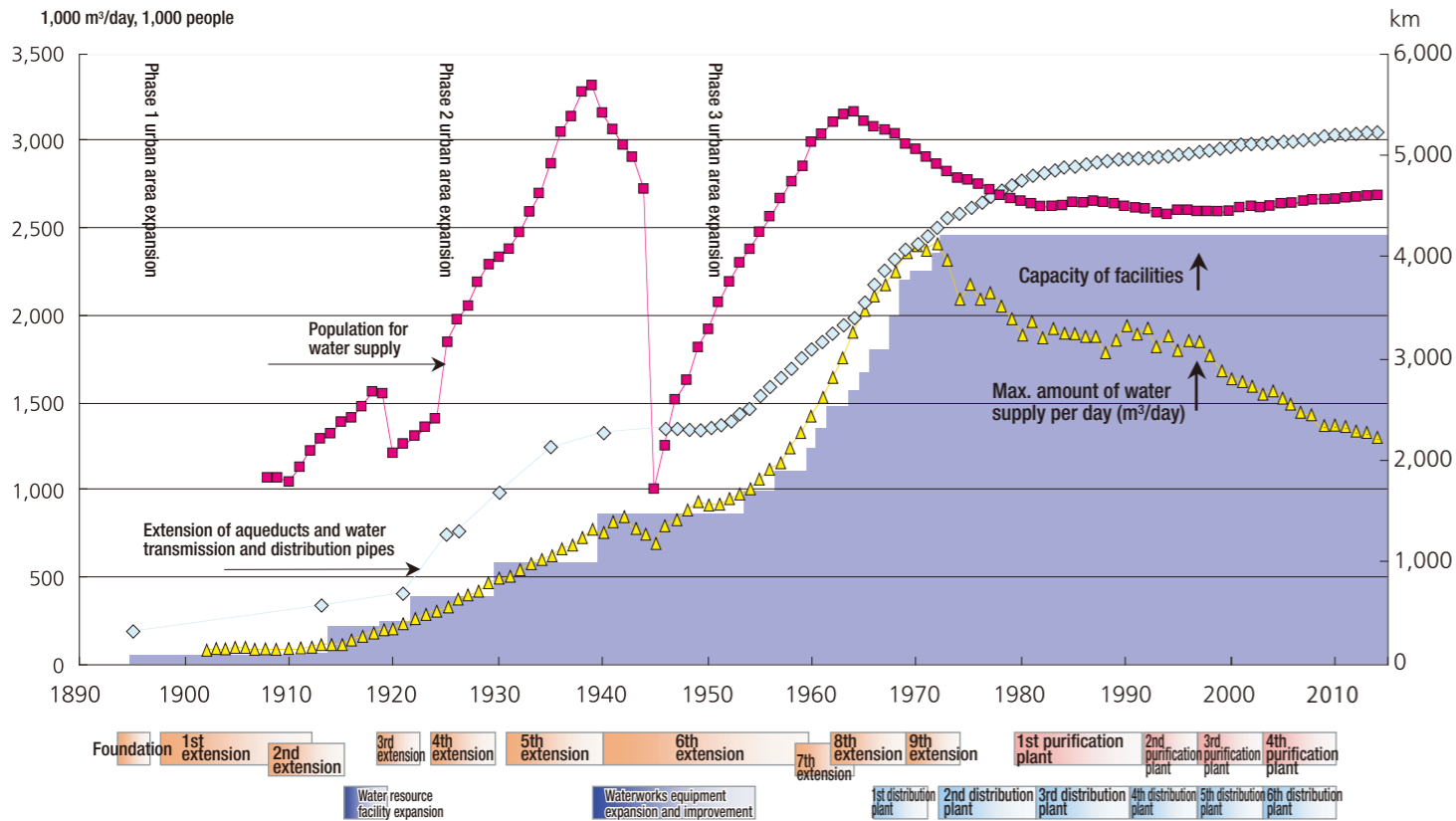


Water Supply Population and History of Expansion Project

The Osaka City Waterworks Bureau was born in November 1895 as the fourth largest modern waterworks following facilities at Yokohama, Hakodate, and Nagasaki, and the Bureau celebrated 110 years of water supply in 2005. The water supply population at the time the facility was established was 610 thousand, with a maximum water supply capacity of 51,240 m³/day. The water purification plant was located at Sakuranomiya on the left bank of the Yodo River and this plant transmitted water purified by slow filtration to a water distribution reservoir in Osaka Castle, from where it was supplied to Osaka City by natural down-flow through a water distribution pipes totaling 325 km in length. The total operational budget was 2.4 million yen (three times the city budget at the time). Subsequently, as the city developed, a growing water demand made it impossible for the Sakuranomiya water resource to satisfy needs and this resulted in the implementation of an expansion of operations nine times including the construction of the Kunijima Water Purification Plant in 1914 during the second waterworks expansion project. A huge water demand in Osaka city after the war, in particular, led to the construction of the Niwakubo Water Purification Plant in 1957 during the sixth waterworks expansion project and the Toyono Water Purification Plant in 1968 during the eighth waterworks expansion project. In addition, to address problems in the deteriorating quality of the water in the Yodo River and a growing water demand volume, the ninth waterworks expansion project was undertaken in 1969. This resulted in acceleration of the rapid filtration equipment at the Kunijima Water Purification Plant (601,000 m³/day), an increase of 198,000 m³/day and an increase of 50,000 m³/day at the Toyono Water Purification Plant, giving Osaka City a water supply capacity of 2,430,000 m³/day in 1973. However, water demand peaked at a maximum daily volume of 2,417,700 m³/day in 1970, leveling out to reach from the growth trend up to that point and beginning to decrease.

Against this background, construction for the 450,000 m³/day planned for the Toyono Water Purification Plant during the ninth waterworks expansion project was suspended in 1975, marking the transition from the period of facility expansion that had continued up to that point to an era of facility maintenance and management. At the present time, with the aim of building an infrastructure to support a rich life for citizens and advanced urban activities in the 21st Century, there is a need for an even more stable and highly-reliable waterworks system, marking the transition from the era of facility maintenance and management to the era of facility restructuring. In particular, learning from the lessons of the Hanshin Awaji earthquake that struck on January 1995, the Osaka City Waterworks Bureau Earthquake Resistance Measures Reinforcement Plan 21 (Basic Concept) was formulated (March 1996) with regard to disaster prevention measures and with the aim of improving waterworks system functions capable of withstanding envisaged earthquakes including near-field types. Then measures were systematically implemented from a comprehensive perspective including prevention planning, emergency recovery planning and pre/post-measures. Furthermore, on the water quality front, while undertaking raw water quality maintenance activities, the Advanced Water Purification Facility Construction Project was promoted from 1992. This resulted in supply of water undergone advanced purification throughout the city in March 2000. Initial objectives such as the removal of mold-like and other odors and the reduction of trihalomethane were achieved from the first and the reinforcement of measures to deal with contaminating organic chemical substances such as agricultural chemicals and environmental hormones that were becoming increasingly prominent in recent years as well as cryptosporidium. Osaka City is making continuous efforts to provide even safer, high-quality water.

Changes in the Osaka City Water Supply Population, Water Supply Volume, Water Supply Capacity, and Extension of Water Transmission/Conveyance/Distribution Pipe Length



Transition of Matters related to Water Treatment

Year/Month	Item	Remarks
1892 August	Beginning of project for establishment of waterworks	
1895 November	Completion of waterworks establishment project, birth of Sakuranomiya water resource	Water supply capacity: 51,240 m ³ /day (slow filtration equipment)
1925 August	Beginning of work on first rapid filtration equipment in Osaka City (Fourth)	Water supply capacity: 577,000 m ³ /day including lime injection equipment (First rapid system)
1930 February	Start of work on chlorination	
April	Start of first chlorine injection of 0.1 – 0.2 mg/L into slow and rapid filtration reservoirs	
1931 June	Pre-chlorination of rapid filtration system (Optional)	
1933 November	Start of work on rapid filtration equipment expansion (Fifth waterworks expansion project) (Completed in 1940)	Water supply capacity: 862,000 m ³ /day (Second rapid system)
1934 -	Installation of new slow filtration lime injection equipment	
1948 January	Post-chlorination raised to 0.7 mg/L (Set)	
1951 January	Post-chlorination raised to 1.5 mg/L (Set)	
1952 Jun.-Aug.	Start of pre-chlorination of first and second rapid systems	City terminal: 0.4 mg/L residue (Target)
1953 June	Post-chlorination injection at Kunijima Water Purification Plant changed to 1.2 mg/L	
1955 August	Pre-chlorination injection of first and second rapid systems changed to 0.5 mg/L at Kunijima Water Purification Plant	
1958 June	Rapid system pre-chlorination injection increased (0.5- 2.7 mg/L)	Black turbidity in raw water
June	Black turbidity in raw water	
June	Start of slow system pre-chlorination injection (0.3 mg/L)	Excluding winter
1960 February	Start of chemical flocculation reservoir and pre-chlorination in the slow filtration system	
February	Hand processing normally used for slow filtration, soda ash used for alkali agent (previously lime)	
September	Slow filtration reservoir remodeled into chemical sedimentation reservoir	
1962 October	Kunijima first rapid system changed to discontinuous point chlorination December	
December	Kunijima second rapid system changed to discontinuous point chlorination	
1963 July	Start of pre-chlorination and discontinuous point chlorination at Niwakubo Water Purification Plant	
1964 April	Start of work on improvements to Kunijima Water Purification Plant purified water equipment as measure to deal with raw water quality contamination for the time being (3 years)	
June	Due to increased chromaticity of filtered water from slow filtration, 5 mg/L of metaphosphoric acid soda was injected as countermeasure	
June	Slow system intake stopped due to raw water quality contamination caused by water shortage	
June	- Completion of lime injection equipment and start of pH value adjustment	
1965 June	Aeration equipment installed in slow filtration reservoir at Kunijima Water Purification Plant	
1966 November	Testing of free chlorination started in slow system	
1967 December	Start of use of slaked lime as alkali agent (Niwakubo water purification plant)	Use of soda ash discontinued

Year/Month	Item	Remarks
1968 February	Start of test injection of polyaluminum chloride as flocculation agent (Kunijima Water Purification Plant)	
May	Liquid aluminum sulfate used (Niwakubo Water Purification Plant)	Water storage concentration changed from 6% to 8%
1969 December	Start of testing red water prevention by pH value adjustment (Kunijima)	
1970 January	Chlorine injection of 42 mg/L recorded at Kunijima Water Purification Plant (38 mg/L at Niwakubo Water Purification Plant)	Black turbidity in raw water due to rainfall in abnormal turbid water
1971 May	Chlorine injection equipment capacity at Niwakubo Water Purification Plant changed (25 – 50 mg/L)	
June	Powdered activated carbon injected (Kunijima, Niwakubo)	
August	Start of pH adjustment processing as red water countermeasure (Kunijima, Tatsumi systems)	
December	Polyaluminum chloride used at low water temperatures (Kunijima)	pH target value: 7.5
1972 June	Use of liquid aluminum sulfate and caustic soda started (Kunijima)	
June	Part of slow filtration equipment at Kunijima Water Purification Plant suspended	
August	Ozone processing testing started (Kunijima)	Complete suspension on September 24, 1974
1973 February	Caustic soda injection equipment completed (Niwakubo)	
June	Use of slaked lime high-concentration equipment started (Kunijima)	
1975 August	Ninth waterworks expansion project suspended 1980	
March	Emergency shutdown valve used on chlorination equipment (Kunijima)	Approx. 15% concentration
March	Raw water toxic substance monitoring equipment completed at Kunijima Water Purification Plant (water quality test laboratory)	
1982 January	Advanced water purification test plant constructed (Kunijima)	
1986	Interim chlorine injection equipment installed (Kunijima third system, Niwakubo first and second systems) Advanced water purification verification plant constructed (Kunijima)	Processing capacity: 60 m ³ /day
1988	Interim chlorine injection equipment installed (Kunijima fourth system)	
1989	Interim chlorine injection equipment installed (Kunijima second system, Niwakubo third system)	Processing capacity: 2,000 m ³ /day
June	Powdered activated carbon injection equipment installed (Toyono)	
1990 -	Interim chlorine injection equipment installed (Kunijima first system, Toyono)	
1992	Advanced water purification equipment construction project started	
1998 March	Water transmission by the Kunijima Water Purification Plant lower system advanced water purification facility initiated	
1999 March	Water transmission by the Niwakubo Water Purification Plant advanced water purification facility initiated	
2000 March	Water transmission by the Kunijima Water Purification Plant advanced water purification facility initiated	
2010 September	Water transmission by the Toyono Water Purification Plant upper system advanced water purification facility initiated	
2010 November	Water transmission by the Toyono Water Purification Plant advanced water purification facility initiated	
2011 February	Water transmission by the Toyono Water Purification Plant advanced water purification facility initiated	
2011 March	Oxygen injection equipment installed (Kunijima)	
March	Oxygen injection equipment installed (Toyono)	
March	Oxygen injection equipment installed (Niwakubo first and second systems)	
March	Oxygen injection equipment installed (Niwakubo third system)	