Water Scarcity and Sewage Treatment in Beijing and Las Vegas

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Abstract. Studying the history of water scarcity and sewage treatment in Beijing and Las Vegas need to look for connections and relationships among events and developments like a historian. 99% sewage treatment and South-to-North water diversion project driven by the Chinese government has greatly alleviated Beijing’s water crisis. However, it is necessary to define the water rights for the South-to-North water diversion in the form of state laws as "Law of the Colorado River" that began 90 years ago. The protection of the Danjiangkou drinking water source area and China's rural sewage treatment still face challenges, so it is necessary to improve the urban sewage treatment standards and accelerate the rural sewage treatment in China.

1. Introduction

1.1 The research process and methods

In grade 9, I spent weekends visiting most of the parks around Beijing. [1] There are almost no lakes in Beijing that can make me have the passion for getting close to the clear water like Yellowstone Lake or Bear Lake. [2]

I have been studying everything I can reach about Beijing water since grade 9. However, sometimes I was blind and did not know what I was exploring. At first, I thought simply that the water in the lakes in Beijing park was not clear because of the lack of flow. Later, I saw some documents about the causes and methods of eutrophication in the water of Beijing rivers and lakes. [3] The problem and the solution were clear and specific years ago. Why has not the problem been solved?

Water eutrophication, water pollution, water scarcity, and water crisis are not only a technical problem but also a historical problem, which is closely related to society, economy, politics, population, geography, hydrology, resources, and law. I began by understanding the river and lake system in Beijing and the causes of eutrophication. While analyzing the situation, structure, and trend of water supply and consumption in Beijing over the years, I also studied the historical background behind the changes and trends.

Both Beijing and Las Vegas have a water resource per capita around 200 cubic meters, while both New Delhi and Beijing are the most populous cities in the world. I chose them to make a comparative analysis of the history and current water situation with Beijing.

As Alex Sotiropoulos, Senior Assistant Director of Admissions of UChicago, told me in his letter, "The Histories itself is meant to reflect a process of inquiry—the title refers to knowledge acquired by the investigation—rather than a fixed sequence of events." I followed the principle and method of the book United States History by John J. Newman and John M. Schmalbach to research the water crisis. "As historians research the evidence, they are looking for connections and relationships among events..."
and developments. They find and test these connections by studying causation, analyzing continuity and change, making comparisons, putting events in context, organizing content by periodization, and probably most difficult, creating synthesis with other historical understandings.”[4]

1.2 Main research conclusions
Understanding the history of Beijing water can help to find the causes and solutions to the water crisis. The rapid development of water-intensive industry and agriculture led to water shortages in Beijing around 1980. The leading causes and manifestations of the water crisis in Beijing around 2000 include the limited carrying capacity of water resources[5], the rapid growth of population, the lagging construction of sewage treatment facilities, the prolonged drought, the continuous decline of groundwater level, and the severe water pollution.[6] The city's 99% sewage treatment [7] and south-to-north water diversion project has greatly alleviated Beijing's water crisis and has undergone fundamental changes since around 2015.

By comparing the formation history of the "Law of the Colorado River", Beijing needs to adopt more legal means to deal with the water rights confirmation, water diversion scheme, pricing mechanism, and the protection of drinking water sources in Danjiangkou reservoir area as early as possible. New Delhi's water pollution crisis, the re-pollution history of the Guanting reservoir in Beijing, and the lack of China's rural sewage treatment will drive China to strengthen the protection of water sources and accelerate the process of rural sewage treatment.

It is rarely possible for people to imagine how dirty the sewage water will be and what treatment processes will be required to clean it up. A visit to a sewage treatment plant will be of great help in strengthening public awareness of water conservation. The sewage treatment in Las Vegas meets the standard of re-entering lake MEAD, which makes me see the hope of clear water in the lake of Beijing park. Water management by law, direct government investment and coordination, and public education are the keys to controlling water pollution and responding to the water crisis.

2. Water resources, water consumption, and water supply in Beijing
The water resources bulletin over the years is critical historical data to understand the water situation in Beijing. On the Beijing municipal government website, there are all electronic documents of the water resources bulletin from 2003 to 2018. [8]

Many people have studied the water resources reports of Beijing in different periods. [9]

The water resources bulletin helps to establish a comprehensive picture of the water situation in Beijing. It is necessary to have an accurate understanding of the concepts of water resources and water supply. The total amount of annual water resources refers to the surface water and underground water formed by precipitation in the same year, excluding the incoming water and the reclaimed water. Water supply refers to the water provided by various water sources. The storage of the reservoir and groundwater can be adjusted for more than one year.

2.1 First, we will analyse the water resources in Beijing and review the relationship between the change of water resources per capita and the historical process of population growth.
Influenced by the inter-annual variation of precipitation, the inter-annual variation of water resources in Beijing is relatively large. On the whole, the amount of water resources in Beijing shows an obvious downward trend. From 1956 to 1979, the average annual water resource was nearly 4.1 billion m³. From 1999 to 2007, it was 2 billion m³ annually, and from 2008 to 2012, it was 2.4 billion m³. The average annual water resources in Beijing in recent years is close to the average of 2.8 billion m³ from 1980 to 2009. Groundwater accounts for about two-thirds of total water resources. [10]
Table 1. The Average Annual Water Resource in Beijing.

| Time Range   | The average annual water resource |
|--------------|-----------------------------------|
| 1956-1979    | 4.1 billion m$^3$                 |
| 1999-2007    | 2.0 billion m$^3$                 |
| 2008 - 2012  | 2.4 billion m$^3$                 |
| 1980-2009    | 2.8 billion m$^3$                 |

Before 1977, water resources per capita in Beijing had not become the most critical constraint factor for the development of Beijing. At that time, the population was 5 million, the total water resource was 4 billion cubic meters, and the annual per capita water resource was 800 cubic meters. By the year 2000, the population had exceeded 10 million, and the total amount of water resources was less than 2 billion cubic meters because of drought, with per capita annual water resources less than 200 cubic meters. Although the decline of total water resources is one of the reasons, the main reason for the decrease of water resources per capita in Beijing from nearly 2000 m$^3$ in 1949 to less than 200 m$^3$ in 2000 is the rapid growth of the population. According to the statistics yearbook, the permanent population of Beijing was less than 2 million in 1949, 3.9 million in 1960, more than 5 million in 1977, more than 10 million in 2000, more than 15 million in 2009, and 20 million in 2019. [11]

Table 2. The Permanent Population in Beijing since 1949.

| Time   | The average annual water resource |
|--------|-----------------------------------|
| 1949   | 2million                          |
| 1960   | 3.9million                        |
| 1977   | 5 million                         |
| 2000   | 10million                         |
| 2009   | 15million                         |
| 2019   | 20million                         |

When the population exceeded 10 million in 2000, Beijing entered a period of drought from 2001 to 2009. The water resource per capita was less than 157 cubic meters per year for eight years [12], which is far below the internationally recognized water shortage warning line of 1000 cubic meters per capita. Besides, the middle route project of south-to-north water diversion and many sewage treatment facilities had not been put into operation during this period, leading to severe problems such as water shortage, water pollution, and over-extraction of groundwater. Beijing was facing a severe water crisis at that time.

2.2 Next, let us review the water consumption in Beijing over the years and the relevant historical background.

Based on Jianhua Wang's change chart of Beijing's water demand from 1949 to 2009 on China water resources, I found that the total water consumption in Beijing reached two peaks in 1977 and 1994.[13] Given the historical context, the peak of 1977 it was mainly due to the rapid development of agriculture and the lack of water-saving irrigation. The peak of 1994 is the resonance by industrial, agricultural water, and domestic water consumption. During this period, Beijing entered the stage of the rapid development of industrialization and urbanization, but water conservation and sewage treatment did not receive enough attention.

In the water resources bulletin of Beijing 2018, the change chart of water structure in Beijing after 2000 is given [14]. Until 2005, agriculture was the largest water user in Beijing. With the decrease of planting area, the popularization of water-saving technology, the transfer of water-consuming industries, the increase of urban population, and the improvement of residents' living standards, the water consumption for agriculture and industry began to decline around 1982, while the domestic water consumption continued to increase. It surpassed industrial water consumption in 1997 and
agricultural in 2005, becoming the largest water consumption category in Beijing. The domestic water consumption in Beijing has increased from 412 million cubic meters in 1980 to 1.84 billion cubic meters in 2018, with the proportion rising from 9.79 percent to 47 percent. Since 2000, with the continuous decline of industrial and agricultural water consumption in Beijing, environmental water consumption has been increasing year by year. It surpassed industrial water consumption in 2011 and agricultural water consumption in 2015, then became the second largest category of water consumption and accounted for 34% of the total in 2018 in Beijing.

![Fig. 1. The Water Consumption Structure in Beijing since 2000.](image)

The total water consumption in Beijing in 2018 was 3.93 billion m$^3$. Among them, domestic water was 1.84 billion m$^3$, accounting for 47% of the total water consumption; environmental water was 1.34 billion m$^3$, accounting for 34%; industrial water was 330 million m$^3$, accounting for 8%; agricultural water was 420 million m$^3$, accounting for 11%. [15]

![Fig. 2. The Water Consumption Structure in Beijing in 2018.](image)

2.3 Third, faced with the severe shortage of water resources, while controlling the rapid growth of water demand, Beijing has adopted different water supply schemes to guarantee Beijing's water supply in different historical periods, such as water diversion from surrounding areas, over-exploitation of groundwater, utilization of reclaimed water, and south-to-north water diversion. The water supply structure has been published in the Beijing water resources bulletin since 1997. From 2001 to 2009, Beijing's annual water supply reached 3.5 billion cubic meters, much higher than the 2.25 billion cubic meters of water resources in the same period. During the nine years, the cumulative shortfall in water resources exceeded 11 billion cubic meters, mainly balanced by excessive exploitation of groundwater and the use of recycled water. The long-term over-extraction of groundwater resulted in the groundwater table level in the Beijing plain area dropping by 12.5 meters from 1999 to 2009, and the underground water volume decreased by 6 billion cubic meters. [16] There are even a series of environmental problems, such as ground subsidence and groundwater pollution.

The total water supply in Beijing in 2000 was up to 4.04 billion m$^3$. After 2001, the total water supply of the city was maintained between 3.43–3.75 billion m$^3$. Water supply is mainly supplied by surface water and groundwater in 2000–2002, of which surface water supply accounts for about 1/3, and groundwater supply accounts for about 2/3. [17] From the year 2003, due to the increasing use of
recycled water, to some extent, it alleviates the burden of surface water and groundwater, and in 2014, the supply of reused water in Beijing reached 860 million m$^3$. The reused water plays an essential role in alleviating the shortage of water resources and becomes an indispensable water source for Beijing. Since the year of 2008, the middle route of the South to North Water Diversion Project has been passed through the Beijing-Shijiazhuang section, the proportion of reused water and the water transfer from South to North increased gradually, and the proportion of groundwater use decreased.

### Table 3. Water Supply Structure in Beijing since 2003.

| Year | Surface Water | Ground Water | Reused Water | South to North Water |
|------|---------------|--------------|--------------|----------------------|
| 2003 | 23%           | 71%          | 6%           |                      |
| 2008 | 16%           | 65%          | 17%          | 2%                   |
| 2015 | 8%            | 47%          | 25%          | 20%                  |
| 2018 | 8%            | 41%          | 27%          | 24%                  |

In the year 2003, the proportion of surface water, groundwater, reused water was 23%, 71%, 6%, respectively.[18] In the year 2008, the proportion of surface water, groundwater, reused water, and water transfer from South to North was 16%, 65%, 17%, and 2%, respectively.[19] In the year 2015, the average proportion of surface water, groundwater, reused water, and water transfer from South to North was 8%, 47%, 25%, and 20%, respectively.[20] In the year 2018, the proportion of surface water, groundwater, reused water, and water transfer from South to North was 8%, 41%, 27%, and 24%, respectively.[21]

![Fig. 3. The Water Supply Structure in Beijing in 2018.](image)

The change of Beijing's water supply structure is closely related to the change of the water supply area of Miyun and Guanting reservoir, the change of Beijing's underground water table level, the change of Beijing's water source caused by the progress of Beijing's reclaimed water treatment projects and the south-to-north water diversion project. [22]

Guanting Reservoir and Miyun Reservoir were completed in 1954 and 1960, respectively. When the water supply per capita was less than 300 cubic meters in 1981, the Beijing municipal government decided that the two reservoirs would no longer supply water for agriculture. The state council decided that the Miyun reservoir would no longer supply water to downstream provinces and cities to ensure Beijing's water supply since 1982. [23] In 1999, Beijing began to overdraw groundwater for more than a decade. Beijing has accelerated the development and utilization of recycled water since 2003. Recycled water supply increased from 210 million m$^3$ in 2003 to 1.32 billion m$^3$ in 2012, accounting for 5.7% of the total water supply in 2003 and 36.7% in 2012. [24]

Before 2008, the Miyun and Guanting reservoirs and underground water sources were connected by strip and treelike pipelines to supply Beijing with tap water. After the south-to-north water
diversion into Beijing, the "loop water transfer mode" [25] has been formed, realizing the joint dispatching of external water diversion, local surface water, and groundwater.

In 2018, Beijing's total water supply was 3.93 billion m³. [26] South-to-north water diversion and reclaimed water have become half of Beijing's water source. Domestic water consumption accounts for 46% of the total water consumption, and environmental water consumption is close to one third. South-to-north water diversion accounts for more than 50% of domestic water consumption. The south-to-North water diversion is already vital for Beijing.

3. The Law of the Colorado River and the South-to-North diversion project
The formation of the Law of the Colorado River is of great significance to the management of trans-regional rivers like the Yellow River and the trans-regional water diversion from south to north.

3.1 The profile of water supply in Las Vegas
According to the information from the official website of SNWA, Southern Nevada gets about 90 percent of its water supply from the Colorado River. About 10 percent comes from groundwater. [27]

The Colorado River Basin has endured 20 years of severe drought, which has resulted in a significant water-level decline at Lake Mead. The federal government is projecting a high probability that Lake Mead water levels will continue to decline. Congress authorized the implementation of a Drought Contingency Plan in 2019. [28]

Nevada has the right to consumptively use 300,000 acre-feet of water per year from the Colorado River. Las Vegas, with a population of 2.2 million, uses about the same amount of 200 cubic meters water per capita annually as Beijing, with a population of about 22 million.

Las Vegas is similar to Beijing in that water was not considered a scarce resource until 1970 because of its abundant groundwater resources. They did not realize how fast the population would grow. Nevada's negotiators felt its share of 300,000 acre-feet per year (4% of the lower basin and 2% of the total river) was more than enough in 1928. At that time, Southern Nevada had no significant agricultural or industrial users, groundwater seemed plentiful, and the area's small population was not anticipated to grow significantly. Negotiators focused instead on hydro-electricity and secured one-third of the electricity generated by Hoover Dam. Until the early 1970s, Las Vegas relied on groundwater supplies to meet most of its water needs. [29]

3.2 The Law of the Colorado River
The history of how the transnational Colorado River water is allocated is very instructive. It is very different from Beijing's south-north water diversion. It is hard to imagine how Beijing's water allocation mechanism based on government orders could work in the Colorado River, and vice versa. [30]

Colorado River is governed by a series of compacts, laws, contracts, regulatory guidelines, court decisions, decrees, rules, and treaties, made in different historical periods, collectively known as the "Law of the River." This collection apportions the water and regulates the operation of the Colorado River among the seven basin states and Mexico. The information can be found on the official website of the Bureau of Reclamation. [31]

The 1922 Compact almost 100 years ago set the main tone of the water right of the Colorado River. The earliest diversion of water in Colorado River can be traced back to the later 1800s. Negotiations began on how to equitably distribute the river's flow and future rights as the amount of water diverted from the river for agriculture increased. These negotiations led to the 1922 Colorado River Compact, which allocated 7.5 million acre-feet of water per year (MAFY) to the Upper Basin and the Lower Basin each. At that time, the upper basin states concerned that Hoover Dam and other water projects in the lower basin would deprive their rights to use the river's flows in the future. The approach suggested by the Secretary of Commerce Herbert Hoover reserved water rights for future upper basin development. It allowed the plan of Hoover Dam in the lower basin to proceed. The 1928 Boulder Canyon Project Act was a legal activity of the federal government that not only ratified the 1922
Compact and authorized the construction of Hoover Dam but also apportioned the lower basin's 7.5 maf among the states of Arizona (2.8 maf), California (4.4 maf) and Nevada (0.3 maf). Nevada's share was 300,000 acre-feet per year. The share was defined 90 years ago and continues to this day. [32]

California Seven Party Agreement of 1931 helped settle the long-standing conflict between California agricultural and municipal interests over Colorado River water priorities inside California. Upper Colorado River Basin Compact of 1948 apportioned the Upper Basin's 7.5 maf among Colorado (51.75 percent), New Mexico (11.25 percent), Utah (23 percent), and Wyoming (14 percent). [33]

The 1922 compact also recognized Mexico's water rights of the river, and the Mexican Water Treaty of 1944 between the U.S. and Mexico committed 1.5 maf of the river's annual flow to Mexico. Minute 242 of the U.S.-Mexico International Boundary and Water Commission of 1973 required the U.S. to take to reduce the salinity of water to Mexico at Morelos Dam. [34]

The Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs of 1970 set rules for the coordinated operation of the reservoirs and conditions for water releases from Lake Powell and Lake Mead. The Secretary of the Interior made some limited modifications to the 1970 operating Criteria in 2005. It is the Colorado River Basin Salinity Control Act of 1974 that authorized desalting and salinity control projects to improve Colorado River quality. [35]

The Supreme Court has played an active role in the history of the regulation of the Colorado Rivers. In the Arizona v. California U.S. Supreme Court Decision of 1964, the Supreme Court settled a 25-year-old dispute between the two states by ruling that lower basin states have a right to use tributary flows before the tributary merges with the Colorado River. In the 1979 Supplemental Decree, Supreme Court made it clear that these rights referred to in the Colorado River Compact and the Boulder Canyon Project Act are entitlements essentially established under state law and have priority over later contracts entitlements. In 2006, the Supreme Court issued a Consolidated Decree to provide a single reference to the provisions of the original 1964 decrees and its subsequent decrees (1966, 1979, 1984, and 2000). [36]

It was unexpected that the management of rivers required such a complex legal system.

3.3 The Law of the south-north diversion project
Beijing already gets nearly a third of its water from the south-north diversion project. It is particularly important that the water rights, water distribution schemes, pricing mechanisms, and water source protection of the south-to-north water diversion project are guaranteed by national laws.

In 2014, the state council issued regulations on the administration of water for the south-to-north water diversion project. [37] The national development and reform commission has issued a policy on the initial price of water supply in the middle line of the project. Regulations on the administration of drinking water sources have been promulgated and implemented. Hubei province has issued a plan for the division of the Danjiangkou drinking water protection area and formulated an environmental protection plan for the Danjiangkou water source area. However, many core issues, such as water rights, water distribution schemes, water price formation mechanism, and economic compensation for water source protection, remain at the level of government administrative orders, rather than national laws and regulations. Negotiations need to start early, and agreements need to be reached early, so as not to become an unsolvable deadlock in the future. Even before the construction of the Hoover dam in 1928, the people of the Colorado basin established a legal basis for future water rights in the form of state law, and the basic principles continue to this day. It is particularly necessary to clarify the water rights and allocation of among the Han River upstream, downstream, and the water diverted to the north in the form of national laws as early as possible.

4. Danjiangkou drinking water protection and rural sewage treatment
The benefits of having access to an improved drinking water source can only be fully realized when there is also access to improved sanitation and adherence to good hygiene practices. The water quality of south-to-north water diversion depends on the protection of the Danjiangkou reservoir water source
and local sewage treatment.

The middle route of the south-to-north water diversion project sends about 9.5 billion cubic meters of water from the Danjiangkou reservoir to water-scarce areas such as Henan, Hebei, Beijing, and Tianjin every year. The total length of the main water channel is 1,432 kilometers. Henan gets 3.77 billion cubic meters water allocation from Taocha, accounting for 39.7 percent; Hebei gets 3.47 billion cubic meters, accounting for 36.6%; Beijing gets 1.24 billion cubic meters, accounting for 13%; Tianjin gets 10.2 cubic meters, accounting for 10.7%. The amount of water reaching Beijing is 1.05 billion cubic meters. [38]

The south-to-north water diversion project was put into operation in December 2014. While marveling at the efficiency of the south-to-north water diversion project constructed by the Chinese government, the difficulty of ensuring the quality of water sources was also highlighted.[39] Danjiangkou reservoir, located on the border of Hubei and Henan provinces, has an average annual inflow of 39.5 billion cubic meters, with 90% water coming from the Han river (90%) that originates in Shaanxi. The amount of water flowing into Hubei from the upstream of the Han River has averaged 33.2 billion cubic meters over the years, including 27.4 billion cubic meters from Shaanxi province and 5.8 billion cubic meters from Henan province. A large proportion of Danjiangkou's water comes from the upstream province of Shaanxi, [40] where a wide range of water sources needs to be protected, making it challenging to control pollution. Three of the five episodes of the south-to-north water diversion series by CCTV4 focus on the environmental protection of the Danjiangkou Reservoir Area in Henan and Hubei province. [41] Unfortunately, the upper basin of the Han river in Shaanxi province, which accounts for 70 percent of the water flow, is barely mentioned. This would be the most significant potential risk to water quality assurance. Rural sewage treatment in these protected areas is a weak link. [42] In 2018, the sewage treatment rate in the urban areas of Beijing reached 99 percent, while even in the suburbs of Beijing, the sewage treatment rate was only 80 percent. China's first provincial legislation explicitly targeting the management of rural domestic sewage treatment facilities has just been implemented in Zhejiang province from January 1, 2020. [43]

The re-contamination of Beijing's Guanting reservoir and the water pollution in New Delhi warn of the difficulty of controlling water pollution. In 1971, the water in the Guanting reservoir was polluted. After that, the river flowing into the reservoir was comprehensively treated. In 1980 Guanting reservoir became one of the vital drinking water sources for Beijing. However, in 1997 the Guanting reservoir stopped supplying drinking water to Beijing because the water quality was substandard. [44] By January 2020, the Water Quality of the Guanting reservoir is category IV, which can be used for general industrial water supply and recreational waters but no direct human contact. The video of the polluted waters in New Delhi is even more frightening and shocking.

Danjiangkou water source and south-to-north water diversion have apparent public goods and externalities, which are prone to the tragedy of the Commons caused by overuse or the lack of supply caused by the desire to "hitchhike." What is the mechanism to motivate farmers in Shaanxi, Hubei and Henan provinces, more than 1,000 kilometers away, to provide clean drinking water for Beijing over a long period at the cost of local development? Will Beijing, Tianjin, and Hebei become too dependent on the diversion of water from the south to the north, leaving the protection of drinking water sources in the Danjiangkou reservoir area and polluting local water sources like Guanting reservoir?

Access to safe water and sanitation are human rights, as recognized in 2010 by the United Nations General Assembly. Over half of the global population or 4.2 billion people lack safe sanitation. (WHO/UNICEF 2019). Globally, at least 2 billion people use a drinking water source contaminated with feces. (WHO 2019).[45]

5. The WASH of Las Vegas and the future of Lakes in Beijing's Parks

Beijing's sewage treatment has entered the stage of large-scale development since 2000. The sewage treatment rate of Beijing, including surrounding rural areas, reached 93.4 %, and the annual renewable water supply was 1.08 billion cubic meters in 2018. The recycled water quality produced by the Beijing sewage treatment plant can only be used for industrial and environmental purposes. With
reclaimed water as the primary source of environmental water, many park lakes and rivers in Beijing are not clear enough to see the bottom in a short period. However, we should still be glad that 99% of the sewage in Beijing has been treated, but not highly treated now. [46]

According to recent data on the website of the Beijing environmental monitoring center, the water quality of Kunming lake in the old Summer Palace and the moat of Beijing's Forbidden City met drinking water standards because of the diversion of water from the south to the north project. [47]

99% of the indoor used water in Las Vegas is highly-treated and recycled for direct or indirect use. [48] Direct reuse flows to irrigated parks, golf courses, and other uses. Indirect reuse of the highly-treated wastewater is returned to Lake Mead via the Las Vegas Wash. The video of the Las Vegas WASH project also shows people the new standards of sewage treatment in Beijing and the hope that the water in the Beijing park lakes is as clear as the Las Vegas WASH.

Finally, I suggest you watch videos of sewage treatment plants [49] and the water crisis in New Delhi. [50] After watching the video, my grandma realized that one more ton of water consumption is one more ton of the kind of sewage you see in sewage treatment plants. The public's participation after receiving the education of water conservation and sewage treatment is as meaningful as legislation, legal enforcement, government investment, and coordination. At the same time, it is recommended to watch the videos about the Las Vegas Wash [51] and Bill Gates Thinks These Toilets Could Change the World. [52] Highly treated sewage water that meets the drinking water standards and sanitary products that do not require sewers or water lines are the new standard and direction. They are also our dreams, hopes, and a beautiful future.

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