

# Maintenance Projects on Water Pipes

## Project Plan

Water pipes and distribution pipes in Osaka City have been brought up to form an extensive lifeline that is not less than approximately 5,000 km through the promotion of nine waterworks expansion projects that have been implemented since the establishment of waterworks and an ongoing water distribution pipe construction project since fiscal 1965.

In the Fourth Water Distribution Pipe Construction Project, in particular, which began in fiscal 1990, the network-specific development of all water supply and distribution pipes as a pipeline system has succeeded in maintaining the pipes to a certain lifeline function level in terms of safety and reliability.

The Osaka City Waterworks Bureau has undergone the assessment of the state of facility construction from the perspective earthquake-resistance measures based on the Great Hanshin-Awaji Earthquake Disaster and the Osaka City Waterworks and Earthquake-resistance Measures Reinforcement Plan 21 (Basic Concept) was formulated in March 1996 as Osaka's basic long-term concept to be promoted with sights set on the 21st Century. Then earthquake-resistance measures based on this plan became an urgent issue.

For this reason, the Fifth Water Distribution Pipe Construction Project aimed at the review of the Fourth Water Distribution Pipe Construction Project and the expansion and reinforcement of earthquake-resistance measures were re-launched for the ten years from 1997 to 2006 to cover a total length of 710 km with a total project budget of 170 billion yen.

In line with the principles of the Osaka City Waterworks and Earthquake-resistance Measures Reinforcement Plan 21 (Basic Concept), the Fifth Water Distribution Pipe Construction Project followed the basic measures of the Fourth Water Pipe Construction Project. Then the Waterworks Bureau worked on the reinforcement of the pipelines toward the establishment of a highly reliable water supply system, including level improvements in the earthquake resistance of pipelines with an expanded target pipeline range, the establishment of effective pipeline earthquake resistance plans in conformity with recovery strategies, and measures for pipeline network reinforcement in terms of system.

The Sixth Water Distribution Pipe Construction Project as a 10-year plan started from 2007 to achieve a more advanced water supply service and level improvements in pipeline earthquake resistance to cover a total length of 668 km with a total project budget of 115.5 billion yen. Since then, it has been promoting the construction of a highly reliable lifeline system, including the strategic renewal of aging pipelines and the networking of water conveyance and distribution mains.

## Project Details

### (1) Strategic Updating of Aging Pipelines

Promoting the systematic updating of common and high-quality cast iron pipes for a length of approximately 825 km (as of the end of fiscal 2006), while attaching priority to mission-critical pipelines to be provided with earthquake resistance with the aim of promoting the formation of an earthquake resistance pipeline system that can be recovered early.

### (2) Functional Enhancement of Lifeline System

Promoting the network reinforcement of water conveyance and water distribution mains and attempting the formation of a highly reliable pipeline network of high water quality for stable water supply from a contemporary point of view while achieving the realization of stable water distribution in a wide area targeting small water distribution pipelines close to customers such as neighborhoods. Furthermore, promoting blocks of water distribution management while establishing a system of water distribution management to conduct the management of wide-area water distribution and control of water distribution mains to achieve highly reliable water distribution responding quickly at normal times and during accidents and disasters.

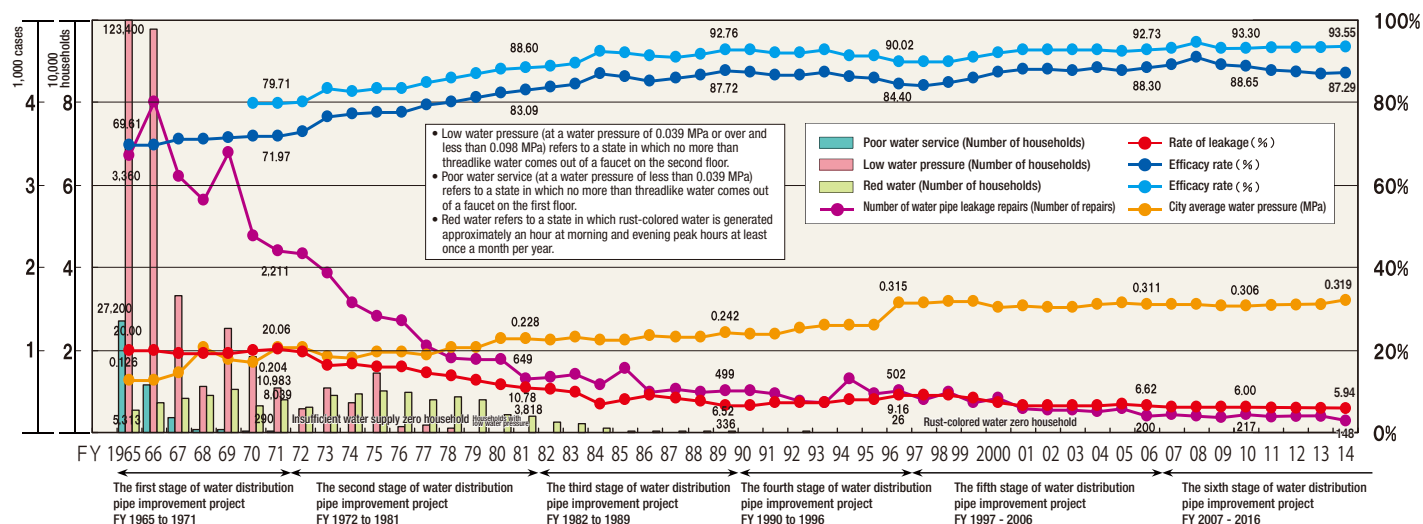
### (3) Project Related to Urban Development

Promoting the formation of a pipeline network required by urban development, including commissioned construction work associated with projects related to urban planning, such as land readjustments, and hindrance relocation work associated with road maintenance projects.

### ■ Illustration of New Water Distribution Pipe Construction in Utility Tunnel



## Effect of Water Distribution Pipe Construction Projects



## History of Water Distribution Pipe Construction Projects

Project Item	First Water Distribution Pipe Construction Project	Second Water Distribution Pipe Construction Project	Third Water Distribution Pipe Construction Project	Fourth Water Distribution Pipe Construction Project	Fifth Water Distribution Pipe Construction Project	Sixth Water Distribution Pipe Construction Project
Business year	FY 1965 to 1971	FY 1972 to 1981	FY 1982 to 1989	FY 1990 to 1996	FY 1997 - 2006	FY 2007 - 2016
Amount of project	1,072km	1,835km	384km	349km	630km	668km
Cost of project	16.1 billion yen	80.7 billion yen	52.1 billion yen	74.5 billion yen	137.6 billion yen	115.5 billion yen
Contents of project	<ul style="list-style-type: none"> <li>Improvements in poor water service resulting from an increase in water demand and insufficiency in water supply through old pipes.</li> <li>Repairs to equipment, including fire hydrants and gate valves.</li> </ul>	<ul style="list-style-type: none"> <li>Elimination of poor water service, low water pressure, and pipes causing red water or water leakage.</li> <li>Repairs to or replacement of old pipes focused on small-diameter pipes (with a diameter of 300 mm or less).</li> </ul>	<ul style="list-style-type: none"> <li>Elimination of red water and improvements in pipeline functions (e.g., improvements in water flow performance and joints) and safety focused on large- and medium-diameter pipes (with a diameter of 400 mm or over)</li> </ul>	<ul style="list-style-type: none"> <li>Promotion of systematic construction of aging pipelines</li> <li>Reinforcement of pipeline system network</li> <li>Improvements in mutual flexibility between water distribution lines</li> <li>Sophistication of water distribution management system</li> </ul>	<ul style="list-style-type: none"> <li>Systematic renewal of aging pipelines</li> <li>Reinforcement of reliability of pipeline system</li> <li>Sophistication of water distribution management system</li> </ul>	<ul style="list-style-type: none"> <li>Strategic renewal of aging pipelines</li> <li>Functional reinforcement of lifeline system</li> <li>Projects related to urban development</li> </ul>
Effect of project	<ul style="list-style-type: none"> <li>Sharp decrease in poor water service in summer. FY1965: 27,200 householders FY1971: 290 householders</li> <li>Rise in average water pressure in city 1.55 kg/cm<sup>2</sup> =&gt; 2.10 kg/cm<sup>2</sup></li> <li>Effective rate improvements FY1964: 72.5% FY1971: 79.7%</li> </ul>	<ul style="list-style-type: none"> <li>Power waer service was almost eliminated in fisacl 1976.</li> <li>Low water pressure almost eliminated in FY1980.</li> <li>Reduction of red water incidents FY1971: 8,039 householders FY1981: 3,818 householders</li> <li>Effective rate improvements FY1971: 79.7% FY1981: 88.6%</li> </ul>	<ul style="list-style-type: none"> <li>Reduction of red water incidents FY1989: 336 householders</li> <li>Improvements in earthquake resistance of water distribution pipes (earthquake resistance rate) FY1981: 75% FY1989: 79%</li> <li>Effective rate improvements Fiscal year 1981: 88.6% FY1989: 92.8%</li> </ul>	<ul style="list-style-type: none"> <li>(Earthquake resistance rate: Seismic intensity range of 5 to 6) 1990: 80% 1996: 83%</li> </ul>	<ul style="list-style-type: none"> <li>(Earthquake resistance rate: Seismic intensity class of 7) 1996: 75% 2006: 84%</li> </ul>	<ul style="list-style-type: none"> <li>(Target earthquake resistance ratio) Level 2 (Seismic intensity class of 7) 2007: 14% 2015: 25%</li> <li>* Proportion of ductile cast iron pipes and steel pipes with a separation-prevention function</li> </ul>

### ■ Major Ductile Cast Iron Earthquake-resistant Joints (General Pipelines)

