Resilience in Tokyo Waterworks: Towards a sustainable waterworks system

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For sustainable waterworks utilities

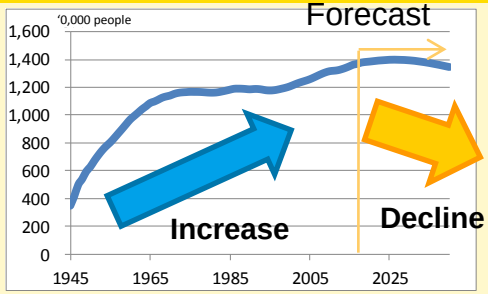
○ In order to sustain the livelihoods of the 13 million Tokyo residents and the urban activities of the Tokyo capital area, resilience to various risks is important.

Conceptual diagram of passive risks

Disconnection of a water transmission pipe by an earthquake

Photo courtesy: Ministry of Health, Labour and Welfare / Japan Water Works Association

Disasters



Tokyo population trend

Climate change

Social changes

Submerged purification plant

Photo courtesy: Japan Water Works Association

Reduced water levels in a dam due to a drought

Source: Ministry of Land, Infrastructure, Transport and Tourism

Foreseeable risks

Risks	Major potential risks	
Passive risks	Disaster	Facility damage caused by earthquake and flood
	Terrorism	Poison contamination by terrorism
	Radioactivity	Water pollution caused by diffusion of radioactive material
	Drought	Reduction of river flow rate
	Global warming	Water quality change due to global warming
	Population decrease	Reduction in toll revenue
Potential risks	Aging	Breakage of aging water pipes
	Equipment work	Malfunction of pumps

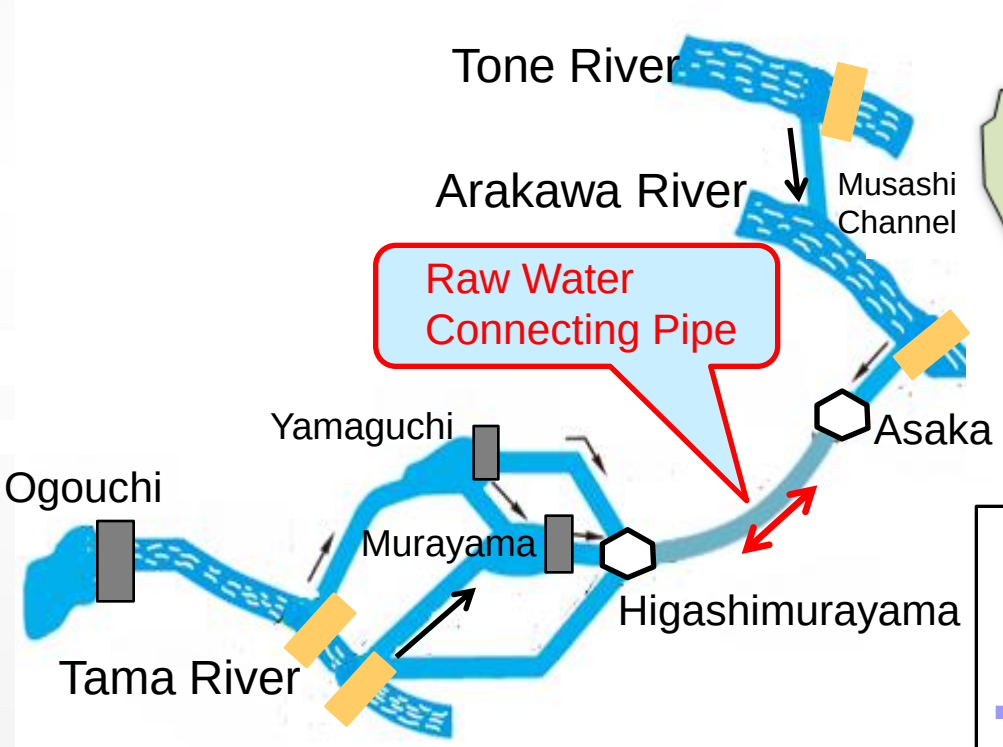
Source: Water maintenance guidelines 2016 JWWA

In addition to taking preventive measures to prepare for the risks listed above, even if it exceeds the assumption, the measures to restore rapidly are important.

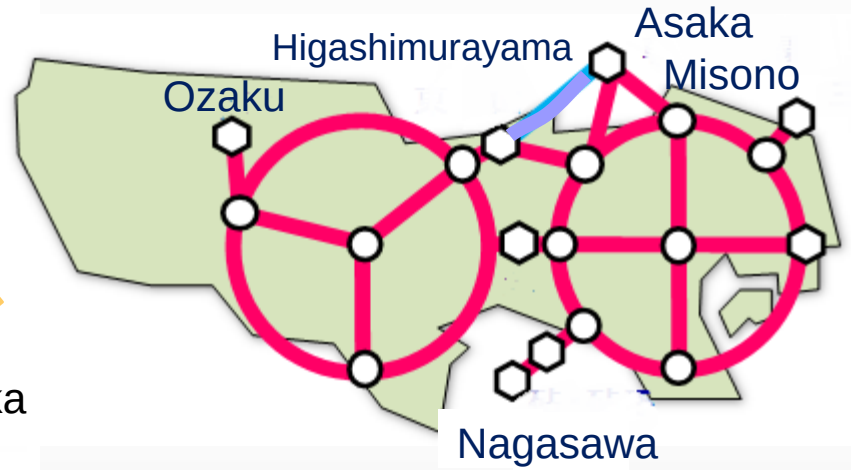
Preventative action: Network to curtail water outages

○ Tokyo Waterworks has implemented initiatives to curtail water outages by forming a network of distribution mains by which other raw water and water supply systems lend each other water.

Raw water connecting facilities of Tone and Tama River systems



Network of Water Transmission



Preventative action : Earthquake resistance at waterworks facilities

Waterworks facilities

Systematic earthquake-resistance reinforcement work based on earthquake resilience diagnosis

Pipes

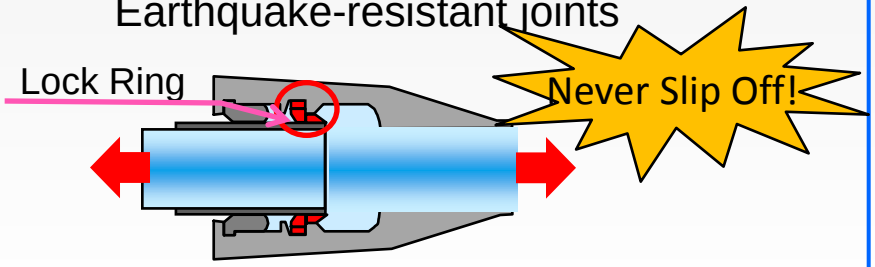
Implementing earthquake-resistant joints along supply routes to important facilities

Earthquake-resistance reinforcement work at a purification plant

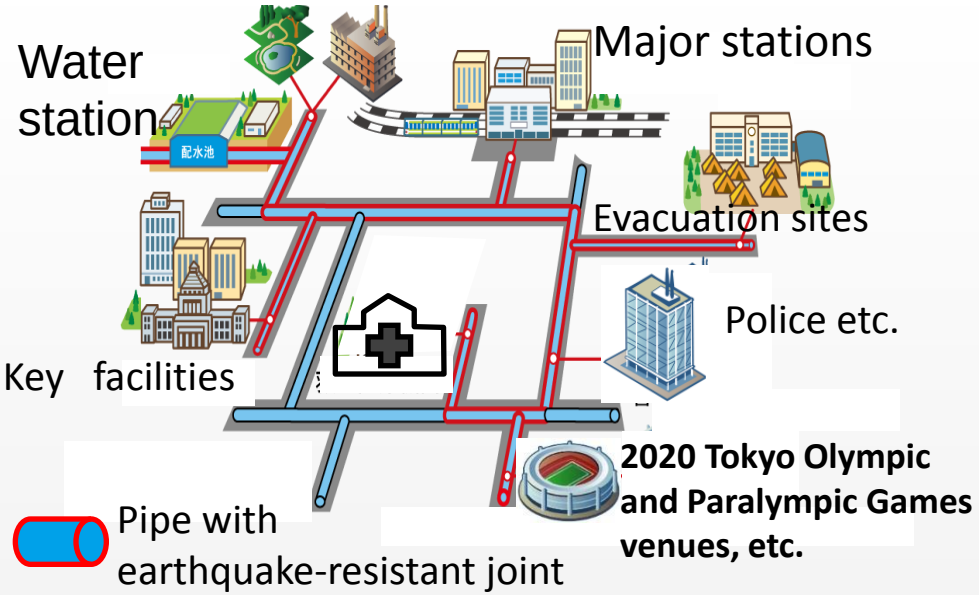
Pre-reinforcement

Post-reinforcement

Earthquake-resistant joints



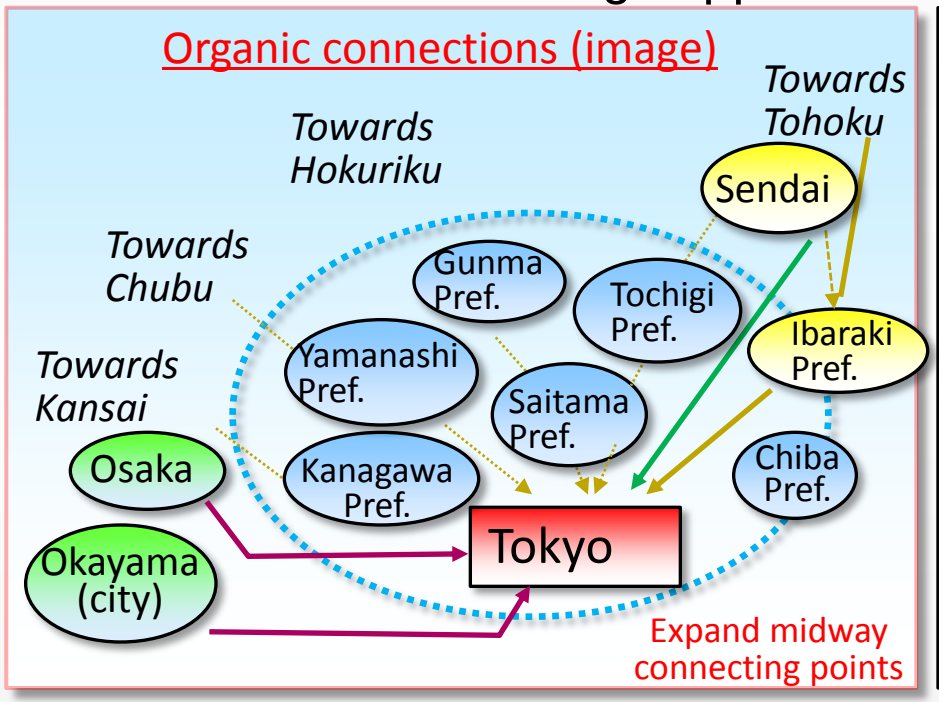
A water pipe replaced by earth-resistant joints(image)



Preventative action : sending and receiving support

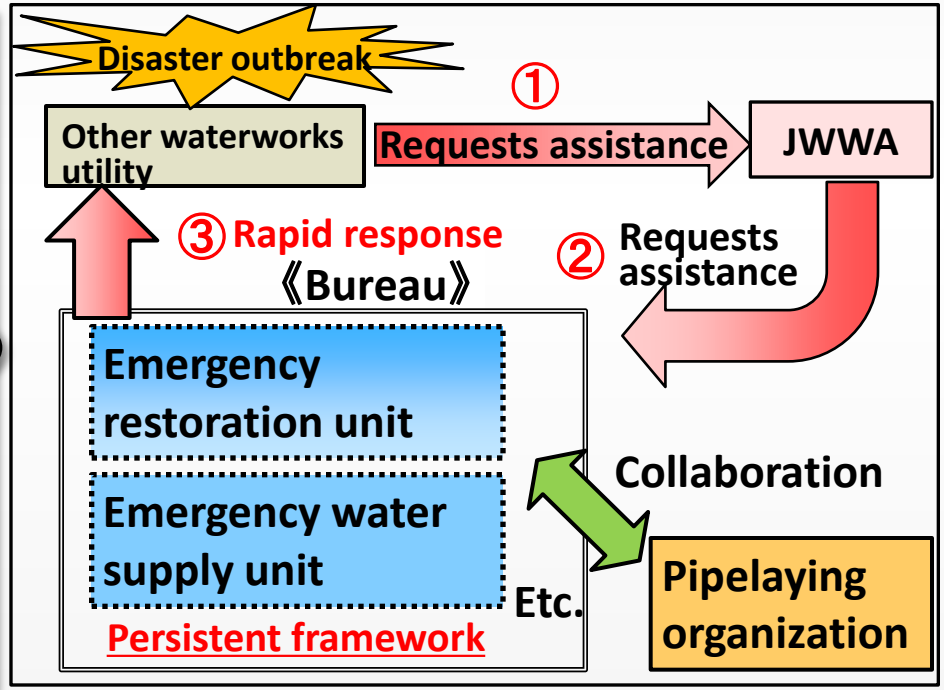
○ Tokyo Waterworks alone will not be able to handle an earthquake occurring directly under Tokyo
○ Pursues signing disaster support agreements and drills for receiving support, etc.
○ Has implemented a framework that enables it to respond immediately to disasters in other regions as the largest utility in Japan.

Initiatives for receiving support



・Receives support from throughout Japan

Tokyowater Rescue emergency disaster response unit



・Pre-registration of staff requesting to participate in disaster response efforts

Disaster support (Initiatives in the Kumamoto earthquakes)

○Requests for support were accepted on April 17, 2016, the day after the main earthquake struck, personnel were assembled and the group departed.
○In the initial confusion after the disaster, general coordination was conducted for rapid restoration.

Dispatch period		Support given	Number of people dispatched
Related to Kumamoto City	First: 4/17 (Sun.) – 4/22 (Fri.)	General coordination of support teams, well facility surveys, leak surveys	10
	Second-Sixth: 4/18 (Mon.) - 5/9 (Mon.)	Transport of portable water bags (40,000 bags) Leak surveys	36
Related to Mashiki-cho	First-Second: 5/3 (Tues.) – 5/15 (Sun.)	Leak surveys / repairs	5
Cumulative total			51


General coordination work underway

Disaster-stricken municipalities were in turmoil in the initial post-disaster period

Tokyo Waterworks conducted general coordination for restoration work
(Coordination with other cities; reporting to Kumamoto City; etc.)

Realization of rapid restoration of waterworks

Preventative action : Terrorism countermeasures

○ The threat of terrorism is on the rise towards the Olympic Games Tokyo 2020

○ In addition to strengthening tangible and intangible measures, build partnerships with residents to prevent terrorism through communal monitoring

Security countermeasures in the purification facilities

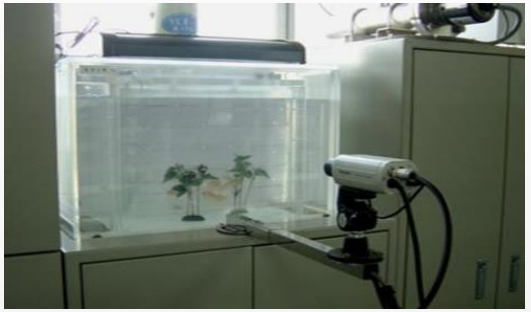
Tangible measures
1) Lids on filter basins, etc.
2) Fences to prevent intrusion (2.5m height)
3) Surveillance cameras (around the fences)
4) Tension sensors
5) Increasing poison detection tanks

Improvement of both tangible and intangible measures

Intangible measures
1) 24-hour monitoring by security guards
2) Enhancement of inspection patrols by guards
3) Building partnerships with residents (Protective surveillance by local residents)

Surveillance cameras

Tension sensors



Poison detection tanks

Prevention action: Flooding countermeasures

○ There has been frequent inundation of rivers in recent years due to typhoons and torrential rainfalls

○ Countermeasures against flooding of waterworks facilities are important

Flood damage

Flood damage caused by torrential rains in Kanto and Tohoku (Ibaraki Pref.)

Photo by courtesy of the Ministry of Land, Infrastructure, Transport and Tourism

Pump room flooding (Yamaguchi Pref.)

The photo by courtesy of Japan Water Works Association

Implements countermeasures based on this damage

Flooding countermeasures

Floodwall installation

Installation of watertight doors

Prevention action: Securing water resources and conserving forests

- ○ Forest management has been conducted for over 110 years to maintain stable water levels in the Tama River, a water resource distinctive to the region
- ○ Achieves around 21,000 tons of CO2 absorption per year through proper management of 23,000 ha of forests

Nearly plains-like terrain

Approx. 100 years later

Grown into a rich green forest

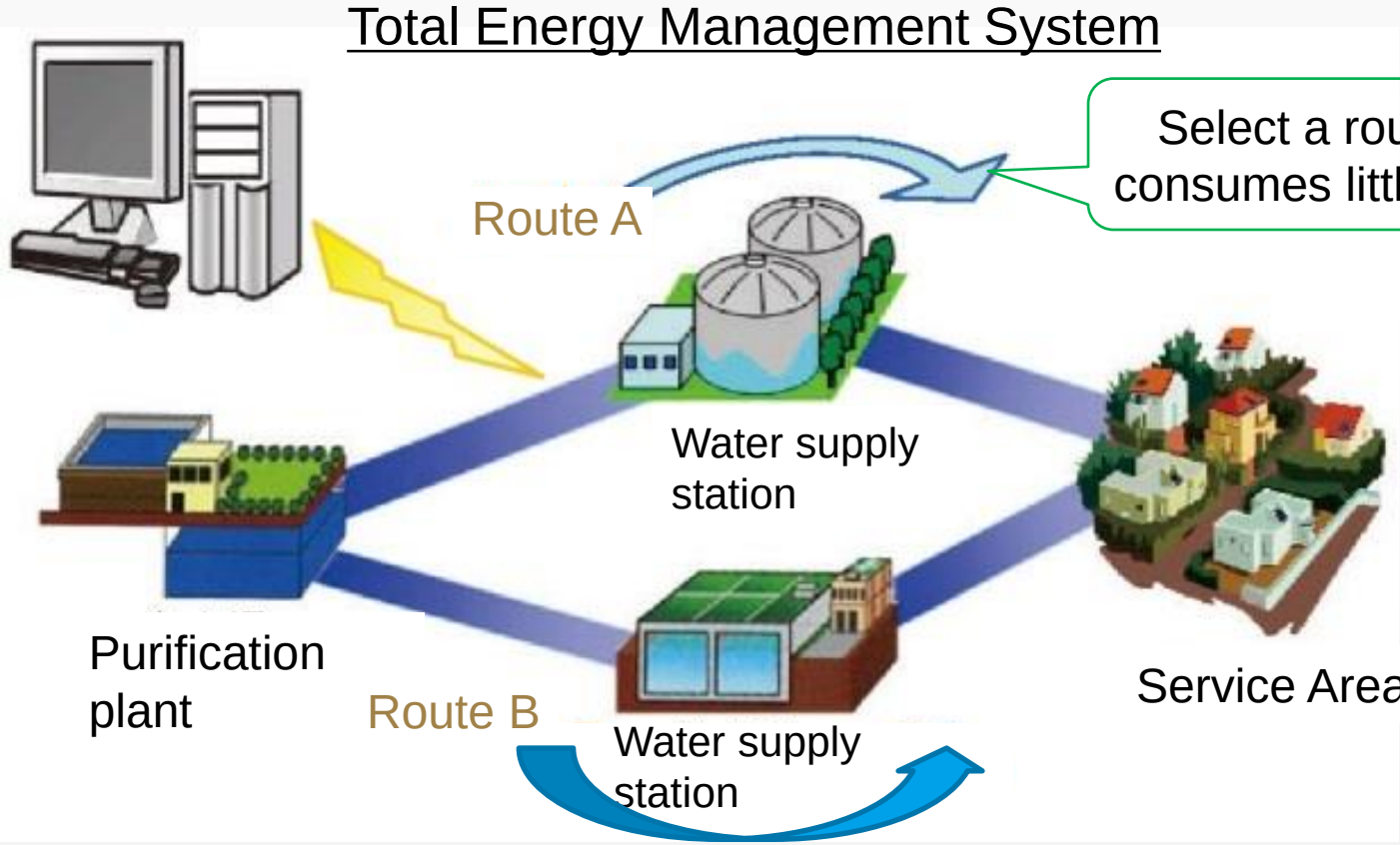
Ogouchi Reservoir and water conservation forest

Prevention action: Suppressing greenhouse gas emissions

○ Consumes around 1% (approx. 800 million kWh) of the electricity used in the Tokyo area

○ Suppressing greenhouse gas emissions through efficient water supply control and management, use of energy-saving equipment, and use of renewable energy, etc.

◎ Efficient water supply control and management



Necessity of rapid restoration

○ Preventative measures that anticipate risks are essential to handling disasters, climate change, and social change

○ If an unanticipated event were to occur that exceeded expectations and overwhelmed the prepared response, our essential social mission is to rapidly restore facilities and resume water supplies.

Social Change | **Climate Change** | **Disasters**

Preventative measures

○Prediction based on experience

○Following mid- and long-term changes

Rapid restoration

○ Preparation in advance based on the assumption of damage

Initiatives toward rapid restoration: Disaster drills

○ Nobody knows when, where, or what kind of disaster may occur
○ Conducts around 3 drills per year based on a variety of hypothetical disasters
○ After each drill, aspects of performance in need of improvement are reviewed and updated

PDCA cycle implementation

Counterterrorism drill at a purification plant

In a real disaster, we can do no more than we did in drills.
If we don't have drills, we can't do anything in a disaster.

Initiatives toward rapid restoration: Preparation of equipment and systems

○ In the event of a disaster, it can be assumed that equipment supplies from manufacturers will be brought to a halt
○ Materials needed for restoration work are stored up in advance
○ Work is performed by securing personnel (Waterworks Emergency Service Unit) directly managed by the Tokyo Waterworks and having them rapidly conduct restoration work

Distribution pipes in storage

Waterworks Emergency Service Unit being dispatched out

Conclusion

- Predict a range of different crises that could strike Tokyo
- Make maximum use of on-site workplace skills accumulated over 120 years of history

To achieve resilient waterworks services for the next 100 years that sustain a Tokyo capital area in which anyone can thrive in safety and peace-of-mind