Flood Management in Japan

1. Comprehensive Flood Control Measures
2. Provision of River information
3. Responses to the Niigata Torrential Rain Disaster
4. About ICHARM
5. Responses to 2011 Thailand Floods
6. Outline of the Tsunami-Resilient City

Occurrence of Heavy Rain with Hourly Rainfall of over 100 mm

Heavy rain with an hourly rainfall of over 100 mm occurred in various parts of Japan, causing inundation.

Damage caused by torrential downpour in Chugoku and Northern Kyushu districts in July 2009

○ Hourly rainfall of 116 mm (Fukuoka city, Fukuoka pref. (Hakata))
○ Hourly rainfall of 72.5 mm (Hofu city, Yamaguchi pref. (Hofu))
○ Damage caused by debris flow, etc. in Northern Kyushu and Chugoku districts
Deaths: 31
Houses flooded above floor level: 2,152, Below floor level: 9,285

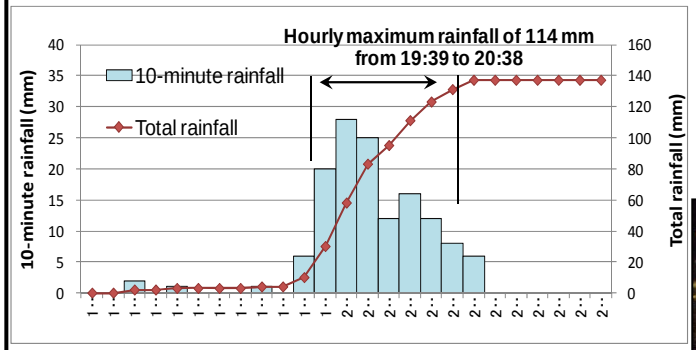
※Based on investigation by Fire Disaster Management Agency on September 3, 2009

Damage in a part of the Kyushu Expressway

Damage of a special nursery home for the elderly

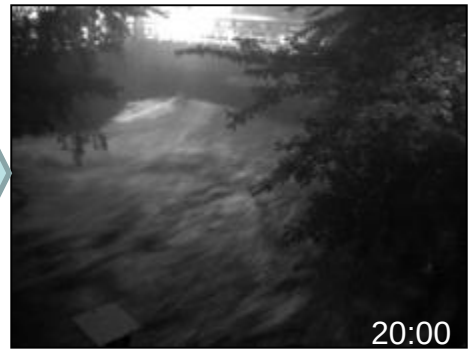
Damage caused by "guerrilla downpour" in Itabashi Ward, Tokyo on July 5, 2010

○ Hourly rainfall of 114 mm (Itabashi Observation Station (Shakujii River Basin))
○ Hourly rainfall of 82 mm (Aogishi Bridge Observation Station (Zanbori River Basin))
○ Shakujii River flooded, causing inundation damage in Itabashi.
Houses flooded above floor level: 58, Below floor level: 50 ※数値は速報値



Itabashi Observation Station

Water level rose by 3.45 m in 10 minutes from 19:50 to 20:00.



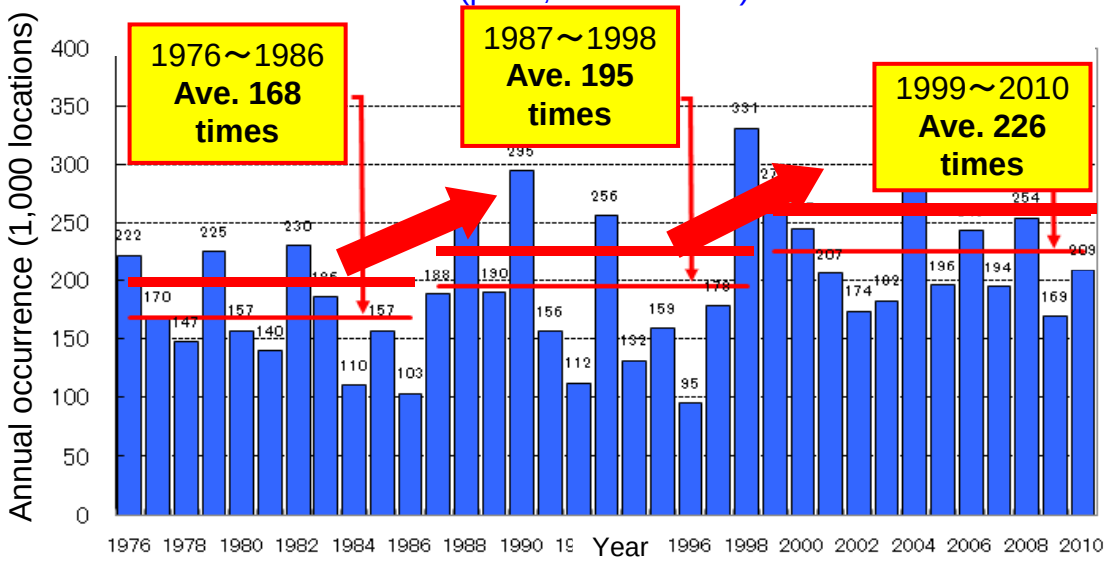
Change of water level in Shakujii River

Based on investigation by Disaster Prevention Office, Fire Disaster Management Agency on September 11, 2009

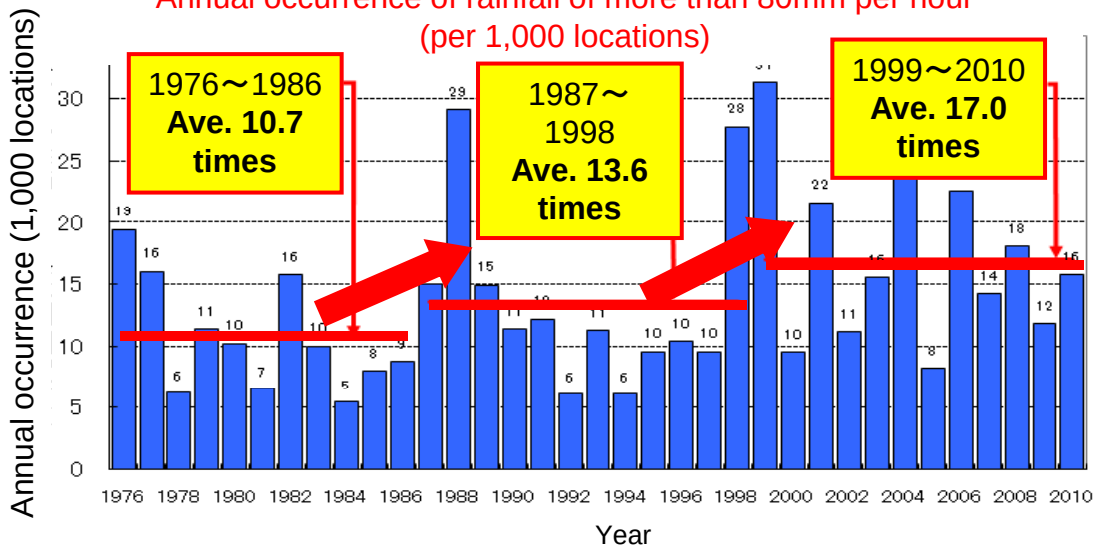
Heavy Rainfall in the Recent Years

Heavy rainfall of more than 50mm or 80mm per hour is tending to increase in the recent years

Annual occurrence of rainfall of more than 50mm per hour
(per 1,000 locations)



Annual occurrence of rainfall of more than 80mm per hour
(per 1,000 locations)



* The graph on the left is the number of annual occurrence of intense rain in a short time - more than 50mm and 80mm per hour, which were observed by AMEDAS (Automated Meteorological Data Acquisition System).

* The number of locations observed by AMEDAS was around 800 in 1976 when the observation started. In time, the locations have been added and has reached approximately 1,300 locations in 2010 (note*). Therefore in order to avoid the fluctuation caused by the number of locations, the occurrence per 1,000 locations is used for the comparison.

(note*): Terminated robot radio rain-gauge stations that were located in the mountainous areas are not included.

(For reference)

Intensity of rain and its behavior (abstract)

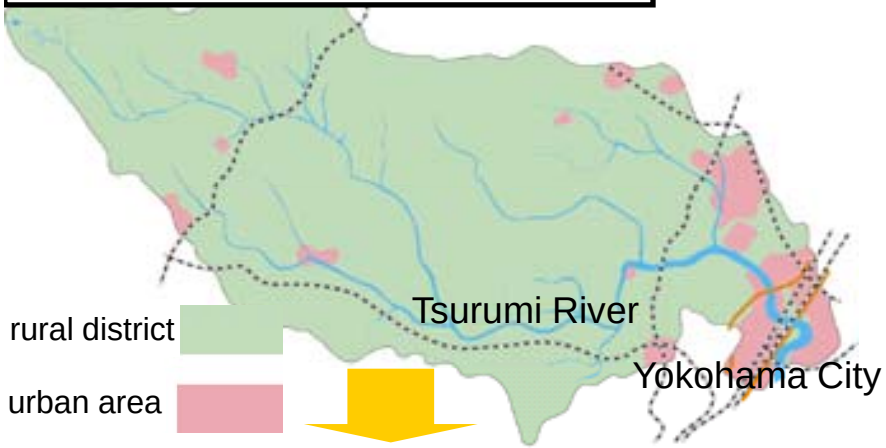
Hourly rainfall (mm)	Impression of the rain	Influence to human	Outdoor condition
10mm ～less than 20mm	Hard rain	Splashes from the ground wet the legs	Puddles appear all over the ground
20mm ～less than 30mm	Intense rain	Wet, even under an umbrella	
30mm ～less than 50mm	Raining buckets		The road turns into a river
50mm ～less than 80mm	Raining like a waterfall (roaring rain continues)	Umbrellas become totally useless	The area is covered in white colored splashes, and visibility is worsened
80mm or more	Threatened by the pressure and feel suffocated		

Material by JMA

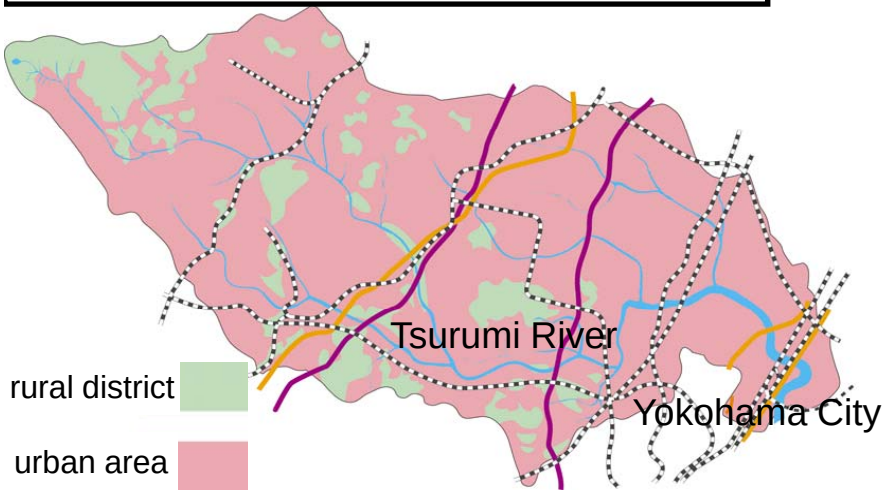
Influences of Urbanization on Floods

Tsurumi River

1958
Urbanization rate: About10%
Population: About 450,000



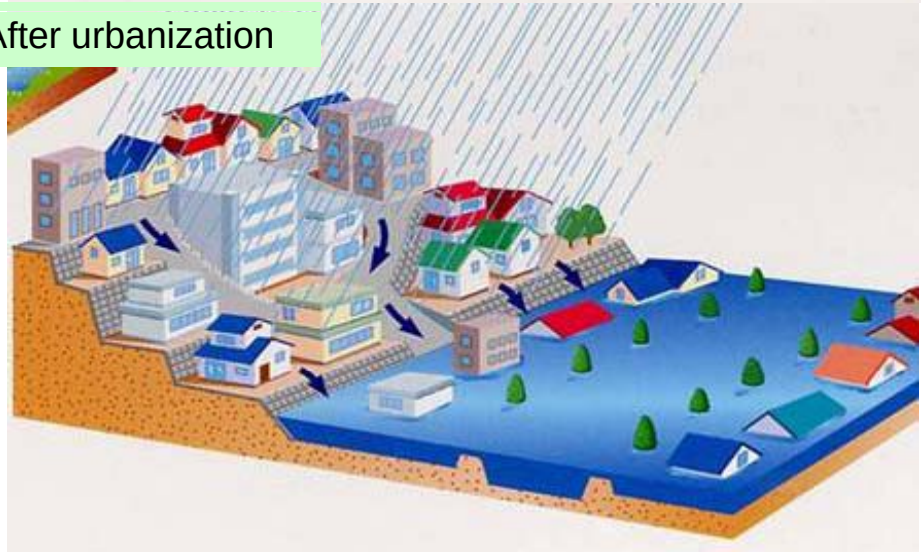
2004
Urbanization rate: About 85%
Population: About 1.88million



Rapid urbanization has resulted in the elimination of rice fields and forests that naturally serve to hold rainwater and absorb it into the ground. There has thus been an increase in the amount of surface runoff flowing into the river, increasing the chances of flooding.

Before urbanization

After urbanization



Comprehensive flood control measures to secure sustainable development

1)River improvement

- River channel improvement
- Construction of dams, retarding basins and discharge channels etc.

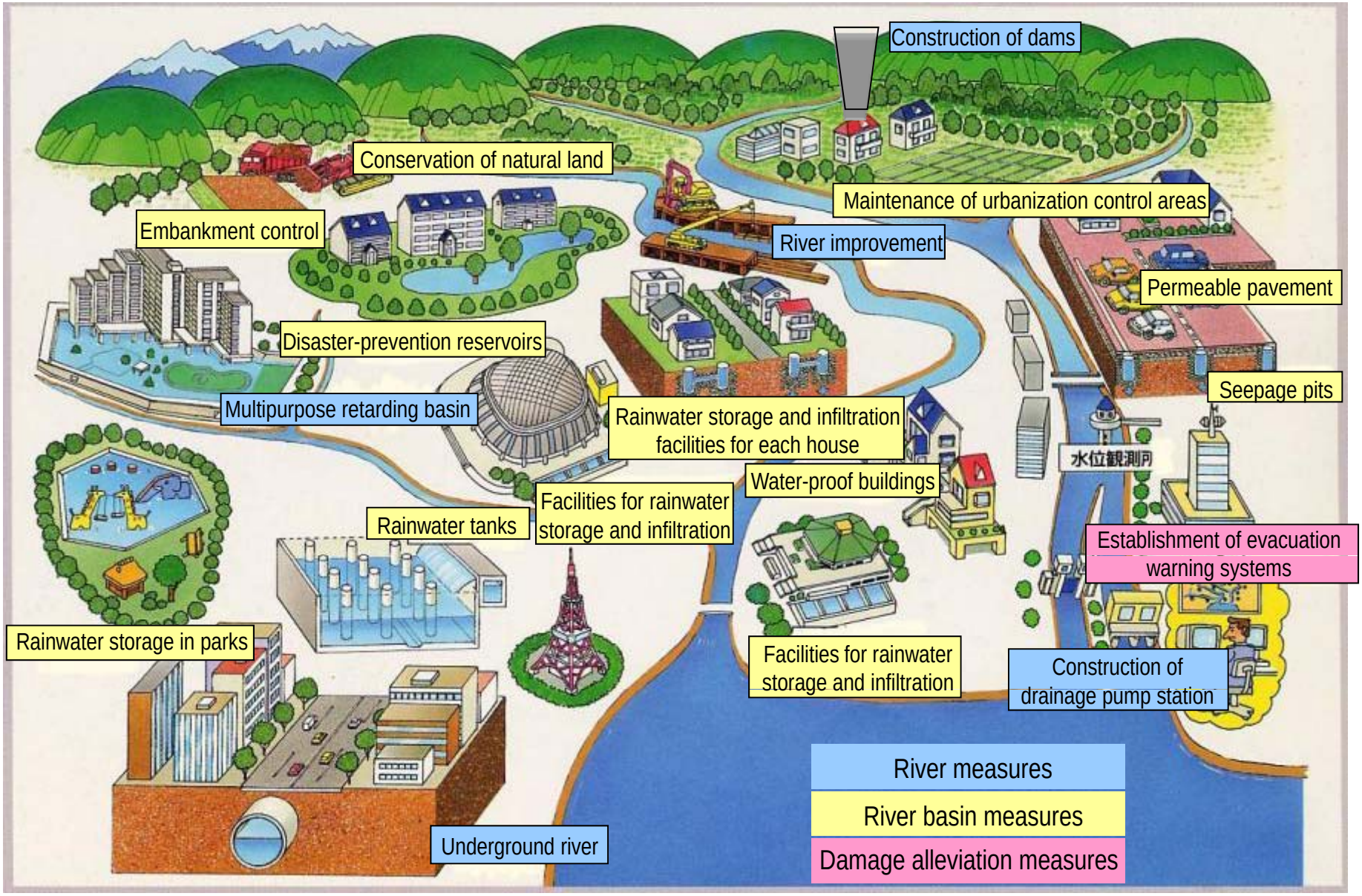
2)Measures for river basins

- Maintaining urbanization control areas
- Conservation of fields
- Constructing reservoirs
- Constructing rainwater tanks
- Constructing permeable pavements and seepage pits

3)Measures to alleviate damage

- Establishing the evacuation warning systems
- Upgrading flood diffence systems
- Promoting awareness of local residents

Comprehensive Flood Control Measures in River Basin

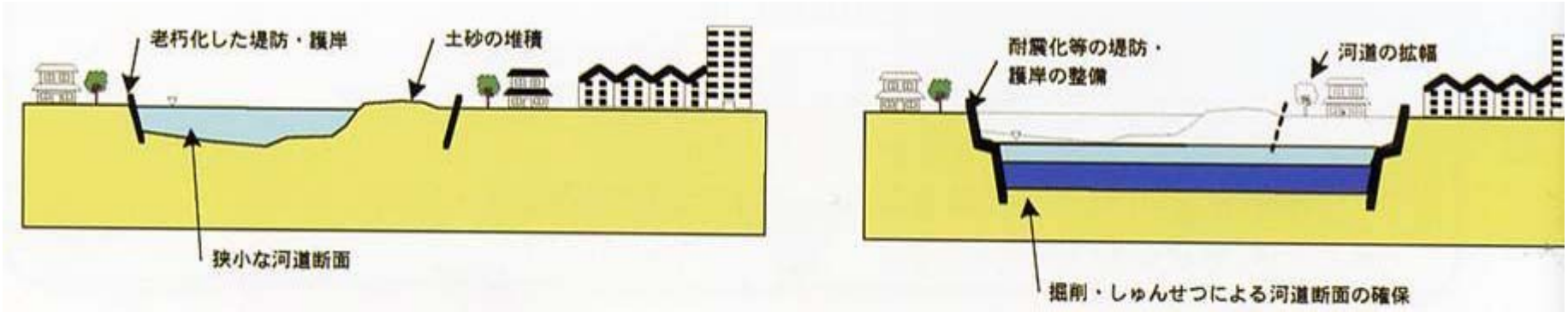


River channel improvement

Widen and dredge rivers

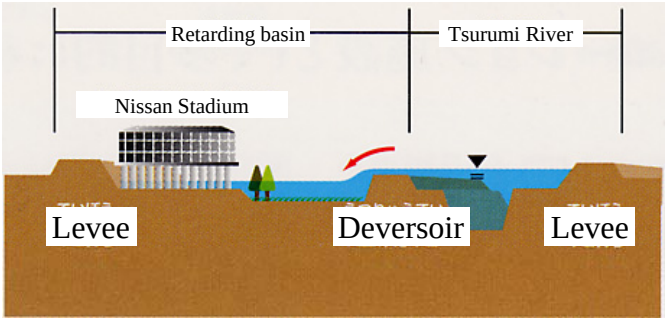
before

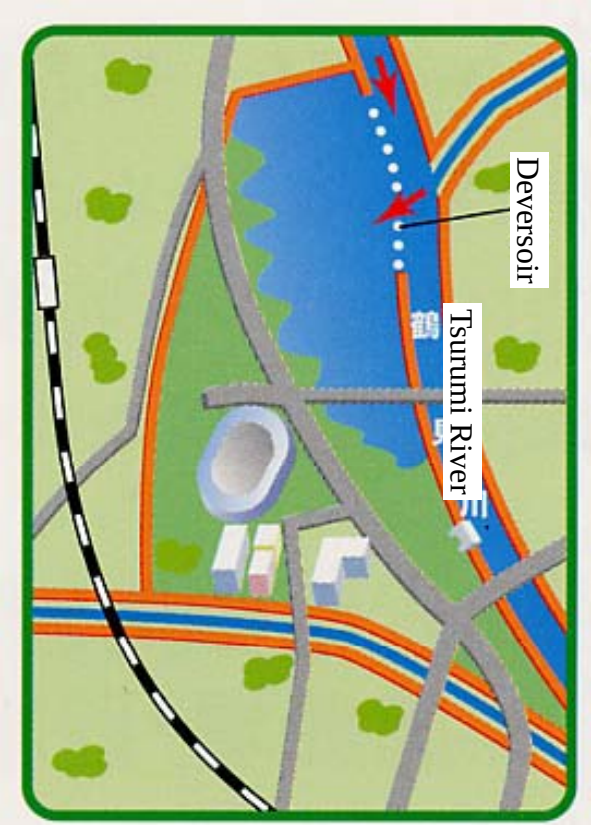
after



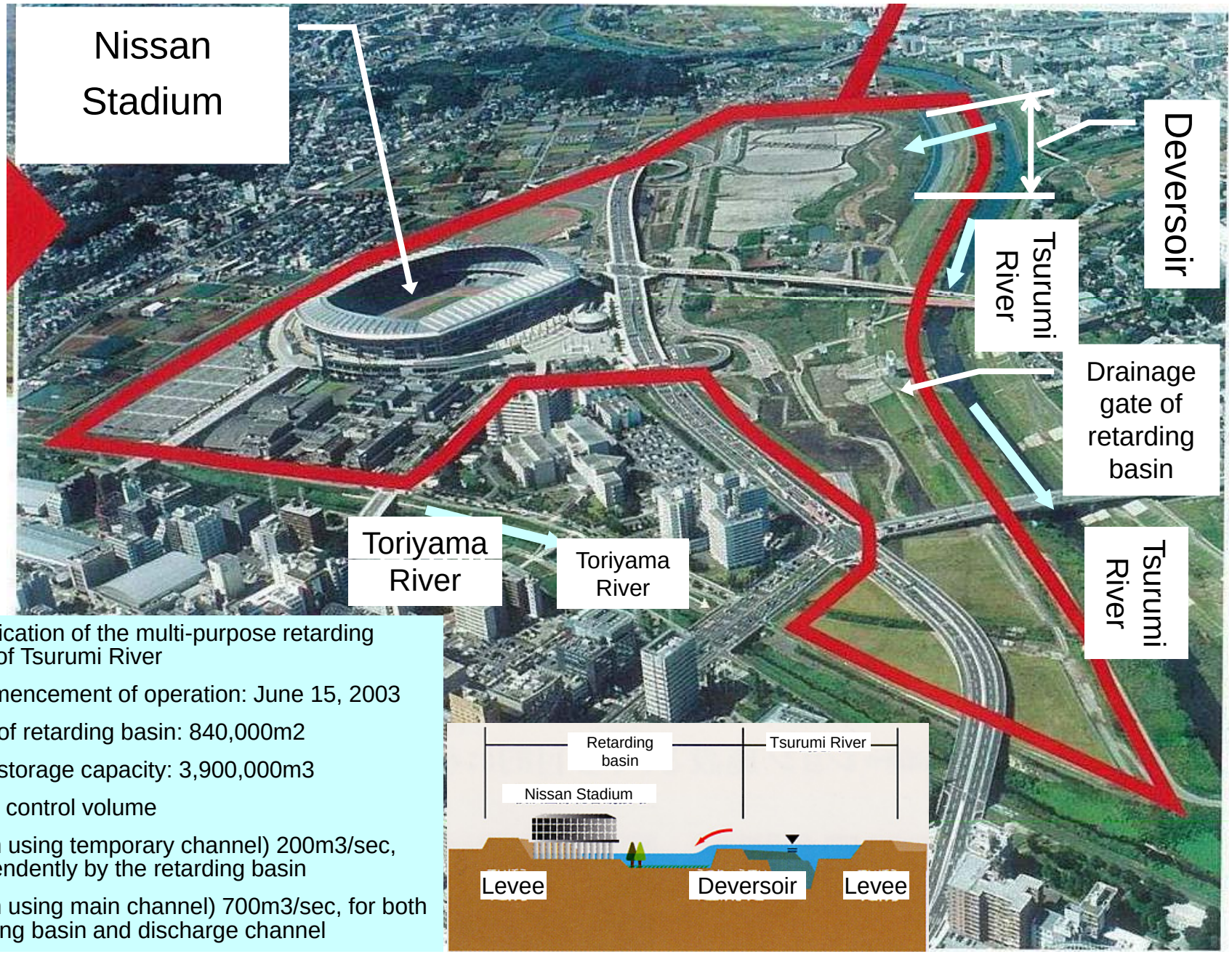
River Improvement (Construction of Retarding Basin, Discharge Channel, etc.)

Multi-purpose retarding basin of Tsurumi River





Multi-Purpose Retarding Basin of Tsurumi River



Specification of the multi-purpose retarding basin of Tsurumi River

- Commencement of operation: June 15, 2003
- Area of retarding basin: 840,000m2
- Total storage capacity: 3,900,000m3
- Flood control volume

(When using temporary channel) 200m3/sec, independently by the retarding basin

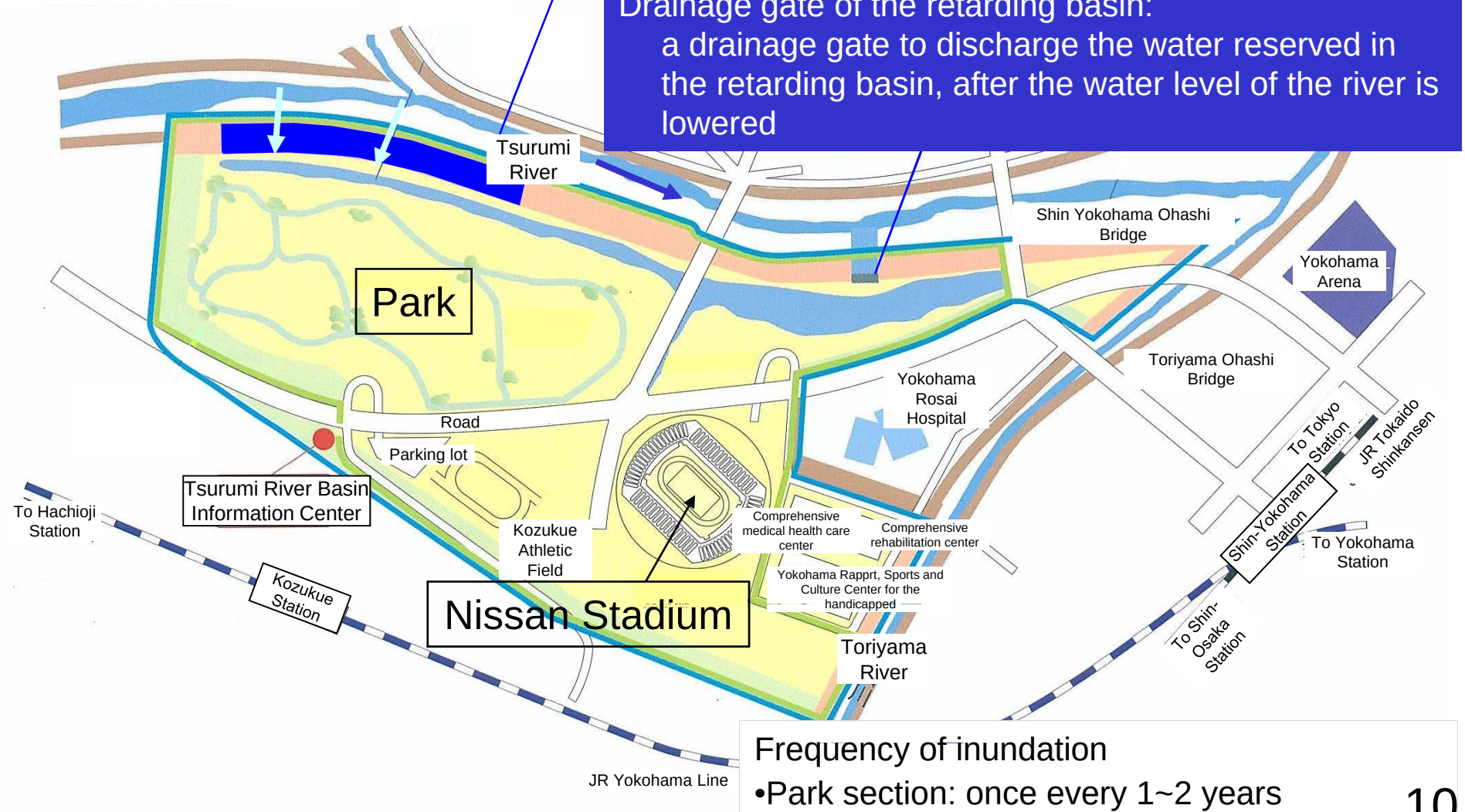
(When using main channel) 700m3/sec, for both retarding basin and discharge channel

Overview of the Retarding Basin of Tsurumi River

Deversoir: the levee at the lowest stage to allow the flooded river into the retarding basin

Drainage gate of the retarding basin: a drainage gate to discharge the water reserved in the retarding basin, after the water level of the river is lowered

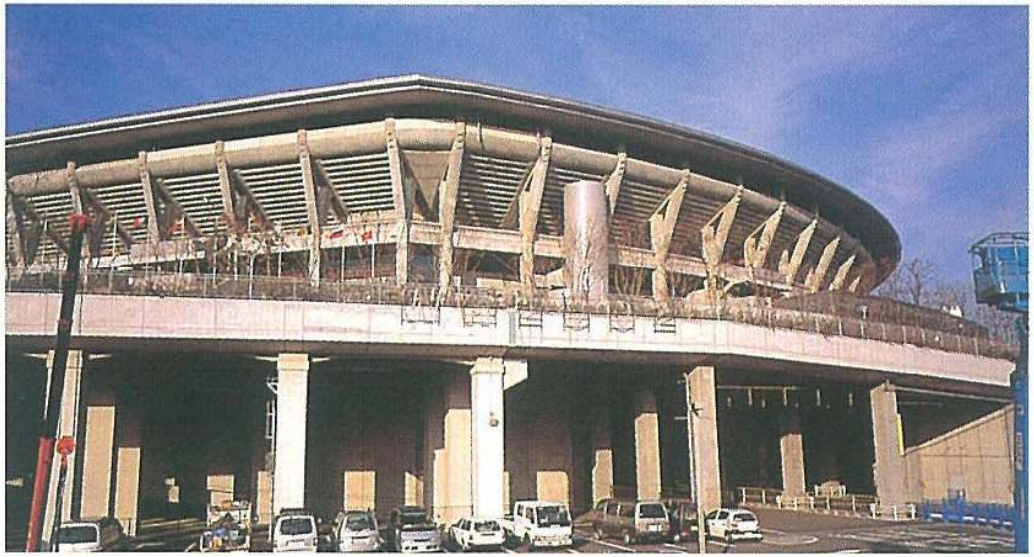
Plain view of the retarding basin



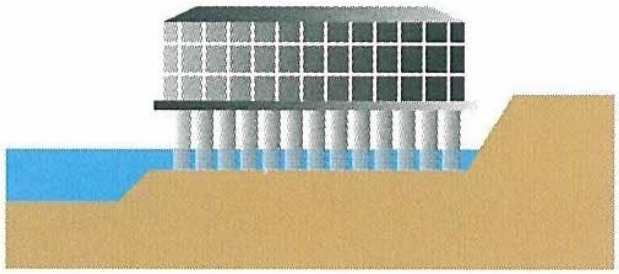
Frequency of inundation
- Park section: once every 1~2 years
- Athletic field section: once every 4~5 years

Introduction of Pilotis

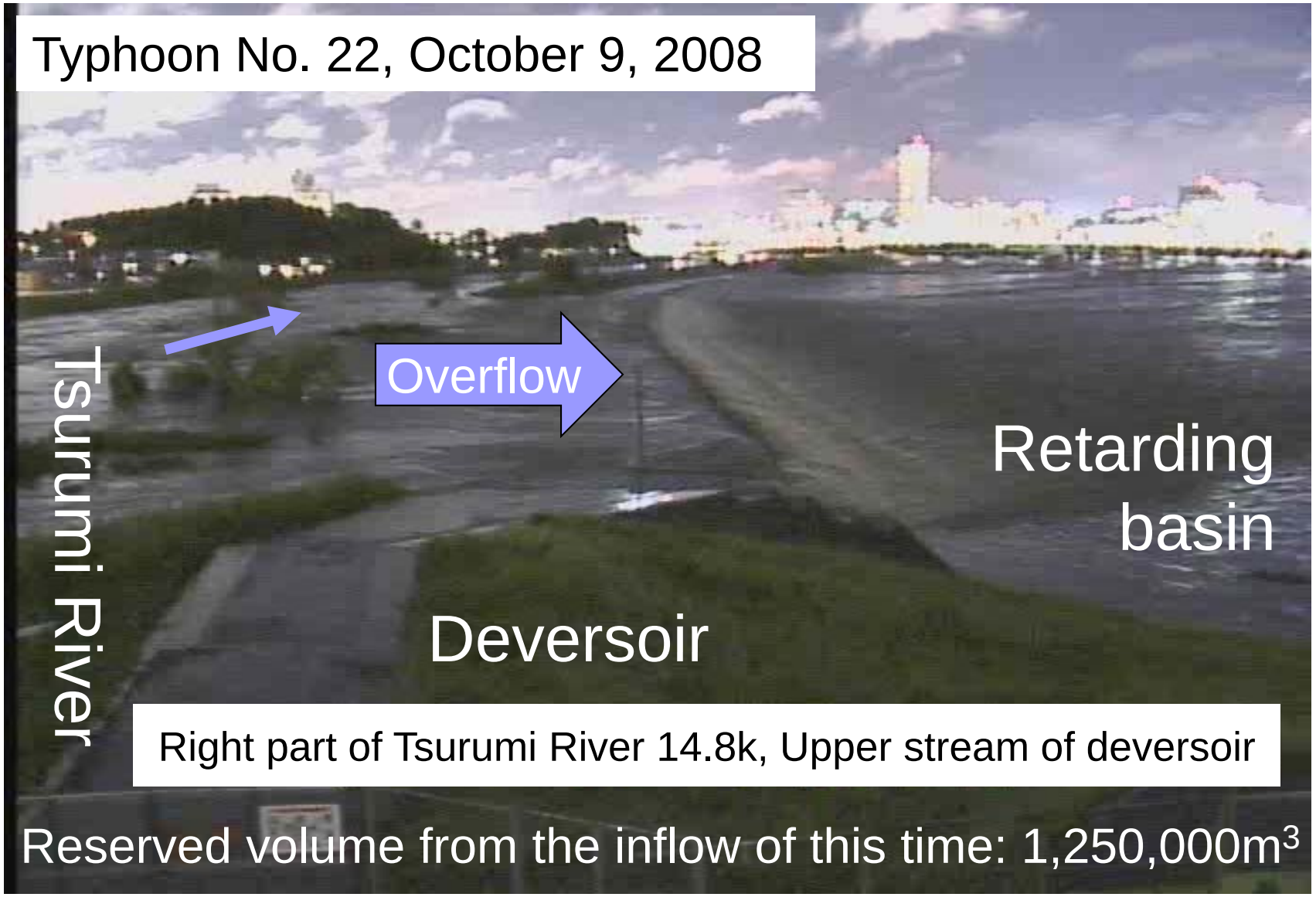
Facilities are built in the retarding basin including the Nissan Stadium, the comprehensive medical health care center, the Sports and Culture Center for the handicapped of Yokohama Rapport, etc. These facilities are built on pilotis (raised-floor) in order to avoid submergence in case of the river overflowing into the retarding basin.



Pilotis structure employed for Nissan Stadium



Condition of Inflow into the Multi-Purpose Retarding Basin of Tsurumi River



Construction of subterranean regulation reservoir

Constructing flood control pond

Flood control pond temporarily stores rainfall so that it does not inundate rivers all at once .

Kirigaoka reservoirs
（Tsurumi River）

Development of rainwater storage facilities

Storing rainwater in a schoolyard

normally

flooded

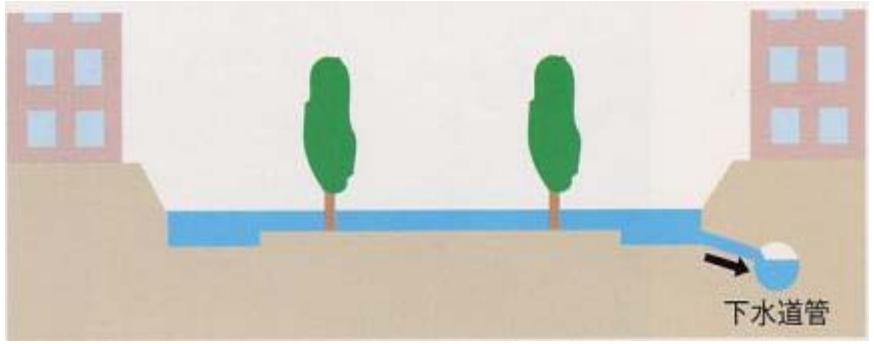
Constructing permeable pavements

permeable pavement

permeable tile pavement

Tokyo

Rainwater storage between buildings in apartment complexes



Installation of Infiltration facilities

Seepage pits・Seepage trench