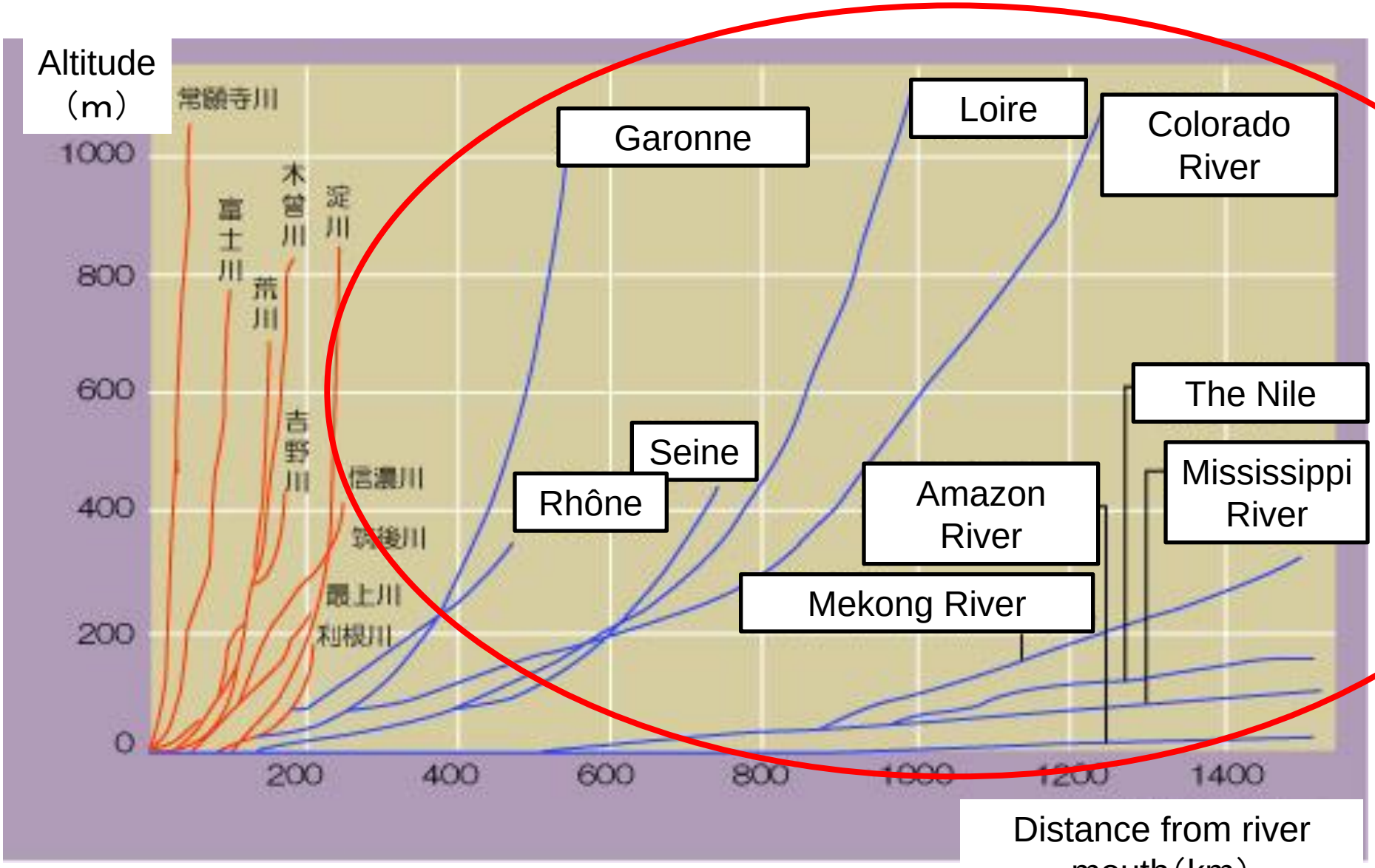
Flood control for sewerage in Tokyo

November,12,2014

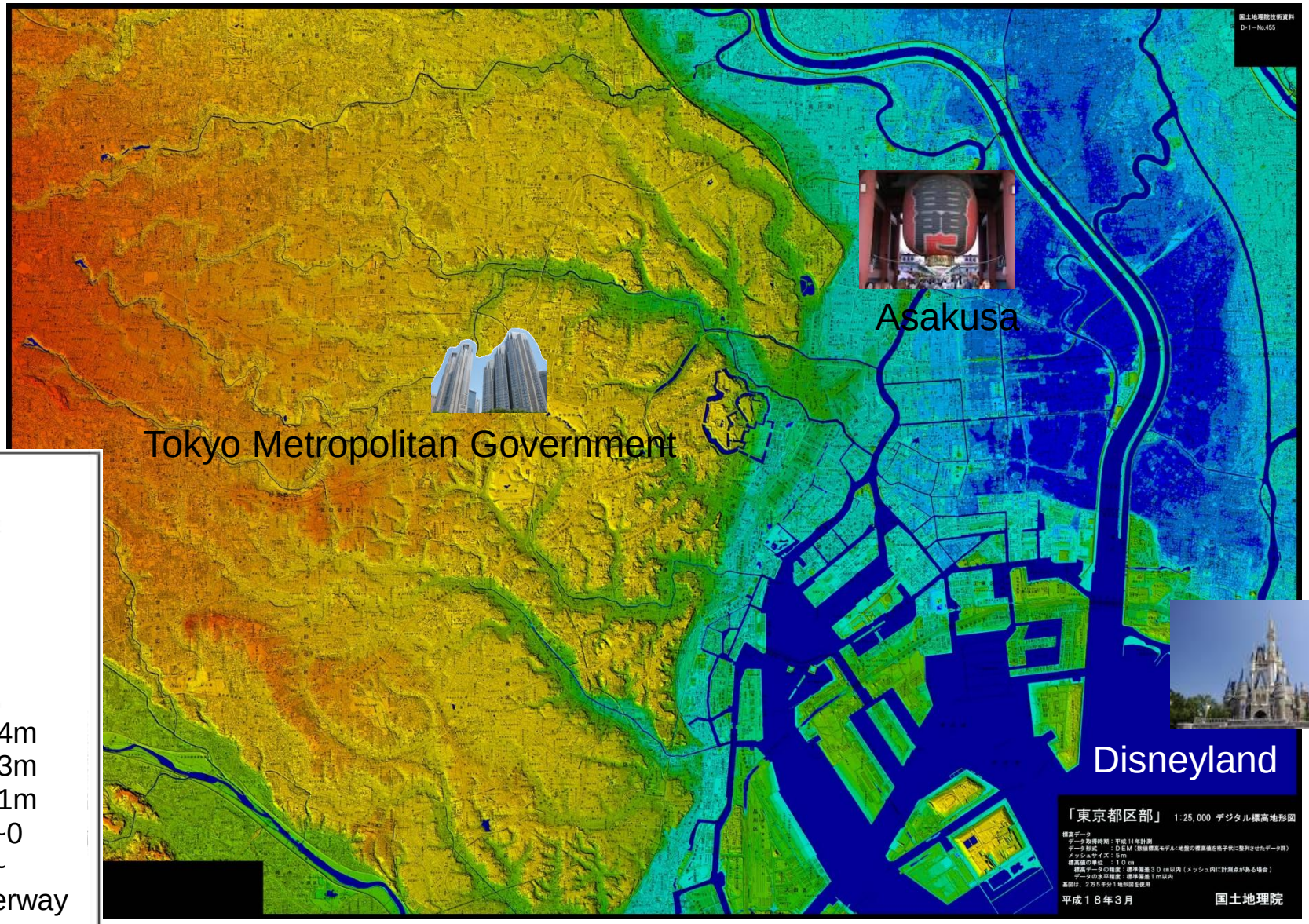
Planning Section

Planning and Coordinating Division

Characteristics of the rivers of Japan



Terrain of Tokyo



Sewerage in Tokyo ①

Outline

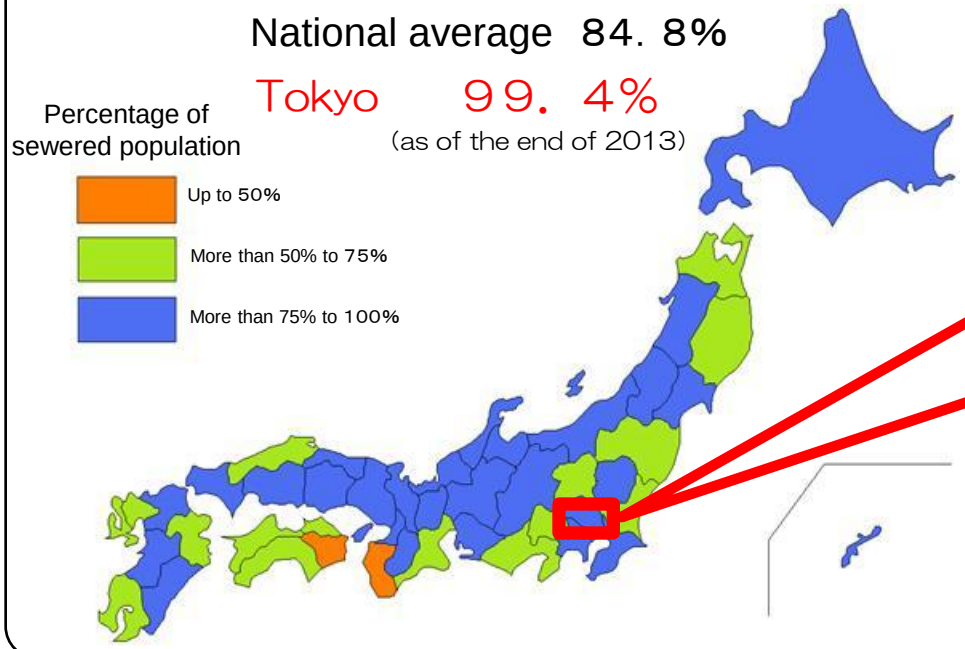
- Tokyo is the capital of Japan, and the political, governmental and economic center of the country.
- The percentage of sewered population is 99.7%, the highest in the country.
- Sewage Works are implemented in two areas: the Tama area and the 23 wards of Tokyo.

Percentage of sewered population

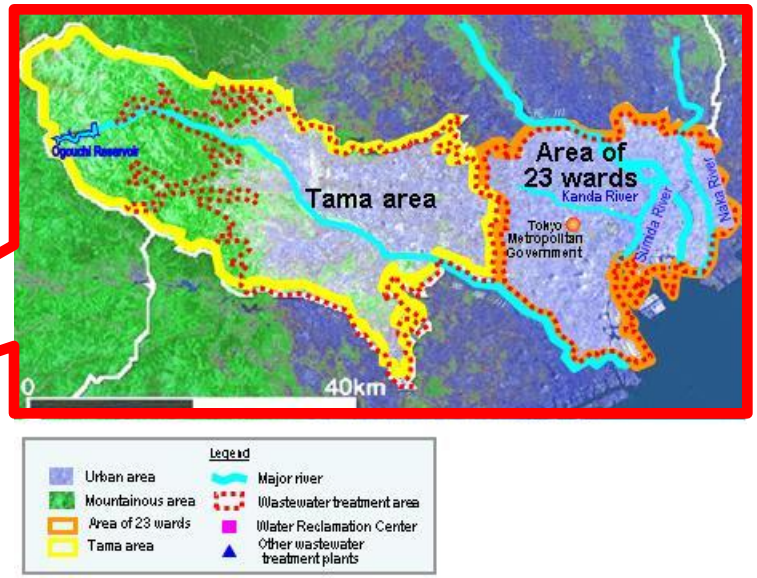
National average 84. 8%

Tokyo 99. 4%

(as of the end of 2013)



▼Topography of Tokyo, and location of Water Reclamation Centers



Sewerage in Tokyo ②

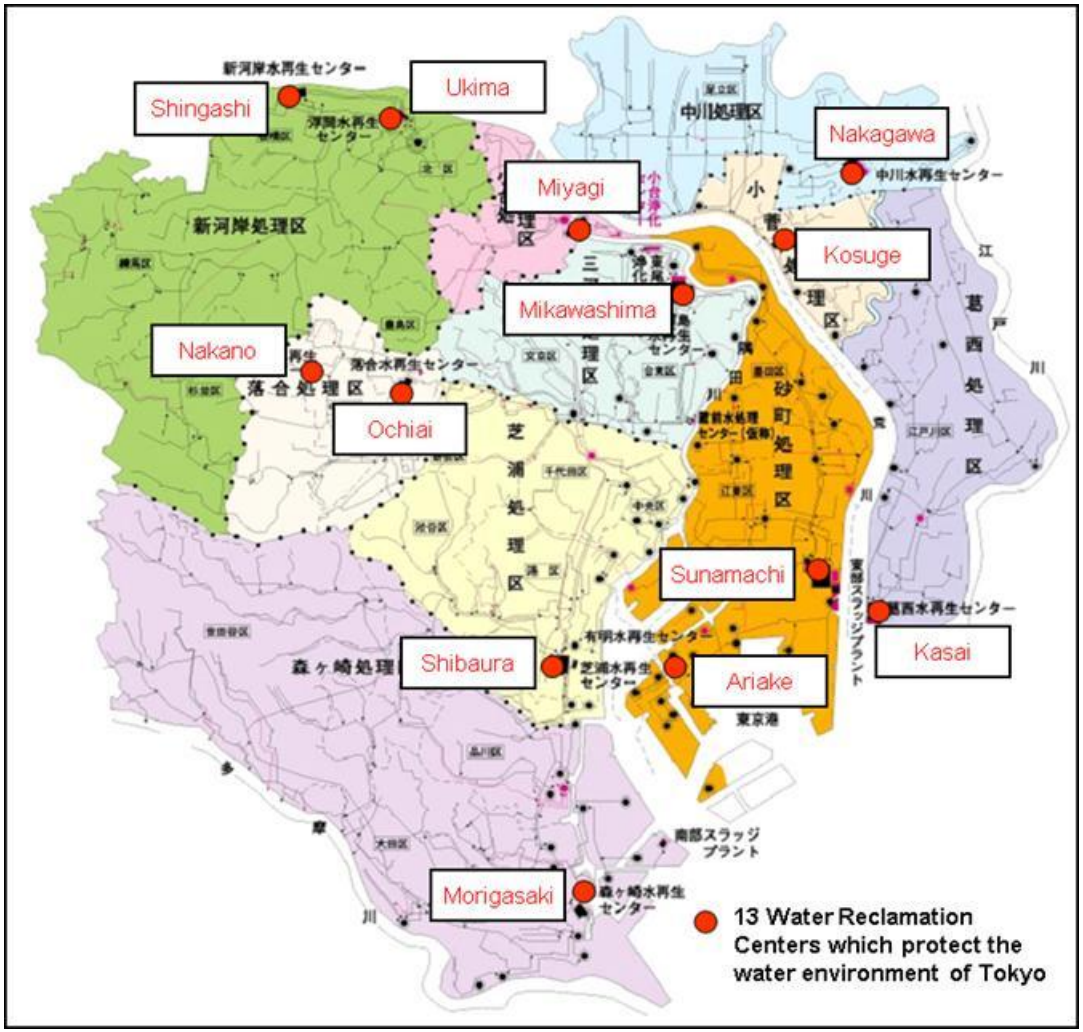
(as of the end of 2013)

Item	23 wards	Tama area
Total sewered area	57,839 ha	49,095 ha
Sewered population (at night)	8,692 million	3,496 million
Percentage of sewered population	100 %	98 %
Sewerage system	Mainly a combined system	Mainly a separete system
Capacity	6,349 million m^3/day	1,433 million m^3/day
Total amount of water treated per year[daily average]	1,578,759 million m^3 [4,325 million m^3/day]	333,214 million m^3 [912 million m^3/day]
No. of water reclamation center	13	7
No. of pumping stations	84	2

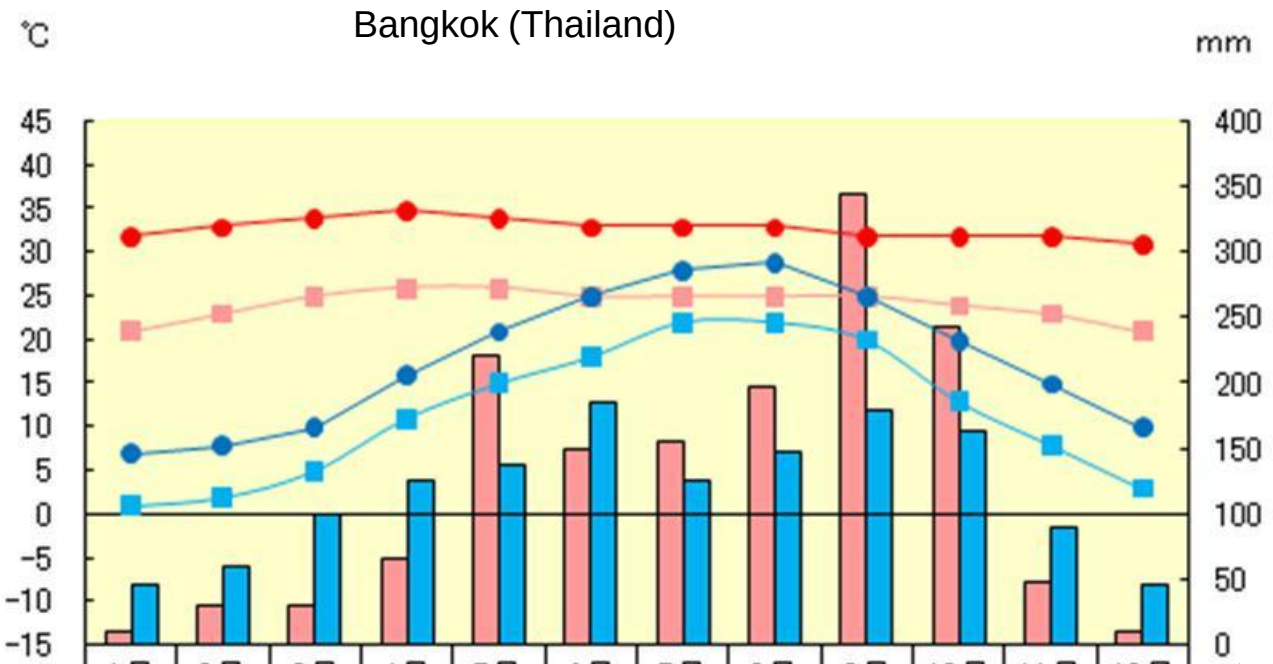
Sewerage of the 23 wards in Tokyo

- Tokyo started building a modern sewerage system in 1884, and the percentage of sewered population reached 100% in 1994.
- 82% of area is a combined sewer system, and 18% of area adopts a separate sewer system.
- A sewer is treated sewer pipes extending a total length of about 16,000 km, 85 pumping stations, 13 Water Reclamation Centers, and two sewage sludge treatment plants.

【Overall project plan 】



Temperature and precipitation of Bangkok and Tokyo



	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月
Rainfall (Thailand)	9	30	29	65	220	149	155	197	344	242	48	10
Rainfall (Tokyo)	45	60	99	125	138	185	126	147	180	164	89	46
Highest temperature (Thailand)	32	33	34	35	34	33	33	33	32	32	32	31
Lowest temperature (Thailand)	21	23	25	26	26	25	25	25	25	24	23	21
Highest temperature (Tokyo)	7	8	10	16	21	25	28	29	25	20	15	10
Lowest temperature (Tokyo)	1	2	5	11	15	18	22	22	20	13	8	3

Annual precipitation

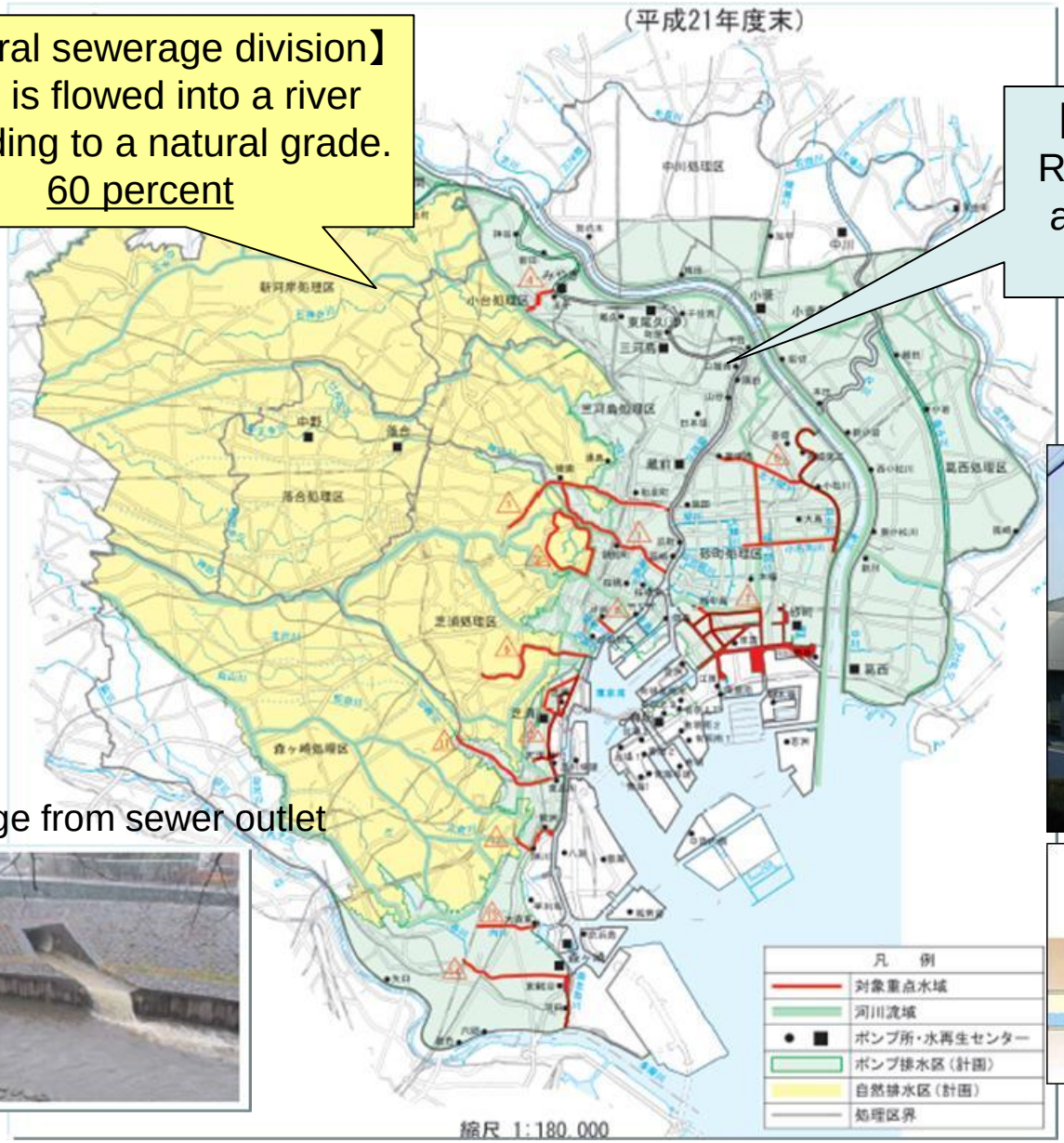
It is almost the same.（1,500mm/year）

webサイト「旅行．Info」より引用http://www.ryoko.info/index.

Sewerage system of Tokyo

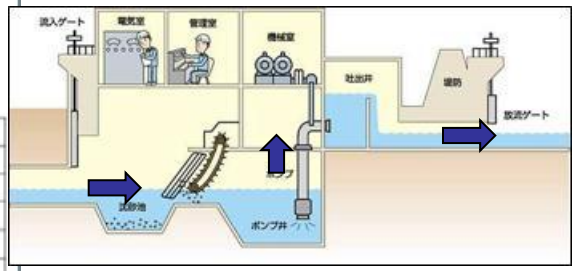
【Natural sewerage division】
Rain is flowed into a river according to a natural grade.
60 percent

【Pump sewerage division】
Rain is flowed into the sea or a river by pumping stations.
40 percent



Rainwater pumping station

Discharge from sewer outlet



Flood damage in recent years

Frequent urban flood disasters

- There has been an increasing amount of rainwater discharge due to ongoing urbanization.
- Super typhoons and localized torrential rains frequently occur.

Date	Meteorological phenomenon	Maximum hourly rainfall (mm/h)	Above and below floor level inundation (No. of buildings)
Oct. 9, 2004	Typhoon No. 22	73	993
Oct. 20, 2004	Typhoon No. 23	45	402
Aug. 15, 2005	Heavy rain	79	191
Sep. 4, 2005	Heavy rain	112	5,048
Aug. 5, 2008	Heavy rain	59	171
Jul. 5, 2010	Heavy rain	107	729
Jul.23.2013	**Heavy rain**	**102**	**442**

Typhoon No. 22 struck the area in October 2004
Azabu Juban subway station

Torrential rains hit the metropolitan area in September 4, 2005
Josui Bridge over the Kanda River
(1-chome Honan, Suginami Ward)

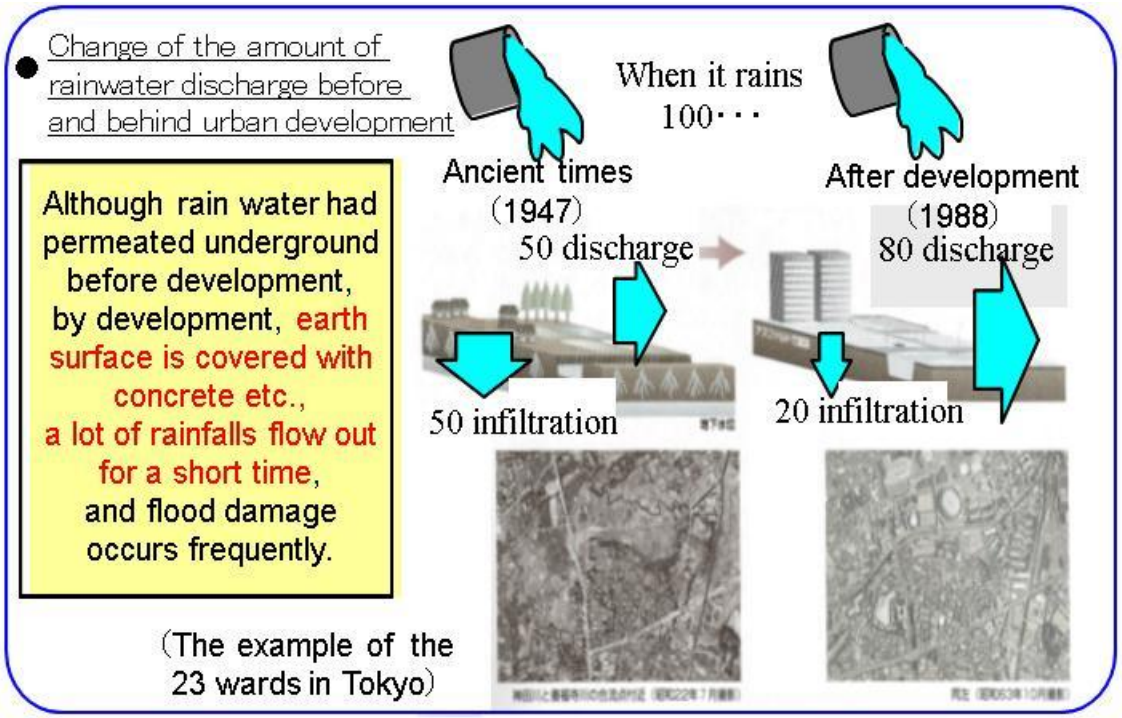
The generating factor of flood damage ①

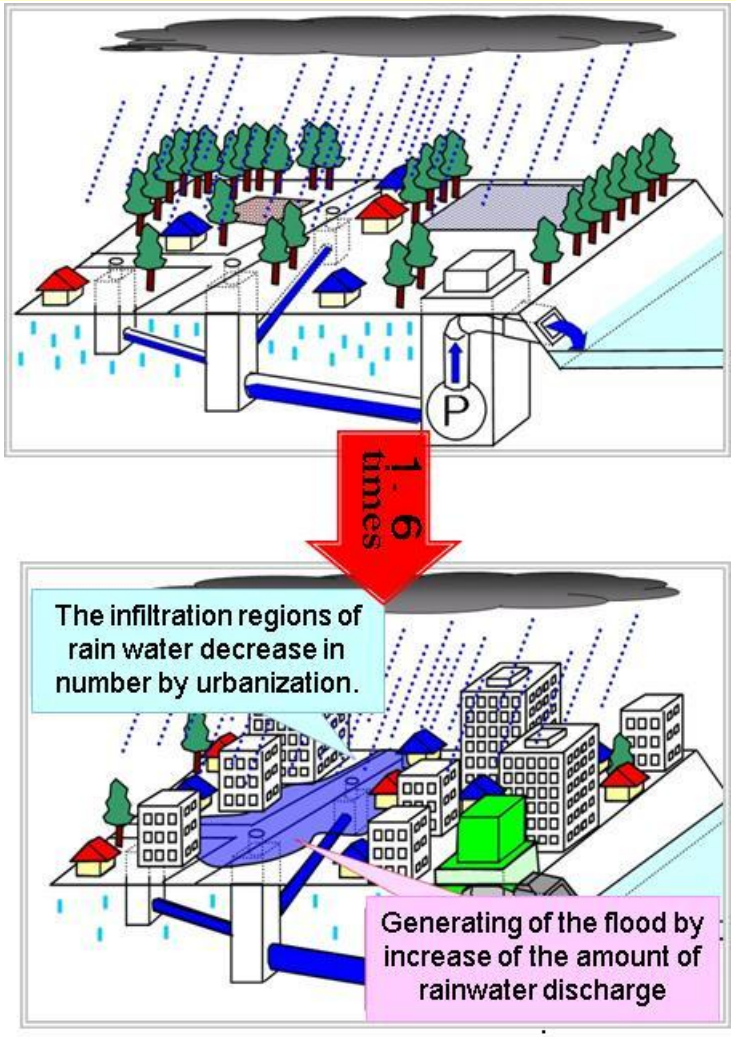
・Flood in recent years

⇒①Ongoing urbanization　② Change of raininess in recent years

③ The advancement of land use（An underground center, a basement etc.）

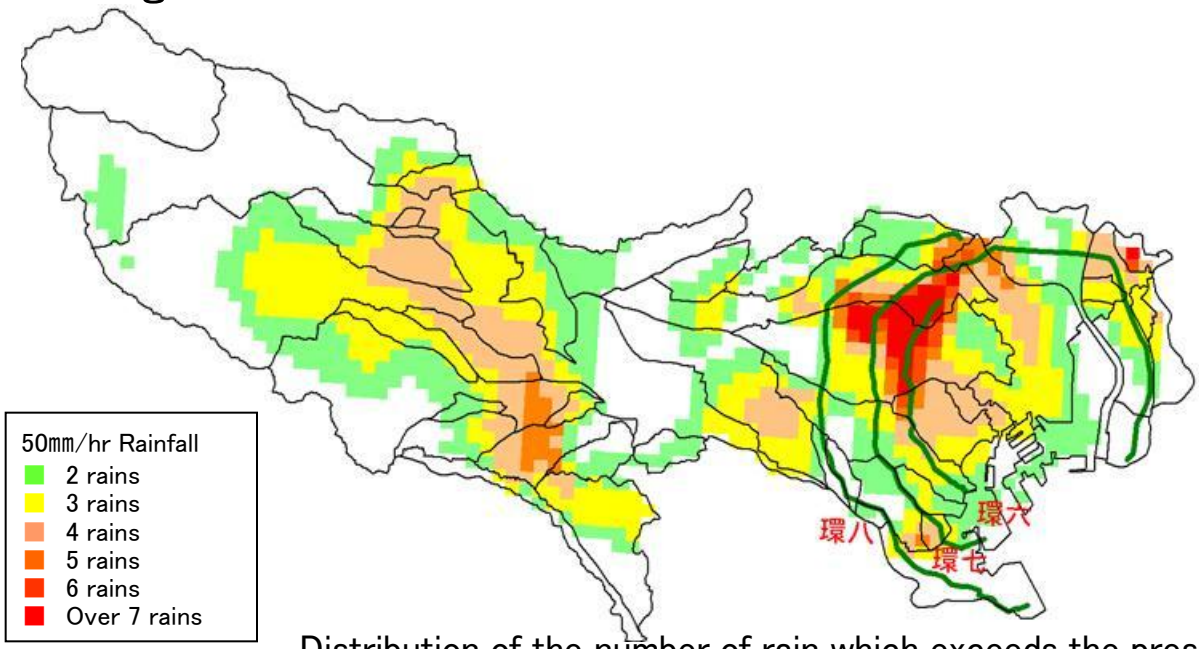
■ Ongoing urbanization





The generating factor of flood damage ②

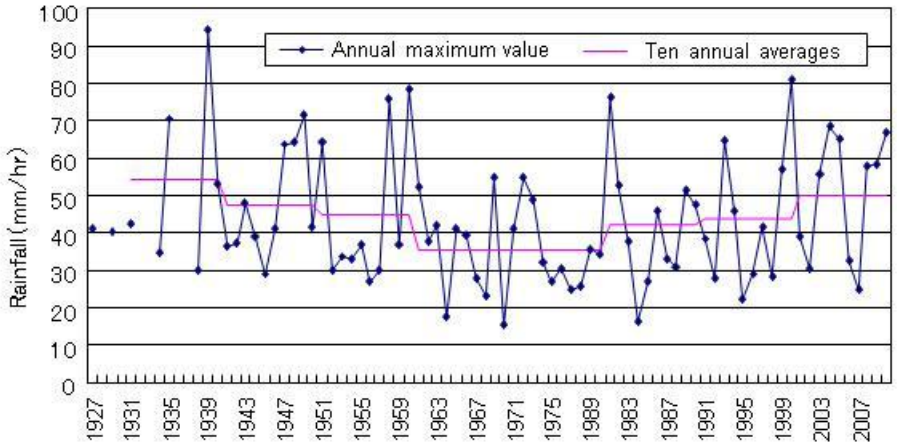
■ Change of raininess



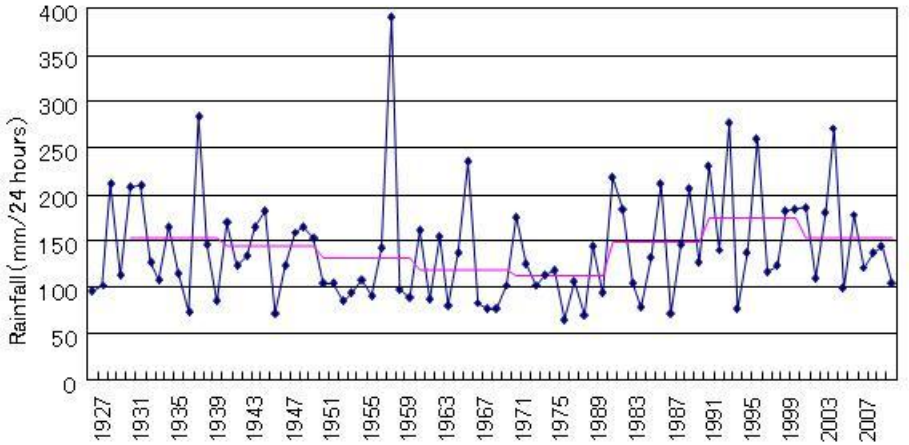
Distribution of the number of rain which exceeds the present plan rain（1989～2009）

An observatory with many rain which exceed the present plan rain

Observatory	The number of rain (Over 55 mm/hr)
Ekota	11
Saginomiya	10
Mizumoto	8
Itabashi-ku	8
Yayoicho	8
Nabeyoko	8



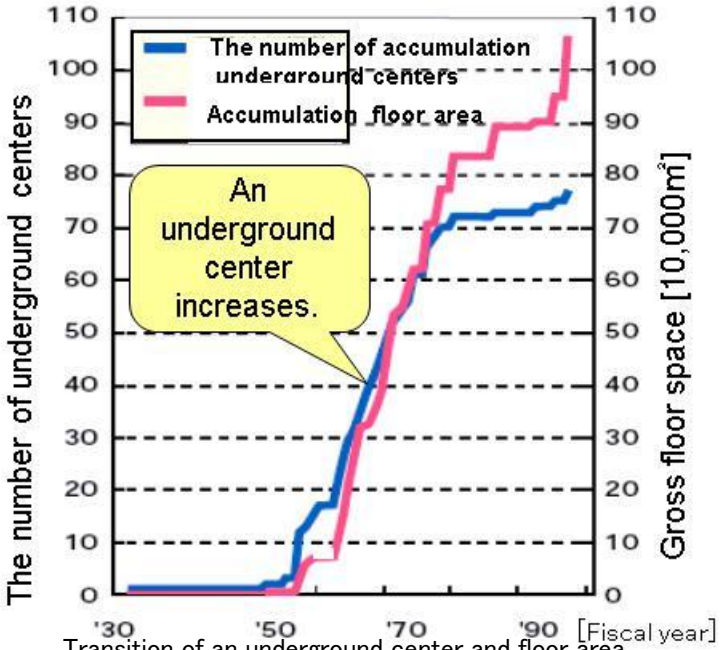
Year maximum-rain-fall aging of the Tokyo District Meteorological Observatories（ 1-hour rainfall ）



Year maximum-rain-fall aging of the Tokyo District Meteorological Observatories（ 24-hour rainfall ）

The generating factor of flood damage ④

■ The advancement of land use



Transition of an underground center and floor area
(KAJIMA technical research center web page)

【 The main underground damage examples in Tokyo 】

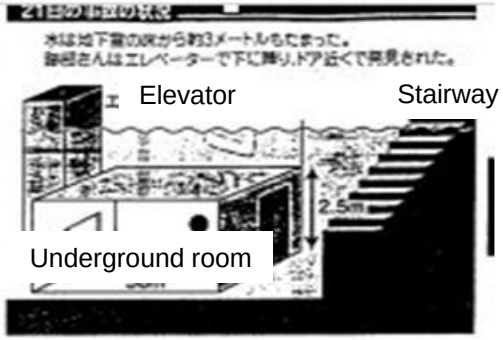
Generating date	Rain classification	Damage situation
July 22, 1977	Thunderstorm	Shinjuku SUBNADE is flooded.
August 27, 1993	Torrential rains	The track of a subway is covered with water and it is traffic rupture (Akasakamitsuke Station).
July 21, 1999	Thunderstorm	A door does not open with water pressure but one man dies (Shinjuku-ku).
August 29, 1999	Torrential rains	The Shibuya underground center is flooded.
October 9, 2004	Typhoon No.22	Azabu-juban Station is covered with water.
September 4, 2005	Torrential rains	341 buildings and The subterranean space of about 36,700㎡ is flooded (Kanda-gawa valley etc.).

August 27, 1993

Flood situation of Akasakamitsuke Station

July 21, 1999

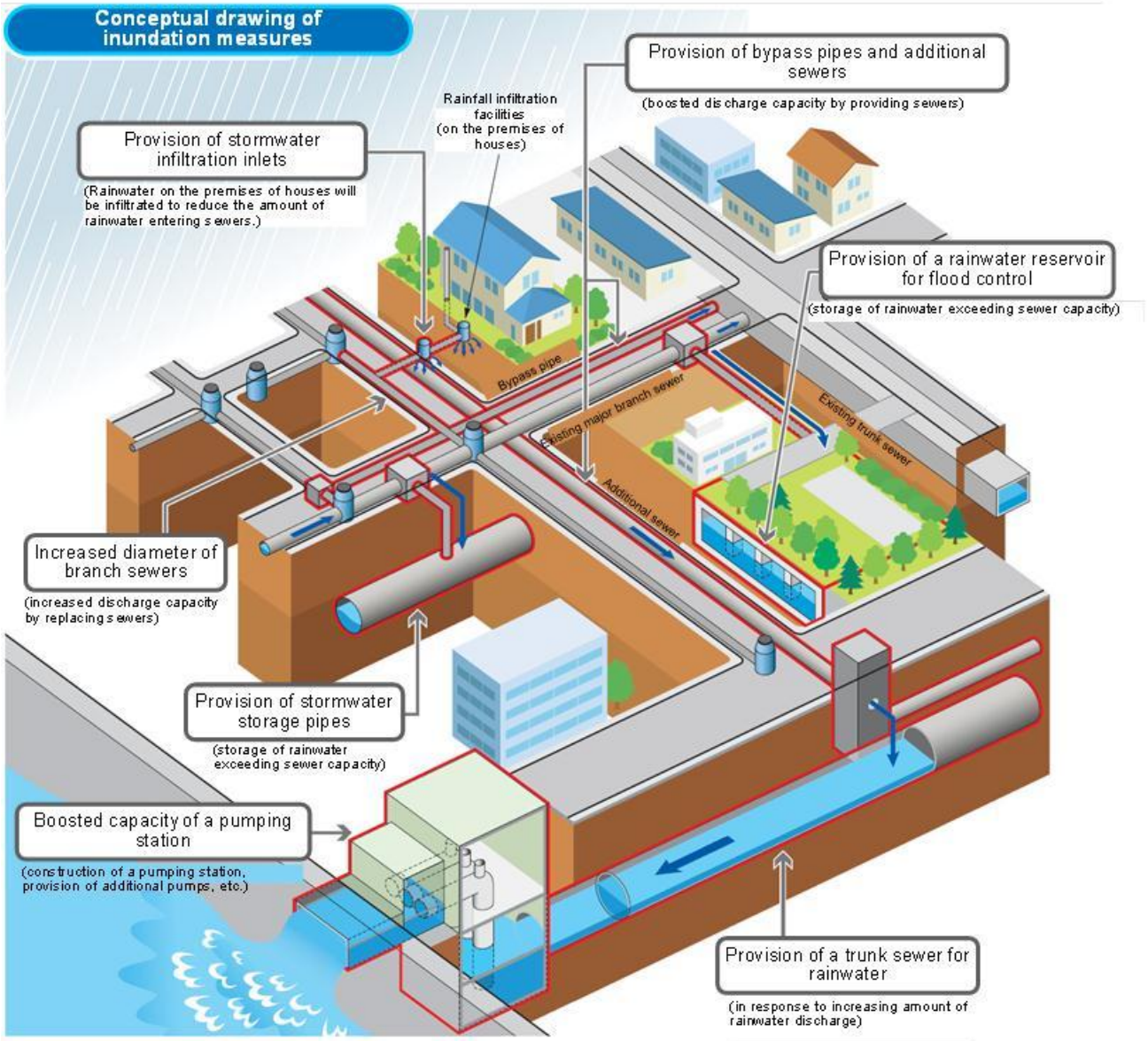
The flood situation of Shinjuku-ku



August 29, Heisei 11

The flood situation of the Shibuya underground center

The main contents of the hard measure of a sewer



▲ The second Tachiaigawa trunk

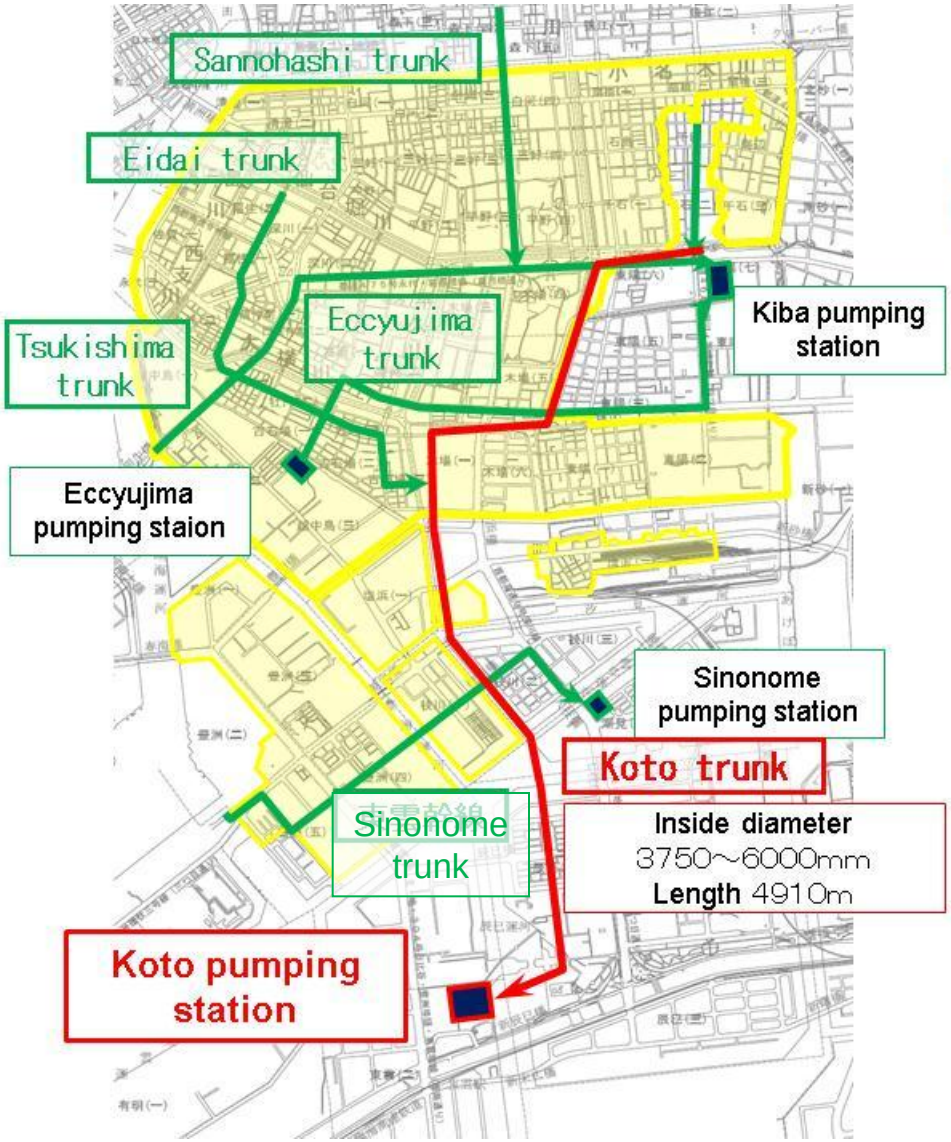
The capability of an established trunk is reinforced as flood control.

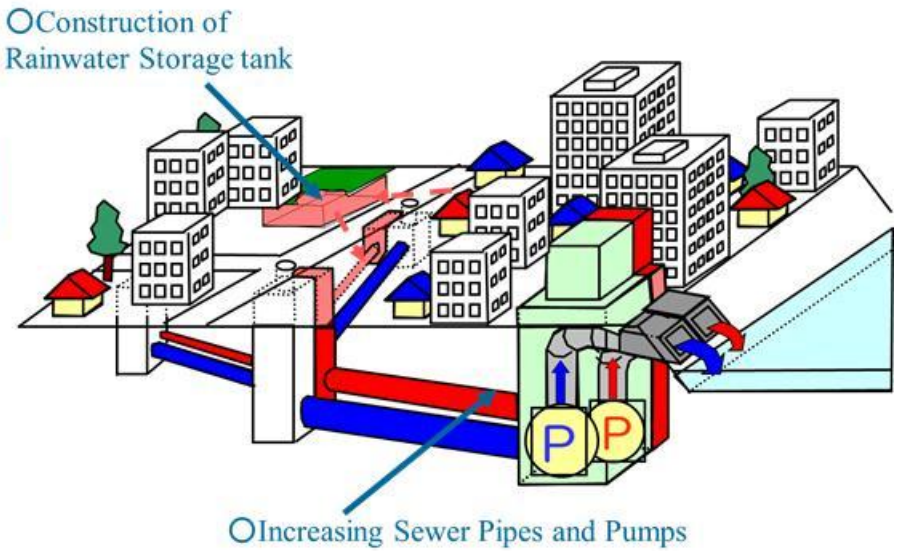
▲Minamisuna rainwater reservoir for flood control

The upper part is used effectively as collective housing etc. (the amount of storage of 25,000 m3).

The example of a hard measure ①

■ Koto trunk、Koto pumping station（ Kiba and Shinonome, Koto-ku, ）





Typical example

Basin

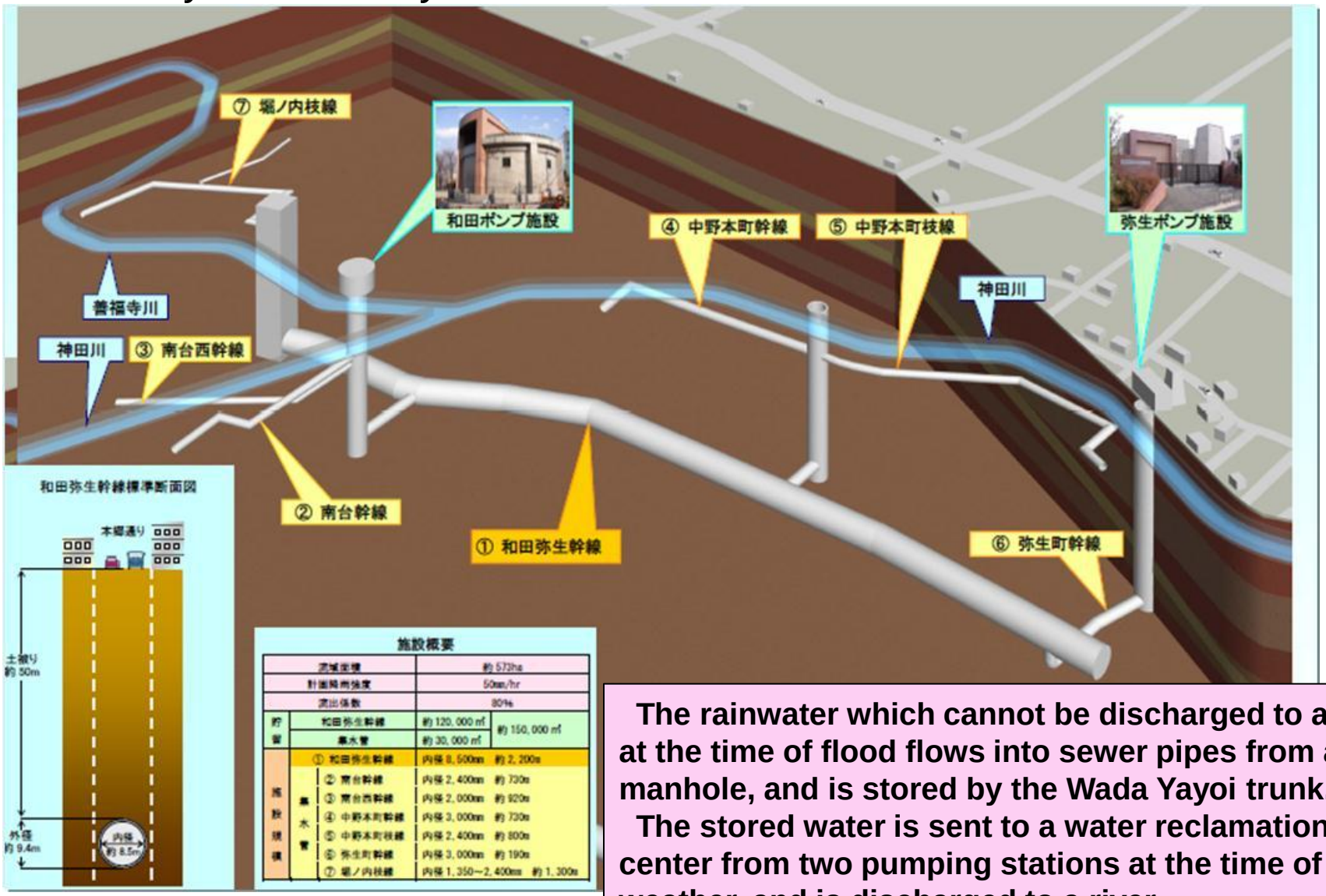
Measure pipe

Measure institution

Established pipe

The example of a hard measure ②

■ Wada Yayoi trunk（ Yayoi-cho and Wada, Nakano-ku, ）

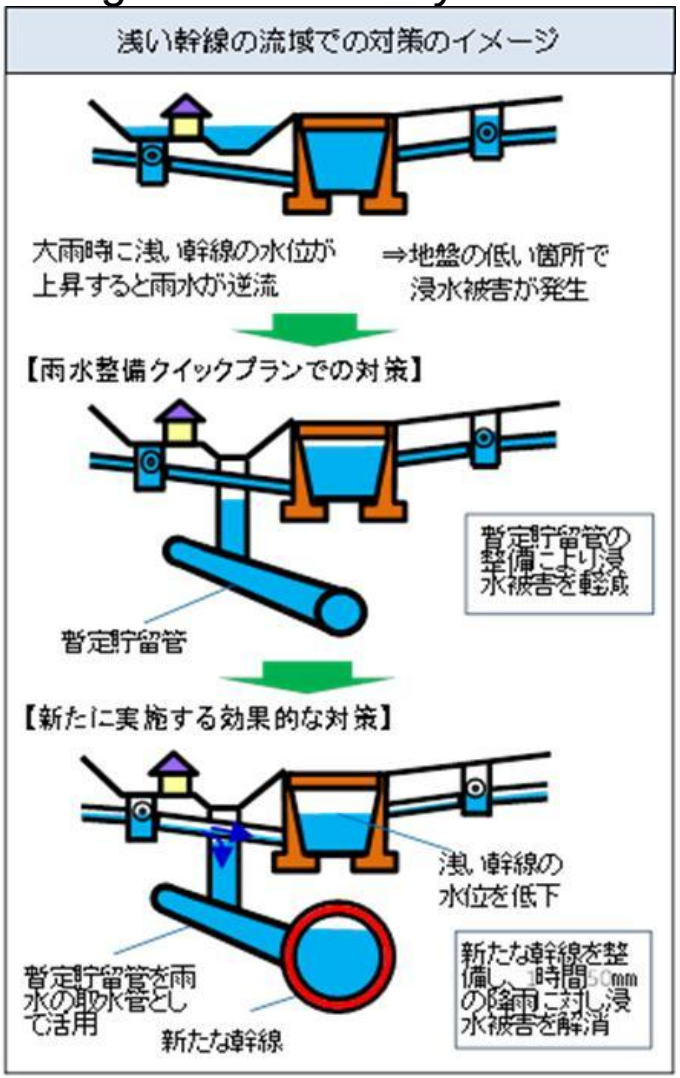


The rainwater which cannot be discharged to a river at the time of flood flows into sewer pipes from a manhole, and is stored by the Wada Yayoi trunk.

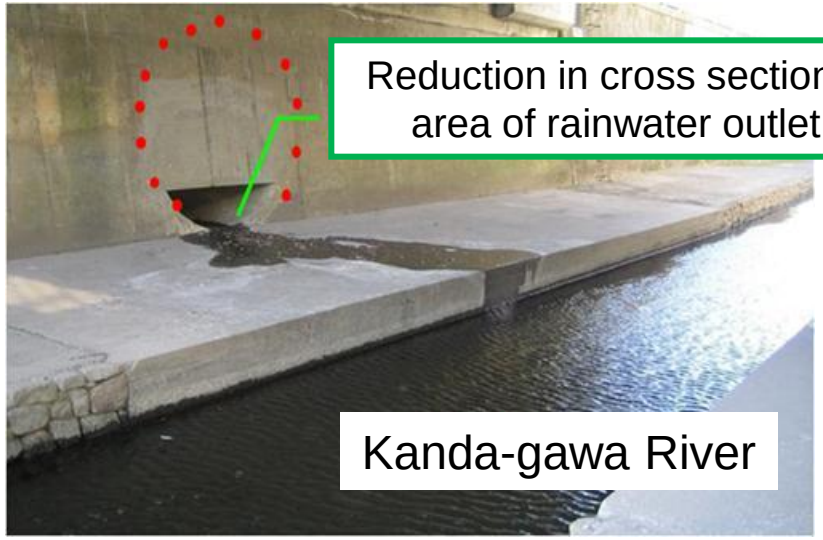
The stored water is sent to a water reclamation center from two pumping stations at the time of fine weather, and is discharged to a river.

The example of a hard measure ③

■ Effective institution maintenance to the valley etc. of the trunk laid underground shallowly



■Relief of the outflow rate regulation to a river from the sewer united with progress of river maintenance



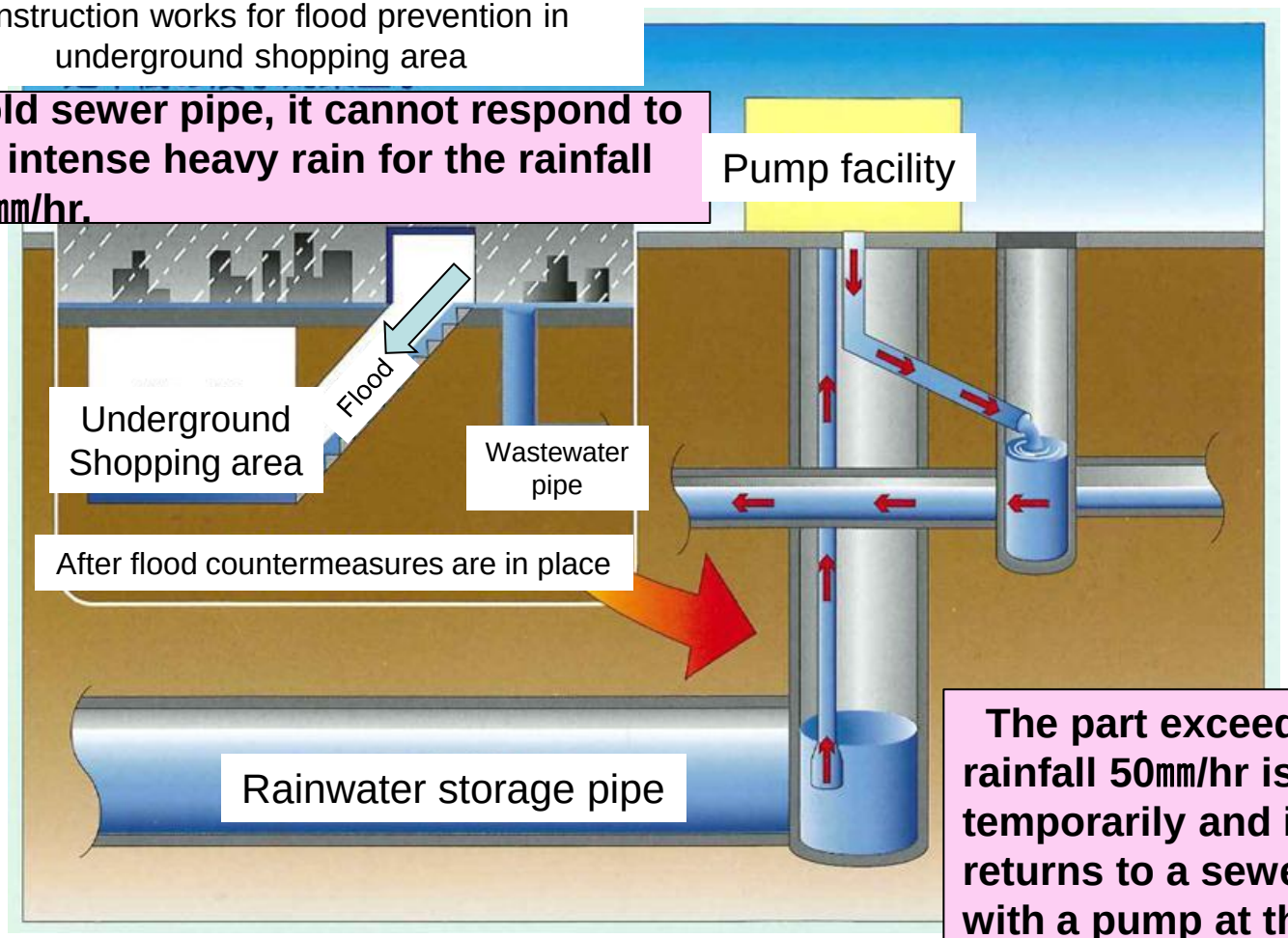
In accordance with the progress of river maintenance of the discharge place of a sewer, regulation of the outflow rate to the river in rainwater outlet is eased, and mitigation of flood damage is aimed at.

The example of a hard measure ④

■It corresponds to the rainfall 75㎜/hr in the large-scale underground center where serious damage is expected by flood.

Construction works for flood prevention in underground shopping area

With an old sewer pipe, it cannot respond to temporary intense heavy rain for the rainfall of until 50㎜/hr.



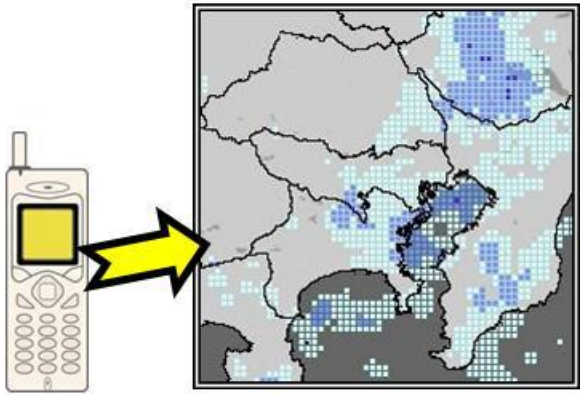
The part exceeding rainfall 50㎜/hr is stored temporarily and it returns to a sewer pipe with a pump at the time of fine weather.

The example of a soft measure ①

■In order to urge self-help and mutual aid, the information about flood is disseminated positively.

○Tokyo Amesh

The rain information on a sewer radar rain gauge system "Tokyo Amesh" is offered in real time, and prevention-of-floods activity and refuge activities are supported.



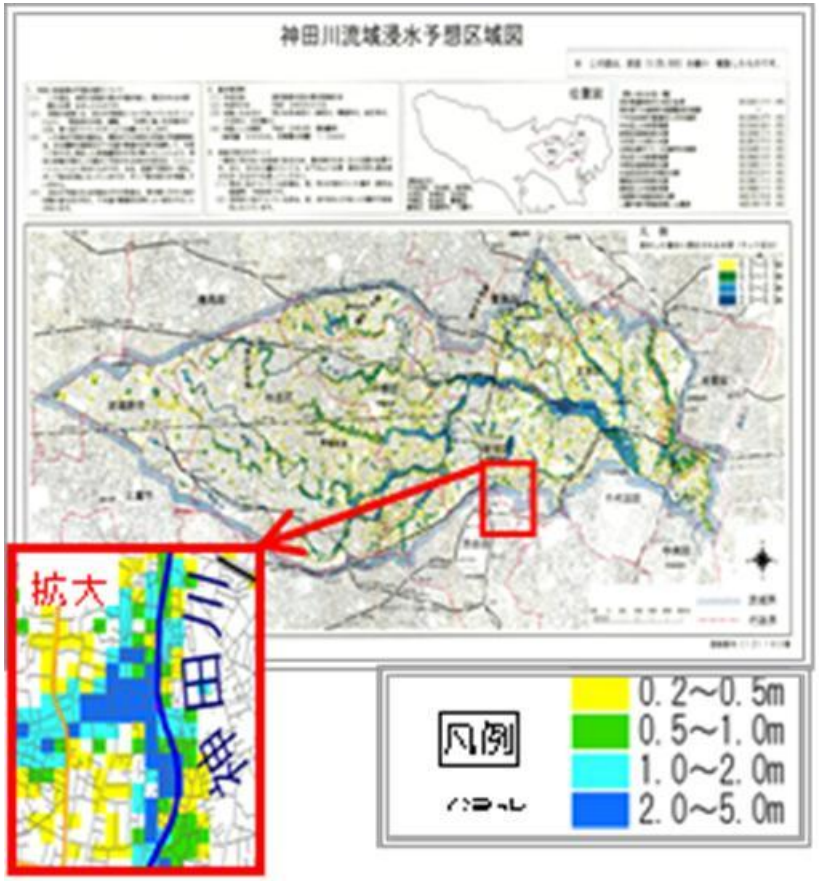
http://tokyo-ame.jwa.or.jp/

It is what made HP and a mobile phone consistent, and is about 72 million-affair (2013) access per year.

The example of a soft measure ②

○ hazard maps

A sewer and a river cooperate, the flood anticipation zone figure at the time of flood is created and released, and the danger of flood is well-known in advance.

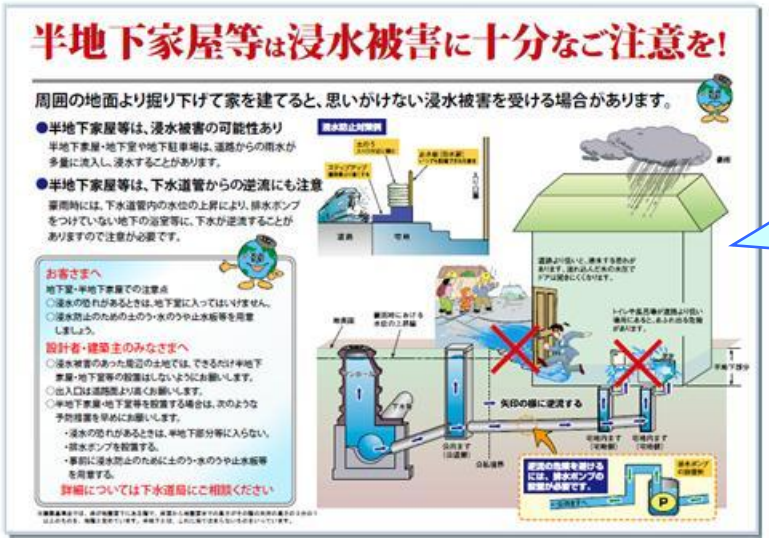


○The effect of infiltration of rain water is advertised positively.

The example of a soft measure ③

○June is preponderantly coped with by regarding it as "a flood prevention month."

The danger of a basement, etc. are advertised in the event about flood, etc.



A flood measure leaflet (a basement and for a half underground house measure) is created.

The example of a soft measure ④

- Distribution of information on trunk river water levels to a prevention-of-floods administrator etc. is expanded.

↓ The example of a display of information trunk river inside water level

（Shinagawaw-ku：Tachiai trunk）

項目	水位1	水位2	水位3	水位4	水位5	水位6	水位7	水位8	水位9
水位 (m)	−2.20	−2.00	−1.30	−1.10	−1.00	−11.0	−0.60	−0.55	−0.40
人孔No.	3314-1C-28	3414-1C-21	3415-3B-15	3416-3A-27	3416-2B-20	3416-3B-27	3417-2B-22	3417-2B-20	3417-4B-16

↓ Electrical scoreboard

（Nakano-ku：Momozono trunk）

Usually, prevention-of-floods activity is supported by displaying the water level of the sewer trunk which cannot be seen and offering it to a related division.

Thank you for your attention.

Mascot of the Bureau of Sewerage: Earth kun

(URL) http://www.gesui.metro.tokyo.jp/