

# 广州市水资源综合治理调研报告

Outline of Water Resource Management Research in  
Guangzhou

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广州历届市委、市政府高度重视水资源治理工作，在制度建设、污染源控制和工程建设等方面取得了阶段性成效。本报告通过系统性梳理广州水资源治理现状，包括污染情况、治理主要做法及取得成效，形成水资源治理的广州经验。同时，也全面总结了广州水资源治理在现阶段仍存在的问题及其原因，并借鉴国外先进地区的成功经验，以期为进一步提升广州水资源治理水平提供经验借鉴。

Water management has been a priority for the city of Guangzhou, and Guangzhou has achieved several milestones in the institutionalization of water management, pollution containment and water engineering. This report sums up the ‘Guangzhou experience’ in water management through a systematic review of the status quo of Guangzhou's water management, including the pollution scene, the main measures taken as well as the achievements accomplished. The report points out the problems in Guangzhou's management method with an analysis of the causes. It also highlights some successful management practices outside China so as to inform decision-making on the improvement of Guangzhou's water management.

## 一、基本现状 Status quo

### (一) 区域概况 City profile

#### 1.人口规模 Population

广州是全国人口最稠密的城市之一。2018 年末，广州常住人口 1490.44 万人，城镇化率为 86.38%；年末户籍人口 927.69 万人，城镇化率为 79.78%。按照常住人口计算，全市建成区内人口密度约为 7600 人/平方公里<sup>1</sup>，其中人口最密集的越秀区，户籍人口密度达到 34574 人/平方公里，加上流动人口，超过 50000 人/平方公里。高密度的人口使得广州的河涌水体环境负担重，污水处理工程措施落地难度大。

Guangzhou is one of the most densely populated cities in China. By the end of 2018, Guangzhou's resident population has reached 14,904,400, with 86.38% living in urban area; 9,276,900 people have been recognized as permanent residents of Guangzhou and 79.78% of them are urban residents. Resident population density of the built-up area of Guangzhou is 7,600 people per square kilometre. Among the 11 districts in Guangzhou, Yuexiu District is the densest one, whose permanent resident density reaches 34,574 people per square kilometre; if migrant population is counted, population density

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<sup>1</sup> 建成区面积采用《广州市土地利用总体规划（2006-2020 年）》规划年末的建设用地面积。The built area here refers to the planned area of the land for construction as stated in the "Masterplan for Guangzhou Land Use 2006-2020".

of the district will exceed 50,000 people per square kilometre. **Dense population generates a large amount of waste water, which burdens the city's rivers and hinders the exercise of water pollution control.**

## **2.经济情况 Economic conditions**

2018年，广州实现地区生产总值22859.35亿元，按可比价格计算，比上年增长6.2%，人均GDP达到150000元。2018年，全市完成一般公共预算收入1632.30亿元，增长6.5%。广州经济基础雄厚，政府财政承受能力强、金融信誉好，为城市水资源治理整治工程的投融资奠定了扎实的经济基础。

**In 2018, gross regional product of Guangzhou reached 2,285.935 billion yuan, an increase of 6.2% year-on-year in comparable prices, and GDP per capita hit 150,000 yuan. 163,230 million yuan of general budget revenue was collected, up by 6.5% compared with that in 2017. The city's fiscal resilience, high economic strength and sound financial reputation lay solid foundations for financing for water management.**

## **3.产业结构 Industrial structure**

2018年，第一产业增加值223.44亿元，第二产业增加值6234.07亿元，第三产业增加值16401.84亿元，三次产业

增加值比例为 0.98:27.27:71.75。相比 2008 年，三次产业增加值的比例为 2.04 : 38.94 : 59.02。2008-2018 年间，第一、二产业的比重逐步下降，第三产业比重逐步提高，产业结构不断优化，使城市水资源污染在源头上得以减少。

Compared with 2017, there was a 22,344 million yuan increase in value of the primary industry of Guangzhou in 2018, 623,407 million in the secondary industry and 1,640,184 million in the tertiary industry, accounting for 0.98%, 27.27% and 71.75% of the total increase respectively and 2.04%, 38.94% and 59.02% of the total increase from the industrial value in 2008. Within the decade of 2008 to 2018, the ratio of the tertiary industry among the three witnessed a growth while the primary and secondary a gradual decline. **The optimized industrial structure indicates a reduction in effluent from the source.**

## (二) 水系概况 Water system profile

### 1.水资源情况 Water resource conditions

广州水资源的主要特点是本地水资源较少，过境水资源相对丰富。本地平均水资源总量 79.79 亿立方米，其中地表水 78.81 亿立方米，地下水 14.87 亿立方米，地表水与地下水的重复量为 13.88 亿立方米，每平方公里有 106.01 万立方米，人均 628 立方米，是全国人均水资源占有量的二分之一。



全市本地水资源可利用总量为 28.38 亿立方米，占全市水资源总量的 35.57%。过境客水资源量 1860.24 亿立方米，是本地水资源总量的 23 倍，其中多年平均可利用量为 397.96 亿立方米。客水资源主要集中在南部河网区和增城区。

**The amount of local water of Guangzhou (water generated within an area) is moderate, but passenger water (water sourced from outside of the area) is relatively abundant.** The volume of the city's local water is 7,979 million m<sup>3</sup>, including 7,881 million m<sup>3</sup> surface water and 1,487 million m<sup>3</sup> groundwater. The overlap between the two is of 1,388 million m<sup>3</sup>. In terms of local water, Guangzhou has 10,601 thousand m<sup>3</sup> per square kilometre and 628 m<sup>3</sup> per capita, half of the national per capita amount; 2,838 m<sup>3</sup> is available, accounting for 35.57% of the total volume. The volume of passenger water, 23 times of that of local water, reaches 186,024 million m<sup>3</sup>, with 39,796 million m<sup>3</sup> available on the basis of a long-term annual average. Rivers in southern Guangzhou and Zengcheng District are the main source of passenger water.

南部河网区处于潮汐影响区域，径流量大，潮流作用也很强。珠江的虎门、蕉门、洪奇沥三大口门在广州南部入伶仃洋出南海，年涨潮量 2710 亿立方米，年落潮量 4088 亿立

方米，与三大口门的年径流量 1377 亿立方米比较，每年潮流可带来大量的水量，部分是可以被利用的淡水资源。

Rivers in the south are affected by tides and thus feature heavy runoffs and strong transportation. Humen, Jiaomen and Hongqili are three of the Pearl River's estuaries located in southern Guangzhou, connecting the river with Lingdingyang, through which the Pearl River runs into the South China Sea. 271 billion m<sup>3</sup> of sea water rises annually and 408.8 billion falls, whereas the annual runoff of the three estuaries are 137.7 billion m<sup>3</sup>. The tides bring the city a large amount of water, some of which is freshwater.

## **2.水系特征 Features of water system**

广州外围主要河流有西江、北江和东江，境内众多河流均属珠江水系，东北部多以山区河流为主，南部主要为西、北江下游水道和珠江广州河道汇流交织而成的河网，境内的主要河流有珠江广州河道、流溪河、白坭河、芦苞涌、增江、西福河、东江北干流以及虎门、蕉门、洪奇门三大如海口门等。

Main rivers surrounding Guangzhou include the West River, North River and East River. Many rivers inside the city are part of the Pearl River system. The northeast of the city is dominated by mountain rivers and the south by the network of

the downstream water courses of the West River, North River and Guangzhou water course of the Pearl River. Main rivers inside the city include Guangzhou water course of the Pearl River, Liuxi River, Baini River, Lubao River, Zeng River, Xifu River, main stream of the East River, and three major estuaries Humen, Jiaomen and Hongqimen.

广州境内骨干河流主要共有 30 条河宽, 5 米以上的河流 (涌) 1368 条, 总长 5092 公里, 河道密度达到 0.7 公里/平方公里, 其中流域面积在 100 平方公里以上的河流有 22 条。全市水库 368 座, 总库容 10.5 亿立方米。其中, 大中型水库 17 宗, 总库容 7.58 亿立方米, 主要生态调蓄湖有东山湖荔湾湖、麓湖、流花湖、白云湖、海珠湖 6 个, 全市水面率约为 10.02%, 密集的河网构成独特的岭南水乡特色, 对改善城市景观、维持城市生态环境的稳定起到重要作用。

There is a total of 30 main rivers and 1,368 five-metre-wide rivers (river branches) in Guangzhou, which makes the total length of rivers standing at 5,092 kilometers and a drainage density at 0.7 km/km<sup>2</sup>. There are 22 rivers with a drainage area of over 100 square kilometers. The city has 368 reservoirs with a total storage capacity of 1.05 billion cubic meters. Among them, there are 17 large and medium-sized ones with a total storage capacity of 758 million cubic meters. There

are 6 main regulation and storage lakes, including Dongshan Lake, Liwan Lake, Lu Lake, Liuhua Lake, Baiyun Lake and Haizhu Lake. With a water surface ratio of about 10.02%, the city has a dense river network (a unique feature of Lingnan water town) which serves a critical role in improving urban landscape and maintaining the stability of the urban ecological environment.

按地形地貌及骨干流水系特征，广州水系划分为 9 大流域，其中，白坭河流域、流溪河流域、增江流域的河涌多为山区型河流，不受潮汐影响；石井河流域、珠江前航道流域的河涌多为山区型河流，下游多为潮汐型河流，即上游不受潮汐影响，下游受潮汐影响；珠江西航道流域、珠江后航道流域、“大石、三枝香、沥滘流域”、“屏环河、沙湾水道流域”的河涌多为潮汐型河流，受潮汐影响。

In terms of the topography and the characteristics of the main streams, Guangzhou water system can be divided into 9 major river basins. Among them, most of the rivers in Baini River Basin, Liuxi River Basin and Zeng River Basin are mountain rivers that are not affected by tides; those in Shijing River Basin and Front Course Basin of the Pearl River are mountain rivers in the upstream areas (not affected by tides) and tidal rivers in the downstream areas (affected by tides); those in

the West Course Basin and Back Course Basin of the Pearl River, "Dashi, Sanzhixiang and Lijiao Basin" and "Pinghuan River and Shawan Waterway Basin" are mostly tidal rivers subject to impacts of tides.

### **(三) 水体污染情况**

#### **(III) Water pollution**

##### **1. 总体污染源情况**

##### **1. Overall sources of pollution**

根据广州 2017 年河涌水质监测资料，广州黑臭水体污染的流域面积占全市流域面积约 13%，全市黑臭水体 COD 含量约为 90052 吨，氨氮含量约为 23430 吨，按流域统计水体污染物总量，具体如下表所示：

According to the data on the river water quality in Guangzhou in 2017, the area of polluted water bodies accounted for about 13% of the city's drainage area. The COD of these polluted water bodies was about 90,052 tons, ammoniacal nitrogen about 23,430 tons. The amounts of water pollutants are detailed as follows:

**表 1：2017 年广州水体污染物统计情况**

**Table 1: The Statistics of Water Pollutants in Guangzhou in 2017**

序号 No.	流域名称 Basin	总流域面积 (平方公里) Total Drainage Area (km <sup>2</sup> )	黑臭水体流域 面积 (平方公 里) Area of Polluted Water Bodies (km <sup>2</sup> )	黑臭水体污染物 总量 (吨) Total Amount of Pollutants (Ton) in Polluted Water Bodies	
				COD	氨氮 Ammoniacal nitrogen
1	白坭河流域 Baini River Basin	803.94	560	15433.9	3810.7
2	增江流域 Zeng River Basin	1730.6	25.6	2319.9	527.8
3	流溪河流域 Liuxi River Basin	2290.6	274.2	13010.0	4494.5
4	前航道流域 Front Course Basin	512.93	257	23414.9	6601.6
5	石井河流域 Shijing River Basin	83.83	52	6802.7	1386.2
6	西航道流域 West Course Basin	66.28	23.57	2750.6	747.5
7	后航道流域 Back Course Basin	101.71	22.4	3753.7	1263.4
8	大石、三枝香、 沥滘流域	176.5	49.9	6528.0	1330.2

序号 No.	流域名称 Basin	总流域面积 (平方公里) Total Drainage Area (km <sup>2</sup> )	黑臭水体流域 面积 (平方公 里) Area of Polluted Water Bodies (km <sup>2</sup> )	黑臭水体污染物 总量 (吨) Total Amount of Pollutants (Ton) in Polluted Water Bodies	
				COD	氨氮 Ammoniacal nitrogen
	Dashi, Sanzhixiang and Lijiao Basin				
9	屏环河、沙湾水 道流域 Pinghuan River and Shawan Waterway Basin	970.8	122.6	16038.7	3268.2
汇总 Total				90052.4	23430.2

数据来源:根据广州市水务局相关材料整理。

Source: Based on the statistics provided by the Bureau of Water Resources of Guangzhou Municipality.

全市水污染存在点源污染、面源污染等污染源，以位于广州中心城区北部石井河流域为例。根据现状河涌截污情况和污染源的分布情况调查，2017年石井河流域点源污染物指标为：COD<sub>Cr</sub>=156mg/L、氨氮 17.26mg/L、总氮=25.22mg/L、总磷=2.32mg/L;根据流域面源污染源各分项，计算出石井河流域内面源污染负荷产生量和如何量，面污染源情况列表如下：

There are point source pollution and non-point source pollution in water in the city. Take Shijing River Basin in the north of downtown Guangzhou as an example. According to the investigation into the pollutant intercepted and the distribution of pollution sources in Shijing River Basin in 2017, the indicators for point source pollutants are as follows: CODcr = 156mg/L, ammoniacal nitrogen = 17.26mg/L, total nitrogen = 25.22mg/L, and total phosphorus = 2.32mg/L; according to the indicators for non-point source pollution in the Basin, the amount and quantity of non-point source pollution are as follows:

表 2：2017 年石井河流域面污染源排放量估算成果表

**Table 2: Estimation of Non-Point Source Pollution Discharge in Shijing River Basin in 2017**

污染类型 Type of Pollution	污染负荷量 ( 吨 ) Pollutant Load (Ton)			
	CODcr	氨氮 Ammoniacal nitrogen	总氮 Total nitrogen	总磷 Total phosphorus
城镇地表径流污染 Urban surface runoff pollution	6543	16.4	163.6	26.2
化肥污染 Pollution from fertilizer	/	0.037	0.375	0.141



污染类型 Type of Pollution	污染负荷量 ( 吨 ) Pollutant Load (Ton)			
	CODcr	氨氮 Ammoniacal nitrogen	总氮 Total nitrogen	总磷 Total phosphorus
养殖污染 Pollution from aquaculture	111	0.6	16.0	47.9
合计 Total	6654	17.0	179.9	74.2

数据来源：根据广州市水务局相关资料整理。

Source: Based on the statistics provided by the Bureau of Water Resources of Guangzhou Municipality.

城市地表径流中的 CODcr、氨氮和总氮所占比重较大，养殖中产生了面源污染负荷总量中 66% 的总磷，是面源污染防治需要重点治理的污染源。

CODcr, ammoniacal nitrogen and total nitrogen constitute large portions of the pollutants in urban surface runoff; total phosphorus accounts for 66% of the non-point source pollution load from aquaculture, which requires special attention in preventing and treating non-point source pollution.

根据流域点源、面源污染分析统计，计算流域内点、面污染源的贡献率，列表如下：

Based on the statistics on point and non-point source pollutants in the Basin, their contribution rates are detailed as

follows:

表 3：2017 年石井河流域点、面污染源贡献率列表

**Table 3: Contribution Rates of Point and Non-Point Source  
Pollutants in Shijing River Basin in 2017**

指标 Indicator	污染物入河量 (吨/年) Amount of Pollutant in River (Ton/Year)			污染贡献率 (%) Contribution Rate (%)	
	点源 Point	面源 Non-point	总量 Total	点源 Point	面源 Non-point
CODcr	4014	6654	10668	37.6	62.4
氨氮 Ammoniacal nitrogen	444	17	461	96.3	3.7
总氮 Total nitrogen	649	179.9	828.9	78.3	21.7
总磷 Total phosphorus	60	74.2	134.2	44.7	55.3

数据来源：根据广州市水务局相关资料整理。

Source: Based on the statistics provided by the Bureau of Water Resources of Guangzhou Municipality.

## 2. 污水直排、雨污水管网情况

## 2. Direct sewage discharge and pipelines of rain and sewage

根据 2018 年初雨污管道接驳情况排查结果，已摸查错漏接管道长度 458 公里，已发现的错漏接点数共计 1003 处。

According to the investigation into the connection of the rain and sewage pipelines in early 2018, there are 458-km wrongly connected pipelines and 1,003 wrong connection points.

表 4：错漏接点位统计表

Table 4: Wrong Connection Points

区域 District	生活污水 Domestic Sewage			数据来源 Data Source	小计 Subtotal
	生活污水混 接错接点 Wrong connection point for domestic sewage	存在缺陷 点 Defect point	不明清水排 出 Unknown water discharge		
黄浦区 Huangpu District	715	12	1	河涌排水 口溯源 River outfalls	728
天河区 Tianhe District	81	0	1		82
海珠区 Haizhu District	59	4	0		63
白云区 Baiyun District	130	0	0		130
合计 Total	985	16	2		1003

数据来源：根据广州市水务局相关资料整理。

Source: Based on the statistics provided by the Bureau of Water Resources of Guangzhou Municipality.

### 3. 城镇污水厂尾水排放情况

### 3. Tailwater discharged from urban sewage treatment plants

截止 2018 年 9 月，广州黑臭河涌范围内共分布 28 座污水处理厂，总处理能力约为 492 万吨/天，主要处理工艺以 A<sup>2</sup>/O 为主。尾水 COD 排放量为 246 吨/天，总氮排放量 73.8 吨/天，氨氮排放量 39.36 吨/天，总磷排放量 4.92 吨/天。

As of September 2018, there had been a total of 28 sewage treatment plants in the area of polluted rivers, which had a total treatment capacity of about 4.92 million tons/day mainly using A<sup>2</sup>/O treatment technology. COD discharged from tailwater was 246 tons/day, total nitrogen 73.8 tons/day, ammoniacal nitrogen 39.36 tons/day, and total phosphorus 4.92 tons/day.

表 5：黑臭河涌范围内的污水处理厂情况（单位：座）

Table 5: No. of Sewage Treatment Plants in the Area of Polluted

#### Rivers

序号 No.	流域名称 Basin	污水厂总量 Total No. of Plants	一级 A 数量 Class A	一级 B 数量 Class B
1	前航道流域 Front Course Basin	7	3	2

序号 No.	流域名称 Basin	污水厂总量 Total No. of Plants	一级 A 数量 Class A	一级 B 数量 Class B
2	西航道流域 West Course Basin	2	0	2
3	后航道流域 Back Course Basin	2	1	0
4	白坭河流域 Baini River Basin	1	1	0
5	增江流域 Zeng River Basin	5	4	1
6	石井流域 Shijing River Basin	1	1	0
7	屏环河、沙湾水道流域 Pinghuan River and Shawan Waterway Basin	3	1	2
8	大石、三枝香、沥滘流域 Dashu, Sanzhixiang and Lijiao Basin	3	1	2
9	流溪河流域 Liuxi River Basin	4	1	3

数据来源：根据广州市水务局相关资料整理。

Source: Based on the statistics provided by the Bureau of Water Resources of Guangzhou Municipality.

#### 4.内源污染情况

#### 4. Endogenous pollution

广州黑臭河涌范围内的内源污染主要有底泥及漂浮物，其中底泥主要分布于感潮区部位，漂浮物主要集中在城中村

人流密集及部分郊外缺少维护管养地带。

The endogenous pollution in the area of polluted rivers in Guangzhou mainly comes from sludge and floating objects. Specifically, the former is mainly distributed in tidal zones while the latter is mostly concentrated in the densely populated areas of urban villages and outskirts lacking maintenance.

流域范围内底泥淤积程度基本在 30c 米-80c 米之间，其中感潮区段淤积程度较为严重，山区段淤积程度较轻。

In the basins, the volume of deposited sludge ranges from 30 to 80 cubic meters, decreasing from the tidal zones to the mountainous areas.

根据广州 7 条典型河涌淤泥检测分析结果，淤泥中有机质、氮和磷含量的平均值分别为 4.21%、1.06g/kg 和 1163mg/kg。

According to the analysis of sludge in 7 typical rivers, the mean values of organic matter, nitrogen and phosphorus in the sludge are 4.21%, 1.06g/kg and 1,163mg/kg respectively.

## 5.岸线生活垃圾堆放情况

### 5. Household garbage dumping along the shorelines

岸线垃圾主要集中在城中村人流密集及部分郊外缺少维护管养地带，其中已完成整治的第一批 35 条黑臭河涌水体蓝线范围内已不存在垃圾堆放点，完成整治的垃圾堆放点

数量为 14 个，接受的垃圾堆放点数量为 42 个。第二批黑臭河涌涉及的垃圾堆放点 740 个。

Garbage along the shorelines is mainly concentrated in the densely populated areas of urban villages and outskirts lacking maintenance. There is no garbage dump point within the blue lines of the first 35 polluted rivers that have been improved. 14 garbage dump points have been improved, increasing the number of dump points being accepted to 42. The second batch of polluted rivers involves 740 garbage dump points.

表 6：垃圾堆放点统计数据表

Table 6: Garbage Dump Points

区域 District	增城区 Zengcheng District	天河区 Tianhe District	海珠区 Haizhu District	番禺区 Panyu District	白云区 Baiyun District	花都区 Huaadu District	荔湾区 Liwan District	越秀区 Yuexiu District	黄浦区 Huangpu District	合计 Total
数量 Quantity	23	12	41	183	92	294	11	0	84	740

数据来源：根据广州市水务局相关资料整理。

Source: Based on the statistics provided by the Bureau of Water Resources of Guangzhou Municipality.

## 二、主要做法及取得的成效

### II. Practices and Outcomes

#### (一) 体制机制建设成效

#### **(I) Outcomes of systems and mechanisms**

##### 1. 河长制工作成效

##### **1. Outcomes of River Chief system**

全面覆盖河流和湖泊。2017年3月，广州市委市政府印发《广州市全面推行河长制实施方案》，明确市委书记担任市级第一总河长，市长担任市级总河长，市四套班子成员单位市级河长。2018年6月，率先在全省印发《广州市湖长制实施方案》，实施范围覆盖湖泊和水库；明确要充分利用河长制工作机制推动落实湖长制，做到河湖长制同部署、同落实、同检查、同考核。全市落实河长3030名，落实四级湖长673人，建立河长巡查、会议、督办等25项配套制度。

**Full coverage of rivers and lakes.** In March 2017, Guangzhou municipal party committee and municipal government issued the *Plan for Full Implementation of the River Chief System in Guangzhou*, specifying that the secretary of CPC Guangzhou Municipal Committee serves as the First City-level General River Chief, the mayor as the City-Level General River Chief and leaders of CPC Guangzhou Committee, Guangzhou municipal government, Guangzhou People's



Congress, Guangzhou PPCC as the City-Level River Chiefs. In June 2018, the city was the first to issue the *Plan for Implementation of Lake Chief System in Guangzhou* in the province, which covers the lakes and reservoirs in the city. The Plan specifically provides that the Lake Chief system should be carried out by drawing lessons from that of the River Chief system in terms of the deployment, implementation, inspection and assessment. The city has engaged 3,030 River Chiefs and 673 Lake Chiefs at four levels, and formulated 25 supporting systems for patrol, meeting and supervision by River Chiefs.

压实各级河长污染源查控责任。以流域为整体，村居为单位，划分 1465 个治理单元，制定了黑臭水体剿灭污染源工作图，要求牵头组织各相关镇街级河长、村居级河长，查清流域内每个村居的小微水体、排水户、违法建设、排水口（雨水口、污水口、河流口）、畜禽养殖、垃圾堆放等污染源情况，明确整治措施和完成时限，落实责任人。市河长办于各区派驻督察组以河涌流域为整体、以村居为单元按工作图进行督察，拉条挂账，逐个销号。

**Accountability of River Chiefs at various levels to inspect and control the pollution sources.** A working plan for eliminating the pollution sources of polluted rivers in basins that have been divided into 1,465 units (villages and communities)

has been prepared. River Chiefs at levels of town, subdistrict, village and community are required to identify the pollution in each village and community in basins, such as micro and small water bodies, sewer users, illegal buildings, drainage outlets (for rainwater, sewage and river), livestock and poultry and garbage dumping, and eliminate the pollution using specific measures within the specified time limits. The city office of River Chiefs assigns supervisors to inspect the work done against the working plan.

## 2.排水一体化管理成效

### **2. Outcomes of integrated drainage management**

推行供排水一体化管理制度。一是建立“以排定供”，新增用水户（居民用水户除外）完成排水接驳后再开始供水；二是“以排限供”，制定《广州市整治违法排水专项行动工作方案》，集中力量整改存量违法排水户，对拒不整改的存量违法排水户，通过实施限制供水或停水，督促其进行整改。

**Promoting the integrated management system of water supply and drainage.** The first measure is "scheduled supply", meaning that water would only be supplied to new water users (excluding residential households) that have been connected to the drainage system; the second one is "limited supply", meaning that water supply to illegal sewer users refusing to

make remedies would be limited or stopped according to the *Special Action Plan for Remediation of Illegal Drainage in Guangzhou*.

**推进“厂、网一体化”运营管理。**市政府印发《关于组建广州市城市排水有限公司的工作方案》，组建市排水公司，同意管理中心城区污水、雨水、合流等排水设施，加快推进“厂、网一体化”运营管理。2018年5月，广州市排水公司正式挂牌成立，为广州水污染治理工作提供了基础支撑。按照“边组建、边管理”的原则，市排水公司正加快推进组建及养护工作。目前已有在职人员 850 人，车牌 38 台，动力站 12 套，接收网管 3769 公里，实施排水设施清疏管道 190 公里，窞井 3622 个，整改晴天溢流口 25 个，整改管网结构性隐患 109 处，发现外水汇入点 237 个，水量约 30 万吨。已封堵 85 个，减少汇入 9.4 万吨。

**Promoting the integrated operation and management of factories and pipelines.** The municipal government issued the *Work Plan for the Establishment of Guangzhou Urban Drainage Co., Ltd.* to set up the Urban Drainage Company that agrees to manage the facilities for the drainage and merge of sewage and rainwater in the central urban areas to accelerate the integrated operation and management of factories and pipelines. In May 2018, Guangzhou Urban Drainage Co., Ltd. was

formally established to support the treatment of water pollution in the city. While improving itself, the Company is speeding up the treatment. At present, the Company has 850 employees, 38 license plates and 12 power stations. It has taken over pipelines of 3,769 kilometers, cleaned drainage facilities of 190 kilometers and 3,622 wells, rectified 25 overflow ports and 109 structural hazards in pipelines, and discovered 237 external water inlets with an influx of about 300,000 tons; 85 of these inlets have been blocked, reducing the influx by 94,000 tons.

### 3. 监督问责机制情况

### 3. Supervision and accountability mechanisms

**严格落实问责。**根据《广州市水环境治理责任追究工作意见》，结合问题交办、问题整改、情况反馈等工作环节，运用互联网+等技术手段，重点对黑臭水体治理工作中的问题整改等工作实施可检查、可追溯、可问责的全过程监管，坚决对不作为、慢作为、乱作为的干部做到有责必问、问责必严，进一步推进责任落实，提升工作执行力。

### **Strict implementation of accountability mechanism.**

Based on the *Opinions on the Accountability for Water Environment Governance in Guangzhou*, technical means (for example, Internet+) are adopted in different links of the work (reporting, improvement and feedback) to supervise the whole

process of treatment of polluted rivers in a way that can be inspected, traced and is accountable. Persons-in-charge who fail to perform their duties properly will be held accountable for the outcomes to enhance their competence.

## **(二) 污染源查控工作成效**

### **(II) Outcomes of pollution source inspection and control**

#### **1. 全面清理整顿散乱污场所**

#### **1. Cleaning up and improving the unplanned, unregulated and polluting locations**

以 2018 年全面清理整顿散乱污场所为例，1-8 月，广州全市新排查“散乱污”场所 41441 个，整治完成 40000 个。Take the cleaning up and improvement of the unplanned, unregulated and polluting locations in 2018 as an example. From January to August, a total of 41,441 such places were identified and 40,000 ones were improved.

#### **2. 强力推进涉河违建拆除**

#### **2. Pushing forward the demolition of the river-related illegal buildings**

成立由市委书记任组长、市长任常务副组长的市违法建设治理工作领导小组。印发实施《广州市违法建设治理三年行动方案（2018-2020 年）》，利用三年时间确保完成 1.01 亿

立方米、力争完成 1.25 亿平方米（不止涉水违法建设）的违法建设治理任务，坚持治污与拆违同步、拆违与问责同步。截止到 2018 年 9 月上旬，拆除 187 条污水河涌管理范围内违法建设 132.52 万平方米。

A steering group for treatment of illegal buildings has been set up, with the secretary of CPC Guangzhou Committee serving as the leader and the mayor as the executive deputy leader. *The Three-Year Action Plan for Treatment of Illegal Buildings in Guangzhou (2018-2020)* has been issued and implemented, which specifies the goals of treating illegal buildings (not limiting to water-related ones) of 101 million square meters (or 125 million if possible) within three years, and managing treatment, demolition and accountability at the same time. As of the beginning of September 2018, the illegal buildings of 1,325,200 square meters within the area of 187 polluted rivers had been demolished.

### 3.着力增强排水户管理

### **3. Enhancing the management of sewer users**

牢固树立用水户即排水户的管理理念，开发排水户检查 APP，由各级河长牵头全面开展餐饮排污类、沉淀物排污类、有毒有害类等典型排水户日常检查，进一步规范排水户排水、排污、排水接驳、雨污分流等方面要求，逐步建立起全

覆盖、可追溯、可倒查的排水户管理系统，目前已摸查 148 万户。

Applications for inspecting sewer users have been developed based on the idea that water users are sewer users. River Chiefs at all levels are required to take the lead in carrying out daily inspections of typical sewer users for the discharge of catering waste, sediments and toxic and hazardous substances. Stricter standards for water and waste drainage, connection of drainage pipelines, separation of rainwater and sewage, etc., have been established to form a traceable sewer user management system that covers all users. At present, 1.48 million sewer users have been identified and inspected.

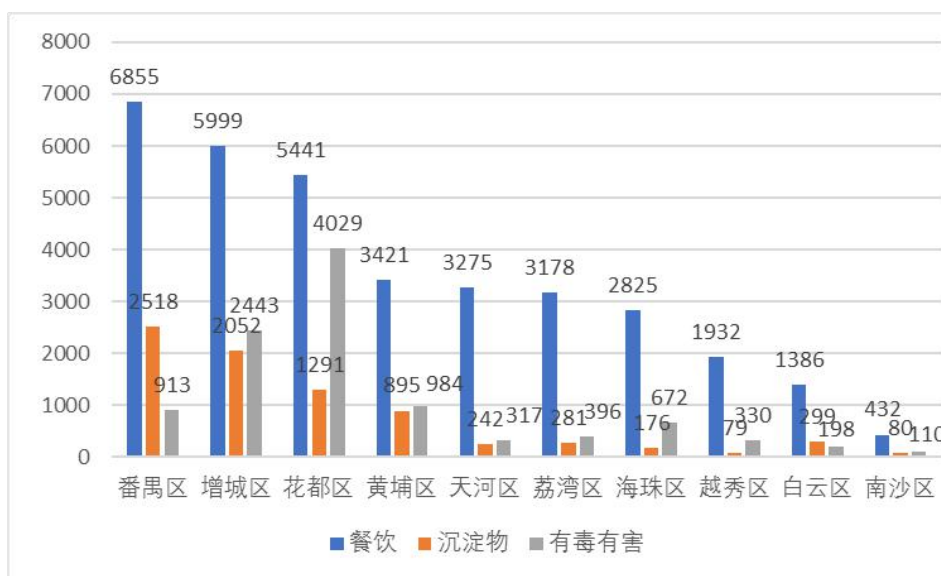


图 1 已核查典型排水户数量统计图（截止 2018 年 9 月 15 日）

Figure 1 Number of Typical Sewer Users Identified (as of September 15, 2018)

### (三) 工程建设成效

#### (III) Outcomes of Water Engineering

##### 1. 补齐主干污水收集处理系统短板

#### 1. Improving the Trunk Sewage Collection and Treatment System

2015-2017 年，建成前锋三期等污水处理厂 12 座，新增污水处理能力 72.05 万吨/日。2015-2017 年广州污水处理能力情况如下图：

From 2015 to 2017, 12 sewage treatment plants including Phase III of Qianfeng Sewage Treatment Plant are completed, with newly added sewage treatment capacity of 720,500 tons per day. The sewage treatment capacity of Guangzhou from 2015 to 2017 is as shown below:

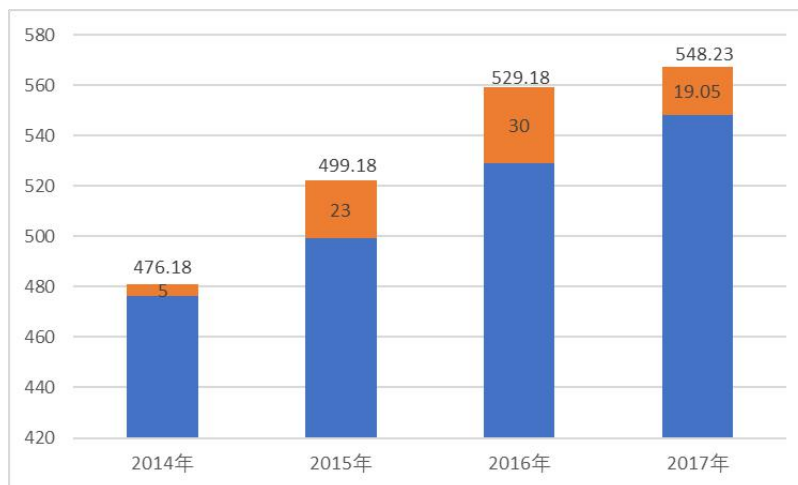


图 2 广州 2015-2017 年污水处理能力年度增长图

Fig 2. 2015-2017 Annual Growth of Sewage Treatment Capacity in Guangzhou

2015-2017 年，共建成污水管网 2458 公里。2018 年 1-8



月建设完成污水管网 1736 公里。

From 2015 to 2017, 2,458 kilometers of sewage pipe network were built and from January to August 2018, 1,736 kilometers were built.

## 2. 重点攻坚城中村治污

### 2. Focusing on Sewage Treatment in Urban Villages

因历史原因，广州存在大量的城中村。全市 187 条黑臭河涌流经的城中村多达 97 个，村域面积约 133 平方公里，居住人口约 365 万，生产的污水直排河涌仍是广州黑臭水体整治工作中的最大“顽疾”。以车陂涌流域中长安排水分区为例，按城中村、事业单位、居民小区等分流统计，排水分区内有 122 个排水单元，经污水量统计分析，城中村排水单元污水量贡献占比最大为 55%。

For some historical reasons, there are a large number of urban villages in Guangzhou. In the whole city, 187 polluted rivers run through 97 urban villages, which cover a total area of 133 square kilometers and involve a population of 3.65 million. Untreated industrial wastewater discharged into rivers is still the biggest problem in treatment of polluted water bodies in Guangzhou. Taking the drainage area of Changban in the Chebei River Basin as an example, there are 122 sewage

discharge units including urban villages, institutions and residential quarters. According to statistics, urban villages contributed the largest amount of discharged sewage, accounting for 55%.

把城中村污水排放作为黑臭水体治理工作的重中之重，以“污水全收集、初期雨水有效控制”为原则有序推进城中村截污纳管工作。152条黑臭河涌涉及的49条城中村截污纳管工作，6条进场施工，其余正在全力开展前期工作，6个已开工的城中村累计完成管道敷设约506公里。35条黑臭河涌涉及的48条城中村截污纳管工程，计划新建管道约7680公里，已完成铺设管道约6395公里，累计完成约83.3%。

Taking sewage discharge of urban villages as the top priority in the treatment of polluted water bodies, we have promoted the sewage pipe renovation work in an orderly manner following the principles of collecting all the sewage and effective control of first-flush rainwater. In the planned sewage pipe renovation project for 49 urban villages where 152 polluted rivers run through, 6 villages are under construction and others are under preparation. In the 6 villages under construction, 506 kilometers of sewage pipes have been laid down in total. In another sewage pipe renovation project for 48 urban villages where 35 polluted rivers run through, 7680 kilometers of new

sewage pipes are planned, among which 6395 kilometers are completed, accounting for 83.3%.

### 3. 合流渠箱改造情况

#### 3. Combined Sewer Improvement

截止到 2018 年 9 月，根据初步统计，全市合流渠箱 293 公里，其中中心六区 240 公里。在沙河涌流域南蛇坑等合流渠箱为试点，摸索渠箱清污分流技术路线。南蛇坑涌暗渠长约 483 米，宽约 3-5 米，总清疏量为 1260 立方米，平均每米清疏约 2.6 立方米，通过清疏暗渠沉积物，既清除了内部污染物，减少河涌内污染，同时恢复提高了渠箱的调蓄和防洪排涝能力。内部铺设污水管，对污水进行分流，流出山水通道，晴天每天可减少约 1 万立方米山水进入污水主管，同时山水还可以补给沙河涌。

As of September 2018, according to preliminary statistics, the city has 293 km completed combined sewers, including 240 km in 6 downtown districts. We have carried out researches on technical process of effluent segregation with the pilot combined sewer project in Nanshekeng of Shahe River Basin. Nanshekeng culvert is about 483 meters long and 3-5 meters wide, with a total dredging volume of 1,260 cubic meters and an average of about 2.6 cubic meters per metre. Removing sediments from the culvert helps reduce pollution in the river

and restore the retention and drainage capacity of the sewage system. Sewage pipes are laid inside the culvert to separate wastewater from clean water flowing down from mountains. In sunny days, 10,000 cubic meters of clean water can be saved from flowing into main sewage pipes and instead they help replenish Shahe River.

#### (四) 充分利用信息化手段

##### (IV) Adoption of Information Technology

##### 1. 河长 APP

##### **1. River Chief APP**

利用桌面 PC、河长 APP、微信、电话及门户网站等五种终端，为各级河长、相关单位以及社会公众提供多维度服务。其中，各级河长利用河长 APP 巡河 30 多万次，上报事物 1 万余件，处理事务 6000 余件，该做法受到国家和广东省的肯定，并在水利部第 140 期河长制工作简报及广东省水利厅第 48 期全面推进河长制工作转刊上刊发推广。

We provide multi-dimensional services for river chiefs, relevant authorities and the public through PC, APP, WeChat, Hotline and Website Portals. River chiefs have used their River Chief App to carry out river patrol for over 300,000 times, report over 10,000 problems and complete over 6000 items of relevant works. The practice has been acknowledged by the

state and provincial government and it has been reported and spread in the 140<sup>th</sup> River Chief Work Report published by the Ministry of Water Resources and the 48<sup>th</sup> Special Issue on the Work of Fully Promotion of River Chief System published by Water Resources Department of Guangdong Province.

## **2. 排水巡检 APP**

### **2. Drainage Patrol APP**

运行广州排水设施巡检 APP。截止 2018 年 9 月，排水巡检 APP 已覆盖全市各级排水管理单位 177 家、养护人员 852 名，采集超 35 万排水设施基础数据。

We have launched Guangzhou Drainage Patrol APP. As of September 2018, the APP has been serving 177 drainage management units and 852 maintenance technicians at all levels in the city with a collection of basic data of over 350,000 drainage facilities.

## **3. 农村污水管理 APP**

### **3. Sewage Administration in Rural Areas APP**

启动农村生活污水管理信息系统建设应用。着力摸清农污设施“家底”，实现全市 1112 个行政村农污管理设施及流域河流域相关信息的数据汇集、管理与可视化，形成统一数据格式和巡查制度，提高农村生活污水管理精细化程度。

We have built and launched the Sewage Administration in

Rural Areas APP based on investigations on sewage treatment facilities in rural areas. With the APP, data collection, administration and visualization of sewage treatment facilities in 1112 administrative villages of the city and information of Liuxi River basin are realized. With unified data format and patrol mechanism based on the APP, the preciseness of domestic sewage management in rural areas is improved.

#### **4.排水户管理 APP**

#### **4. Wastewater Discharge Unit Management APP**

深化排水户管理思路，探索建立“建筑物-排水户-排水接驳井”的数据信息关联关系，打通公共排水管网到排水户之间的“最后一公里”，切实提升排水户管理水平，对排水户违法排水行为实现“抓得住、罚得重、管得全、压得实”的管理目标。

We have strengthened the management of wastewater discharge units and explored the relational database of buildings, wastewater discharge units and drainage joint pits. We have worked to facilitate the last kilometre from public drainage network to wastewater discharge units and improve the management of discharge unites so as to achieve the goals of clear identification, heavy punishment, extensive management and firm control on illegal discharge behaviors.

## (五) 鼓励公众共同参与治理

### (V) Encouragement of Public Participation

#### 1. 拓宽公众参与渠道

#### 1. Provide Diversified Channels for Public Participation

建立民间河长制度，发动热心市民参与到水环境治理中。截止 2018 年 9 月，现有民间河长 754 人；3972 名党员认领 559 个河湖。

We have established a volunteer river chief system and invited citizens to participate in water environment treatment. As of September 2018, there are 754 volunteer river chiefs and 3972 CPC members volunteer to oversee 559 rivers and lakes.

设立“广州水务”“广州治水投诉”等微信公众号，接受公众监督与投诉。结合“世界水日”“中国水周”，开展了户外徒步、志愿者巡河等主题活动，发动市民积极参与。

We have launched several WeChat official accounts, including Guangzhou Water and Guangzhou Water Problem Complaints, to receive public supervision and complaints. We have also organized theme activities including outdoor hiking and volunteer river patrol on World Water Day and China Water Week to involve citizens.

## 2. 利用传媒宣传治水

### **2. Publicity of Water Environment Treatment**

开播《作风建设在路上》《G4 出动》《水秀花城》等专题系列治水节目，采取线上宣传与线下活动相结合的方式，每月发布《开门治水控源在行动》，继续深入发动群众，监督曝光治水工作中存在的不作为、慢作为等问题、违法排污等行为，营造全社会共治监督、共治共管、共同保护河涌的良好氛围。

We have launched several special TV programs on water environment treatment, including *Work Style Construction on the Road*, *G4 Out* and *Water Scenery in Guangzhou*. Online publicity and offline activities, including monthly report of *Water Environment Treatment in Action*, are combined to involve citizens in overseeing government employees related to water treatment who are not doing their job or doing it with reluctance as well as illegal wastewater discharge behaviors and create an atmosphere to involve the whole society in supervision, governance and protection of rivers.

## 3. 建立有奖举报制度

### **3. Establishing A Rewarding System for Spotters**

实施《广州市违法排水行为有奖举报办法》以来，发放线索奖励 159 宗，合计 47700 元，对打击违法排水行为发挥



了积极作用。

Since the implementation of *Measures for Rewarding Spotters of Illegal Wastewater Discharge behaviors of Guangzhou Municipal Government*, 159 reports have been rewarded, with a total amount of 47,700 Yuan. The rewarding system has played a positive role in fighting illegal wastewater discharge problems.

#### **(六) 治理成功的典型案例**

#### **(VI) Successful Cases of Sewage Treatment**

沙河涌发源于白云山，流域集雨面积 34.3 平方公里，地势北高南低，干流全长 14.14 公里，自北往南穿越广州市中心城区，汇入珠江。河道上游为山区性河流，河道落差较大；下游河道平缓蜿蜒，受珠江潮汐影响。

Shahe River originates from Baiyun Mountain and the rainwater collection area of its basin is 34.3 square kilometers. The river runs from north to south with a total length of 14.14 km. The river runs through downtown Guangzhou from north to south and join the Pearl River. The upstream of the River is a mountainous river with comparatively large drop and its downstream is rather gentle and winding and affected by the tides of the Pearl River.

白云山山溪水及径流雨水原经 6 条支流汇入沙河涌，后因沿线污水排入的增多，导致六条支流水环境不断恶化，故对 6 条支流进行了加盖封闭，形成了现状的 6 条合流渠箱。年溢流次数达 40 多次，溢流时将大量漂浮物、合流渠箱的积泥一并排入沙河涌，成为沙河涌黑臭的主要原因。

Creeks of Baiyun Mountain and runoff rainwater used to join Shahe River through 6 tributaries, however, the water environment of these tributaries deteriorated due to increase of sewage discharge along their routes. Therefore the tributaries were capped and closed into 6 combined sewers as status quo, which overflows for over 40 times annually. When they overflow, a large number of floats and sediments of combined sewer are flushed into Shahe River and it is the major reason why Shahe river becomes a polluted river.

主要采取以下治理措施：

We have taken the following measures:

(1) 溢流口改造，充分利用厂网能力，截留初雨处理。

(1) Renovating overflow ports and making full use of sewage treatment plants to intercept first-flush rainwater

采取了合流渠箱截流口改造，降低堰前水位、清疏暗渠沉积物等措施，充分挖掘截污干管的截流倍数及污水处理厂的处理能力，将雨天截流的雨水混合水送入污水处理厂处

理，削減河涌溢流污染。如广州大道北渠箱改造前暗渠出口设置有两道截污堰，堰高 0.8 米-1.2 米，渠箱内水位高，旱天用水高峰期及降小雨时，溢流频繁。通过拆除截污堰，增设与下游河道顺接的刘槽，迅速降低了渠箱内水位，溢流次数明显减少。

We have taken several measures, including renovating the overflow ports of the combined sewer, lowering the water level before weirs, removing sediments from culverts, improving the interception ratio of trunk sewers and the treatment capacity of sewage treatment plants, sending mixed water collected on rainy days to sewage treatment plant to reduce overflow pollution in rivers. For example, the culvert outlet in Guangzhou Avenue North has two interception weirs before renovation. The weirs are 0.8-1.2 meters and the water level in the drainage is high. therefore, overflow is frequent during peak hours of water use in dry days or in slightly rainy days. By removing interception weirs and adding sluices connecting to downstream river channel, the water level in the drainage is lowered quickly and the overflow frequency is notably reduced.

(2) 降低河道水位，用“清水”进行河涌生态补水

(2) Lowering water level of the river and introducing clean water to replenish the river.

改变沙河涌涌口水闸的双向调度方式，不再引珠江潮水补水，而形成自北向南的单向流，有效解决了珠江水泥沙在沙河涌的淤积问题；降低下游感潮段的景观水位（降低后上游水深在 0.3 米-0.5 米之间），有效解决了河道水位过高，河水倒灌排水管道问题；以上游各合流渠箱的山溪水和沙河涌上游京溪净水厂的再生水位补水水源，其中各合流渠箱的山溪水有 3.5 万立方米/天，京溪净水厂有 8.5 万立方米/天再生水进入河涌，解决了枯水期沙河涌所需的生态基流，并促进了水体的流动，恢复水生态。

We have changed the dual-directional dispatching mode of the sluices of Shahe River and stopped replenishing the river with tidal water of the Pearl River to form a one-way flow from north to south in order to effectively solve the problem of sedimentation of the Pearl River in Shahe River. We have also lowered the landscape water level of downstream tidal section (the lowered depth of the upstream is 0.3-0.5 meters) to solve the problems of excessively high water level and intrusion of drainage water. Mountain streams from upstream combined sewers and the reclaimed water of Jingxi Water Treatment Plant located in upstream of Shahe River are used to replenish the River, among which mountain streams provides 35,000 cubic meters/ Days and Jingxi Water Treatment Plant provides 85,000

cubic meters/day, in order to meet the demand of ecological base current when Shahe River is in dry season, to facilitate water flow and to restore aquatic ecology.

(3) 合流渠箱内部改造，实现渠箱内部“清污分流”

(3) Renovating combined sewers and separating wastewater from clean water in the sewage system.

在区域污水管网尚未完善的情况下，首先在合流渠箱内敷设截污管，并进行混凝土方包处理，将排入合流渠箱的污水进行截流；同时实施合流渠箱上游山溪水渠两侧的截污。经改造后实现了合流渠箱内的污水与上游清水的分流。总体达到“四减一增”的效果，即源头减量，沿程减压、末端减负、河涌减污、增加进厂浓度，促使污水收集与处理系统提质增效，实现河涌长制久清。

Under the condition that the regional sewage network has not been fully improved, we have laid down interception pipes in combined sewers with concrete coverage to intercept wastewater. We also implemented sewage interception measures on both sides of mountain stream channels in upstream combined sewer. After the renovation project, wastewater is separated from upstream clean water in the combined sewer. We have realized the overall goals of reducing sewage volume from the source, reducing sediment pressure, reducing sewage

treatment pressure at the end and increasing the wastewater concentration before treatment, improved the quality and efficiency of sewage collection and treatment system and achieved river environment conservation on long-term basis.

### **三、存在问题及原因分析**

#### **III. Existing problems and cause analysis**

##### **(一) 污水治理规划和建设滞后**

###### **(I) Delayed sewage treatment planning and construction**

近年来，广州市大力推进排水管网特别是污水管网建设，但整体上仍不能满足城市快速发展需求。主要体现在以下三个方面：

In recent years, Guangzhou has spared no efforts to advance the drainage pipeline network construction, especially sewage pipeline network, but on the whole, the demands brought by rapid urban development have not been met yet, which is manifested in the following three problems:

##### **1. 管网数量明显不足**

###### **1. Obviously inadequate pipeline network**

截止 2018 年 9 月广州全市城镇排水管网 20827 公里，其中污水管网仅 6736 公里，区域管网建设不均衡，白云、增城区管网密度较低。

By September 2018, Guangzhou had laid a total of 20827

kilometers of drainage pipelines in urban area, of which only 6736 kilometers are sewage pipelines; further, pipeline construction has been disproportionate among the districts with Baiyun and Zengcheng districts maintaining a low density of pipelines.

## 2. 污水处理能力仍有缺口

### 2. Gap in sewage treatment capacity

受征地拆迁等因素制约，广州市污水处理厂建设进度较慢，全市现有污水处理能力 548 万 m<sup>3</sup>/d，尚有缺口 79 万 m<sup>3</sup>/d。

Impacted by land expropriation and relocation, the construction of sewage treatment plants in Guangzhou progressed slowly. At present, its sewage treatment capacity has reached 5.48 million m<sup>3</sup> per day with a gap of 0.79 million m<sup>3</sup> per day.

## 3. 中心城区雨污分流比例较小

### 3. Low proportion in separation of rainwater and sewage in downtown areas

中心城区合流制区域面积约占 72%，暴雨时污水溢流问题突出，不利于河涌水质的长制久清。

72% of downtown areas merge sewage and rainwater. As a result, the problem of sewage overflow will become prominent

during rainstorms, which is not conducive to long-term treatment and clarity of river water.

## (二) 城中村、散乱污染场所等污染源较多

(II) Numerous pollution source in urban villages and unplanned, unregulated and polluting locations

因历史原因，广州市存在大量的城中村。据排查，187条黑臭河涌流经的城中村多达99个，村域面积约133平方公里，居住人口约365万，产生的污水直排河涌仍然是广州市黑臭水体整治工作中最大“顽疾”。

Because of historical reasons, a lot of urban villages exist in Guangzhou. According to an investigation, 187 polluted rivers flow through up to 99 urban villages with an area of 133 square kilometers and a population of 3.65 million. Direct sewage discharge into the rivers from villages remains the most stubborn problem for Guangzhou to remedy the polluted waters.

### 1. 城中村截污不彻底

#### 1. Incomplete pollution interception in urban villages

因城中村建筑、人员密集，施工空间有限，对城中村多实行绕村截污，村内污水收集管网不完善，导致污水收集未能真正取得实效。

Because of densely distributed buildings and population in urban villages, there is limited space for pipeline constructions,



so urban villages have been seen as a whole during pollution interception pipeline construction with insufficient pipelines within the villages; therefore, the sewage collection system cannot function effectively.

## 2. 散乱污场所众多

2. Numerous unplanned, unregulated and polluting locations

城中村内依附了众多的村级工业园及“散乱污”场所，产生大量高浓度工业污水，缺乏配套的污水处理设施。

Urban villages have accommodated a lot of village-level industrial parks and unplanned, unregulated and polluting locations which have generated a large amount of highly concentrated industrial wastewater. However, the villages have not been equipped with supporting sewage treatment facilities.

## 3. 违法建设数量较多

3. Various illegal buildings

截止到 2018 年 9 月，经初步摸查，广州 187 条黑臭河涌两岸涉嫌违法建设面积约 237 万平方米，其不仅产生大量垃圾、污水直排河涌，且严重占用河道管理范围，导致涌边截污管网难以铺设。

By September 2018, according to preliminary investigation,

there had been a total of 2.37 million square meters of suspected illegal buildings along the banks of 187 polluted rivers in Guangzhou, which not only generated and directly discharged a large amount of waste and wastewater into these rivers, but also seriously intruded into the watercourse management areas. As a result, it is impossible to lay pollution interception pipelines along the river banks.

### **(三) 排水管理工作水平亟待提升**

(III) Drainage management expertise in need for improvement

与国内外先进城市相比，广州排水设施管理相对粗放、设施运行状况不佳，未能全面发挥其污水收集处理作用。Compared to cities with advanced experience at home and abroad, Guangzhou has remained less sophisticated in the drainage facility management and been poor in facility operations; as a result, it cannot put sewage collection and treatment facilities into full play.

#### **1.多头管理**

##### **1. Multiple redundant authorities**

中心城区公共排水设施采用“市、区两级+雨、污分割”管理模式，造成排水设施系统性不强，产生大量管理交叉界面及管理真空区域，容易造成责任主体不清的问题。

The public drainage facilities in downtown areas are applicable to the management model of “two levels of municipality and districts and two parts of rain and sewage”, so drainage facilities cannot function systemically, resulting in various overlapping management in some fields and also some management vacuums in other fields because of unclear responsible subjects.

## 2.投入不足

### 2. Insufficient investments

排水设施日常管养主要由第三方服务机构承担，维护管理水平参差不齐，大量设施未能得到有效养护。截止 2018 年 9 月，经初步摸查，广州全市排水管网现存结构性隐患达 49709 个，严重影响设施的正常运行。

The daily management and maintenance of drainage facilities are mainly entrusted to a third party service agencies with different capacities, so too many facilities have not been effectively maintained. By September 2018, based on preliminary investigation, Guangzhou had had 49,709 structural hazards in its drainage pipeline network, which seriously impacted the proper operations of these facilities.

## 3.执法效果不佳

### 3. Poor law enforcement

水污染执法存在“宽松软”现象，执法程序较长、处罚力度不足，执法震慑作用未能充分显现，排水违法屡犯、累犯现象尚未有效遏制。

Law enforcement in field of water pollution has been extensive, loose and weak with prolonged enforcement procedures, inadequate punishment and less deterrent effects, so the recidivism phenomenon in terms of illegal drainage has not been effectively controlled.

#### （四）精细化管理水平有待提升

##### (IV). Refined management yet to be achieved

排水户-收集管-转输管-处理设施全流程闭环管理不到位，全市约有 10 万户非居民供水户，但自 2010 年起发放排水许可证仅 2320 个，排水户接驳市政管网区存在管理真空，部分排水设施建设、管理权责不清，存在推诿现象，按效付费的河涌水质管养机制尚未健全。

A closed full-process management of sewer user - collection pipeline - transfer pipeline - treatment facility has been put in place. Guangzhou has 100,000 non - residential water users, but has only issued 2,320 wastewater discharge permits since 2010. As a result, when a fair proportion of sewer users connected to municipal pipelines have been left unregulated because of unclear division of responsibilities and buck passing in

construction and management of some drainage facilities and unsound river water quality management and maintenance mechanism based on pay for performance system.

#### 四、国外先进地区的治理经验分析

IV. Analysis of treatment experience in overseas countries and regions

##### (一) 美国

##### (I) The US

##### 1. 法治建设

##### 1. Legal construction

——完善的水环境保护法律体系。美国关于水环境保护方面的立法始于 1899 年，出台了旨在清理航道为目的的《垃圾法》。基于对水污染势态日趋严重和控制地表水污染的考量，美国国会于 1948 年着手制定并颁布实施了《联邦水污染控制法》，后经不断完善与修订，最终形成了至今依然发挥着重要作用的《清洁水法》。该法严格控制地表水的污染，努力以污染控制技术为基础对不同类型的点源污染排放进行限制，对面源污染、填埋物、油类物质与危险物质泄漏事故等方面的控制也做出了明确规定。此后，为了禁止在海上倾倒放射性等有害物质和保护沿海地区的生态系统，美国又陆续制定并颁布实施了《海洋倾倒法》和《海岸带管理法》等一系列专门性与综合性的法律规章制度。

**--Perfect legal system for protecting water environment.** The US started to legislate for protecting water environment in 1899, promulgating the *Refuse Act* with the aim to clear the waterway. In view of the increasingly severe water pollution and the need to control surface water pollution, the Congress formulated and promulgated the *Federal Water Pollution Control Act* in 1948, which evolved to be the *Clean Water Act* that has played an important role ever since. The Clean Water Act has strictly controlled the surface water pollution, strived to restrict different types of point source pollution discharge with pollution control technologies, and specified how to control point source pollution, landfill waste, oily materials and hazardous materials leakage. After that, in order to prohibit dumping radioactive and hazardous substance into sea and protect ecological system in coastal areas, the US has formulated and promulgated a series of specialized and comprehensive laws and regulations, including *Ocean Dumping Act* and *Coastal Zone Management Act*.

——**标准化的工业污染源管理。**美国的工业污染源治理标准包含了排放标准、总量控制、排放许可制度三大关键技术要素。由联邦政府针对一些特殊的工业企业、污水处理、污染物排放、污染物浓度等统一制定工业污染源排放标准，

是美国工业污染管理的突出特色和技术基础。联邦环保局依据“最佳可行技术”为统一的污水排放标准，对工业行业实行分类管理。其中，工业污染源控制分浓度和总量两种。工业废水的处理，规定必须使用该行业最好的、可行的处理技术处理，并且要求所有监测数据应即时向社会公开。

**--Standardized management of industrial pollution sources.**

The treatment standards for industrial pollution sources in the US cover three key technical factors, namely pollution discharge standard, total quantity control and discharge permit system. It is a unique feature and technology base of industrial pollution management in the US to formulate uniform discharge standards for industrial pollution sources by the federal government for special industrial enterprises, sewage treatment, pollutant discharge and pollutant concentration. The Federal Environmental Protection Agency incorporates the “best feasible technologies” into the uniform sewage discharge standards to conduct classified management of industrial enterprises. Industrial pollution sources have been controlled on basis of pollution concentration and total quantity. For industrial wastewater treatment, the Agency stipulates that the best feasible treatment technologies in the industry must be adopted and all monitoring data must be open to the public in real time.

## 2. 源头控制

### 2. Pollution source control

——全面实施农业面源污染控制计划。农业面源污染是水环境污染治理的难点，污染物来源主要是畜禽粪便、化肥以及农药。美国控制农业面源的主要做法是实行最佳管理措施（简称“BMP”）。BMP 是指降低或预防污染的有效方法与措施，该计划主要包括环境质量改进和保护 - 储备两类项目。2008-2012 年期间，BMP 共提供 72.5 亿美元资金用于资助各州进行农业面源污染控制以及农民环保技术培训。此外，美国在农业领域广泛开展了病虫害防治工作，推行轮作倒茬、耐性作物选育、土壤改良等措施，这在很大程度上削减了农药用量；针对化肥过度使用推行精准化施加技术，同时制定严格的化肥施用法律，迄今已有 48 个州制定了相关地方性法律法规。

**--Non-point pollution source control plan in agricultural field has been fully implemented.** The non-point pollution sources in agricultural field have been a difficult point in water environment pollution treatment. The main pollutant sources are livestock and poultry manure, chemical fertilizer and pesticides. The US has mainly adopted Best Management Practices (BMP) to control non-point pollution sources in agricultural field. BMP has been an effective approach and measure to reduce or



prevent pollution, which comprises of two types of environmental quality improvement and environment protection - preservation projects. From 2008 to 2012, BMP mainly provided 7.25 billion USD to fund all states in non-point pollution source control in agricultural field and training of farmers on environmental technologies. In addition, in agricultural field, the US has adopted plant disease and insect prevention and control, crop rotation, seed selection of tolerable crops, soil improvement and other measures, which to a large extent has reduced pesticide usage; for the problems of excessive use of fertilizers, the US has promoted precise fertilizing technologies and formulated strict fertilization laws. 48 states have formulated local laws and regulations in this field so far.

——**有毒污染物优先控制。**1984年，美国颁布“国家污染物排放淘汰制度”，该制度要求明确有毒污染物的排放许可限值，并要求采用废水生态毒性试验进行安全性验证，借以禁止致毒量超限的有毒废水排放。迄今，无论是工业废水或城市生活污水在排放前均需进行生态毒性测试，同时受控于程序化监管，这一做法成功避免了有毒污染物排放导致的水环境生态风险问题。

**--Priority control of toxic pollutants.** In 1984, the US

established National Pollutant Discharge Elimination System, which clearly set the discharge limits for toxic pollutants and required security verification through wastewater eco-toxicity tests, so as to prohibit discharge of poisonous wastewater whose toxic quantities exceed the limits. So far, both industrial wastewater and urban domestic sewage need to go through eco-toxicity tests before being discharged and also be controlled with procedural regulations, so ecological risks in water environment resulting from toxic pollutant discharge have been successfully avoided.

### **3. 资金支持**

#### **3. Financial support**

——**排污费全额用于污水处理厂运作。**美国用水产生的排污费统一来自自来水价，而水价完全由市场进行调节，但其指定不能以盈利为目的，只保证投资的收回。以 2011 年美国国务院所在地雾谷为例，居民用水排污费为 5.9 美元/1000 加仑，最高按 6000 加仑水量征收，另单独收取污水处理费 6.75 美元；企业用户与居民用户类似，只是费用更高。美国污水处理厂日常运行与维护、人员工资和部分设施改造等均由排污费支付，满足不了的部分再由各级财政根据实际需求予以补贴。这一做法从根本上避免了污水处理厂因经费欠缺而导致开公率不足的情况发生，从而使得纳入排水管

网系统地各种污、废水得到净化处理。

**--All the sewage charges should be used for operating sewage treatment plants.** In the US, the sewage charges deriving from water usage have all come from tap water price which has been entirely adjusted by the market demands. However, such a price can only recover the investments without any profits. Take the Foggy Bottom in 2011 (where Department of State is located) as an example, the sewage charges for residential users were 5.9 USD/1000 gallons for less than 6000 gallons and an additional charge of 6.75 USD of sewage services; the charges for enterprise users were similar to those of residential users except for higher prices. The daily operation and maintenance costs, the staff wage and facility renovation costs have all been paid with the sewage charges and certain fiscal subsidies based on the actual gap. This has fundamentally prevented sewage treatment plants from insufficient operation rate for lack of funds and so the sewage and wastewater drained into drainage pipeline network can be effectively treated and purified.

——**节能、节水型企业税收减免政策。**自 20 世纪 60 年代，美国开始对环保领域的技术型企业给予所得税减免优惠。1986 年，所得税减免措施针对节能、节水等资源循环利用

用型企业开始实施。1991年，美国23个地方政府针对资源循环利用投资领域给予税收抵免扣除，而循环利用技术设备则获得相应的销售税免除。2008年，修订的《企业所得税法》特别规定，对符合条件的节能节水、水环境保护项目的收益享受减征免征所得税。此外，针对环保企业用地也予以税收优惠。

**--Tax relief policies for energy and water-saving enterprises.** Since 1960s, the US started to adopt income tax relief policies for technology-based enterprises in the environmental protection field. In 1986, the US expanded such policies to energy and water-saving enterprises and other resource recycling enterprises. In 1991, 23 state governments started to implement tax credit and deduction policies for those investing in resource recycling field with the resource recycling technological equipment being exempt from sales tax. In 2008, the modified *Corporate Income Tax Act* specially stipulated that, the profits from eligible energy and water-saving and water environment protection projects can be exempt from income tax. In addition, the enterprises eligible for environmental protection requirements can also enjoy tax preference policies in land use.

——**设立国家周转基金。**美国水环境周转基金主要包括清洁用水和安全饮用水周转基金。清洁用水基金主要针对水

环境保护项目提供低利率贷款；安全饮用水基金则根据各州饮用水需求数据分配年度预算额，并规定各州获得不少于当年基金预算的 1% 的额度，同时针对印第安属地和阿拉斯加土著等落后地区提供不少于 1.5% 年度预算额。

**--Clean Water State Revolving Fund has been set up.** The water environment revolving funds mainly include the Clean Water State Revolving Fund and the Drinking Water Safe Revolving Fund. The Clean Water State Revolving Fund aims to provide low rate loans for water environment protection projects; the Drinking Water Safe Revolving Fund is responsible for allocating annual budget based on the drinking water demand data of all states and stipulates that all states can obtain no less than 1% of the budget each year; however, Indian territories and Alaska native area can receive no less than 1.5% of the budget.

#### 4. 循环经济

#### 4. Recycling economy

大力发展固体废弃物循环利用产业。自 20 世纪 90 年代以来，建设以循环经济为导向的循环型社会成为欧洲、美国、日本等发达地区和国家实施可持续发展战略的重要途径和方式。“减量化、再利用、再循环”是循环经济的基本行为准则，而实现废物回收利用则是循环经济闭环流动的关键关

节。生产、生活中产生的各种废弃物是导致水环境污染的重要原因。美国近年来大力推动废弃物循环利用产业发展，规模不断壮大。根据 2019 年美国固体废物处理与技术服务展览会展情介绍，美国每年处理大约 5.44 亿吨固体废物，其中 3.7 亿吨采取填埋处理，2900 万吨采取焚烧产能处理，剩余 1.46 亿吨则被循环利用。全美固体废物行业的总产值高达 960 亿美元，约占美国 GDP 总量的 1%，固体废物行业年上缴税收约 141 亿美元。美国大约有 2.7 万多家企事业单位参与固体废弃物的管理和运营，目前共提供了近 37 万个工作岗位，其中有 55% 属于公共事业单位，其余 45% 是私营企业。废弃物循环利用产业的发展不仅对全美总体经济做出了贡献，同时也大量削减了各种污染物负荷，特别是对水环境的保护起到了非常重要的作用。

**- To strive to develop solid waste recycling industry.** Since 1990s, to build a recycling society oriented to recycling economy has become an important method and means for the EU, US and Japan to implement sustainable development strategy. It is the basic code of conduct of recycling economy to “reduce, reuse and recycle” with waste recycling being the key link in the closed cycle. All kinds of waste in production and life have been an important cause of water environment pollution. In recent years, the US has strived to develop the

waste recycling industry to a bigger and bigger size. According to the introduction of Waste Expo 2019, the US can handle about 544 million tons of solid waste, of which 370 million tons are disposed in landfills, 29 million tons are incinerated to generate electricity, and the remaining 146 million tons are recycled. The gross output value of solid waste industry in the US has reached 96 billion USD, about 1% of GDP; the solid waste industry pays 14.1 billion USD of tax annually. About 27,000 enterprises and public institutions have participated in the management and operation of solid waste, creating a total of 370,000 jobs, of which 55% come from public institutions and 45% come from private enterprises. The development of waste recycling industry has not only contributed to the overall economic growth, but also reduced various pollutant loads, in particular, it has played an important role in protecting the water environment.

## **(二) 新加坡**

### **(II) Singapore**

在治水过程中，新加坡政府在体制改革、资源投入、法制建设等方面多管齐下治污水。

Singapore government has taken various measures including reforms in systems, investment in resources and

development of a legal system to treat sewage in the process of sewage control.

## 1.法治建设

### 1. Development of a legal system

制定法律严惩污染行为，社会成本高。新加坡制定了全面的水资源管理法律体系,对水污染违法犯罪行为严格管理。新加坡 1968 年《环境公共卫生法》规定，违反该法丢弃废弃物将被处罚最高 500 新元，再犯最高 2000 新元，而当时新加坡人均年收入区区 1000 新元，因此几乎所有的违法者都选择立即认罪以减轻处罚，并不敢再犯。《水污染控制和排放法》实施后，污染行为在罚款基础上又增加了监禁处罚。在长期严刑峻法的威慑下，新加坡如今执法压力大大减轻。2010 年水污染全年接到投诉只有区区 368 例。

**Formulating laws that impose severe punishment on those causing pollution.** Singapore has developed a comprehensive legal system for the management of water resources, imposing severe punishment on crimes and offenses related to water pollution. The *Environmental Public Health Act* of 1968 stipulates that littering in violation of the Act would get a fine of up to S\$500 and up to S\$2,000 for repeated violation. At that time, the per capita income in Singapore was S\$1,000. As a result, almost all offenders pleaded guilty immediately to



alleviate the punishment and dare not break the law again. After the implementation of the *Water Pollution Control part in Environmental Protection and Management Act*, those causing pollution may be imprisoned in addition to fines. The deterrence effect of severe punishment for a long term has significantly eased the burden on law enforcement. In 2010, there were only 368 complaints about water pollution received throughout the entire year.

## 2.体制改革

### 2. Reforms in systems

**整合管理部门统筹协调资源。**新加坡水资源管理职能是一个从分散到统一的过程。经过多次调整，2001年起公用事业局整合了所有的供水和排水职能，归属环境和水资源部，新加坡和水有关的全部职能高度集中到一个部属局中。由于职责高度集中，上下水统一管理，新加坡没有“多头治水”的弊端，水务规划系统性强，从源头到末端能够顺畅地闭环运作。在职能归一的同时，新加坡的水务管理并非大包大揽，而是牢牢抓住规划和执法，具体运营委托专业企业。这也促进了新加坡水务企业数量众多、实力强劲，在国际上富有竞争力。

**Integrating management departments to coordinate and schedule resources.** Singapore had been integrating its

functions of water management that were originally decentralized. After several adjustments, the Public Utilities Board (PUB) integrated all functions of water supply and drainage in 2001. The PUB under the Ministry of the Environment and Water Resources is fully responsible for water-related functions in the country. Due to the high concentration of responsibilities and the uniform management of water supply and sewage, Singapore does not have to deal with the issue of "water management by multiple authorities". The systematic and powerful water affair planning ensures smooth closed-loop management from the source to the end. Although unifying the functions of water affair management, the government does not attempt to do everything itself; instead, it is responsible for planning and law enforcement and entrusts specialized enterprises with specific operations. This is also why there are a great many powerful and competitive Singaporean water affair companies across the globe.

### **3.资金来源**

### **3. Sources of funds**

投入大量资金提供治理保障，公众和企业为治水买单。在“十年清河、十年河清”运动中，新加坡河和加冷盆地流域总面积仅 93 平方公里，仅此一项工程新加坡政府总共花费

近 60 亿新元（占新加坡同期 GDP 的 1.5%-3%）。新加坡政府投入资金主要来源于居民和产业的水费支出。1965-2000 年，新加坡政府先后 11 次提高水价。2015 年水费收入相当于 40 亿元人民币，基本覆盖当年运营成本和固定资产投资。2017 年新加坡以水务入不敷出为由启动新一轮涨价，涨幅高达 30%-50%，预计分阶段涨价到位后水费收入将达到 60 亿元人民币/年。新加坡将用水成本全部推给国民和企业的做法抬高了全社会成本，新加坡长期属于全世界用水最贵的国家之一。

**Investing a significant amount of funds collected from the public and enterprises to guarantee the governance of water affairs.** Singapore government spent nearly S\$6 billion (accounting for 1.5%-3% of the country's GDP for that period) on a 10-year program to clean waterways, while the total area of the Singapore River and Kallang Basin was only 93 square kilometers. The funds invested mainly came from the water fees paid by residents and industries. From 1965 to 2000, the government raised water prices 11 times. In 2015, the revenue of water fees was equivalent to 4 billion yuan, which basically covered the operating costs and investment in fixed assets in the same year. In 2017, Singapore increased the prices by 30%-50% on the ground of failure to make ends meet. It is expected that

the revenue of water fees will reach 6 billion yuan/year after the staged price increase is completed. Burdening nationals and enterprises with all the costs of water utilization has raised the social cost, which is why Singapore has long been one of the countries that charge the highest water fee around the world.

#### 4.规划工程

#### 4. Planned projects

**建设集水区杜绝污染排放。**集水区建设是新加坡治水的核心工程。新加坡的“集水区”实质是供水排水管网全覆盖、统一供应、统一收集、统一处理的用水区域，具有三个突出特点。一是集水区覆盖比例高。目前新加坡已建成供水管道 6100 公里、排水管道 3400 公里，管网密度 13.3 公里/平方公里（上海为 9.0 公里/平方公里），有 2/3 的面积为集水区，2060 年目标是 90%。这意味着届时除了保护区外，新加坡其余国土基本没有自然循环的水体。二是雨污双零排放。新加坡对集水区内的雨水、污水实现了全部收集、雨污完全分离，掐断了所有污染物的传播途径，所有雨水都将在处理后进入水库作为水源，所有污水进入污水处理厂处理后循环再生或外排入海。三是集水区土地利用严格管理。新加坡国土规划科学、执行有力，规划要求不能在集水区建设有污染的项目等确保水源水质安全。

**Developing catchment areas to eliminate the discharge of pollution.** The development of catchment areas is a core project for water control in Singapore. These "catchment areas" are essentially areas fully covered by water supply and drainage pipelines for uniform supply, collection and treatment of water, and have three major features. First, high coverage ratio. At present, Singapore has built 6,100 kilometers of water supply pipelines and 3,400 kilometers of drainage ones. The density of pipelines is 13.3 km/km<sup>2</sup> (which is 9.0 km/km<sup>2</sup> in Shanghai). Two-thirds of the country is catchment areas, and the ratio is expected to reach 90% in 2060. This means that except in the protected areas, there will be no naturally circulating water body in other parts of Singapore. Second, no discharge of both rain and sewage. All the rainwater and sewage in the catchment areas are completely collected and separated to cut off the transmission of all pollutants. All the treated rainwater will flow to reservoirs as a water source, and all the sewage will be treated by the sewage treatment plant for recycling or discharging into the sea. Third, strict management of land use in the catchment areas. The scientific national land planning which prohibits the construction of polluting projects to secure the safety of water sources is fully enforced.

### (三) 日本

#### (III) Japan

##### 1. 法制建设

##### 1. Development of a legal system

国家政府颁布有《湖泊水质保护特别措施法》，地方政府对一些重要湖泊的保护还制定专门法规，如茨城县的《霞浦湖富营养化防止条例》，其排污标准甚至比国家要求更加严苛。同时，日本也非常注重规划指导。如对琵琶湖、霞浦湖的污染治理与生态修复，都制定了中长期战略规划和具体的实施计划，并定期评估、适时修正、始终贯彻，才有了如今的成效。如何更好、更有效地实现水资源、水环境的科学利用和依法管理，日本政府及其地方政府立法、执法的经验做法和坚持规划引导、一张蓝图绘到底的成功实践，值得广州借鉴。

The central government has enacted the *Law Concerning the Special Measures for the Prevention of Lake Water Quality*, and local governments have also formulated special regulations on the protection of some important lakes, such as *Ibaraki Prefectural Ordinance for the Prevention of Eutrophication of Lake Kasumigaura* which imposes even more stringent standards for pollution discharge than the national law does. Meanwhile, Japan also pays great attention to planning and

guidance. For example, medium- and long-term strategic plans and specific implementation plans for pollution control and ecological restoration in the areas of Lake Biwa and Lake Kasumigaura have been developed, regularly evaluated, revised as appropriate and thoroughly implemented to make the achievements today. Regarding the better and more effective use of water resources, scientific use and management of water environment by law, Guangzhou may draw lessons from the experience of legislation and law enforcement and the practices of consistent planning and guidance and one blueprint by Japanese central and local governments.

## 2. 监测管理

## 2. Monitoring and management

日本政府针对日益严峻的发展、环境、资源之间的紧张关系带来的压力，为了促进与实现经济的循环发展，协调环境与人类的关系，于 20 世纪 70 年代末开始投入了大量的监测资金建立水环境自动监测系统对公共水环境进行常规监测，并赋予环境部、县和指定的市政府对企业或商业设施的水污染排放物、不能达标的封闭或半封闭水域、生活污水排放实施全程检查与监督的权利

In response to pressure caused by the growing tension among development, environment and resources, Japanese

governments had invested a large amount of funds in the late 1970s in the establishment of an automatic monitoring system for water environment which monitors the public water environment on a regular basis to promote and realize the development of circular economy and coordinate the relationship between the environment and human beings. Meanwhile, the Ministry of the Environment, prefecture and designated municipal governments were granted the right to inspect and monitor the water pollutants discharged by enterprises or commercial facilities, closed or semi-enclosed waters that were not up to standards, and the whole process of domestic sewage discharge.

### 3.治理技术

### 3. Treatment technologies

植物水质净化。日本特别重视水生态系统的可持续发展和水污染的生物治理，20世纪90年代中期开始，日本政府为实现经济发展与资源环境的良性循环发展，充分利用天然或人工湿地植物净化、水培植物净化法、水生植物和滤材结合净化、生物浮床净化等技术方法，日本水环境治理开始渐次进入生物多样性恢复阶段，创造适宜多种生物生息繁衍的良好生态环境和更美好的生态空间，实现人与自然和谐共处，逐步在有限的区域内重建并恢复水生态系统。



**Water purification with plants.** Japan attaches great importance to the sustainable development of aquatic ecosystems and the biological treatment of water pollution. Since the mid-1990s, Japanese governments have made full use of purification with plants in natural or artificial wetlands, hydroponic plants, the combination of aquatic plants and filtration materials and bio-floating beds to form a virtuous cycle of development of economy, resources and the environment. Subsequently, Japan began to restore the biodiversity in the water environment by creating a good ecological environment and a better ecological space suitable for the living and breeding of a variety of creatures. As people live in harmony with the nature, the water ecosystems have been gradually redeveloped and restored in some areas.

(四) 澳大利亚 (请补充)

(四) **Australia (Please add)**

(五) 瑞典 (请补充)

(五) **Sweden (Please add)**

## 五、下一步工作计划

### V. Work Plan for the Next Stage

坚持以问题为导向，借鉴国外先进城市的成功经验，广州在提升水资源治理水平中需在制度建设、树立理念、公民

环保意识和市场化运作机制方面进一步完善。

Targeting at problems and drawing lessons from the success of advanced foreign cities, Guangzhou needs to further improve the governance of water resources from the following perspectives: institutionalization, establishment of concepts, public awareness of environmental protection and market-oriented operation mechanisms.

### **(一) 制度建设**

#### **(I) Institutionalization**

**建立水环境生态安全管理体系。**水环境管理目标应从水体质量和数量管理转变为生态安全管理。水环境是地球生态环境最为重要的组成，水体的质量和数量影响整个生态系统。传统水环境管理的工作重点偏重于水污染控制与洪涝灾害防控，而对维护水环境生态安全与平衡考虑不足。良好的水生态系统不仅可以提供清洁水源、生物资源，同时还可自然调蓄洪涝、净化水体污染。以美国水环境治理经验为例，尽管各州水资源分布差异较大、水环境管理模式不尽相同，但从总体上看，其水环境治理工作注重生态系统的统一性和综合性，强调河流治理与流域治理、水污染控制与水环境生态恢复、水资源开发利用与雨水污水再生回用、工程措施与非工程措施等二者间相结合。通过治水实现广州水环境生态系统的修复与平衡是提升水资源治理的关键所在，而建立水

环境生态安全管理体系则是有效治水、实现可持续发展的必由之路。为此，应建立以水环境功能区划为基础的全省水环境生态安全管理体系，实现河流与流域的统一管理，污染治理与生态恢复的综合管控，水环境与土壤、大气环境管理的统一，以及滞后被动式环境治理向超前主动性环境管理的转变。

**Establishing a system for the management of the ecological safety of water environment.** The goal of water environment management should be switched from the management of the quality and quantity of water bodies to that of ecological safety. Water environment is the most essential part of the Earth's ecological environment, and the quality and quantity of water bodies have an impact on the entire ecosystem. Traditionally, water environment management often prioritizes the control of water pollution and the prevention and control of floods, but neglects maintaining the ecological security and balance of water environment. A well-functioned water ecosystem can not only provide clean water and biological resources, but also regulate and store floods and purify polluted water bodies. Taking the water environment management in the United States as an example. Despite the difference in the distribution of water resources and environment management

models in different stages, the governance of water environment in the country focuses basically on the unity and integration of the ecosystems and stresses on the combination of river and basin governance, control of water pollution and ecological restoration of water environment, development and utilization of water resources and recycling of rainwater and sewage, engineering and non-engineering measures. Realizing the restoration and balance of the water environment and ecosystem in Guangzhou through water control is the key to improving the governance of water resources, and a system for the management of the ecological safety of water environment must be established to realize effective water control and sustainable development. Therefore, such system based on the functional zoning of water environment in the entire province should set up to unify the management of rivers and basins, pollution control and ecological restoration, and water environment and soil and atmosphere, and to switch from outdated passive environmental governance to advanced active environmental management.

## **(二) 治理理念**

### **(II) Philosophy of governance**

建立并完善以水资源为纽带的循环经济发展模式。循环

经济是以清洁生产、物料循环利用和废弃物资源化为特征的生态型经济，由于它对环境资源破坏程度最小、利用程度最大，因此最大化降低了经济发展的环境成本。美国等西方发达国家之所以在生产水平较高的程度下维持相对较好的生态环境，其不断完善的循环经济体系及稳步提高的发展水平是最重要的原因。广州水资源治理需以水资源节约利用、水环境综合治理为主轴，力图以治水“促转型、扩投资、优环境、惠民生”，实质上是以水资源为纽带推进循环经济发展模式的建立与完善。传统经济发展模式的突出特点是资源高消耗、污染高产出、环境高成本，而现代循环经济发展模式则要求清洁生产、资源减量、废物循环。水资源不仅作为最重要的生产资料参与生产力发展的各个环节，是循环经济体系最为关键的制约因素，同时也是人类生存发展最重要的生命基础，而水体本身还是最大的污染净化场，空气、土壤及各种固体废弃物所含有的污染物通过降雨、渗流等多种形式最终聚集于水环境。只有建立了以水资源为纽带的循环经济发展模式，才能从根本上改变当前水环境面临的各种问题，真正实现经济社会的可持续发展。

**Establishing and improving a development model of circular economy associated with water resources.** A circular economy is an eco-friendly economy characterized by clean production, cyclic utilization of materials and waste recycling.

As it does the least harm to the environment and resources and best utilize them, it minimizes the environmental cost of economic development. The primary reasons why developed countries, for example, the United States, maintain a relatively satisfactory ecological environment as well as high productivity are their constantly improving circular economic system and level of development. The governance of water resources in Guangzhou should be based on the conservation of water resources and comprehensive management of water environment to "promote transformation, expand investment, optimize the environment and improve people's livelihood" through water control. In essence, the governance should facilitate the establishment and improvement of a development model of circular economy associated with water resources. The traditional economic development model is characterized by high consumption of resources, heavy pollution and high environmental costs. On the contrast, the modern circular economy development model emphasizes clean production, resource reduction and waste recycling. Water resources are not only the most important means of production in all aspects of productivity development and the most critical restraint factor for the circular economy system, but also the foundation for the

survival and development of human beings. Water bodies themselves are the largest areas for purification as pollutants in the air and soil and solid wastes will be eventually accumulated in the water environment through rainfall, seepage and etc. Only by establishing a development model of circular economy associated with water resources can Guangzhou resolve the existing challenges facing the water environment for good and realize the sustainable economic and social development.

### **(三) 公民意识**

#### **(III) Public awareness**

水资源治理不是政府短期行为，而是长期发展战略。水资源的价值源自社会普遍需求，而水环境的保护离不开全社会的共同努力。美国治理水环境的特色之一即强化公民意识的培养，以形成社会共识，从而最大程度调动社会力量参与水环境保护工作。美国是世界上首次以立法形式推行环境教育理念、培养公民环保意识的国家。颁布于 1970 年的美国《国家环境教育法》迄今仍在不断修订以适应时代发展的需求。因此，美国公民自小就树立了牢固的环境保护意识，这对美国水环境保护工作的顺利实施起到了很大的推动作用。目前，广州公民环保意识相对淡薄，主动参与性不高，尽管对环境治理持肯定态度，但“人人有责、责任在我”的公民意识并不强烈。为此，有必要在全市上下广泛开展水资源治理

教育实践活动，持续培育水环境保护“责任在我”的公民意识，形成“政府推行、社会参与、人人有责、责任在我”的良好社会氛围，借以凝聚力量、形成共识。这是水资源治理建设可持续发展的必要条件。

The governance of water resources is not a government-initiated short-term program, but a strategy for long-term development. The value of water resources derives from the general demand of society, and the protection of the water environment depends on the joint efforts of the public. In the United States, strengthening the public awareness is a critical part of water environment governance, which contributes to mobilizing public participation in the protection of water environment to the maximum degree. America is the world's first country that promotes the idea of environmental education and foster the public awareness of environmental protection through legislation. *The National Environmental Education Act* promulgated in 1970 is still being revised from time to time as required. As a result, American citizens have established a strong sense of environmental protection since childhood, which contributes significantly to the water conservation in the country. At present, Guangzhou citizens have weak awareness of environmental protection. Despite their



positive attitude toward environmental protection, very few of them have come to realize that their participation is required. Therefore, extensive education on the governance of water resources is required to foster the public awareness of water environmental protection promoted by governments. This is indispensable for the sustainable governance of water resources.

#### **(四) 市场运作**

#### **(IV) Market-oriented operation**

水资源治理工作不仅是一项社会性公益事业，同时也是产生经济效益的产业行为。单纯依靠政府财政投入、公民无偿参与的方式难以保障水资源治理的持久推进，而通过市场化机制引入资金、技术以及人力物力进而形成强大的“治水”经济力量已是现实需求。实践证明，相对完善的市场化运行机制不仅为先进地区水环境保护工作提供了稳定运行的长期动力，同时也为其国家经济发展作出了贡献。广州是全国经济发达地区，具有相对较高的市场化经济水平、完善的所有制经济形式以及多元化融资—投资环境，这使得水资源治理市场化运行成为可能。所谓市场化运行机制就是按照循环经济的总体要求，将水资源及其环境功能作为生产力构成要素纳入市场，在效益—成本原则下，实现其优化配置与合理利用。这就要求政府针对地方性法律法规、财经政策、产业政策、行政指令、行业规范、激励机制以及政府服务等方面

进行选择性的调整或专门制定，以实现对现有市场经济行为的约束和引导，同时借助于道德、舆论、公民意识等社会力量，培育起一个有利于水环境保护的市场化运行机制并在实践中不断完善，最终实现水资源治理的社会效益与经济收益的和谐统一。

The governance of water resources is not only a social public welfare undertaking, but also an industrial behavior that generates economic benefits. It is challenging to guarantee sustained governance by depending solely on fiscal investment and unpaid public participation, and it is much more practical to gather funds, technologies and labor forces for water control through market-oriented operation mechanisms. It has been proved that mature market-oriented operation mechanisms not only provide a driving force for long-term and stable protection of water environment in advanced areas, but also contribute to local economic development. As a developed area in China, Guangzhou boasts a market-oriented economy, a sound form of ownership economy and an environment for diversified financing and investment, which makes market-oriented governance of water resources possible. The market-oriented operation mechanisms integrate water resources and their functions as factors of productivity into the market as per the

overall requirements of circular economy, and optimize their allocation and utilization under the cost benefit principle. The local government is required to adjust certain or customize laws and regulations, financial policies, industrial policies, administrative directives, industry norms, incentives and government services to constrain and guide the existing market economy. Meanwhile, it should also leverage such social forces as morality, public opinions and public awareness to develop market-oriented operation mechanisms that are conducive to the protection of water environment and improve them in practice, and ultimately balance the social and economic benefits of water resources governance.