

43rd BCWWA Annual Conference 2015

**Emergency water supply
system in Sendai City**
**based on our experiences from
the Great East Japan Earthquake**

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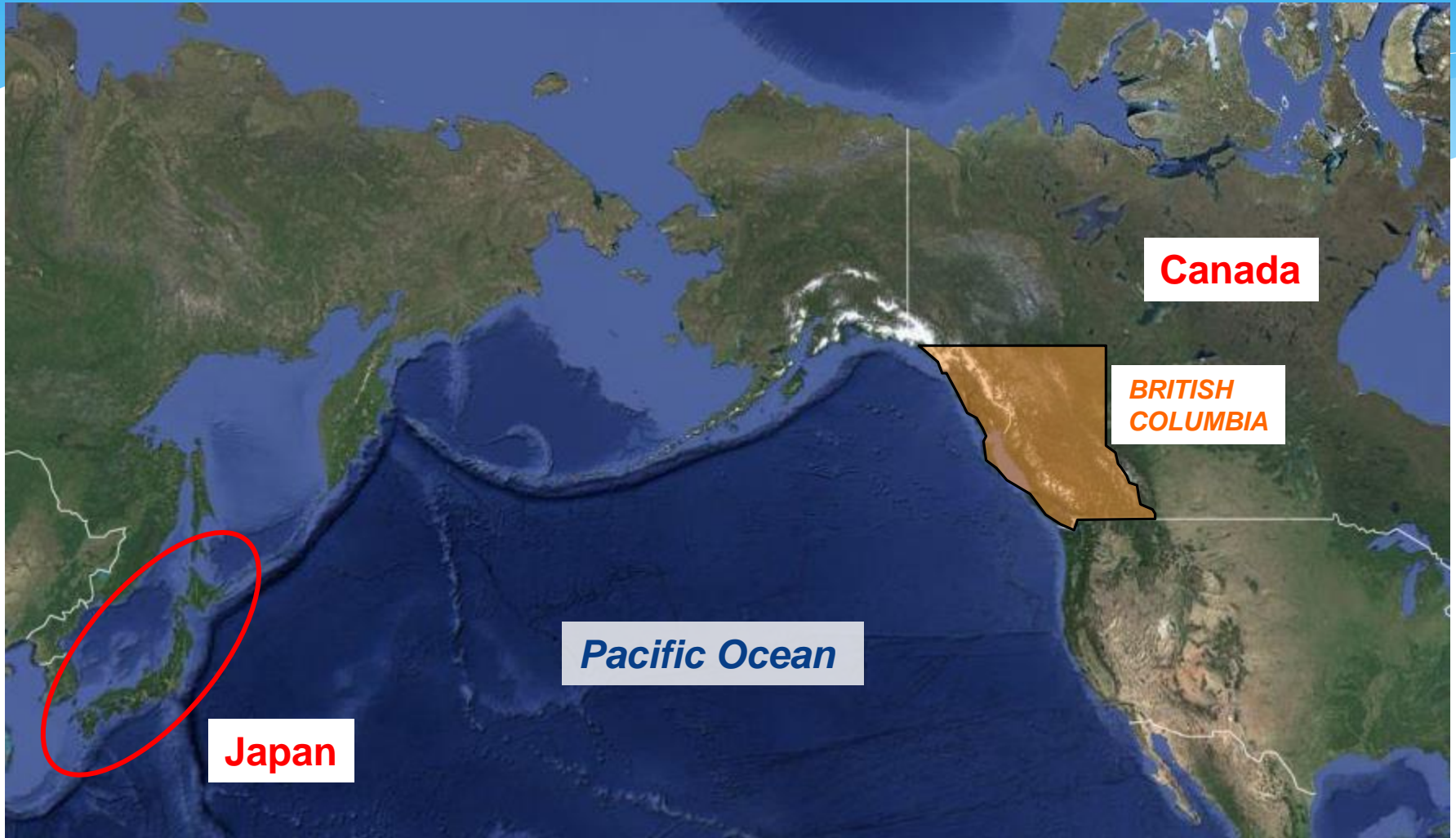


Contents

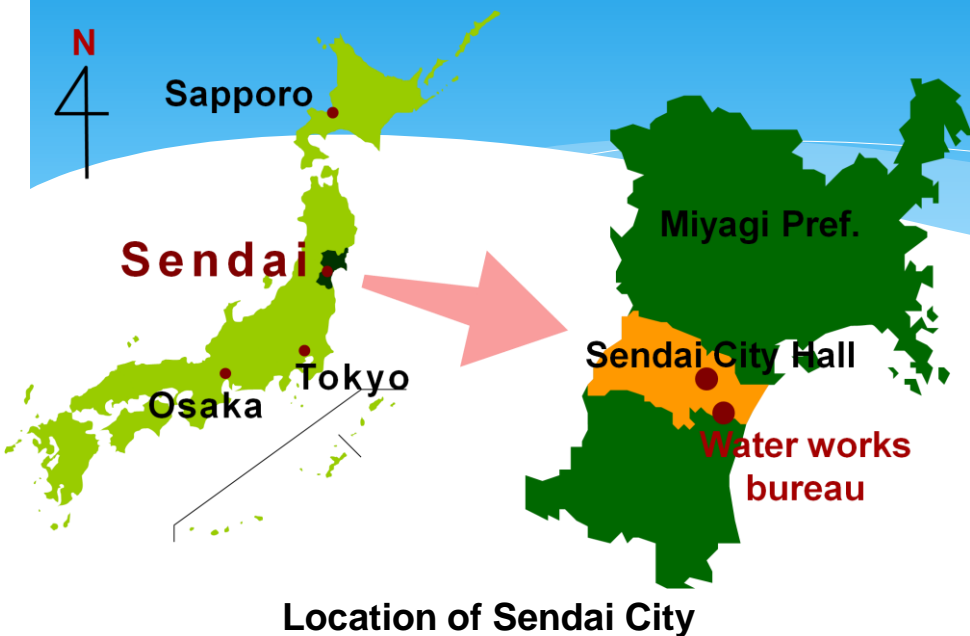
- 1) **Outline of the Sendai City waterworks bureau**
- 2) **Our disaster measures
before the Great East Japan Earthquake**
- 3) **Damage situation and subject of
the Great East Japan Earthquake**
- 4) **Solutions passed through
the Great East Japan Earthquake**



Outline of the Sendai City



Outline of the Sendai City



Center of the City



Hirose River



Aoba Festival



Date Masamune

Data of Sendai City

| | |
|---------------------|---------------------|
| Population | 1,073,942 |
| Area | 786 km ² |
| Average temperature | 12.4°C(54.3°F) |
| Rain fall | 1,254 mm/y |



City Emblem



Star Festival

Outline of the Sendai City

Outline of Sendai City Waterworks Bureau

| | |
|---------------------------------------|---|
| Service area | approx. 363 km ² |
| Total length of pipeline | approx. 3,619 km |
| Number of Purification plants | 4 main and 4 small plants + Received from Miyagi Prefectural Bulk Water Supply |
| Population served | 1,041,836 |
| Percentage served | 99.6 % |
| Average distribution per a day | 329,439 m ³ /day |
| Effective rate | 96.5 % |
| Beginning of supply | March, 1923 |
| Number of the staff | 408 |

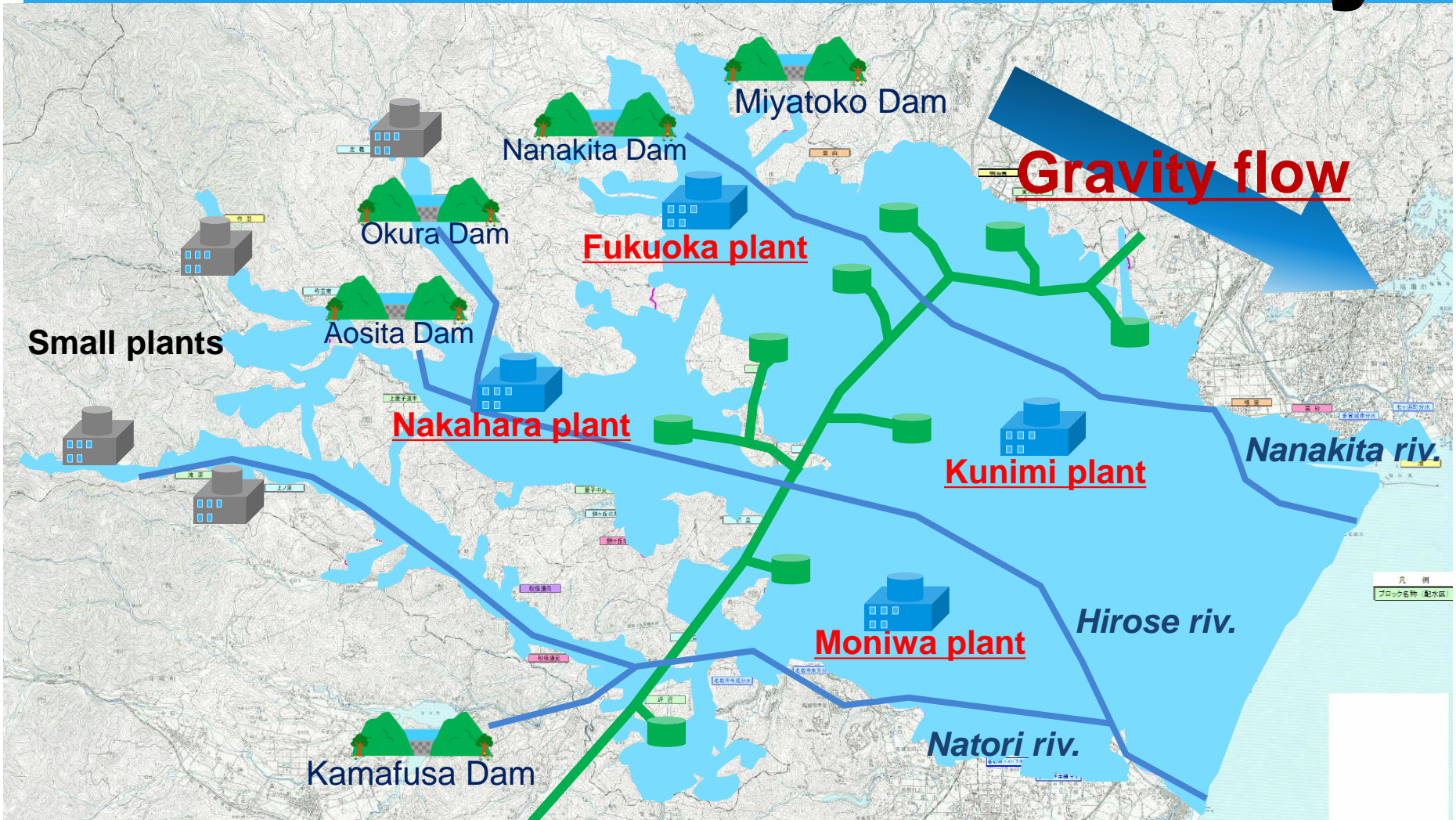


Logo



**Mascot
"Watter-Kun"**

Outline of the Sendai City



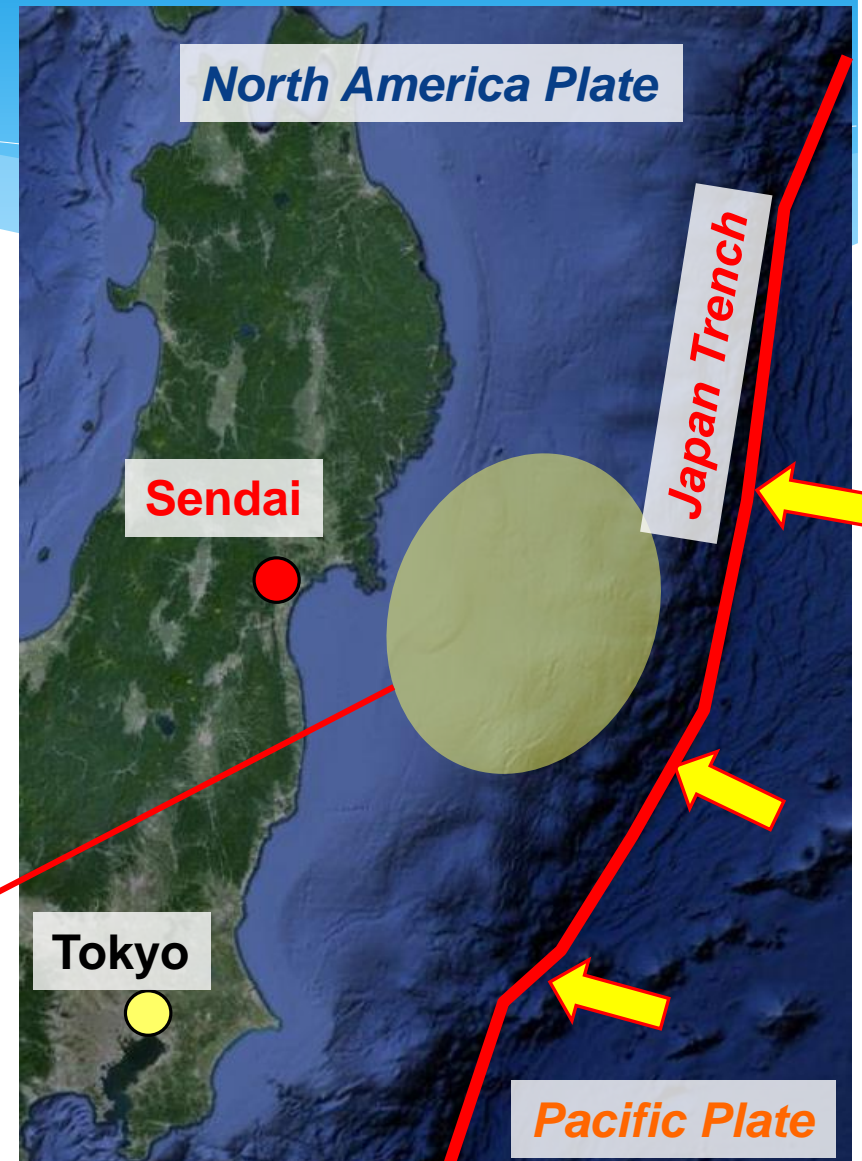
Nanbuyama plant of Miyagi Prefectural Bulk Water Supply

Outline of the Sendai City

Sendai City has experienced a large earthquakes every 37 years.

The data of “Miyagi Earthquake” occurred since 1793

| Date | Passed year (year) | Magnitude (Mw) |
|-----------|--------------------|----------------|
| Feb. 1793 | Unknown | M8.2 |
| Jul. 1835 | 42 | M7.3 |
| Oct. 1861 | 26 | M7.4 |
| Feb. 1897 | 35 | M7.4 |
| Nov. 1936 | 39 | M7.4 |
| Jun. 1978 | 41 | M7.4 |
| Mar. 2011 | 32 | M9.0 |



Disaster measures before the 3.11 Tohoku Earthquake

Restraint of damage

- Renovating water purification and distribution facilities
- Renovating pipelines to Earthquake Resistance pipe (“ER Pipe”)

Minimization of Influential area

- Promotion of Dual water distribution system
- Subdivision of water distribution blocks
- Settlement of emergency stop valve to distribution tanks

Speedup of disaster response

- Disaster training for waterworks staffs
- Making risk management manual
- Storage of materials for repairs

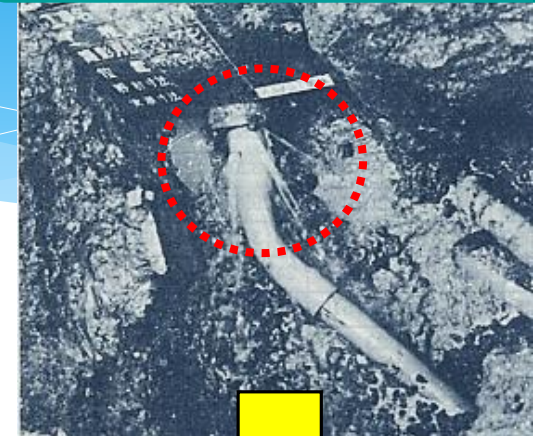
Emergency water supply

- Installation of “Emergency water supply facilities”
- Deployment of water trucks
- Cooperation with other water utilities

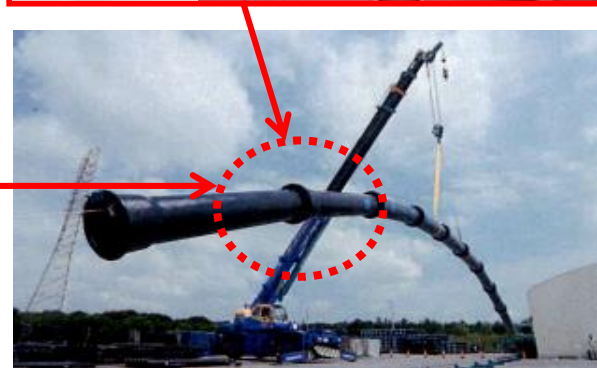
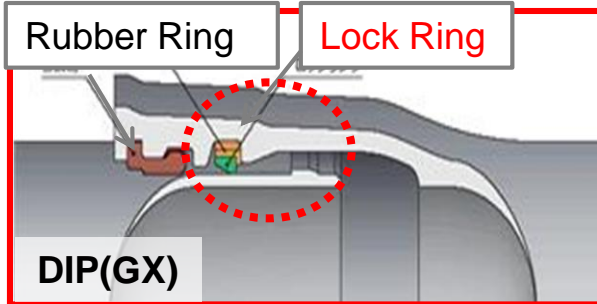
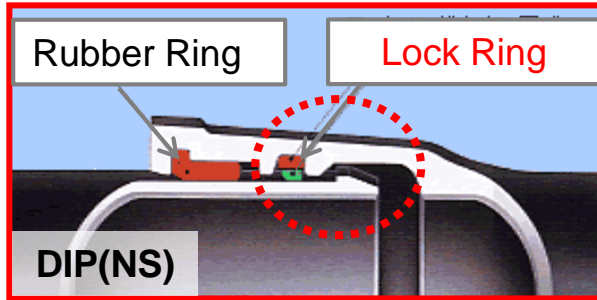
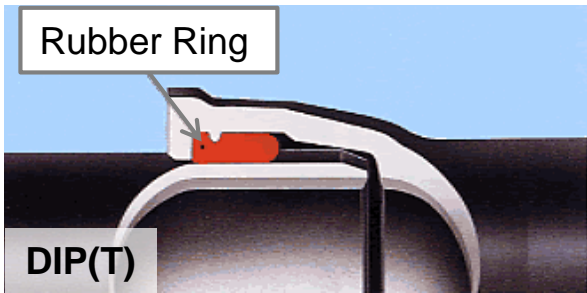
What is “ER pipe”?

| Year | Happening and Introduction of ER pipes at SWWB |
|------|--|
| 1978 | Miyagi Earthquake |
| 1979 | Adoption of DIP(S) and DIP(SII) |
| 1982 | Disuse of VP(TS) and adoption of VP(RR) |
| 1994 | Disuse of VP(RR) for diameter over 75mm pipes |
| 1998 | Adoption of DIP(NS) |
| 2011 | Great East Japan Earthquake |
| 2015 | Adoption of DIP(GX) for diameter 75mm~400mm |

Many VP's were suffered and broken!



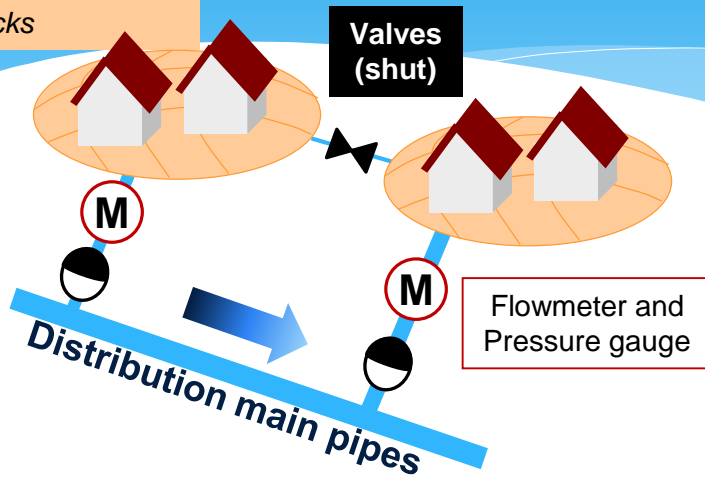
Replacing to ER pipe



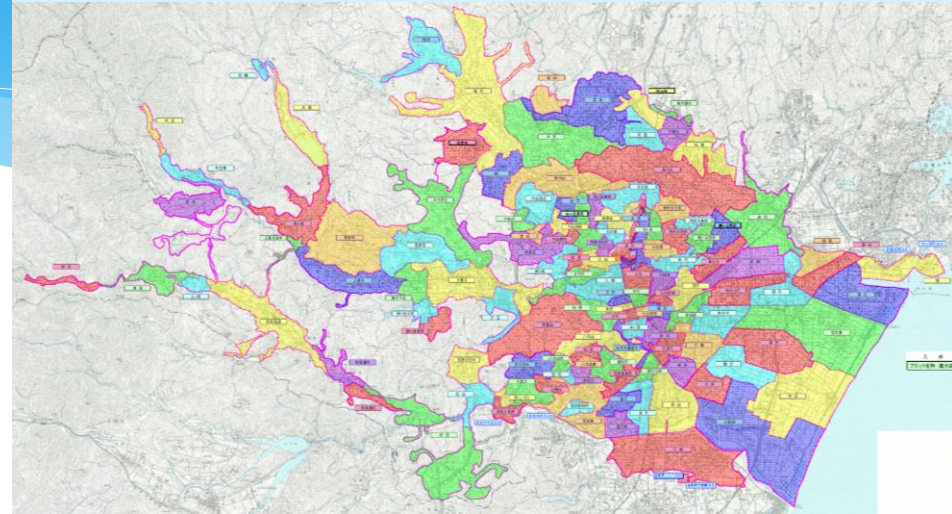
Water distribution system

(1) Block distribution system

Water Distribution blocks

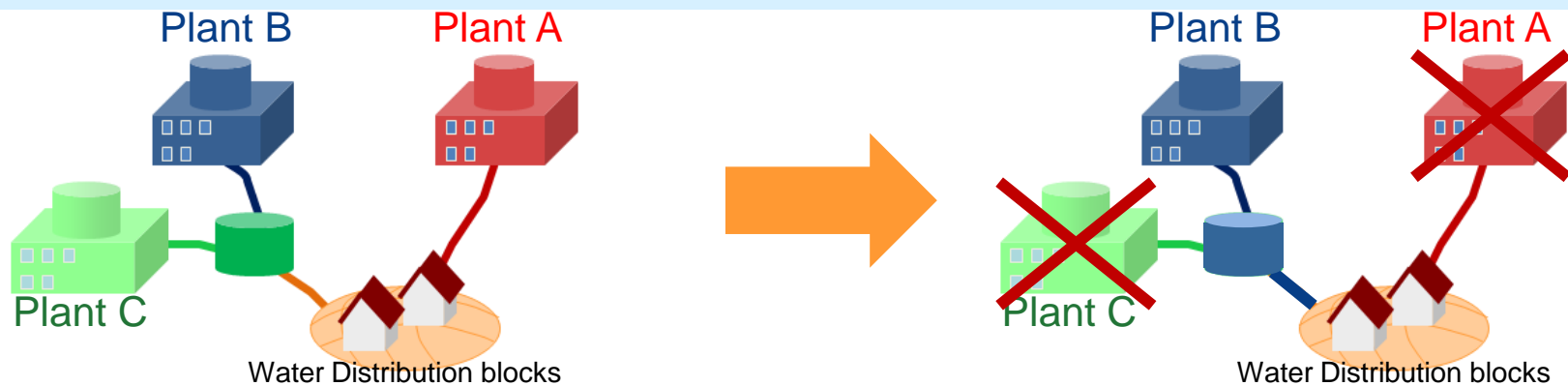


We divide distribution area into 128 blocks



(2) Dual water distribution system

Dual transmission to reservoir and blocks from more than 2 purification plants



Even if our own plants are stopped, we can distribute the water from the other plants.

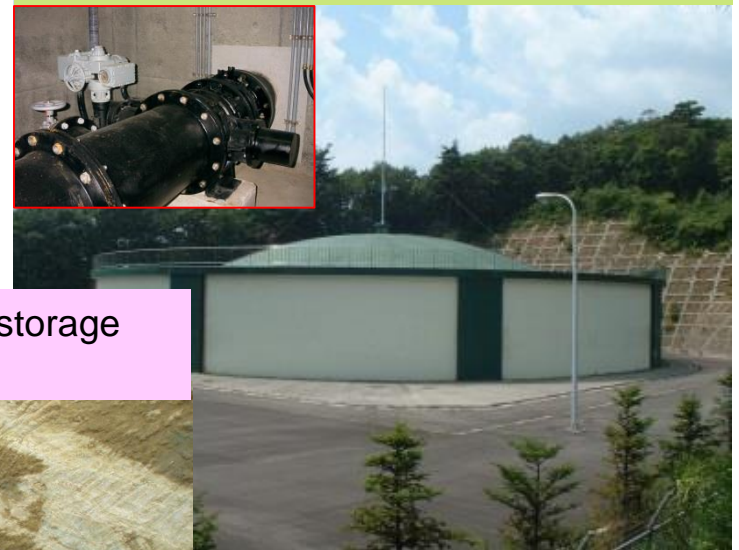
What is “Emergency water supply facilities”?

We established the following water supply facilities in preparation for “the Miyagi Earthquake” that was would occur in the near future.

Emergency water supply taps
[main pipe type] (24 locations)



Water reservoir outfitted with
Emergency stop valves (20 locations)



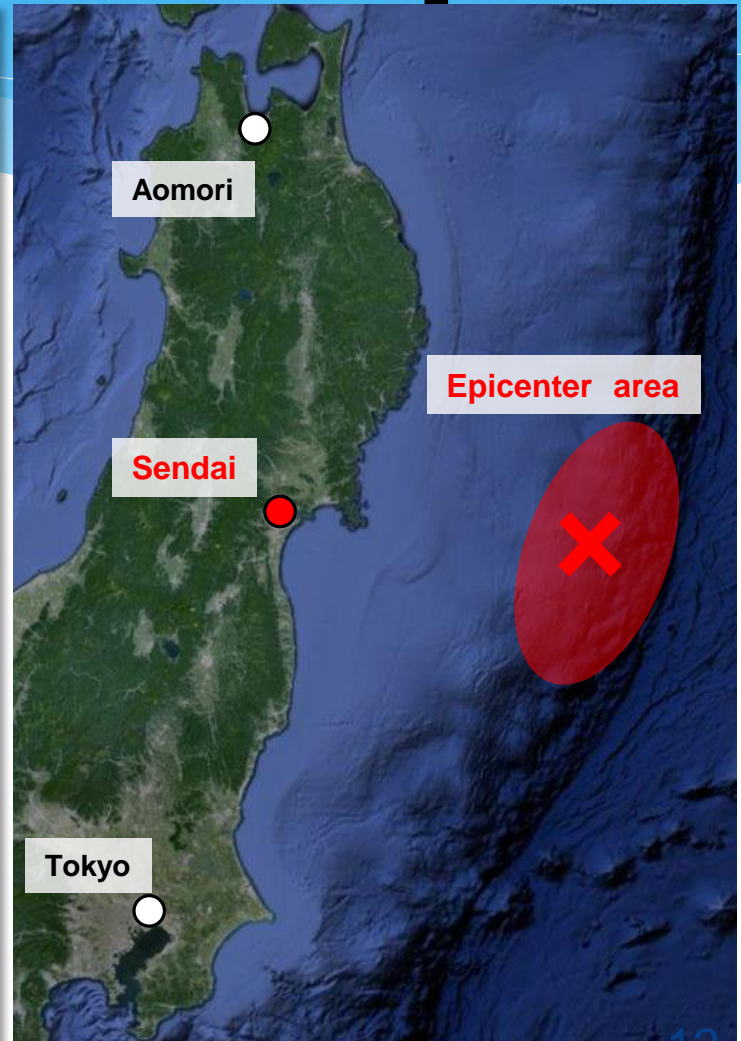
Emergency drinking water storage
tank (21 locations)



Damage situation of the 3.11 Tohoku Earthquake

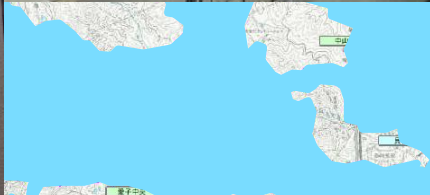
Outline of The 3.11 Tohoku Earthquake

| | | |
|---------------------------------|---|--|
| Primary Quake | Date | 2:46 pm on March 11, 2011 |
| | Magnitude | 9.0(Mw) |
| | Scale | Maximum intensity of Japanese scale of 7 (Observed on northern part of Miyagi Pref.) |
| The biggest Aftershock | Date | 11:32pm on April 7, 2011 |
| | Magnitude | 7.2(Mw) |
| Tsunami | Over 10 meter high tsunami was hit in various part of eastern Japan | |
| Loss of lives (As of Mar, 2015) | Dead | 15,891 |
| | Injured | 6,152 |
| | Missing | 2,584 |



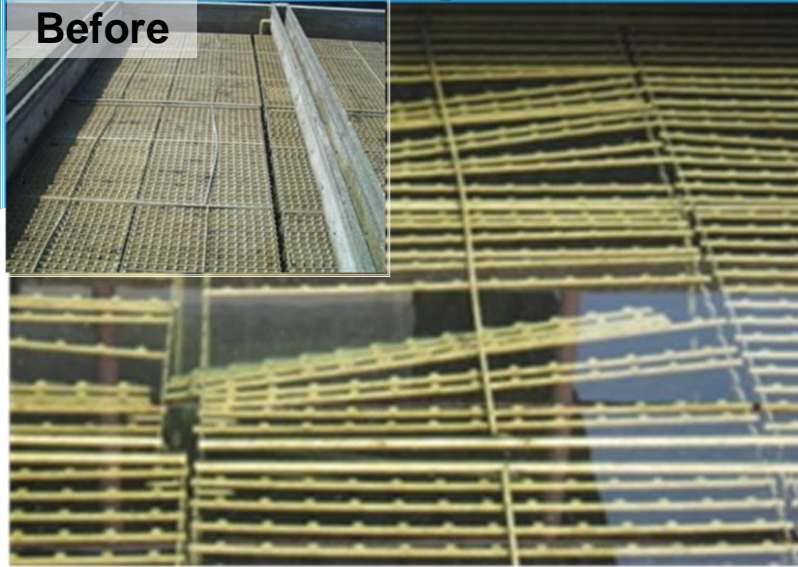
Damage situation in Sendai City

**Landslides
damage to
hillside areas**



**Tsunami
damage to
coastal areas**

Damage to water facilities



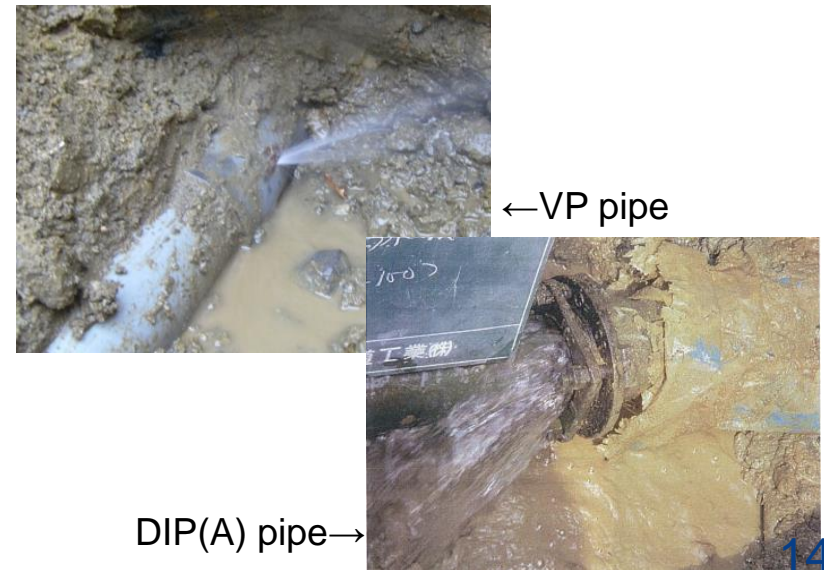
Damage to the tilted plates in plate settler



Collapse of flow arrangement wall(Anyoji Reservoir)



Damage to Air valves on distribution main



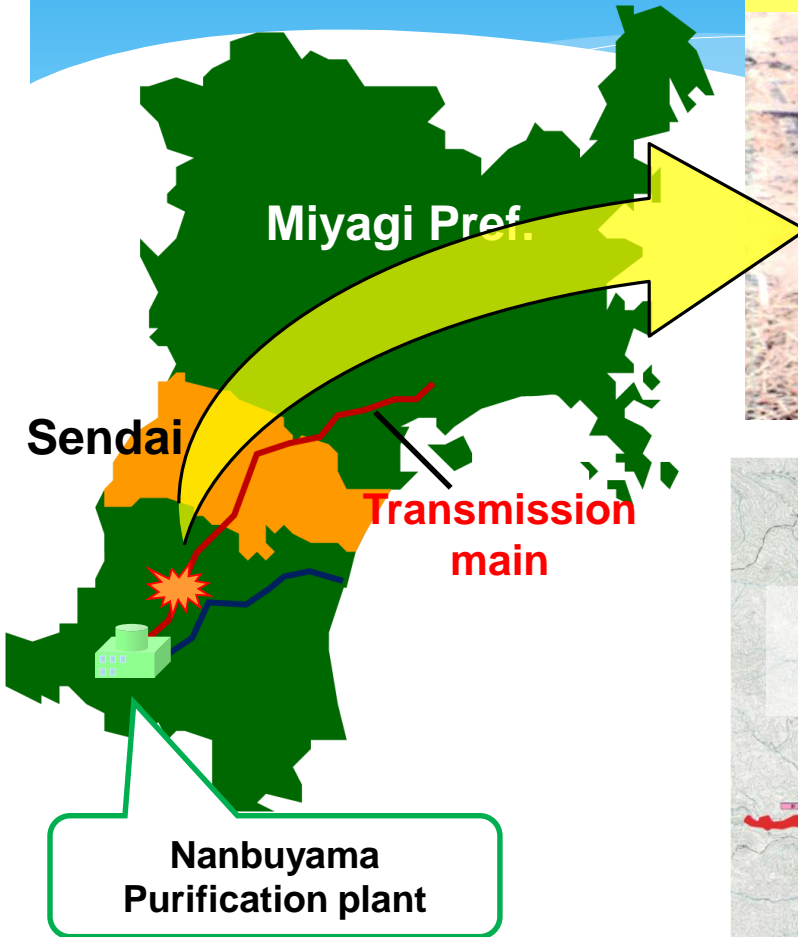
DIP(A) pipe→

←VP pipe

Leakage of non ER pipes

Damage to water facilities

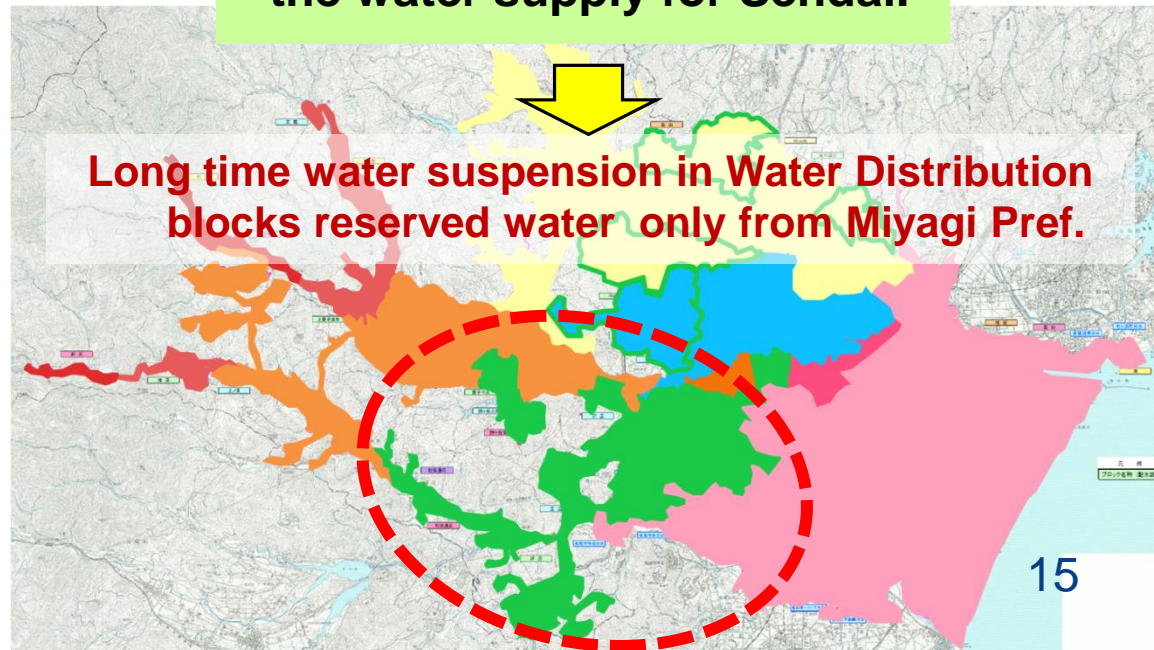
Damage of the Miyagi Prefectural Bulk Water Supply



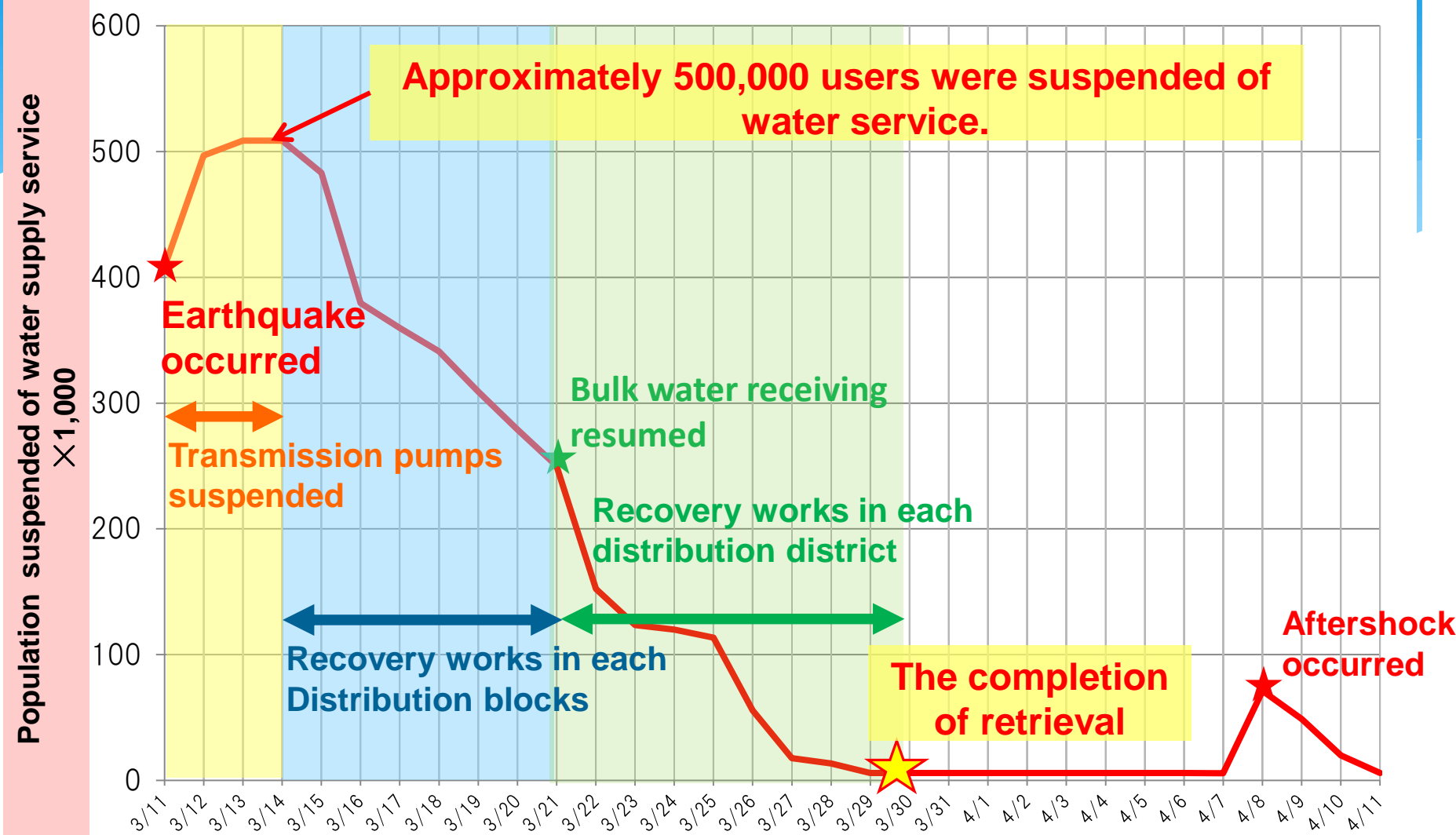
Transmission main pipeline was damaged



It took 10 days to recover the water supply for Sendai.

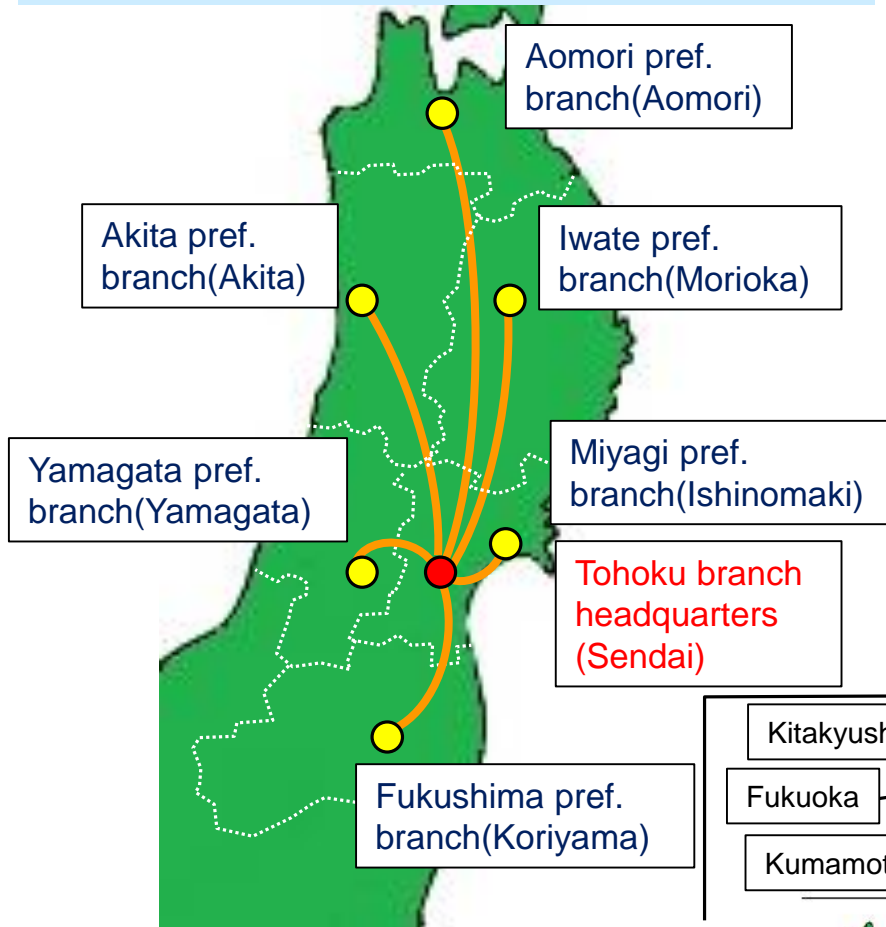


Water service restoration process

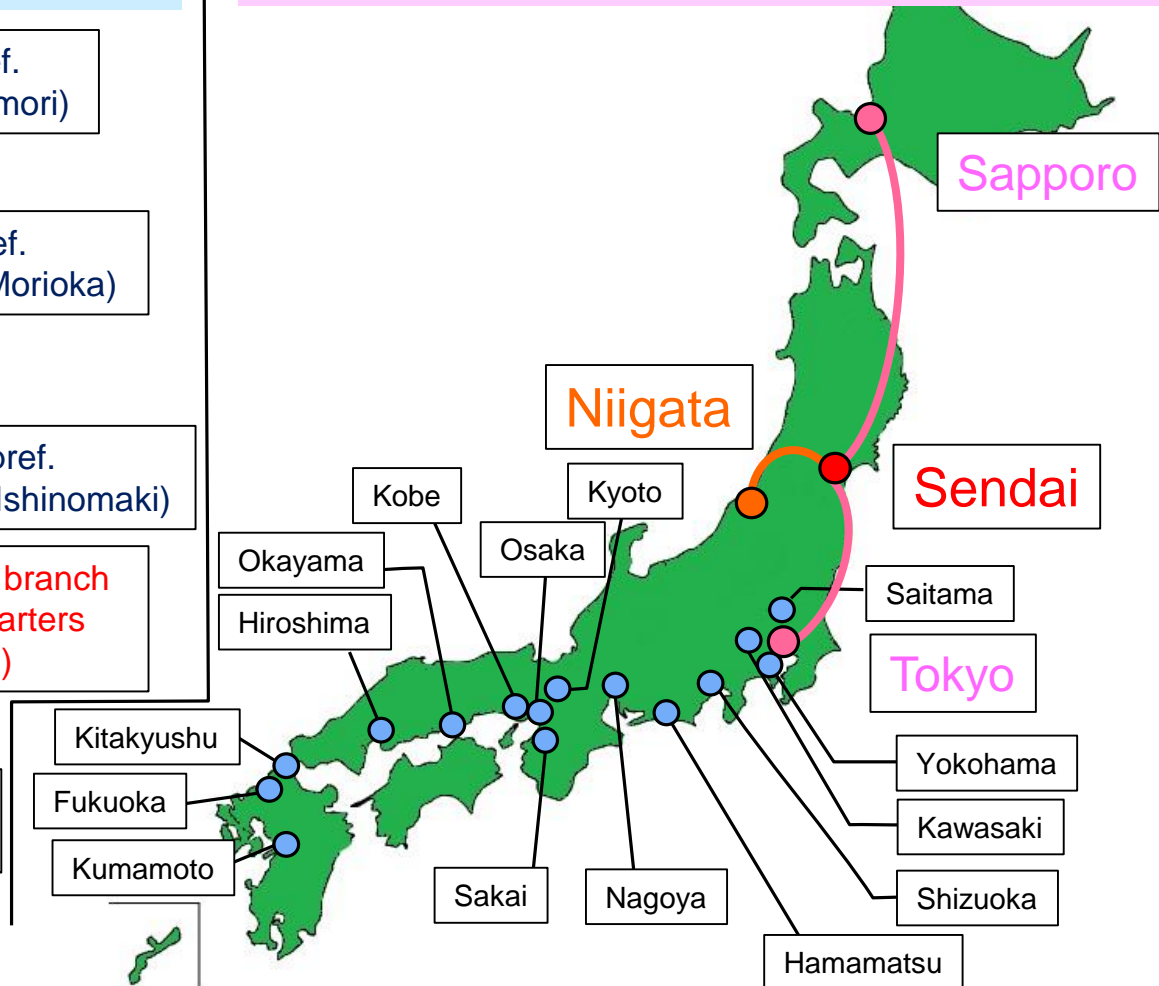


Cooperation with other water utilities

Mutual aid agreement with Tohoku branch of JWWA

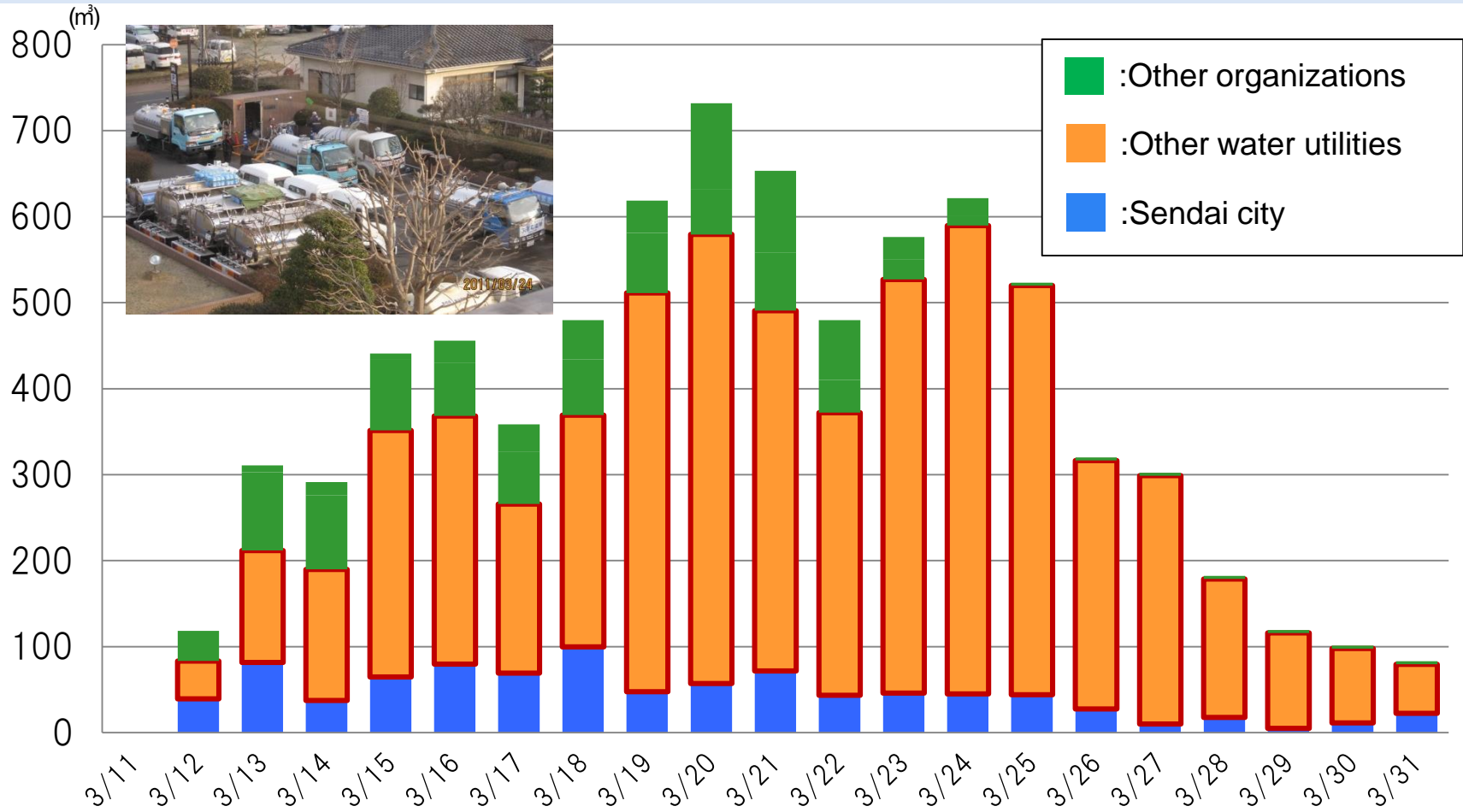


Mutual aid agreement with Ordinance-designed city



Cooperation with other water utilities

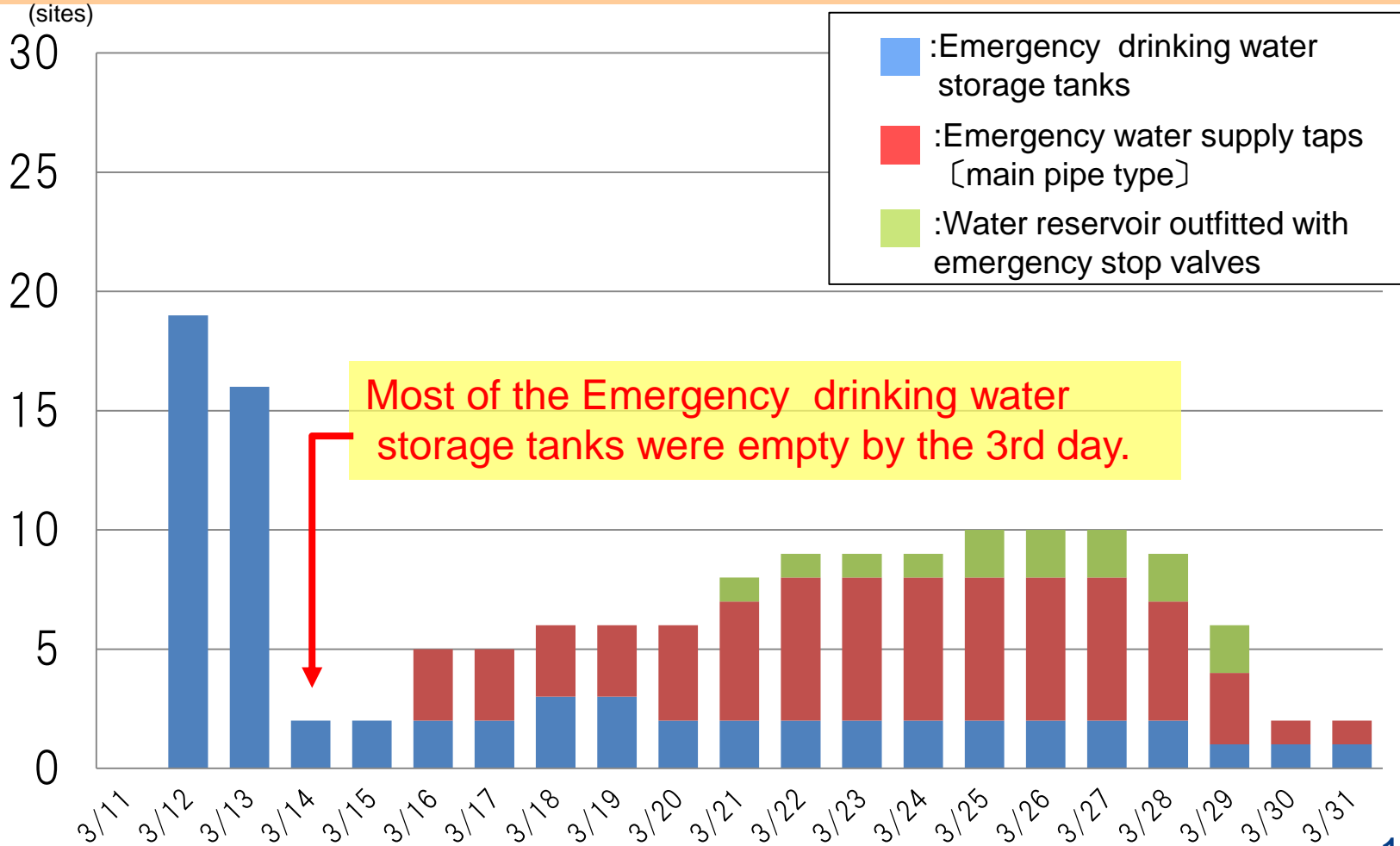
Amount of Emergency water supply by water trucks



61 water utilities from other cities throughout the country dispatched emergency response teams to Sendai.

Subject of the 3.11 Tohoku Earthquake

Commissioning of the Emergency water supply facilities



Subject of the 3.11 Tohoku Earthquake

Shortage of human resources for Emergency Water Supply Operation

A huge business of disaster responses



Emergency water supply facilities which
were difficult to set up



Citizens flooded into few number of
water supply facilities



Solutions passed through the 3.11 Tohoku Earthquake

Damage to water facilities



Disaster Strikes

Suspension of water supply



Restoration activity

Emergency water supply activity

Priority devotement of staff

Stricken water utility

Citizens

Cooperation

Support team from other water utilities

Agreement companies

Solutions passed through the 3.11 Tohoku Earthquake

We are undertaking a project to install “Emergency water supply taps(ground type)” at public schools until 2019.

Features

1)This will allow citizens to set up water supply stations on their own in a disaster.

2)It's possible to set up water supply stations within the walking range(1km).



It enables to disperse citizens who need water supply.

Emergency water supply taps [ground type]

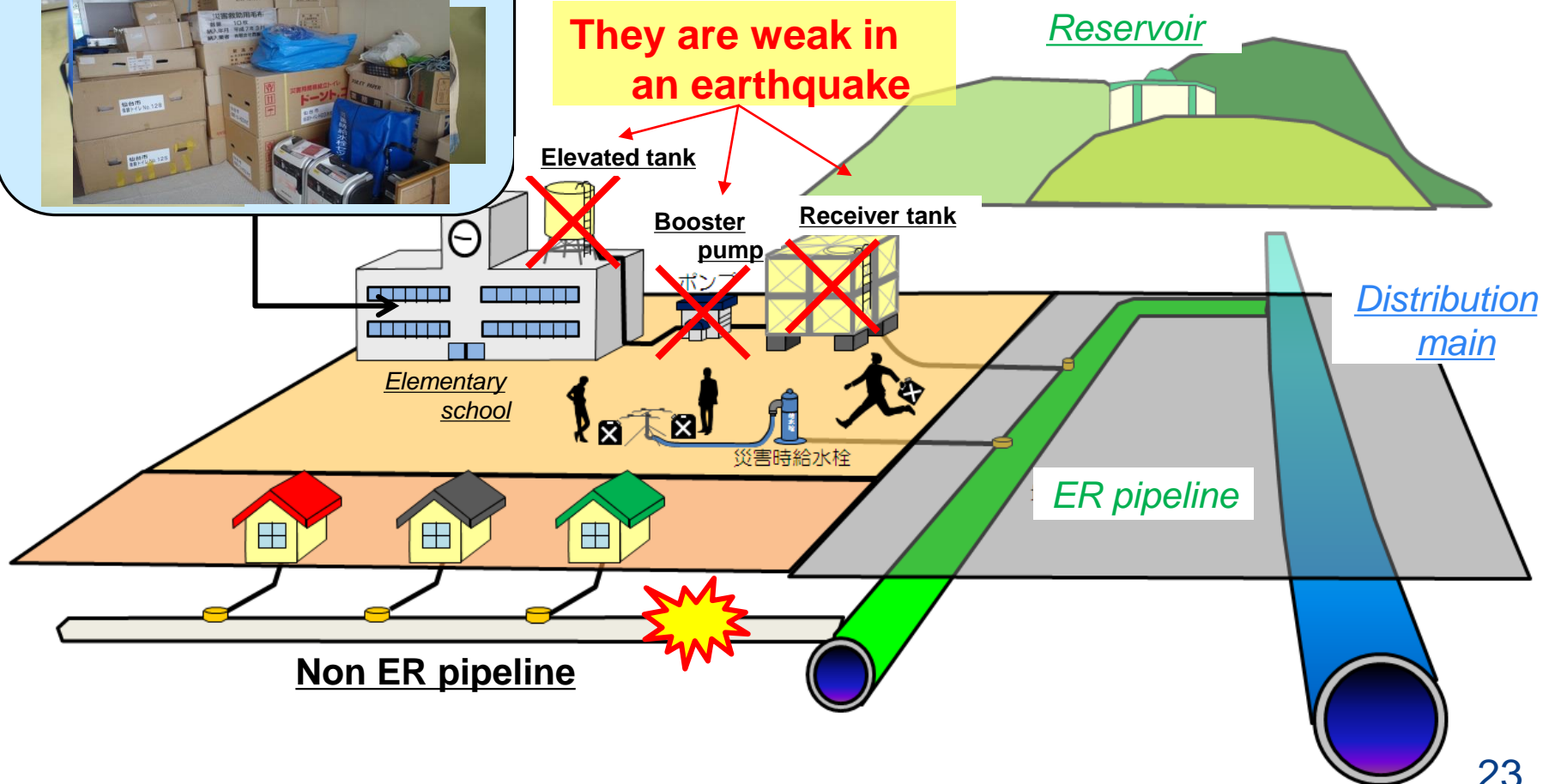


Solutions passed through the 3.11 Tohoku Earthquake

Tools for setup are kept in emergency depot.



They are weak in an earthquake



Steering of Evacuation center in Sendai City passed through 3.11



They hold disaster training every year.

Steering of Evacuation center in Sendai City passed through 3.11



Explaining of Emergency water supply taps at disaster training.

We are going to promote **citizen cooperation** in emergency water supply operations through disaster training.

Cooperation with other water utilities

Disaster training with other waterworks utilities.



Training with Tokyo MG water works bureau



Training with Sapporo city water works bureau

We hold disaster training every year, aiming to create a system for the rapid provision and acceptance of aid.

Efficient emergency water supply by water trucks



Water replenishment station(Moniwa Plant)



1m³



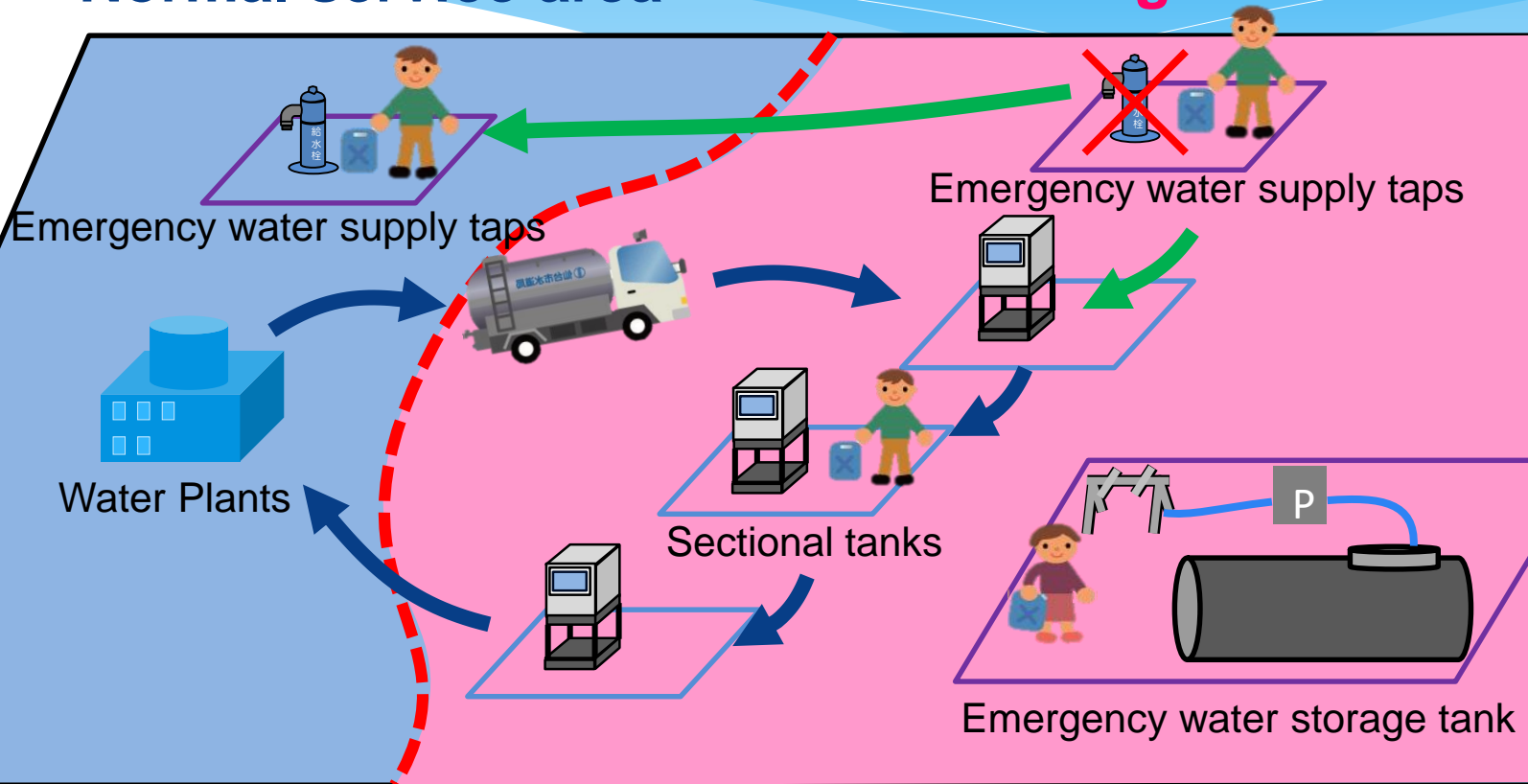
Sectional tank(1m³)

We adopted them after the Great East Japan Earthquake to practice efficient emergency water supply by water trucks.

Policy of Emergency water supply passed through the 3.11 Tohoku Earthquake

Normal service area

Outage area






We are going to supply water by combining various methods at the disaster.

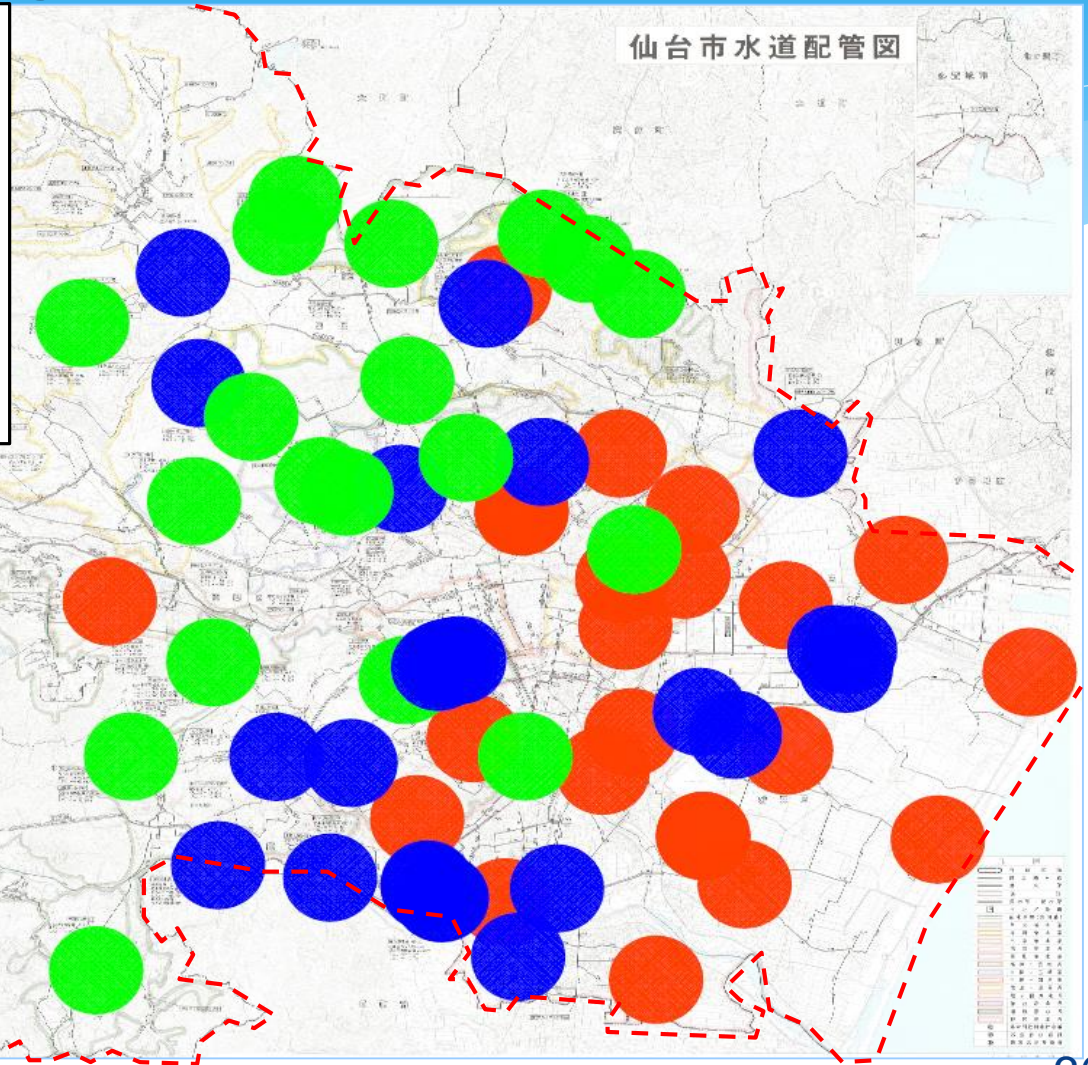
**Thank you very much
for your attention!**



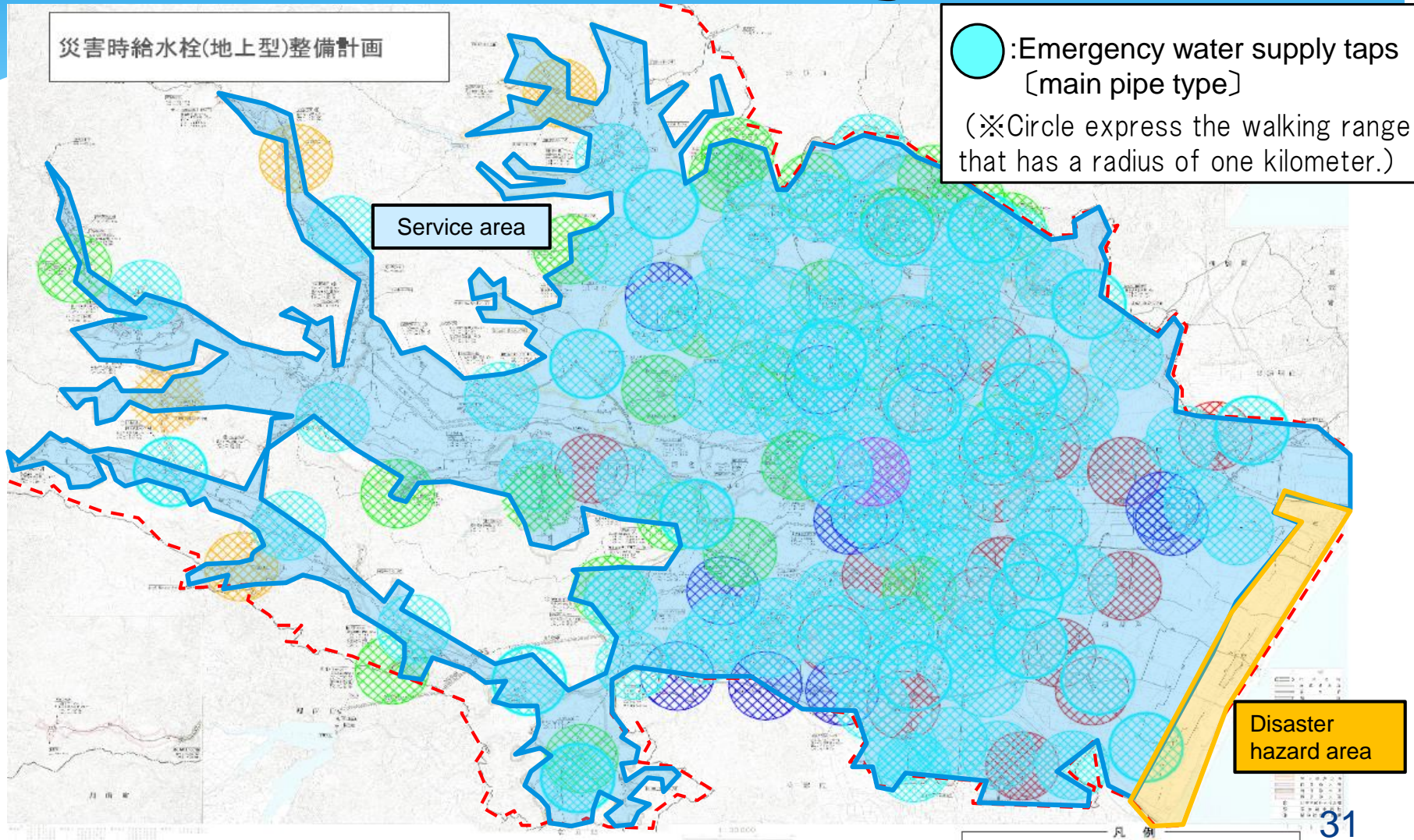
What is “Emergency water supply facilities”?

-  :Emergency drinking water storage tanks
-  :Water reservoir outfitted with emergency stop valves
-  :Emergency water supply taps [main pipe type]

(※Circle express the walking range that has a radius of one kilometer.)

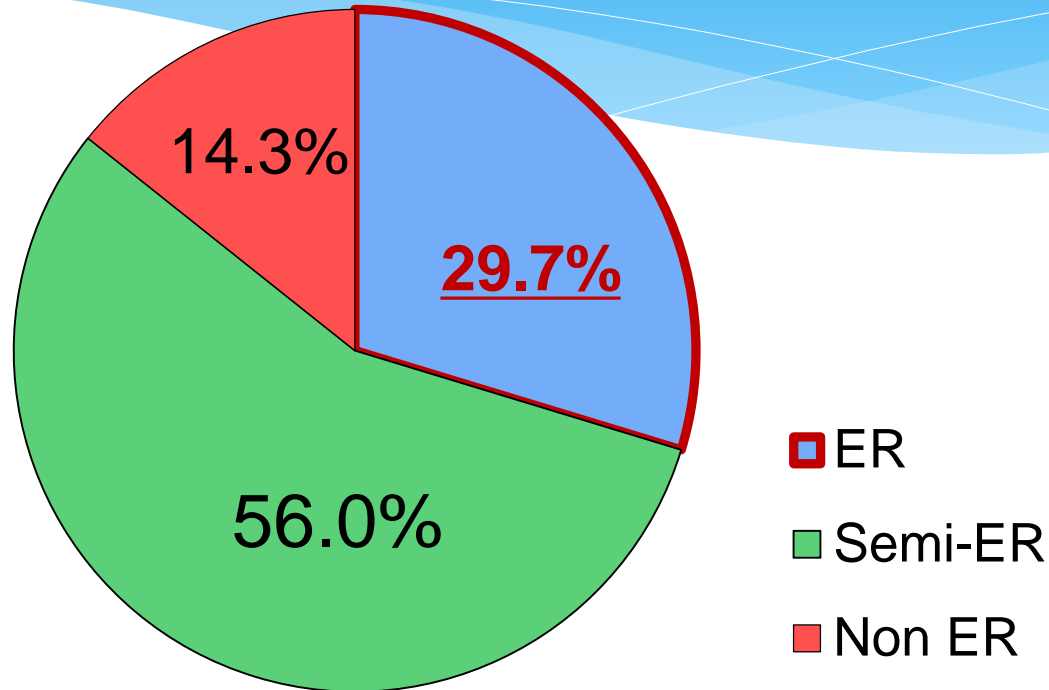


Emergency water supply taps 〔main pipe type〕



Ratio of the ER pipes

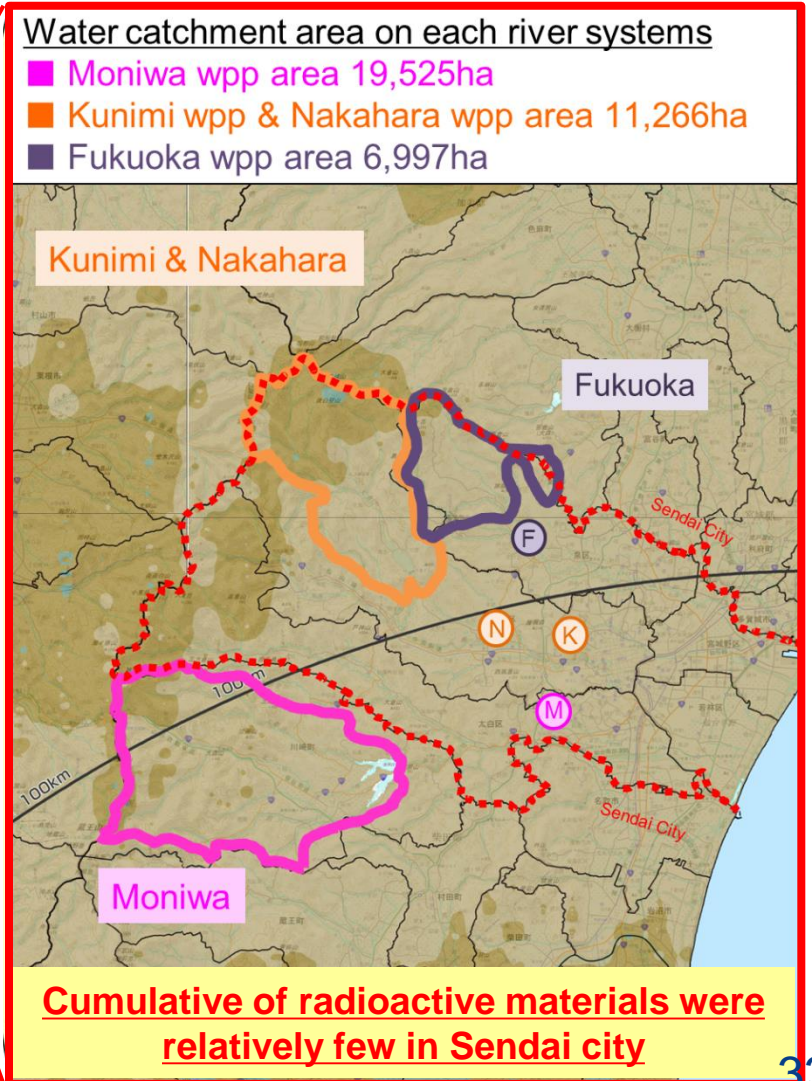
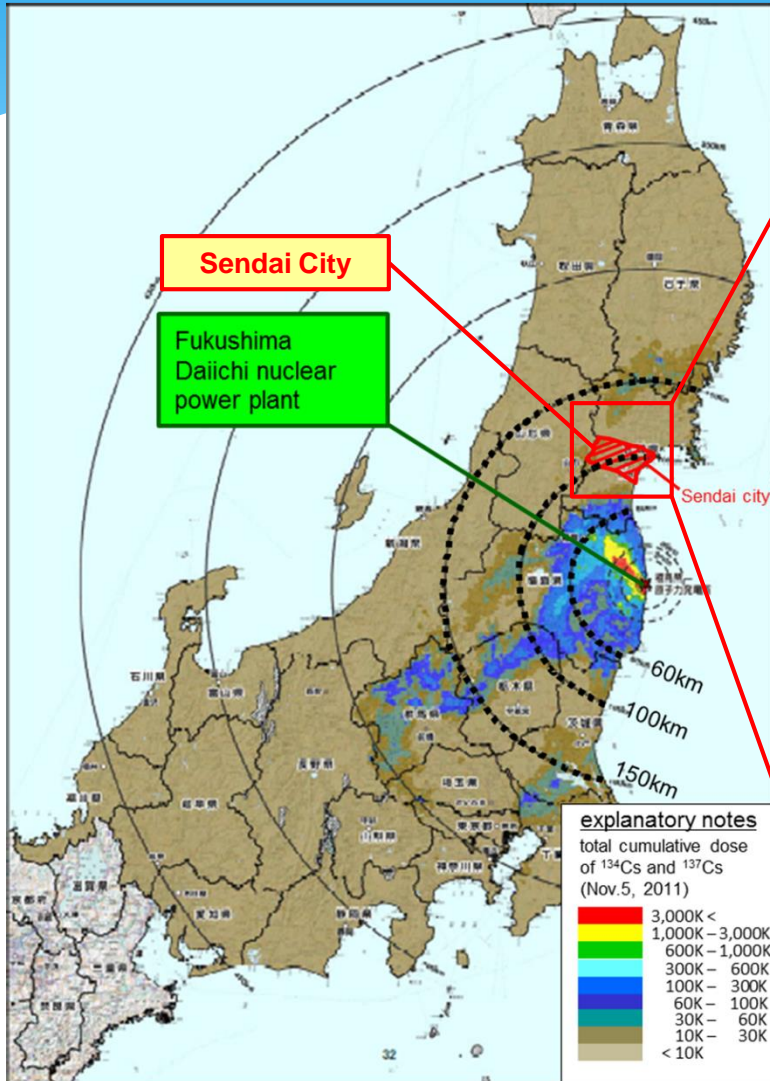
We have to replace non-ER pipe and Semi-ER pipe to ER pipes!



Classification of the ER capability in SWWB

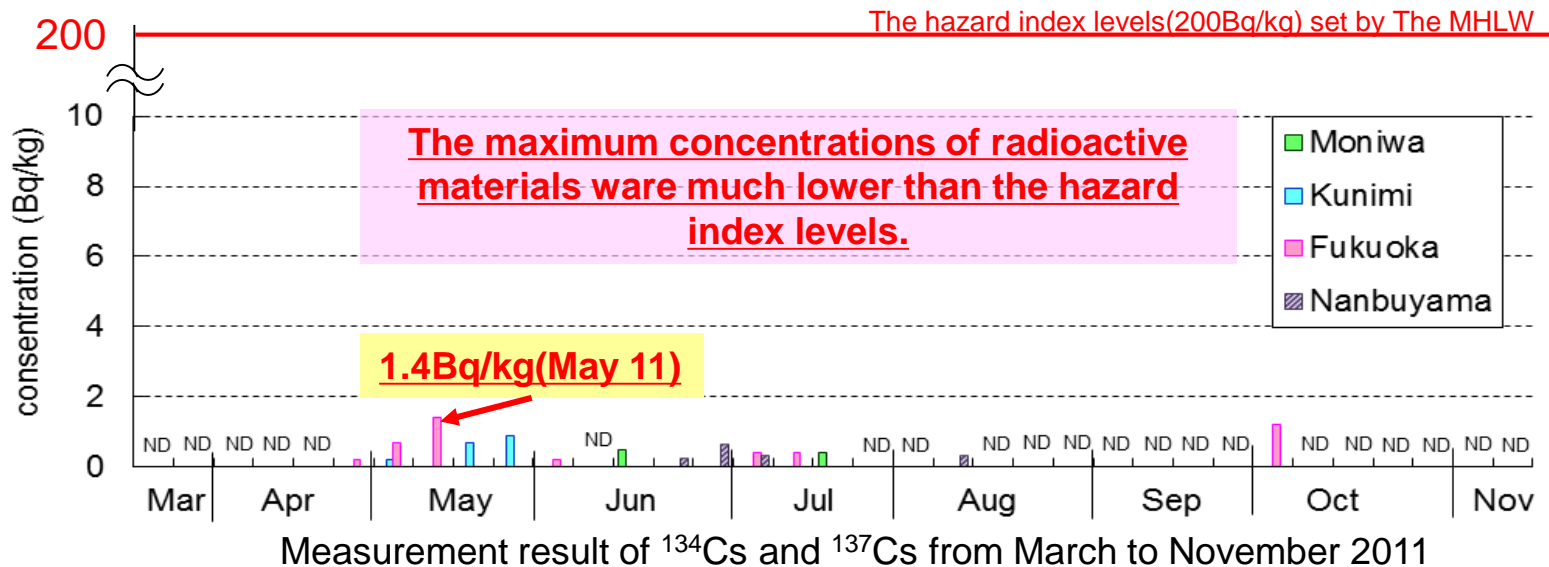
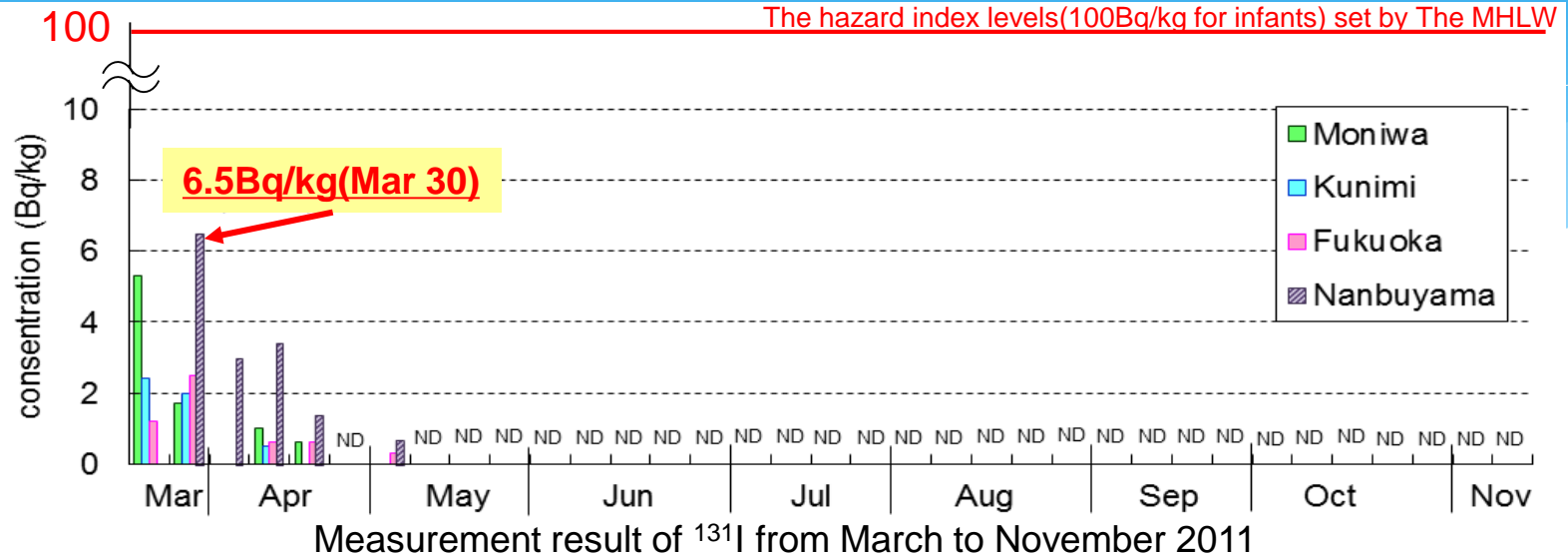
| | |
|--------------|---|
| ER pipe | DIP(S, SII, NS,GX, PII, F, KF), SP, SUS |
| Semi-ER pipe | DIP(K,A,T,M),VP(RR) |
| Non ER pipe | VP(TS),CIP,ACP |

Influence of radioactive materials on treated water



Water catchment area and cumulative dose of ^{134}Cs and ^{137}Cs

Influence of radioactive materials on treated water



Model of the Disaster Reduction for Connecting all to the Water of Life

