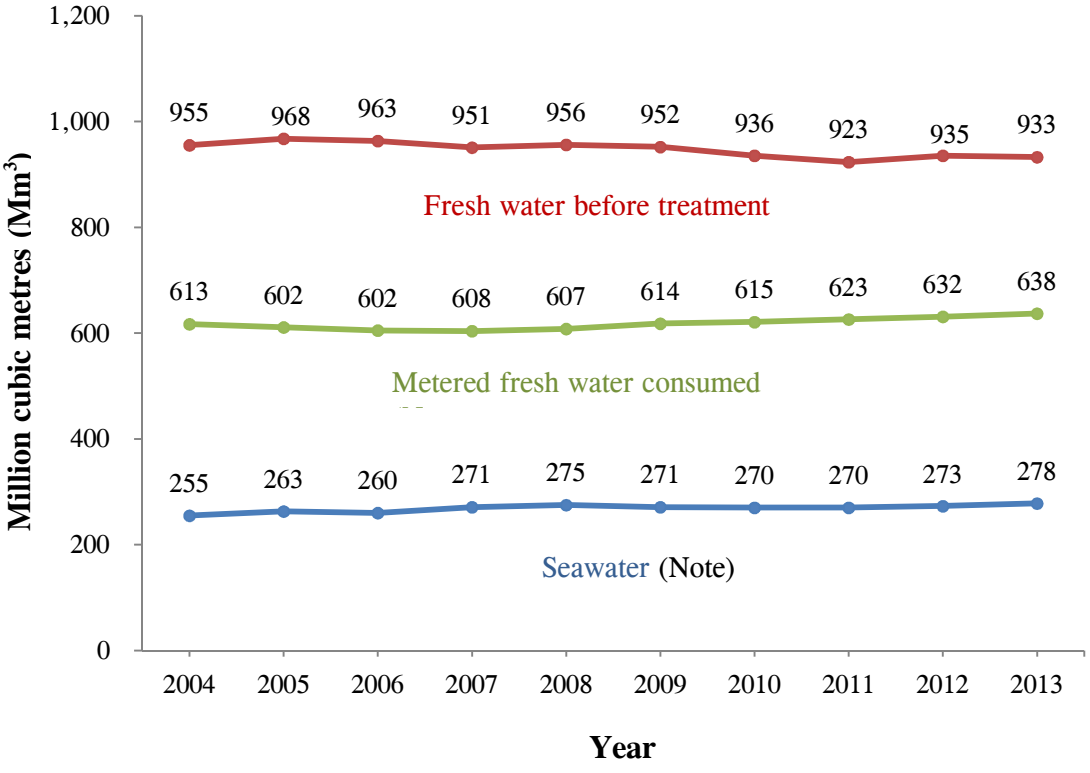
1.1 This PART describes the background to the audit and outlines the audit objectives and scope.

Background

1.2 The Water Supplies Department (WSD) is responsible for supplying fresh water and seawater (for flushing) for consumption by Hong Kong's population of seven million for domestic and non-domestic use (see Figure 1).

Figure 1

Water supplied by WSD
(2004 to 2013)



Source: *WSD records*

Note: *Seawater supply is not metered, and the quantities of seawater supply shown are those recorded by WSD pumping stations.*

Remarks: *The data for 2014 were not available from the WSD up to the completion of audit in February 2015.*

Unmetered water consumption

1.3 As shown in Figure 1, the quantities of metered fresh water consumed by users were substantially less than those of raw fresh water before treatment at WSD water treatment plants. The 32% ((933 − 638) ÷ 933 × 100%) difference between the water quantity before treatment and the metered quantity is known as the unmetered water consumption, which included:

(a) water losses due to water mains leakages (Note 1);

(b) water consumed during water treatment processes and for operational purposes, such as water mains flushing, testing of new mains and fire fighting by the Fire Services Department;

(c) water consumed by users but not metered due to unauthorised water consumption (see para. 1.6); and

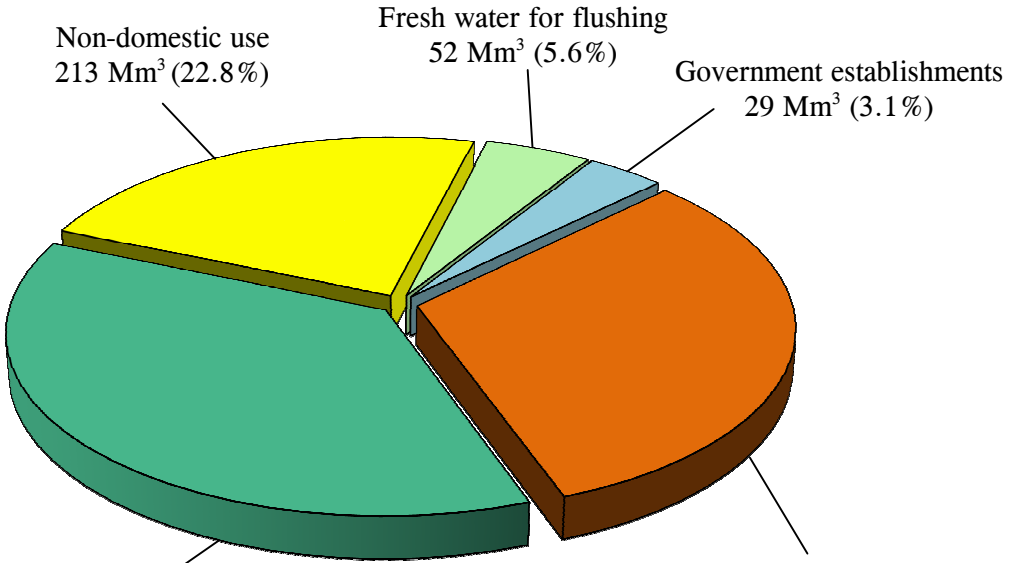
(d) water consumed by users but not metered due to inaccurate metering (see para. 1.6).

1.4 Figure 2 shows an analysis of fresh water consumed in 2013.

Note 1: *Water mains include both government mains and private mains. Private mains are water mains laid between government water mains and water meters of consumers.*

Figure 2

Analysis of fresh water consumed (2013)



Source: *WSD records and Audit analyses*

Note: *Other unmetered consumption included leakage in private mains and those mentioned in paragraph 1.3(b) to (d). According to the WSD, it was conducting a review of the quantities of different nature of unmetered water consumption and did not have the breakdown information for the time being.*

Water losses due to water mains leakages

1.5 In 2010, the Audit Commission (Audit) conducted a review of "Managing and reducing water mains bursts and leaks", the results of which were included in Chapter 8 of the Director of Audit's Report No. 55 of October 2010. The main audit observations included inadequacies in managing WSD term contractors in repairing water mains bursts, addressing the causes of water mains bursts, implementing the Water Mains Replacement and Rehabilitation Programme, implementing water pressure management schemes, and reducing fresh-water leakage inside residential developments. The WSD accepted all audit recommendations and took actions to make improvement. As a result, fresh water losses due to leakage in government mains had reduced from 173 Mm^3 in 2010 to

157 Mm^3 in 2013 (a 9% decrease). Furthermore, as of December 2014, the WSD had installed 136 bulk meters in residential developments to monitor private mains leakage.

Water losses due to unauthorised consumption and inaccurate metering

1.6 In 2011, Audit conducted a review of "Water losses from unauthorised consumption and inaccurate metering", the results of which were included in Chapter 12 of the Director of Audit's Report No. 57 of October 2011. The main audit observations included inadequacies in taking enforcement action against unlawful water taking, carrying out inspections of unauthorised water consumption, and implementing water-meter replacement programmes. The WSD accepted all audit recommendations and took actions to make improvement. According to the WSD, it has strengthened actions on detection, prosecution, promotion and education on unauthorised water consumption. In this connection, the number of surprise inspections in 2014 had increased by 74% to 1,235 as compared to that in 2013, whereas the number of convictions had increased by 41% to 113 cases during the period. Regarding inaccurate metering, the WSD had continued its meter replacement programme and had replaced 770,000 water meters from 2011 to 2014 with the overall water-meter accuracy improved from 95.3% in 2011 to 96.7% in 2014.

Water supplies in Hong Kong

1.7 In 2013, 65% of fresh water in Hong Kong was supplied from Dongjiang (DJ) in Guangdong (GD) Province under Dongjiang Water Supply Agreements (hereinafter referred to as Supply Agreements), supplemented by rainwater collected from catchments in the territory. Furthermore, seawater is supplied to 80% of the local population for flushing, while the remaining 20% of the population use fresh water for the purpose.

1.8 For a domestic water account, the first 12 cubic metres (m^3) of water used in a four-month period is supplied free of charge with remaining water consumption being charged based on a four-tier charging system (see para. 4.3(a)). For non-domestic water accounts, different water charging schemes apply to different trade sectors (see para. 4.3(b)). For flushing purposes, seawater is supplied free of charge whereas the first 30 m^3 of fresh water used in a four-month period is

supplied free of charge, with remaining fresh water used for flushing being charged at a flat rate of $4.58 per m^3. The costs of supplying free seawater and fresh water for flushing are met wholly from government rates (see para. 4.3(c) and (d)(i)). For billing purposes, readings of all domestic water meters and most non-domestic meters are taken by WSD meter readers (Note 2) every four months using hand-held computers. For about 5,000 large-consumption non-domestic meters, their readings are taken on a monthly basis. For the supply of fresh water for flushing, normally only one meter is installed for a building and the cost is met by management fees.

Water purchased from GD Province

1.9 Since 1960, the Government of the Hong Kong Special Administrative Region has entered into a number of Supply Agreements with GD Provincial Government for supplying water from GD to meet water demand in Hong Kong. According to the Supply Agreement finalised in 2014 covering 2015, 2016 and 2017, GD Province would:

(a) supply an annual quantity of up to 820 Mm^3 of DJ water to Hong Kong at the costs of $4,223 million, $4,492 million and $4,778 million respectively; and

(b) allocate up to an ultimate annual quantity of 1,100 Mm^3 of fresh water to Hong Kong for future use. The timing of the supply in excess of 820 Mm^3 and the price for such quantity is subject to future negotiation.

1.10 In 1999, Audit conducted a review of "Water purchased from Guangdong Province", the results of which were included in Chapter 12 of the Director of Audit's Report No. 33 of October 1999. The main audit observations included the lack of provisions in the Supply Agreements for: (a) reducing the water supply quantities where necessary, resulting in substantial overflow of both DJ water and local rain water; and (b) meeting the latest Mainland water quality standards. The WSD accepted all audit recommendations and took actions to make improvement. Since the Supply Agreement finalised in 2006, DJ water supply to Hong Kong has been adjusted on a monthly basis depending on the actual water demand. In 2014, the overflow of water from reservoirs was 23 Mm^3 comparing to 120 Mm^3 in 1999.

Note 2: *As of December 2014, the WSD had 157 meter readers.*

Furthermore, both GD Province and the WSD have taken actions to improve the quality of DJ water supply to Hong Kong, which has met the latest Mainland standards.

Total Water Management Strategy

1.11 In the 2003 Policy Address, the Government pledged to implement a Total Water Management (TWM) programme to enhance water conservation and water resource protection, and to explore new water sources. In October 2005, the WSD commissioned a study to examine the fresh water supply and demand situations in Hong Kong and to evaluate major options of water supply and demand management measures. In 2008, the WSD promulgated the TWM Strategy for the period up to 2030, which aims to achieve an optimal balance between water demand and supply in order to ensure sustainable use of water in Hong Kong.

1.12 The TWM Strategy covers five main areas, namely water conservation, active leakage control, extending use of seawater for flushing, using new water resources (including water reclamation) and protection of water resources. The WSD's key initiatives in water demand management include stepping up public education on water conservation, promoting the use of water-saving devices, enhancing water leakage control and extending the use of seawater for flushing to more areas. Regarding supply management, the WSD has implemented pilot schemes and studies to take forward the seawater desalination and water reclamation projects and measures to strengthen protection of existing water resources.

WSD's water charges, expenditure and staff resources

1.13 According to the 2013-14 Waterworks Operating Accounts, the water charges collected and expenditures were $2,556 million and $8,562 million respectively, and the latter comprised the costs of DJ water of $3,802 million, staff cost of $1,529 million, operating and administration expenses of $1,748 million, and depreciation of $1,483 million. As of December 2014, the WSD administered 2.87 million water accounts (comprising 2.59 million domestic accounts and 0.28 million non-domestic accounts). As at 31 March 2014, the WSD had 4,028 staff, comprising 3,913 civil servants and 115 non-civil service contract staff. A WSD organisation chart is at Appendix A. In 2013-14, the WSD's recurrent expenditure for the planning and distribution of water supply amounted to $6,261 million. For the five years between 2009 and 2013, financed by the Capital

Works Reserve Fund (CWRF — Note 3), the WSD spent an average of about $3.4 billion per annum on capital works, mainly related to the Water Mains Replacement and Rehabilitation Programme and the improvement of existing treatment plants.

Audit review

1.14 In October 2014, Audit commenced a review to examine the WSD's management of the water supply and demand. The review focused on the implementation of initiatives promulgated under the TWM Strategy and government policy on water charges, covering the following areas:

(a) water supply management (PART 2);

(b) water demand management (PART 3);

(c) implementation of government policy on water charges (PART 4); and

(d) way forward (PART 5).

Audit has identified areas where improvements can be made by the Government in the above areas, and has made recommendations to address the issues.

Acknowledgement

1.15 Audit would like to acknowledge with gratitude the full cooperation of the staff of the Development Bureau (DEVB), the Financial Services and the Treasury Bureau (FSTB), the WSD, the Drainage Services Department (DSD), the Architectural Services Department (ArchSD), the Leisure and Cultural Services Department (LCSD), the Food and Environmental Hygiene Department (FEHD) and the Correctional Services Department (CSD) during the course of the audit review.

Note 3: *According to Financial Circular No. 3/2011, waterworks with a value not exceeding $30 million can be funded under a CWRF block vote.*

PART 2: WATER SUPPLY MANAGEMENT

2.1 This PART examines the WSD's implementation of water supply management initiatives promulgated under the 2008 TWM Strategy.

Total Water Management Strategy

2.2 In 2013, the total fresh water supplied by the WSD was 933 Mm^3, of which 611 Mm^3 (65%) and 322 Mm^3 (35%) were supplied from DJ water and collected from catchments in the territory respectively.

2.3 In accordance with the TWM Strategy, in order to safeguard against the risk of fresh water shortage in the long term, the WSD has taken actions to strengthen its water supply management through implementation of the following three initiatives:

(a) carrying out pilot schemes and studies on using reclaimed water (Note 4) as a new source of water for non-potable purposes such as flushing, cleansing and irrigation (paras. 2.4 to 2.12);

(b) protecting existing water resources (paras. 2.13 to 2.22); and

(c) developing seawater desalination (paras. 2.23 to 2.32).

Use of reclaimed water

2.4 Under the 2008 TWM Strategy, the Government pledged to actively consider implementing initiatives for water reclamation and using reclaimed water for non-potable purposes such as toilet flushing and landscape irrigation.

Note 4: *Reclaimed water is recycled water mainly reclaimed from treated sewage effluent.*

2.5 According to the WSD, due to geographic constraints, high costs would be incurred in installing seawater-supply networks for supplying seawater for flushing in Northeast New Territories (NENT). Based on a consultancy study commenced in 2005, the WSD proposed under the 2008 TWM Strategy that reclaimed water from Shek Wu Hui Sewage Treatment Works in NENT could be used for toilet flushing in the region after going through additional treatment processes. At that time, the estimated capital cost for installing additional treatment plants and a reclaimed-water distribution system for the purpose was $634 million. According to WSD consultant, the estimated unit cost of producing reclaimed water would be $3.2 per m^3, and that the initiative would save 21 Mm^3 of fresh water a year (representing 40% of the fresh water used for flushing in 2013).

2.6 In 2009, the WSD set up an inter-departmental working group to take forward the initiative to supply reclaimed water to NENT for non-potable purposes. From 2009 to 2011, the WSD engaged a consultant to formulate water quality standards for using reclaimed water for non-potable purposes. In 2012, the working group endorsed a set of reclaimed water quality standards for use in Hong Kong and the financial viability of supplying reclaimed water to NENT. The working group also endorsed the implementation strategy for supplying reclaimed water to NENT in 2022.

2.7 According to the WSD:

(a) since 2012, the WSD has commenced planning for the infrastructure for supplying reclaimed water to NENT under the public works programme which is targeted for completion in 2022. This would match the forecast first population intake in NENT new development areas starting from 2023; and

(b) concurrently, the WSD has also planned to engage a consultant to study the related legal and financial framework for supply of reclaimed water. The study is targeted for completion by early 2016.

2.8 According to the result of the economic assessment conducted by the WSD in 2012, the costs of providing the following three water sources for flushing in Sheung Shui and Fanling were:

(a) reclaimed water at \$3.8 per m^3;

(b) fresh water at \$5.6 per m^3 (Note 5) ; and

(c) seawater at \$10.4 per m^3 (Note 6).

Need to expedite using reclaimed water for flushing

2.9 Audit noted that the WSD, since 2008, had planned to provide reclaimed water for flushing in NENT. However, the planning work for the related infrastructure only commenced in 2012 which was targeted for completion by 2022. According to the WSD, the proposed project would help save 21 Mm^3 of fresh water a year and that the cost of using reclaimed water is lower than that of using fresh water and seawater for flushing. Furthermore, this project would also help lessen the risk of fresh water shortage in the adverse situation. Audit considers that the WSD needs to expedite actions to implement the proposed project.

Need to explore extending the use of grey water and rainwater for non-potable purposes

2.10 Under the 2008 TWM Strategy, the Government pledged to conduct trial schemes on using recycled water from baths, showers, wash basins and kitchens (known as grey water) and rainwater for non-potable purposes (such as irrigation and flushing). In 2009, the DEVB and the Environment Bureau issued a joint technical circular on green government buildings which set out guiding principles for using grey water and rainwater for non-potable purposes at government buildings. From 2009 to 2011, the WSD conducted a review of the technical and water-quality standards for using grey water and rainwater for non-potable purposes. In 2011, the WSD sought comments from relevant stakeholders and fine-tuned the technical and water-quality standards.

Note 5: *According to the WSD, this unit cost was calculated based on the marginal cost and quantity of supplying fresh water for flushing in Sheung Shui and Fanling.*

Note 6: *According to the WSD, the high unit cost was due to the long distance involved in pumping seawater from the sea to the service areas in Sheung Shui and Fanling.*

2.11 From April 2005 to November 2014, under the trial schemes, rainwater harvesting systems had been installed by the ArchSD and the DSD in 59 government/school buildings, and grey-water recycling systems in 3 other government buildings (namely Headquarters Building of the Electrical and Mechanical Services Department (EMSD) at Kai Tak (Note 7), Big Wave Bay Beach Building of the LCSD at Shek O, and recreation facilities of the LCSD at Jordan Valley), and rainwater harvesting systems in other 26 government buildings/schools would be completed from December 2014 to November 2019. In October 2014, the WSD commenced a post-implementation review of the trial schemes.

2.12 In Audit's view, in collaboration with the ArchSD and the DSD, based on the results of the post-implementation review, the WSD needs to formulate a strategy for rolling out the schemes to other government/school buildings and promoting implementation of the schemes in private buildings.

Protecting existing water resources

2.13 Heavy rainfall in West Kowloon sometimes leads to water overflow in the Kowloon Reservoir, Shek Lei Pui Reservoir, Kowloon Reception Reservoir and Kowloon Byewash Reservoir (collectively known as Kowloon Group of Reservoirs) and such water overflow will increase the flooding risk in the area. In early 2000, the DSD formulated the Lai Chi Kok Transfer Scheme to alleviate the flooding risk. The Scheme comprised the construction of a drainage tunnel to intercept surface run-off from the West Kowloon hinterland at the upstream and the overflow from the Kowloon Group of Reservoirs for discharge directly to Victoria Harbour. In 2004, the WSD and the DSD planned to optimise water conservation by implementing the Lai Chi Kok Transfer Scheme (with reduced tunnel size) which included the Inter-reservoirs Transfer Scheme (IRTS) that would serve the dual purposes of flood control and achieving water conservation in West Kowloon. Under the IRTS, a drainage tunnel would be constructed to connect Kowloon Group of Reservoirs with Lower Shing Mun Reservoir and convey overflow water from the former to the latter. Upon completion of the IRTS, water resource of about 2.5 Mm^3 a year would be generated.

Note 7: *The system at EMSD Headquarters building commenced operation in 2005 while the other systems have been put into service from 2010.*

2.14 In 2005, the DSD informed the Panel on Development of the Legislative Council (LegCo) that:

(a) the Lai Chi Kok Transfer Scheme (with reduced tunnel size) and the IRTS would bring up the flood protection standard in stages and achieve water conservation; and

(b) the construction works for the IRTS would commence in 2010 and was targeted for completion in 2012.

In April 2007, the LegCo Finance Committee (FC) approved funding of $26 million for conducting site investigation, design and environmental impact assessment of the IRTS project. The WSD was the works agent. From May 2007 to February 2008, the WSD engaged two consultants and a contractor for the project, as follows:

Date	Nature of consultancy/contract	Cost ($ million)
May 2007	Consultancy for the design and works supervision	5.5
August 2007	Consultancy for environmental impact assessment	0.9
February 2008	Contract for site investigation	20.9
	Total	27.3

2.15 In August 2009, in view of the substantial tunnel construction works being carried out in the territory in the forthcoming years, and for the purpose of reducing the project cost, the DSD proposed, and the DEVB endorsed, that commencement of the construction works for the project (at an estimated cost of $350 million at that time) should be deferred by five years to 2015. In the same month, the DSD informed the DEVB that:

(a) the IRTS and the drainage tunnel to be constructed under the Lai Chi Kok Transfer Scheme were designed to cater for a 1-in-200-year storm; and

(b) with the proposed reduced tunnel size and temporary reservoir management, the drainage system could still serve to maintain the flood protection standard to cater for a 1-in-50-year storm even if the implementation of the IRTS was deferred.

Delay in implementing IRTS

2.16 Audit noted that, up to December 2014, the WSD and the DSD had yet to seek funding for carrying out the IRTS construction works. According to the WSD and the DSD, the estimated cost of the construction works had increased from $350 million in 2009 to $868 million in 2014 (a 148% increase).

2.17 In Audit's view, in the light of the need to reduce the risk of flooding in West Kowloon during heavy rainfall and the benefit of generating 2.5 Mm^3 of additional fresh water a year by implementing the IRTS, the DSD, in collaboration with the WSD and the DEVB, needs to expedite actions to implement the IRTS. The WSD and the DSD also need to inform the Panel on Development of the implementation progress of the IRTS.

Delay in improving priority catchwater systems

2.18 A catchwater system comprises catchwater channels which intercept surface water in the water gathering ground and carry the water to reservoirs for storage. As of December 2014, the WSD maintained 45 catchwater systems having a total length of 120 kilometres (km), of which 57 km (48%) were constructed before 1941. According to the WSD, blockage of catchwater systems resulting from slope failure would lead to flooding in the downstream areas.

2.19 Using a systematic approach (Note 8), the WSD identified the need to improve four catchwater systems, namely Shing Mun, Beacon Hill, Golden Hill and Tai Lam Chung catchwater systems (having a total length of 26 km). In February 2007, the WSD commissioned a consultancy (Consultancy A) at a fee of $4 million to carry out, among other tasks, a pilot and preliminary feasibility study for improving these four catchwater systems. The study was funded by a block vote of the CWRF. The study recommended the carrying out of improvement works at a total cost of $607 million.

Note 8: *The approach takes into account the catchwater channel and its associated operation facilities, the adjoining natural and man-made slopes, and the nearby stream courses and storm drainage systems.*

2.20 In October 2008, in informing the Panel on Development of the TWM in Hong Kong, the Government said that the WSD would commence the improvement project by 2011. In December 2009, the WSD commissioned another consultancy (Consultancy B) to carry out the investigation, design and construction works supervision for the project at a cost of $17.9 million, which was funded by a block vote of the CWRF. According to the works programme included in the consultancy brief of Consultancy B, construction works for:

(a) Package A of the project covering Shing Mun, Golden Hill and Tai Lam Chung catchwater systems would commence in June 2011 and was targeted for completion in December 2012; and

(b) Package B of the project covering the remaining improvement works would commence in July 2012 and was targeted for completion in January 2016.

2.21 Audit noted that, up to December 2014, the WSD had yet to seek funding for carrying out the project construction works. In January 2015, the WSD informed Audit that in the short term the WSD would:

(a) repackage the related works with a view to implementing the priority works using CWRF block vote funding in the near future; and

(b) enhance regular inspections and maintenance to keep the normal functioning of the related catchwater systems.

2.22 In Audit's view, in order to protect the local fresh water resources and minimise flooding in the downstream areas, the WSD needs to expedite actions to improve the four priority catchwater systems and to keep the Panel on Development informed of the implementation progress.

Developing seawater desalination

2.23 In 2008, the Government informed the LegCo Panel on Development that the WSD had completed a pilot study on seawater desalination by adopting the reverse osmosis technology (Note 9). In May 2012, the WSD informed the Panel on Development that:

(a) with the fast pace of economic development of cities in GD Province, the demand for water resources from DJ continuously increased. In view of this, the Government of GD Province promulgated in 2008 the "Water Resources Allocation Plan in the DJ River Basin of GD Province" setting out the maximum amount of water that cities in GD Province and Hong Kong could draw from DJ. The water consumption of some areas in GD like Shenzhen and Dongguan had already exceeded their allocated quantities in the Plan even under normal yield condition;

(b) under the Supply Agreement, the Government of GD Province agreed to supply up to an ultimate annual quantity of 1,100 Mm^3 of fresh water to Hong Kong. However, when a severe drought happened, the whole region of DJ River Basin would likely face water shortage. To better prepare Hong Kong for water shortage arising from severe droughts, there was a genuine need to study in good time and develop new water sources to safeguard the sustainable development of Hong Kong;

(c) climate change would bring about more frequent extremely dry weather and increase the likelihood of the occurrence of consecutive droughts. Being one of the responsible partners to other economic zones in the Pearl River Delta, Hong Kong should investigate and explore alternative water resources in order to mitigate difficulties encountered by its neighbours in GD Province when they faced a drought, noting that Hong Kong would also encounter drought at that moment;

Note 9: *Reverse osmosis is a process in which relatively pure water is separated from seawater through a semi-permeable membrane by applying hydraulic pressure.*

(d) due to projected increase in population of about 700,000 from 2010 to 2020, the WSD anticipated that the annual water consumption in 2020 would grow by 42 Mm^3, after accounting for a predicted saving of 41 Mm^3 brought about by the achievements under various water demand management initiatives;

(e) based on the past record of local yield collected in the water gathering ground, and risk assessment of water resource adequacy under adverse scenarios (e.g. the average long-term yield collected would decrease, the occurrence of consecutive droughts and the increase in water demand associated with population increase), the water shortage risk after 2020 would increase with a deficit of fresh water resources of up to 39 Mm^3 a year under an adverse scenario;

(f) to relieve the ever-increasing shortage of fresh water resources in coastal areas and on islands, General Office of the State Council of the People's Republic of China published "Vision on Expediting Seawater Desalination Industry Development" on 13 February 2012, where it put forward a proposal to expedite the seawater desalination industry development. The target was attaining a total desalination capacity of 2.2 to 2.6 Mm^3 per day by 2015; particularly on islands, with desalinated water exceeding 50% of the total additional water resources. As a coastal and well-developed city with scarce fresh water resources, Hong Kong had unlimited supply of seawater from the ocean that was not affected by the acute climate changes. Building a desalination plant to provide potable water would be an appropriate solution to alleviate the shortage of its fresh water resources; and

(g) based on the predicted demand for fresh water in 2020 and the time required for delivery of a desalination plant, it was time to commence the preliminary design, environmental impact assessment and site investigation. The proposed implementation programme was as follows:

2012 to 2014:	planning and investigation study of the desalination plant;
2015 to 2017:	detailed design and inviting tender for construction; and
2018 to 2020:	construction of the desalination plant.

2.24 In June 2012, the FC approved funding of $34.3 million for the WSD to carry out a planning and investigation study for the construction of a desalination plant at Tseung Kwan O. The study commenced in December 2012. According to the WSD, as of February 2015, the study had been largely completed, and the study affirmed that the project was technically feasible and cost-effective.

2.25 In January 2015, the WSD advised the Sai Kung District Council that:

(a) the estimated cost of the project on seawater desalination was $9.3 billion; and

(b) it had planned to seek funding from the FC in the first quarter of 2015 for employing consultants to take forward the design and site investigation of the project.

2.26 In March 2015, the WSD informed the Panel on Development that:

(a) the output capacity of the desalination plant would be 50 Mm^3 of fresh water a year, accounting for 5% of the total fresh water supply in Hong Kong. There were provisions in the plant for future expansion to an ultimate capacity of 100 Mm^3 of fresh water a year;

(b) the construction works of the plant would take place between 2018 and 2020. The first stage of the plant was expected to be commissioned in 2020; and

(c) the estimated cost of seawater desalination at the plant would be $12 per m^3, vis-a-vis $4 per m^3 and $8 per m^3 for drinking water produced from local catchwater and DJ water respectively. Of the estimated cost of $12 per m^3, $7 per m^3 and $5 per m^3 were operation cost and capital depreciation cost respectively.

Need to closely monitor the supply of fresh water

2.27 According to the WSD, it had adopted a complex computer model for risk assessment to arrive at the estimated 39 Mm^3 of annual shortage of water supply after 2020 (see para. 2.23(e)), which in simple terms can be summarised as follows:

	Quantity (Mm^3)
Estimated water demand in 2021 (based on forecast made in 2010 — Note 1)	991
Less: Supply of DJ water	820
Local water resources in severe drought situation (Note 2)	132
Estimated water shortfall	39

Note 1: This estimate had taken into account the predicted saving brought about by implementing various water demand management initiatives.

Note 2: This represented the sum of water collected during the year and the usable reservoir storage at the beginning of the year.

2.28 In May 2012, the WSD informed the Panel on Development that, under adverse scenarios and based on the Long-term Demand Forecast (2010), the water shortage risk after 2020 would increase with a deficit of fresh water resources of up to 39 Mm^3 a year (see para. 2.23(e)). In February 2014, the WSD updated the water-demand forecasts under Long-term Demand Forecast (2013) by adopting upper- and lower- bound demand scenarios. Compared to the 2010 forecast, the 2013 forecast revised the projected annual water demand downward for the period 2021 to 2029 (see Appendix B).

2.29 According to the WSD, the decreases in water-demand forecasts between those in Long-term Demand Forecast (2010) and Long-term Demand Forecast (2013) were mainly attributable to decreases in the projected annual growth rates of:

(a) population from 0.9% to 0.7% (based on projections of the Census and Statistics Department);

(b) domestic per capita water consumption from 1% to 0.5% (for upper-bound water-demand forecasts — Note 10); and

(c) the trade water consumption from 1.5% to 1.1%.

2.30 Audit noted that one of the justifications for implementing a desalination plant was that, based on Long-term Demand Forecast (2010), the water shortage risk after 2020 would increase with a deficit of fresh water resources of up to 39 Mm^3 under an adverse scenario (see para. 2.23(e)). However, owing to decreases in the projected annual growth rates of population, and domestic and trade water demand, the Long-term Demand Forecast (2013) shows decreases in water demand ranging from 6 Mm^3 to 76 Mm^3 vis-à-vis those stated in Long-term Demand Forecast (2010) (see columns (d) and (e) in Appendix B).

2.31 In March 2015, the WSD informed Audit that, in considering the desalination plant project together with the DEVB, it had carried out a preliminary review in respect of the decrease in water demand and an assessment of GD Province, under severe drought situation and assuming upper-bound water demand, to supply an annual water quantity exceeding 820 Mm^3 to Hong Kong before 2030. The findings were as follows:

(a) the estimated water deficit in 2021 would decrease by 15% from 39 Mm^3 (see Long-term Demand Forecast (2010) in para. 2.27) to 33 Mm^3;

(b) however, in recent years, cities dependent on the DJ water resources had already consumed 10,000 Mm^3 of water annually from DJ, nearing the allocation limit of 10,183 Mm^3 under a drought year. In a severe drought year, which would affect both DJ River Basin of GD Province and Hong Kong, the flow in DJ would be substantially reduced. For example, in the severe drought year of 1963, the annual flow of DJ mainstream was only 5,050 Mm^3. With climate change, there would be more frequent

Note 10: *For the lower-bound water-demand forecasts, the WSD assumed a zero growth rate for the domestic per capita water consumption.*

occurrences of such severe droughts. In such events, the available water resources in the DJ would be much affected and the supply of DJ water of another 142 Mm^3 on top of 820 Mm^3 to meet the water deficit in 2029 (see column (f) in Appendix B) would be at the great expenses of other cities in the region;

(c) according to a WSD consultant's report, the production cost per m^3 of desalinated water using the reverse osmosis desalination technology was inversely proportional to the design capacity of desalination plants. The increase in unit production cost was becoming apparent when the design capacity was less than 50 Mm^3 per year. Amongst the 16 overseas plants studied by the consultant, half of them were designed with output capacity between 48 Mm^3 and 73 Mm^3. After making reference to the above factors, the WSD had set 50 Mm^3 as the annual output capacity of the first stage of the desalination plant, which accounted for about 5% of potable water consumption in Hong Kong; and

(d) to prepare for the impact of climate change and safeguard water security in Hong Kong, the DEVB and the WSD considered it time to take forward the development of an alternative water source by seawater desalination which was not susceptible to climate change.

2.32 Audit noted that, under the Supply Agreement, GD Province has agreed to allocate up to an annual quantity of 1,100 Mm^3 of fresh water to Hong Kong for future use. Therefore, the occurrence of water deficits in future is subject to GD Province not being able to supply an annual quantity in excess of 820 Mm^3. In Audit's view, the WSD needs to closely monitor the supply of fresh water from GD Province and the proposed desalination plant.

Audit recommendations

2.33 **Audit has *recommended* that the Director of Water Supplies should:**

Use of reclaimed water

(a) **expedite actions to implement the project for supplying reclaimed water for flushing in NENT;**

(b) **in collaboration with the Director of Architectural Services and the Director of Drainage Services, based on the results of the post-implementation review of the trial schemes on using grey water for flushing and rainwater for non-potable purposes at government/school buildings, formulate a strategy for rolling out the schemes to other government/school buildings and promoting implementation of the schemes in private buildings;**

Protecting existing water resources

(c) **expedite actions to improve the four priority catchwater systems;**

(d) **keep the Panel on Development informed of the implementation progress of the IRTS and the project for improving the four priority catchwater systems; and**

Developing seawater desalination

(e) **closely monitor the supply of fresh water from GD Province and the proposed desalination plant.**

2.34 **Audit has also *recommended* that the Director of Drainage Services should, in collaboration with the Secretary for Development and the Director of Water Supplies, expedite actions to implement the IRTS.**

Response from the Government

2.35 The Director of Water Supplies agrees with the audit recommendations in paragraphs 2.33 and 2.34. He has said that:

(a) regarding paragraph 2.33(a), an inter-departmental steering committee chaired by the DEVB will be set up and it will closely monitor the progress of implementing the project for supplying reclaimed water for flushing in NENT;

(b) regarding paragraph 2.33(b), the DEVB and the Environment Bureau are reviewing their joint technical circular on green government buildings (see para. 2.10) and the WSD has made a proposal to them that the joint circular should highlight the policy on using recycled water in government buildings. Furthermore, to promote wider use of recycled water in the private sector, the WSD has also made a proposal to the Hong Kong Green Building Council that, in the Council's current review of the Building Environmental Assessment Method Plus standard, it should put higher weightings on those assessment criteria related to use of recycled water in buildings. The WSD will continue to take forward the above proposal in government and private buildings;

(c) regarding paragraph 2.33(d), when an opportunity arises, the WSD will inform the Panel on Development of the implementation progress of the IRTS (in conjunction with the DSD) and the project for improving the four priority catchwater systems; and

(d) regarding paragraph 2.33(e), the WSD will work in collaboration with the parties concerned, including GD Province, to closely monitor the situation of future demand and supply of DJ water.

2.36 The Secretary for Development and the Director of Drainage Services agree with the audit recommendation in paragraph 2.34.

PART 3: WATER DEMAND MANAGEMENT

3.1 This PART examines the WSD's implementation of water demand management initiatives promulgated under the 2008 TWM Strategy.

Total Water Management Strategy

3.2 As shown in Figure 2 in paragraph 1.4, of the 933 Mm^3 of fresh water consumed in 2013, 344 Mm^3 (36.9%) was for domestic uses, 213 Mm^3 (22.8%) for non-domestic uses, 52 Mm^3 (5.6%) for flushing, 29 Mm^3 (3.1%) for government establishments and the remaining 295 Mm^3 (31.6%) was unmetered consumption.

3.3 Under the 2008 TWM Strategy, the WSD pledged the following initiatives to reduce water demand:

(a) enhancing public education on water conservation (paras. 3.4 to 3.8);

(b) retrofitting water-saving devices at government facilities (paras. 3.9 to 3.14);

(c) conducting water-efficiency audits (paras. 3.15 to 3.19);

(d) extending the use of seawater for flushing (paras. 3.20 to 3.24); and

(e) implementing programmes to replace and rehabilitate aged water mains, and apply new technologies to improve water pressure management and detection of water mains leakage (these programmes were covered in a previous audit review conducted in 2010 — see para. 1.5)

Enhancing public education on water conservation

3.4 In a water bill sent to a customer, the WSD states the daily water consumption of his household, and suggests that the customer could divide the amount by the number of water users during the period to arrive at the daily per capita water consumption of his household. The WSD also states that the daily per capita domestic water consumption in Hong Kong is 130 litres, and the world average is 110 litres.

3.5 To encourage the young generation to appreciate the need for water conservation, develop water-saving habits and share the knowledge and good water-saving habits with their families, since 2009 the WSD has organised various education programmes and promotion campaigns on water conservation (see Appendix C).

Need to evaluate effectiveness of measures to promote water conservation

3.6 In 2011, the WSD appointed a consultant to conduct a Domestic Water Consumption Survey. According to the Survey results:

(a) 86% of the households knew that the Government was promoting water conservation and 98.8% of the households supported water conservation;

(b) 39.7% of primary students had heard of water conservation;

(c) 32.5% of respondents considered the Government's work on public education and promotion activities on water conservation "very effective/effective"; and

(d) 19.9% of respondents considered the activities in (c) not effective, and 82.2% of these respondents recommended that the WSD should strengthen promotion on television.

3.7 Notwithstanding the efforts made by the WSD in organising various education programmes and promotion campaigns since 2009, Audit noted that the daily per capita domestic water consumption in Hong Kong had been around 130 litres from 2009 to 2014. In Audit's view, the WSD needs to take measures to evaluate the effectiveness of its public education and promotion activities on water conservation with a view to identifying areas for improvement.

No performance indicators for public education programmes

3.8 In March 2013, the WSD set a target of saving at least 10 litres of fresh water per capita per day. However, the WSD had not set any performance indicators on education programmes and promotion campaigns on water conservation and published such performance indicators in its Controlling Officer's Reports (CORs). The WSD needs to make improvement in this area.

Retrofitting water-saving devices at government facilities

3.9 In 2009, the WSD engaged the EMSD as its consultant for retrofitting water-saving devices (including water-saving taps, showers, urinals and flushing cisterns) at government buildings and schools. In December 2009, EMSD survey found that 3,277 government buildings and schools could achieve water saving by retrofitting with water-saving devices.

3.10 In 2011, the WSD conducted a review to evaluate the cost-effectiveness of a pilot scheme on retrofitting water-saving devices at 421 government buildings and schools at a total cost of $104 million (Phase 1 retrofitting works — implemented in December 2009). The review found that the retrofitting works would generate an annual saving of $21.43 million, and the average payback period of the works was 5.1 years.

3.11 In view of the cost-effectiveness of retrofitting water-saving devices as revealed in the pilot scheme, the WSD commenced Phase 2 retrofitting works in April 2012 and completed the works in February 2014, in which 19,600 water saving devices were retrofitted in 177 venues. Up to mid-January 2015, the capital cost involved was $73 million.

3.12 In September 2014, the WSD commenced Phase 3 retrofitting works to install flow controllers for water taps and showers at all government buildings and schools, which was targeted for completion by August 2016. As of January 2015, 53,000 water-saving devices had been installed at 633 government buildings and schools. According to the WSD, it would commence Phase 4 retrofitting works to replace urinals and flushing cisterns installed at 800 government venues (using fresh water for flushing) with water-saving ones in September 2015, which was targeted for completion by September 2017.

Some government facilities consumed more water after retrofitting with water-saving devices

3.13 According to the WSD's review of the pilot scheme on retrofitting water-saving devices at 421 government buildings/schools (see para. 3.10), after implementation of the scheme, fresh water consumption had:

(a) decreased at 300 (71%) venues. The decreases ranged from 0.3% to 99.5%;

(b) remained unchanged at 2 (1%) venues; and

(c) increased at 119 (28%) venues. The increases ranged from 0.4% to more than 100% (see Table 1).

Table 1

Government buildings and schools consuming more fresh water after retrofitting with water-saving devices

Percentage increase	Number of government buildings and schools
5% or below	14
More than 5% to 10%	12
More than 10% to 50%	54
More than 50% to 100%	14
Over 100% (Note)	25
Total	**119**

Source: Audit analyses of WSD records

Note: The two largest increases occurred at the Tsing Yi North Pumping Station (3,983%) and the Sheung Wan Seawater Pumping Station (1,454%).

3.14 In Audit's view, the WSD needs to conduct a review to ascertain the reasons for the water-consumption increases and take remedial actions where necessary.

Conducting water-efficiency audits

3.15 In 2013, government facilities consumed 29 Mm^3 of water, accounting for 3.1% of the total fresh water consumed (see Figure 2 in para. 1.4). The WSD had, from June 2010 to June 2013, engaged a consultant to conduct water-efficiency audits for the LCSD, the CSD and the FEHD (Note 11) at a total cost of $2.9 million, which were targeted for completion by May 2012, March 2014 and June 2012 respectively. Table 2 shows the water consumption of these three government departments.

Table 2

Water consumption of the LCSD, the CSD and the FEHD (2011-12 to 2013-14)

Government department	Major use of fresh water	Water consumption		
		2011-12 (Mm^3)	2012-13 (Mm^3)	2013-14 (Mm^3)
LCSD	– irrigation and park cleansing – swimming pool replenishment and cleaning	12.1	12.4	12.8
CSD	– domestic water consumption by persons in custody – laundry services for Hospital Authority and Department of Health – environmental and intensive cleansing programmes of correctional institutions/facilities	4.5	4.6	5.0
FEHD	– water replenishment for street-washing vehicles – public-toilet use – water consumption in FEHD markets	3.6	3.7	3.6

Source: WSD records

Note 11: *According to the WSD, these three government departments were selected for conducting water-efficiency audits because they had been the largest government water consumers from 2009-10 to 2012-13.*

3.16 In September 2012, the WSD issued the best-practice guidelines on water conservation to the LCSD (see examples of the best practices in Appendix D). According to the LCSD and the WSD:

(a) the best-practice guidelines have been implemented at six parks and five swimming pools (Note 12); and

(b) the overall water consumption at these 11 venues in 2014 had decreased by 7.2% when compared to that in 2011.

3.17 According to the WSD, as of February 2015, the water-efficiency audit for the FEHD had been completed, and that for the CSD was still in progress. In Audit's view, the WSD needs to take measures with a view to ensuring the early completion of the audit for the CSD and thereafter issue related best-practice guidelines on water conservation to it.

Some LCSD venues consumed more water after implementing related best-practice guidelines

3.18 Notwithstanding the overall 7.2% water reduction at 11 LCSD venues from 2011 to 2014, Audit examination revealed that water consumption at 4 (namely Kowloon Park, Shatin Park, Tsuen Wan Park and Kowloon Park Swimming Pool) of the 11 venues had in fact increased from 2011 to 2014, with increases ranging from 5% to 63% (see Table 3).

Note 12: *The six parks were Hong Kong Park, Kowloon Park, Shatin Park, Tai Po Waterfront Park, Tsuen Wan Park and Tuen Mun Park and the five swimming pools were Fanling Swimming Pool, Kowloon Park Swimming Pool, Kowloon Tsai Swimming Pool, Morrison Hill Swimming Pool and Shatin Jockey Club Swimming Pool.*

Table 3

Four LCSD venues with increase in water consumption (2011 and 2014)

Venue	Water consumption		Increase in water consumption
	2011 (a) (m^3)	2014 (b) (m^3)	(c) = (b) − (a) (m^3)
Kowloon Park	176,923	185,666	8,743 (5%)
Shatin Park	204,372	332,403	128,031 (63%)
Tsuen Wan Park	30,305	34,799	4,494 (15%)
Kowloon Park Swimming Pool	368,191	467,411	99,220 (27%)

Source: WSD records

3.19 In Audit's view, the LCSD, in collaboration with the WSD, needs to conduct a review to ascertain the reasons for water-consumption increases at the four venues and, taking into account experience gained in implementing the best-practice guidelines at the 11 LCSD venues, take actions to roll out the implementation of the guidelines to other LCSD venues.

Extending the use of seawater for flushing

3.20 For the purpose of saving fresh water, the WSD has provided seawater for flushing since the 1950s. Areas not yet covered by the seawater networks are provided with fresh water for flushing. In 2013, 52 Mm^3 of fresh water was used for flushing, accounting for 5.6% of the total fresh water consumed (see Figure 2 in para. 1.4).

3.21 Under the 2008 TWM Strategy, seawater for flushing would be extended to areas wherever it was economically justified to do so (Note 13). The WSD has formulated a programme for implementation (see Table 4). After the commissioning of the seawater supply systems in Pok Fu Lam and Northwest New Territories, the coverage of the seawater network would increase to about 85% of the total population.

Table 4

Implementation programme for extending seawater supply network

Expansion Area	Number of residents	Actual completion date	Estimated quantity of fresh water saved a year (Mm^3)
Northwest New Territories	600,000	December 2014	21.9
Pok Fu Lam	98,000	July 2013	5.5

Source: WSD records

Many buildings at Pok Fu Lam not yet connected to seawater supply network

3.22 The seawater supply system at Pok Fu Lam was substantially completed in July 2013. As of February 2015, of the total 570 buildings at Pok Fu Lam covered under the seawater supply system, works to convert the supply of fresh water to seawater for flushing for:

Note 13: *The reasons for not supplying seawater to some areas include: (a) the population is sparse and scattered; (b) the areas are located far from the sea; and (c) the areas are located in high level requiring high capital and operation cost for providing a seawater supply system.*

(a) 111 buildings (20%) had been completed;

(b) 81 buildings (14%) were in progress; and

(c) 378 buildings (66%) had not yet commenced.

3.23 Under the flushing-water conversion scheme, related water consumers are invited to apply to the WSD for conversion and to pay for the associated connection fee. They are also required to carry out necessary works to facilitate the facilities conversion. According to the WSD:

(a) some water consumers are unwilling to convert their flushing by using seawater for the following reasons:

  (i) buildings might be redeveloped in the near future;

  (ii) the lack of management offices or owners' corporations to coordinate among the consumers to apply for seawater conversion and to carry out the necessary modification works; and

  (iii) they need to pay for costs of the connection works and modification of the internal flushing systems; and

(b) for water consumers willing to convert their flushing facilities by using seawater, they need time to apply for road-excavation permits for carrying out the works.

3.24 In Audit's view, the WSD needs to take measures with a view to completing works for supplying seawater for flushing to the remaining 378 buildings at Pok Fu Lam at an early time.

Audit recommendations

3.25 **Audit has *recommended* that the Director of Water Supplies should:**

(a) **take measures to evaluate the effectiveness of WSD public education and promotion campaigns with a view to identifying areas for improvement;**

(b) **set performance indicators on education programmes and promotion campaigns on water conservation and publish such indicators in the WSD's COR;**

(c) **conduct a review to ascertain the reasons for water-consumption increases at 119 government buildings and schools after being retrofitted with water-saving devices and take remedial actions where necessary;**

(d) **take measures with a view to ensuring the early completion of water-efficiency audit for the CSD and thereafter issue best-practice guidelines on water conservation to it; and**

(e) **take measures with a view to completing works for supplying seawater for flushing to the remaining 378 buildings at Pok Fu Lam at an early time.**

3.26 **Audit has also *recommended* that the Director of Leisure and Cultural Services should, in collaboration with the Director of Water Supplies:**

(a) **conduct a review to ascertain the reasons for the water-consumption increases at the four LCSD venues after implementing the related best-practice guidelines; and**

(b) **take actions to roll out the implementation of the guidelines to other LCSD venues, taking into account experience gained in implementing the best-practice guidelines on water conservation at 11 LCSD venues.**

Response from the Government

3.27 The Director of Water Supplies agrees with the audit recommendations in paragraphs 3.25 and 3.26. He has said that:

(a) regarding paragraph 3.25(a), the WSD will conduct a customer survey in 2015-16 to evaluate the effectiveness of its public education and promotion activities on water conservation;

(b) regarding paragraph 3.25(c), among the 25 cases with increases in water consumption of over 100% (see Table 1 in para. 3.13), about half are WSD installations, and most of them are pumping stations. As far as the WSD's facilities are concerned, the majority of the increase in water consumption was due to operation needs, maintenance and improvement works. For the two cases with the largest increases at Tsing Yi North Pumping Station and Sheung Wan Seawater Pumping Station, the increase in water consumption was due to construction of green roofs and cleansing of additional silt screens installed for preventing possible intake of silt generated by the construction works of the Central and Wan Chai Bypass. The WSD will conduct a review of the remaining facilities to ascertain the reasons for the water-consumption increases;

(c) regarding paragraph 3.25(d), the WSD will expedite the water-efficiency audit for the CSD for completion within 2015-16; and

(d) regarding paragraph 3.25(e), the WSD will take more proactive measures to expedite the seawater conversion at Pok Fu Lam. In this connection, it will provide advice and technical support to the consumers/agents for inspecting their internal plumbing systems and carry out the necessary modification works to facilitate the conversion. It will also seek support from the related District Council and District Office to help the consumers/agents expedite the conversion.

3.28 The Director of Leisure and Cultural Services agrees with the audit recommendations in paragraph 3.26. She has said that:

(a) regarding paragraph 3.26(a), the LCSD will, in collaboration with the WSD, re-examine the water consumption of the four LCSD venues and identify the reasons for the water-consumption increases at these venues; and

(b) regarding paragraph 3.26(b), the LCSD has implemented the Best Practice Guidelines on water conservation at the 11 selected LCSD venues as far as practicable. Based on its operational experience, it has provided comments and suggestions to the WSD for further refinement of the guidelines. It will take action to roll out the implementation of the refined guidelines to other LCSD venues taking into account the operational experience gained.

PART 4: IMPLEMENTATION OF GOVERNMENT POLICY ON WATER CHARGES

4.1 This PART examines the WSD's implementation of government policy on water charges.

Government's policy on water charges

Tariff structure for water charges

4.2 In 1979, the Government introduced a tariff structure for water charges which was designed with regard to:

(a) the minimum water requirements to sustain a healthy/hygienic life;

(b) the need to take into account the impact of increased water charges on industry and on domestic consumers;

(c) the need to encourage the conservation of water and to discourage extravagant use and waste; and

(d) the need to put the waterworks accounts into balance.

Pursuant to the Government's policy, water tariff should be set to recover the net production cost (Note 14), and achieve a target return on Average Net Fixed Assets (ANFA — Note 15). Moreover, in setting the water tariffs, the Government also took into account the affordability, financial performance of the waterworks operation, the prevailing economic situation and the views of LegCo Members.

Note 14: *In June 1992, the WSD informed the Executive Council that: (a) full production cost represented the average gross cost per unit of potable water; and (b) net production cost represented the average net cost per unit of water supply after deducting from the full production cost the relevant contribution from rates (the contribution from rates (see paras. 4.4 and 4.5) was first applied to meet the deficit in respect of flushing water supply).*

Note 15: *ANFA is the average of the values of the net fixed assets (i.e. net of depreciation) at the beginning and end of a financial year.*

4.3 The tariff structure for supplying fresh water and seawater is as follows:

(a) fresh water supply for domestic uses should be charged through a four-tier system, as follows:

(i) First tier	12 m^3 of fresh water (effective from February 1995) should be supplied free of charge for a domestic household in a four-month period. This was to provide the minimum quantity of water required for health and hygiene. The quantity was determined by reference to the average household size in public housing, and the related net production cost should be met by the Government.
(ii) Second tier	Water tariff for the next 31 m^3 of fresh water (effective from February 1995) consumed by a domestic household in a four-month period should be approximately in line with the net production cost.
(iii) Third tier	Water tariff for the next 19 m^3 of fresh water (effective from February 1995) consumed by a domestic household in a four-month period should be approximately in line with the full production cost.
(iv) Fourth tier	Water tariff for the remaining fresh water consumed by a domestic household in a four-month period should be approximately 40% above the third tier (i.e. 40% above the full production cost). The purpose was to discourage extravagant and wasteful use of water above the level necessary to maintain a reasonable standard of living.

(b) fresh water supply for non-domestic uses should be charged dependent on the nature of trades, as follows:

(i) General trade purposes	Water tariff should be approximately in line with the net production cost (i.e. at the same rate of charge as the second tier of domestic water supply (see (a)(ii)).
(ii) Non-ocean-going vessels	Water tariff should be linked to the second tier rate of charge for domestic uses.
(iii) Construction purposes	Water tariff should be approximately in line with full production cost (i.e. at the same rate of charge as the third tier of domestic water supply (see (a)(iii)).
(iv) Ocean-going vessels	Water tariff should be linked to the fourth tier rate of charge of domestic supplies (see (a)(iv)). The purpose was to discourage shipping liners from taking on water in Hong Kong.

(c) seawater for flushing should be supplied free of charge, the cost of which should be met wholly from contribution from government rates; and

(d) for fresh water supply for flushing:

(i) The first 30 m^3 of fresh water supply (effective from 1981) in a four-month period	The water should be supplied free of charge, the cost of which should be met wholly from contribution from government rates.
(ii) Remaining fresh water supply	The water tariff should be linked to the rate of charges for general trade purposes (see (b)(i)).

Rates contributions to meet water cost

4.4 According to the Rating Ordinance (Cap. 116), the amount of government rates payable by a tenement having no fresh water supply is to be reduced by such a percentage as prescribed by resolution of LegCo. With effect from April 1984, by resolution of LegCo, the reduction rates have been set at 15% for a tenement having no fresh water supply and 7.5% for a tenement having unfiltered water supply.

4.5 The Rating and Valuation Department provides the WSD with the information on the rates collected, concessions granted, water supply status for the past year and the projected estimates of rates revenue for the next five years for the latter to prepare the Waterworks Operating Accounts. In general, 15% of rates paid by a household or an entity having fresh water supply and rate concessions granted (Note 16) are accounted for as revenue in the Waterworks Operating Accounts. In 2013-14, the total waterworks revenue generated from contribution from government rates and from the Government due to rates concessions was $3,971 million.

Waterworks Operating Accounts

4.6 Every year, the WSD prepares the Waterworks Operating Accounts for the immediate past financial year for submission to the Waterworks Accounts Committee (WAC — Note 17) for vetting and endorsement.

4.7 Table 5 shows the 2013-14 Waterworks Operating Accounts (see Appendix E for the Accounts of 2009-10 to 2012-13).

Note 16: *This was to cover the shortfall in contribution from rates resulting from the rates concessions granted by the Government in the past years.*

Note 17: *The WAC is chaired by the Permanent Secretary for the Financial Services and the Treasury (Treasury), with members including the Director of Water Supplies and representatives from the FSTB, the DEVB, the Treasury and the WSD.*

Table 5

Waterworks Operating Accounts
(2013-14)

Particulars		$ million
Revenue		
Water charges		2,555.8
Contribution from rates		2,236.4
Government contribution to cover rates concessions		1,734.2
Government contribution relating to free water allowance to consumers (Note)		918.7
Water supply to government establishments		159.0
Fees, licences and reimbursable works		22.7
Interest from deposits		3.8
Total revenue	**(a)**	7,630.6
Expenditure		
Cost of DJ water		3,802.2
Operating and administration expenses		1,747.9
Staff costs		1,528.7
Depreciation		1,482.7
Total expenditure	**(b)**	8,561.5
Deficit	**(c) = (a) − (b)**	(930.9)
Return on ANFA		
ANFA	**(d)**	$50,086.9 million
Target rate of return on ANFA	**(e)**	3.4%
Actual rate of return on ANFA	**(f) = (c) ÷ (d) × 100%**	(1.86%)

Source: WSD records

Note: The first 12 m^3 of fresh water was supplied free of charge for a domestic household in a four-month period, the net production cost of which was met by the Government.

4.8 Summaries of the Waterworks Operating Accounts are included in WSD annual reports which are uploaded onto WSD website for public information.

Waterworks Accounts Committee

4.9 Every year, the WSD prepares and submits to the WAC water-tariff-revision proposals and a set of five-year projections on forecasts of income and expenditures, capital spending, outlays and growth of water consumption. The WAC usually meets once a year (or by circulation) to examine the above-mentioned submissions. In the event that the WAC endorses proposed revisions to the water tariffs, the proposal would be submitted to the Executive Council (ExCo) for approval.

Target rate of return on ANFA

4.10 Following a review of government utilities, ExCo decided in 1995 that a target rate of return should be set for each government utility to reflect the cost of capital employed in setting up, maintaining and enhancing the services, and the target rate of return should be measured on the basis of ANFA which broadly represented the level of capital employed by the utilities, and that the target rates of return should be reviewed at five-year intervals taking into account changes in policy and economic and investment market conditions. For 2012-13 and 2013-14, the target rate of return on waterworks operation had been set at 3.4%.

Water tariffs

4.11 Water tariffs for supplying fresh water had remained unchanged from 1995 to 2014 (Note 18). Table 6 shows the water tariffs and water consumption for 2013-14. According to the WSD, in reviewing the water tariffs:

(a) the overriding principle was to comply with the policy on achieving the target rate of return for the waterworks operation as a whole; and

(b) the Government will take into consideration the affordability, the financial performance of the waterworks operation, the prevailing economic situation and the views of LegCo Members.

Note 18: *With the exception of the water tariff for the supply of fresh water for ocean-going vessels which was last revised in 1996.*

Table 6

Water tariffs and water consumption (2013-14)

Particular	Water tariff ($/m^3)	Water consumption (Mm^3)
Domestic water supplies		
First Tier (first 12 m^3)	Free	84.7
Second Tier (next 31 m^3)	4.16	156.0
Third Tier (next 19 m^3)	6.45	49.0
Fourth Tier (remaining)	9.05	53.7
	Sub-total (A)	343.4
Non-domestic water supplies		
General trade purposes	4.58	197.1
Non-ocean-going vessels	4.58	0.6
Construction purposes	7.11	13.1
Ocean-going vessels	10.93	0.6
	Sub-total (B)	211.4
Flushing water supplies		
Seawater for flushing	Free	276.4
Fresh water for flushing — first 30 m^3 in a four-month period	Free	31.4
Fresh water for flushing — exceeding 30 m^3 in a four-month period	4.58	16.1
	Sub-total (C)	323.9

Source: *WSD records*

Remarks: *The data in this Table are slightly different from those in Figure 2 in paragraph 1.4 because the former related to April 2013 to March 2014 whereas the latter related to January to December 2014.*

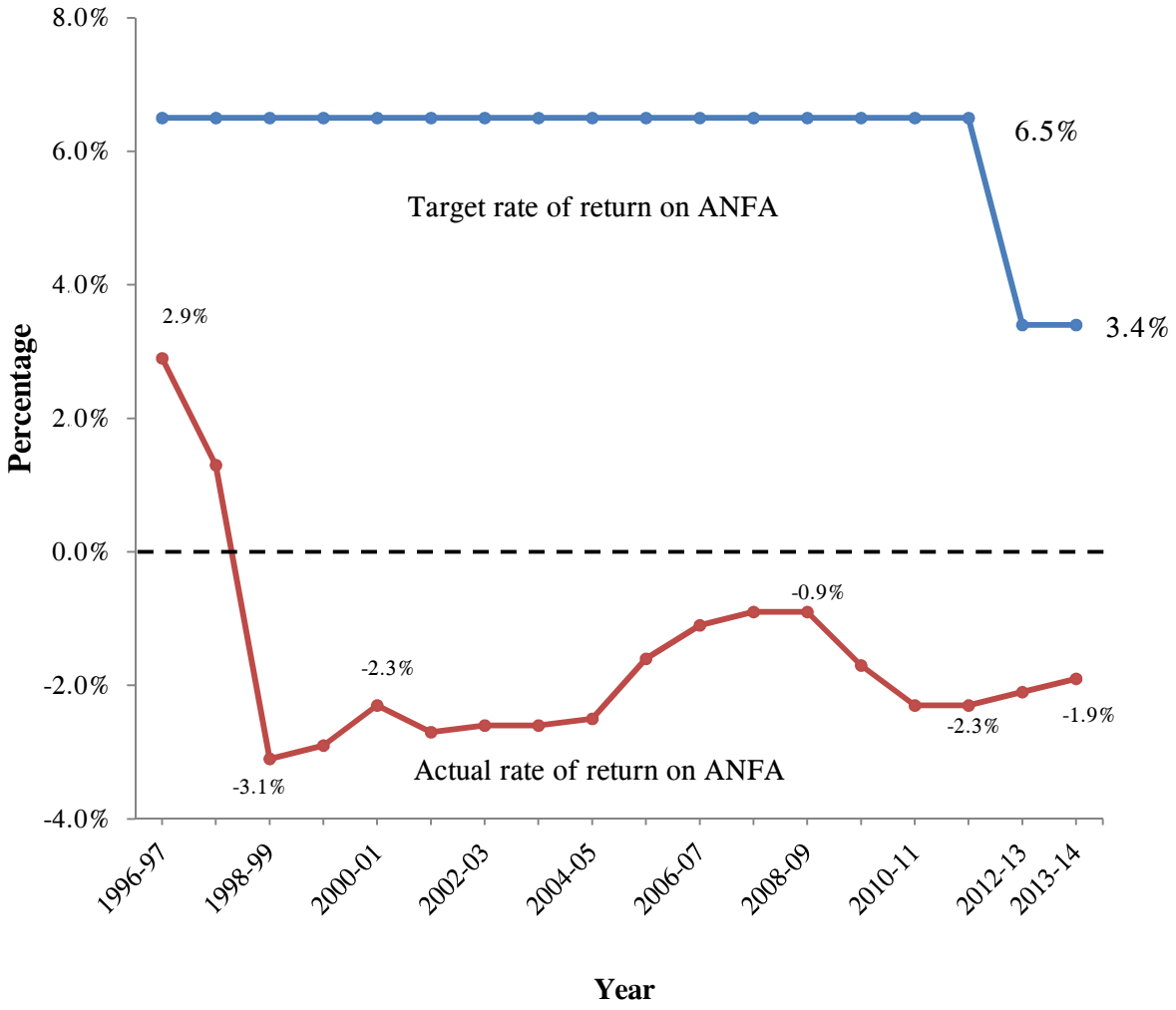
4.12 In 1996, the Government proposed tariff increases of 8.5% for domestic water supply and of 9.3% for non-domestic water supply. In the event, with the exception of tariff for supply of fresh water for ocean-going vessels, LegCo did not approve the proposed increases in water charges on the grounds that, although not being able to achieve prescribed return on ANFA, the waterworks operations could still achieve an operating surplus. In 1999, the Government submitted a consultation paper to the then LegCo Panel on Financial Affairs proposing an increase of water tariff by 5%. In the event, the LegCo Panel did not support the proposed increase on the grounds that the economy at that time had not recovered.

Target rates of return on ANFA not met since 1998-99

4.13 The target and actual rates of return on ANFA are included in the Waterworks Operating Accounts and published in WSD annual reports. Owing to deficits in the Waterworks Operating Accounts from 1998-99 to 2013-14, the waterworks operation had achieved negative returns on ANFA during the period. Notwithstanding such negative returns, the Government had continued to adopt positive target rates of return on ANFA from 1998-99 to 2013-14 (see Figure 3).

Figure 3

Target and actual rates of return on ANFA (1996-97 to 2013-14)



Source: WSD records

No disclosure of target return on ANFA included in the unit production cost

4.14 Audit examination revealed that the WSD had adopted the following computation in arriving at the full and net unit production costs of fresh water:

(a) ***Full unit production cost:***

Operating expenses of supply of fresh water
plus target return on ANFA
then divided by units of metered-water consumption

(b) ***Net unit production cost:***

Full unit production cost
less unit contribution from rates

4.15 In 1992, the WSD informed ExCo that net unit production cost of $4.29 at that time represented the average net cost per unit of water supply after deducting the relevant contribution from rates (see Note 14 to para. 4.2). Audit noted that the net unit production cost of $4.29 had included a target return on ANFA.

4.16 Furthermore, in the Report of the Subcommittee to study the Waterworks (Amendment) Regulation 1995 compiled by LegCo Secretariat, it was stated that the net production cost in 1994-95 was $4.86 per m^3 of fresh water supply. Audit also noted that this net unit production cost had included a target return on ANFA.

4.17 Audit noted that, under the Government's policy, the waterworks operation should achieve a target return on ANFA (see para. 4.10). Accordingly, the WSD had included such a target return in the computation of the net unit production cost.

4.18 Moreover, Audit noted that the WSD had not disclosed the amount of target return on ANFA included in the production costs. As revealed in WSD records, for 2013-14:

(a) the full unit production cost (inclusive of target return on ANFA of $2.61) was $14.53 (see Appendix F); and

(b) the net unit production cost (inclusive of target return on ANFA of $2.61) was $10.76 (after deducting unit rates contribution of $3.77 — see Appendix G).

4.19 In March 2015, the WSD informed Audit that:

(a) the Government's policy was to assess the financial performance of the waterworks operation as a whole, including the overall cost recovery rate and rate of return on ANFA in the waterworks operating accounts;

(b) since 1979, with a view to achieving the target rate of return on ANFA for the Waterworks Operating Accounts as a whole in accordance with the Government's policy, the water tariffs for domestic consumers in different tiers had been proposed to increase on a uniform rate basis. With the passage of time and change of situations, the water tariffs would be different from the net and full unit production costs; and

(c) in 1986, the WAC agreed that, following a change in the capital financing structure (from loan capital to equity capital), the notional revenue from the Government in respect of free water allowance to domestic consumers would be more realistically assessed on the basis of production cost plus an expected return on ANFA rather than on production cost plus interest on government loan. Accordingly, the WSD had included the target return on ANFA in calculating the net unit production cost in the submission to ExCo.

4.20 In Audit's view, as the net unit production cost and full unit production cost are significant factors in determining the water tariffs (see para. 4.3(a)(ii) and (iii), and (b)(i) and (iii)), the WSD needs to publish such cost information in its annual reports and inform the public that the costs have included a target return on ANFA.

No disclosure of quantity of water supply for calculating unit production cost

4.21 In April 2014, in response to a question of a LegCo Member during examination of the Estimates of Expenditure 2014-15 relating to the proposed construction of a desalination plant (see paras. 2.23 to 2.32), the WSD said that the estimated unit cost of fresh water produced (Note 19):

(a) at 2012-13 price level from desalination was $12; and

(b) at 2013-14 price level from:

  (i) locally collected fresh water was $4.2; and

  (ii) DJ water was $8.8.

4.22 Audit noted that the $4.2 and $8.8 unit costs were calculated based on the quantity of total fresh water supply before treatment (933 Mm^3 in 2013 — see Figure 1 in para. 1.2). In March 2015, the WSD informed Audit that:

(a) the unit costs were calculated based on the total quantity of fresh water before treatment because they represented the resources consumed in producing one unit of fresh water; and

(b) to be consistent with its methodology adopted since 1979, the WSD had used the metered-water quantity for calculating the net and full unit costs.

Note 19: *The WSD provided similar information to the Panel on Development in April 2012 and March 2013.*

4.23 However, Audit noted that the WSD had used the lower metered-water quantity for calculating the net and full unit production costs for water-tariff setting purposes. Given the 32% difference (see para. 1.3) in water quantities between that of fresh water before treatment and the metered-water quantity, the WSD needs to publish in its annual reports the different bases of calculating unit water production costs.

Government's policy to discourage extravagant and wasteful water use not achieved

4.24 According to the Government's charging basis submitted to ExCo in 1992, the charging rate for the fourth tier for domestic consumers in the water tariff review proposal should be approximately 40% above the third tier (i.e. 40% above the full production cost). The purpose was to discourage extravagant and wasteful use of water above the level necessary to maintain a reasonable standard of living.

4.25 According to the WSD's records, the full unit production cost in 2013-14 was $14.53 (see Appendix F). Accordingly, if the "40% above the full production cost" charging basis was to be adopted for the fourth tier for domestic consumers, the water tariff should have been $20.34 /$m^3$ vis-à-vis the current tariff of $9.05 /$m^3$.

4.26 In this connection, Audit noted that the per capita domestic water consumption in Hong Kong is around 130 litres per day, which is 18% higher than the world average of 110 litres per day (Note 20). In Audit's view, the WSD needs to take into account the Government's policy on discouraging extravagant and wasteful use of water in reviewing water tariffs in future.

Note 20: *The world daily per capita water consumption is published in the WSD's annual reports and water bills.*

No revision of free water quantity to account for reduction in average household size

4.27 Under the four-tier water tariff system, to provide the minimum quantity of water required for health and hygiene, and by reference to the average household size in public housing, since 1995, the first 12 m^3 of fresh water has been supplied free of charge for a domestic water account in a four-month period, the net production cost of which is met by the Government (see para. 4.3(a)(i)). Similarly, since 1981, the first 30 m^3 of fresh water supply for flushing in a four-month period has also been supplied free of charge, the cost of which is met wholly from contribution from government rates (see para. 4.3(d)(i)).

4.28 However, Audit noted that, according to the Housing Department, the average household size in public housing had decreased from 4.6 persons in 1981 to 3.7 persons in 1995, and further decreased to 2.8 persons in 2013. Taking into account the reduction in the average household size, in 2013, the quantity of free fresh water (First tier) for a domestic water account in a four-month period should have been 9.1 m^3 (12 m^3 × 2.8 ÷ 3.7), which is 24% less than 12 m^3, and the quantity of free fresh water for flushing in a four-month period should have been 18.3 m^3 (30 m^3 × 2.8 ÷ 4.6), which is 39% less than 30 m^3.

4.29 In Audit's view, the WSD needs to take into account the reduction in the average household size in public housing, and the latest minimum quantity of water required for meeting the health and hygiene standard, in reviewing the water-tariff system in future.

LegCo Members' views on water tariffs

4.30 In examining the Waterworks (Amendment) Regulation 1995 in February 1995, some LegCo Members expressed the view that water charges levied on the commercial sector should be calculated on a commercial basis (i.e. based on cost recovery and a reasonable return rate), and any future increases in domestic water charges should be fixed on the basis of not exceeding the operating cost (i.e. without a commercial return). In Audit's view, the WSD needs to take into account LegCo Members' above views in reviewing water tariffs in future.

Audit recommendations

4.31 **Audit has *recommended* that the Director of Water Supplies should:**

(a) **publish information in WSD annual reports showing that:**

(i) **the net and full fresh-water unit production costs have included a target return on ANFA; and**

(ii) **the calculation of the net and full fresh-water unit production costs for charging purposes is based on the quantity of metered fresh water consumed; and**

(b) **in reviewing water tariffs in future, in collaboration with the Secretary for Development, take into account:**

(i) **the Government's policy on discouraging extravagant and wasteful use of water;**

(ii) **the reduction in the average household size in public housing and the latest minimum quantity of water required for meeting the health and hygiene standard; and**

(iii) **some LegCo Members' views that water charges levied on the commercial sector should be calculated on a commercial basis, and any future increases in domestic water charges should be fixed on the basis of not exceeding the operating cost.**

Response from the Government

4.32 The Director of Water Supplies agrees with the audit recommendations in paragraph 4.31. He has said that:

(a) regarding paragraph 4.31(a), the WSD has stated the quantities of fresh water before treatment and metered fresh water consumed in the annual reports. The WSD will make clear in the annual reports the relevance of the net and full fresh-water unit production costs in setting water charges; and

(b) regarding paragraph 4.31(b), the WSD commenced a review of water tariffs in 2014. The review will take into account the factors stated in (i) to (iii) of the paragraph.

4.33 The Secretary for Development agrees with the audit recommendations in paragraph 4.31(b).

PART 5: WAY FORWARD

5.1 This PART outlines the major audit observations and examines the way forward.

Water supply management

5.2 This audit reveals that the WSD needs to expedite actions in using reclaimed water for flushing, and in implementing the IRTS and the project for improving four high-priority catchwater systems. Early completion of these initiatives would contribute to an increase in supply of fresh water locally. Audit also notes that, owing to decreases in water-demand forecasts in coming years up to 2029, the WSD needs to closely monitor the supply of fresh water from GD Province and the proposed desalination plant.

Water demand management

5.3 This audit also reveals that the WSD needs to expedite actions to complete the water-efficiency audit on the CSD and issue related best-practice guidelines to it, and to complete works for supplying seawater for flushing to buildings at Pok Fu Lam. Early completion of these initiatives would also contribute to a reduction in demand for fresh water.

Implementation of government policy on water charges

5.4 The waterworks operating accounts had shown deficits averaging $988 million per year for the period from 2011-12 to 2013-14. The WSD needs to conduct a review of water tariffs, and in particular taking into account the Government's policy of discouraging extravagant and wasteful water use, and some LegCo Members' view that domestic water charges should be fixed on the basis of not exceeding the operating cost.

Way forward

High per capita domestic water consumption

5.5 Audit noted that, despite the implementation of various water-saving initiatives by the WSD in recent years, metered fresh water consumption had increased from 613 Mm^3 in 2004 to 638 Mm^3 in 2013 (a 4.1% increase), and the daily per capita domestic water consumption had been around 130 litres from 2009 to 2014, which was 18% higher than the world average of 110 litres. In this connection, the WSD has set a target of achieving 10 litres of water saving per capita per day. However, no target date has been set for achieving the water-saving target. In Audit's view, the WSD needs to consider setting a target date for the purpose.

Government's policy not achieved due to freezing of water tariffs

5.6 Since the freezing of water tariffs in 1995, the waterworks operating cost has increased significantly, albeit being compensated partly by the increase in contribution from rates. Consequently, the Government's policy objectives on the waterworks operation to recover the cost and achieve a target return on ANFA have not been achieved.

5.7 In Audit's view, the WSD, in collaboration with the DEVB, needs to formulate a water-tariff-revision plan for achieving the Government's policy objectives on water charges.

Audit recommendations

5.8 **Audit has *recommended* that the Director of Water Supplies should:**

(a) **consider setting a target date for achieving 10 litres of water saving per capita per day; and**

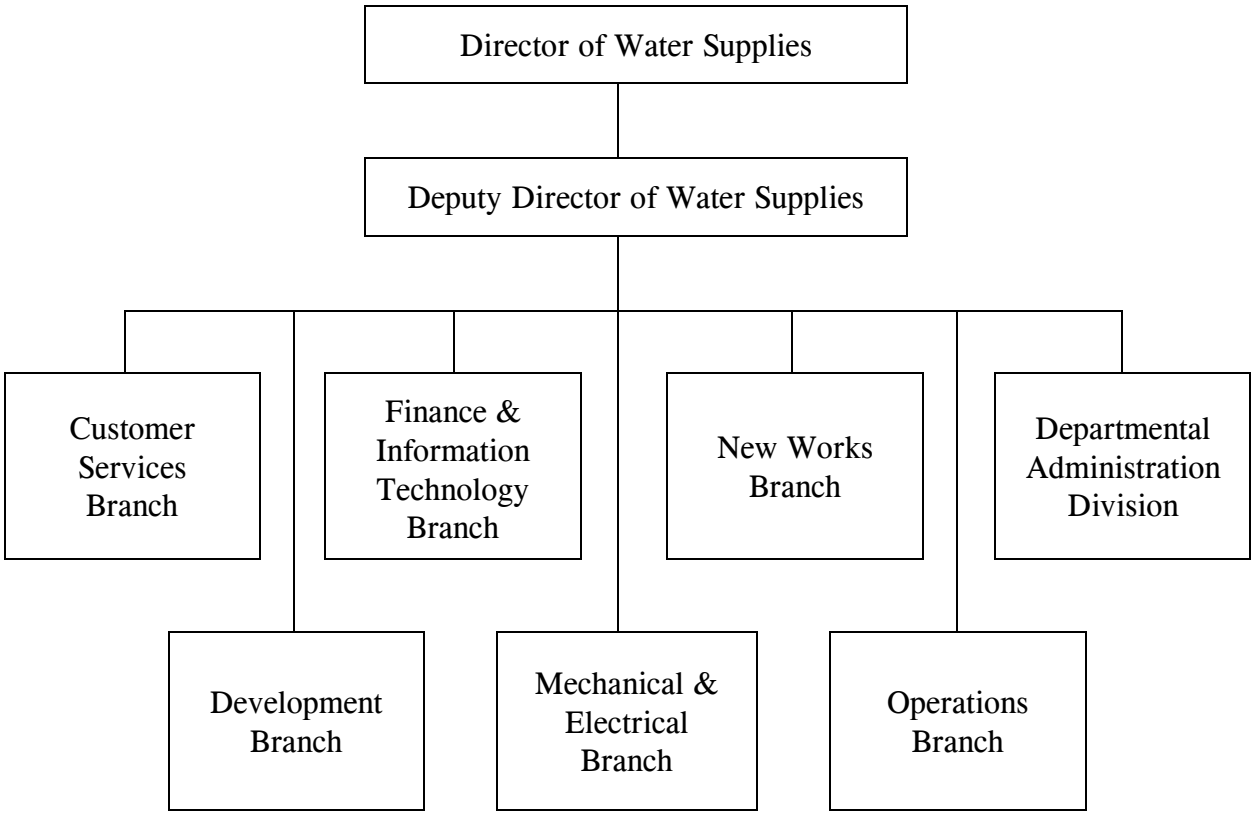
(b) **in collaboration with the Secretary for Development, formulate a water-tariff-revision plan for achieving the Government's policy objectives on water charges.**

Response from the Government

5.9 The Director of Water Supplies agrees with the audit recommendations in paragraph 5.8 and the Secretary for Development agrees with the audit recommendation in paragraph 5.8 (b).

Appendix A
(para. 1.13 refers)

Water Supplies Department
Organisation chart
(February 2015)



Source: WSD records

Appendix B
(paras. 2.28, 2.30 and 2.31(b) refer)

Water-demand forecasts (2021 to 2029)

Year	Water-demand forecasts			Decreases in water-demand forecasts between 2010 and 2013		Estimated water deficit based on 2013 water-demand forecasts (Note 3)	
	2010	2013					
		Upper-bound (Note 1)	Lower-bound (Note 2)	Upper-bound	Lower-bound	Upper-bound	Lower-bound
	(a) (Mm^3)	(b) (Mm^3)	(c) (Mm^3)	(d) = (a) − (b) (Mm^3)	(e) = (a) − (c) (Mm^3)	(f) (Mm^3)	(g) (Mm^3)
2021	991	985	959	6	32	33	7
2022	1,007	999	970	8	37	47	18
2023	1,022	1,013	981	9	41	61	29
2024	1,040	1,029	993	11	47	77	41
2025	1,053	1,040	1,001	13	52	88	49
2026	1,069	1,053	1,012	16	57	101	60
2027	1,085	1,067	1,022	18	63	115	70
2028	1,105	1,084	1,035	21	70	132	83
2029	1,118	1,094	1,042	24	76	142	90

Source: *WSD records and Audit analysis*

Note 1: *The upper-bound demand estimate was based on the assumption that the per capita consumption would grow at an annual rate of 0.5%.*

Note 2: *The lower-bound demand estimate was based on the assumption that the growth of the per capita consumption would be contained by water conservation measures and other factors such as the decreasing trend of household size.*

Note 3: *The calculation of estimated water deficit is based on annual local water resources of 132 Mm^3 and DJ water supply of 820 Mm^3. Under the Supply Agreement, GD Province would allocate up to an ultimate annual quantity of 1,100 Mm^3 of fresh water to Hong Kong. However, according to the WSD, the timing of the supply in excess of 820 Mm^3 and the price of such quantity are subject to future negotiation.*

Appendix C
(para. 3.5 refers)

Water conservation education programmes and promotion campaigns (September 2009 to December 2014)

Programme/campaign	No. of organisations participated	No. of participants
1. School Roadshow	443	134,970
2. Water Conservation Ambassadors Selection Scheme (Note 1)	180	20,661
3. Visit to Water Resources Education Centre	512	16,034
4. School Water Audit (Note 2)	62	2,799
5. Water Conservation Design Competition	25	55
6. Distribution of multi-lingual Posters and Leaflets for Domestic Helpers	295	N/A
7. Distribution of Teaching Kit for Liberal Studies "Water: Learn and Conserve"	About 500	N/A
8. Water Conservation Competition — Creative Water Saving Ideas to Share with Every Home	28	785
9. "Let's Save Water" Cap Design Competition	159	10,889
10. "Save Water • Cherish the World"		
(a) Roving Exhibition	(a) 77	(a) around 400,000 households
(b) Mobile Showroom	(b) 183	(b) around 51,000 visitors
11. "All About H_2O" Lecture Series	12	2,097
12. "Cherish Water Resources" Waterworks Installations Drawing Competition	102	809

Programme/campaign	No. of organisations participated	No. of participants
13. "Let's Save 10L Water" Campaign	240	126,178 households
14. Installation of Flow Controllers at Selected Housing Estates	16	13,388 households
15. Water Conservation Forum for Hotel and Catering Industry	78	200

Source: WSD records

Note 1: The WSD appoints students as Water Conservation Ambassadors to help promote water conservation. As of December 2014, there were 2,200 Water Conservation Ambassadors.

Note 2: The WSD provides teaching kits to schools for conducting school water audits to promote water conservation. Participating students are tasked to find out water consumption in their schools and propose suitable means to save water.

Appendix D
(para. 3.16 refers)

Major best-practice guidelines for achieving water efficiency at LCSD facilities

Best practice guidelines (general)
(a) Enhance staff awareness on water conservation
(b) Appoint designated staff to manage and oversee efficient use of water
(c) Conduct regular water-efficiency audits
(d) Promote the water-saving message to visitors through prominent posters
(e) Replace aged devices with Water Efficiency Labelling Scheme accredited appliances
(f) Switch from fresh water supply to seawater for flushing
(g) Replace cyclic urinals by sensor-flush type
(h) Use high-pressure and low-flow jet instead of hose for cleansing
Best practice guidelines for parks
Irrigation
(i) Use automatic timer or moisture-sensor-controlled system
(j) Select vegetation requiring less water
(k) Consider rainwater harvesting as an alternative source of water for irrigation
Water features
(l) Check for and rectify equipment failure to avoid continuous water replenishment
(m) Control water quality by using appropriate filter system instead of regular water replenishment
Best practice guidelines for swimming pools
Pool replenishment and filtration
(n) Review the effectiveness of filtration plant and backwash frequency to enhance water efficiency
(o) Install pool water circulation system where appropriate to avoid direct discharge of overflow to the sewerage system
(p) Reuse of backwash water for flushing

Source: LCSD records

Appendix E
(para. 4.7 refers)

Waterworks Operating Accounts (2009-10 to 2012-13)

Particulars	2009-10 $ million	2010-11 $ million	2011-12 $ million	2012-13 $ million
Revenue				
Water charges	2,475.8	2,463.9	2,502.6	2,527.2
Contribution from rates	1,493.3	1,343.2	1,458.1	1,680.4
Government contribution to cover rates concessions	1,277.7	1,349.1	1,489.3	1,880.6
Government contribution relating to free water allowance to consumers	1,025.5	1,112.8	1,173.4	912.4
Water supply to government establishments	150.0	163.2	154.5	156.2
Fees, licences and reimbursable works	18.6	18.8	24.2	25.1
Interest from deposits	2.1	3.5	4.8	5.9
Total revenue (a)	6,443.0	6,454.5	6,806.9	7,187.8
Expenditure				
Cost of DJ water	3,010.0	3,200.0	3,397.1	3,594.5
Operating and administration expenses	1,589.3	1,635.6	1,680.3	1,698.3
Staff costs	1,303.2	1,300.4	1,401.3	1,486.0
Depreciation	1,189.6	1,273.8	1,353.5	1,416.7
Total expenditure (b)	7,092.1	7,409.8	7,832.2	8,195.5
Deficit (c) = (a) − (b)	(649.1)	(955.3)	(1,025.3)	(1,007.7)
Return on ANFA				
ANFA (d)	$38,464.1 million	$41,352.8 million	$44,235.0 million	$46,941.6 million
Target rate of return on ANFA (e)	6.5%	6.5%	6.5%	3.4%
Actual rate of return on ANFA (f) = (c) ÷ (d) × 100%	(1.7%)	(2.3%)	(2.3%)	(2.1%)

Source: WSD records

Appendix F
(paras. 4.18(a)
and 4.25 refer)

Fresh water net and full unit production costs (2013-14)

(a)	Total operating expenditure	$8,561.5 million
	Less: Expenditure not related to fresh water production	
	Seawater	$942.3 million
	Others	$22.7 million
(b)	Expenditure of fresh water production	$7,596.5 million
(c)	Metered water consumption (Note)	637.3 Mm^3
(d)	Full unit production cost (d) = (b) ÷ (c)	$11.92 /$m^3$
(e)	Target return on ANFA	$2.61 /$m^3$
(f)	Full unit production cost (f) = (d) + (e) (inclusive of target return on ANFA)	$14.53 /$m^3$
	Less: Unit contribution from rates	$3.77 /$m^3$
(g)	Net unit production cost	$10.76 /$m^3$

Source: WSD records

Note: This sum is slightly different from the related sum in Figure 1 in paragraph 1.2 because the former related to April 2013 to March 2014 whereas the latter related to January to December 2014.

Appendix G
(para. 4.18(b) refers)

Rates contribution per unit of fresh water supply (2013-14)

Particulars	
Total amount of rates contribution and government contribution to cover rates concessions	$3,970.6 million
Less:	
Seawater processing cost	$942.3 million
Target return on ANFA for supplying seawater	$375.7 million
Amount of rates contribution to meet financial deficit of supplying fresh water for flushing (Note 1)	$492.3 million
Target return on ANFA for supplying fresh water for flushing	$124.0 million
Balance (a)	$2,036.3 million
Related water consumption for calculating amount of rates contribution per m^3 of water supply	
Water consumption for domestic uses	343.4 Mm^3
Water consumption for general trade purposes (Note 2)	197.1 Mm^3
Sub-total (b)	540.5 Mm^3
Amount of rates contribution per m^3 of water supply (c) = (a) ÷ (b)	$3.77 /$m^3$

Source: WSD records

Note 1: As approved by ExCo, for determining the water tariff purposes, the financial deficit of supplying fresh water for flushing (related water supply cost less related income received) should be met wholly from contribution from government rates.

Note 2: According to the WSD, water consumption by the other non-domestic sectors is not included in the calculation because they do not pay any government rates.

Appendix H

Acronyms and abbreviations

ANFA	Average Net Fixed Assets
ArchSD	Architectural Services Department
Audit	Audit Commission
CORs	Controlling Officer's Reports
CSD	Correctional Services Department
CWRF	Capital Works Reserve Fund
DEVB	Development Bureau
DJ	Dongjiang
DSD	Drainage Services Department
EMSD	Electrical and Mechanical Services Department
ExCo	Executive Council
FC	Finance Committee
FEHD	Food and Environmental Hygiene Department
FSTB	Financial Services and the Treasury Bureau
GD	Guangdong
IRTS	Inter-reservoirs Transfer Scheme
km	kilometres
LCSD	Leisure and Cultural Services Department
LegCo	Legislative Council
m^3	Cubic metres
Mm^3	Million cubic metres
NENT	Northeast New Territories
TWM	Total Water Management
WAC	Waterworks Accounts Committee
WSD	Water Supplies Department