Flood Control of Wastewater Service in Tokyo

Second Tachiai River Pipe (Shinagawa Ward) already used as a temporary storage

Yoshinari Nakajima
JSWA
Tokyo Downtown: 23-Ward Area

<table>
<thead>
<tr>
<th>City</th>
<th>Area</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokyo 23-W</td>
<td>630km²</td>
<td>9.7 million</td>
</tr>
<tr>
<td>Taipei</td>
<td>270km²</td>
<td>2.6 million</td>
</tr>
</tbody>
</table>
Overview of Sewerage Plan & Facilities

Design population: 8,692,000
Sewered area: 57,839 ha
pumping stations: 91
WWTPs: 16
Design flow: 6,090,000 m³/d
Sewer length: 16,112 km
As of March 2019
Rainfall Intensification in Tokyo

○ Rising frequency of rainfalls over 50mm/h
○ Very heavy rain in a short period of time

Over 700 houses flooded

July 23, 2013

Annual frequency of rainfall over 50mm/hr
(Source: Japan Meteorological Agency)

Heavy rain in short time
Long continuous rainfall (typhoon, etc.)

No. of times

Rainfall Types

Rainfall

Time

Extreme rainfall

Over 700 houses flooded
Most are urban floods in recent years.

How it happens

Flood at valley & hill bottom

Water Level

Discharge to rivers

River water level

Inflow

Cost of Flooding in Tokyo

Urban floods 180 billion yen (87%)

Others 26 billion yen (13%)

*10-year total from FY1999 to 2008
(Source: Flood Statistics)

July 23, 2013

Floods in Tokyo
Goals of Flood Control and Responsibilities

- No flood for 60mm/h
- No floor flood for 20-year storm, 75mm/h in downtown & 65mm/h in western suburb
- Life protection for over the planned storms
Adaptation by Structural Solutions

- Provision of stormwater infiltration inlets
- Provision of bypass pipes and additional sewers
- Provision of a rainwater reservoir for flood control
- Provision of a trunk sewer for rainwater
- Increased diameter of branch sewers
- Provision of stormwater storage pipes
- Boosted capacity of a pumping station
- Provision of rainfall infiltration facilities (on the premises of houses)
- Provision of a rainwater reservoir for flood control (storage of rainwater exceeding sewer capacity)

- Minamisuna Rainwater Reservoir with multiple dwelling units above for the effective use of space (storage capacity of 25,000 m³)
- Wada Yayoi Trunk Sewer provided along the Kanda River, which floods extensively (inner diameter of 8.5 m; storage capacity of 150,000 m³)
Structural Solutions

- Build sewerage facilities for 50 mm/h rainfalls
- Increase the capacity to 75 mm/h for extensive underground shopping streets & areas where severe damage occurred

Sewer for storing rainwater
(Tagara and Sakuragawa, Nerima Ward)

2.0m

Pumps for rainwater
(Kamiya, Kita Ward)
I – 1 Priority to drain 50 mm/hr rainfall events
  i. Valley & Hill Bottom
  ii. Sewer-shed for shallow depth trunks

I – 2 Priority to severely flooded areas from 50 mm/hr or over
  iii. Upgrade for 50 mm/h or over

I – 3 Priority to drain 75 mm/hr
  iv. Augmentation of shallow depth trunks
  v. Extensive underground shopping streets
HBs & Vs

Sewer surcharge and flooding at valley & hill bottom

Sewer-shed of shallow trunks

Surcharged shallow trunk cause backflow to collectors leading to floods at valleys.

Priority to drain 50 mm/h
Solution to shallow trunks

Install a new trunk to prevent surcharge and flooding
To drain 50 mm/h or over

- New trunks complement existing facilities to reduce flooding even from rainfall with 50 mm/h or over
- Expedite completion of planned projects ASAP
To drain 75mm/h; flooded areas with 50mm/h sewer capacity

- Build facilities that prevent sewer flood from 75mm/h rainfall
To drain 75mm/h; underground shopping streets

- Build facilities to **prevent runoffs from entering underground shopping streets** from 75 mm/hr rainfalls

![Diagram showing drainage system](image)

- Rainfall of 75 mm/hr
- Prevent sewer flood and accommodate runoffs
- Existing sewers
- Storage Sewers
- Underground shopping area
- Entrance

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15
Other Solutions

- Storage by uncommissioned trunk sewers
- Install small bypass line
- Install catch basins in partnership with road authority

Where sewer discharge is regulated due to uncompleted river flood defense

Complement undersized sewer
Install bypass line
Additional catch basins
Project Sites

已完成16个，共54个

已完成区域以灰色表示

Legend

- 50mm/h drainage
- 50mm/h or over drainage
- 75mm/h drainage for underground shopping streets
- 75mm/h drainage for flooded areas from 50mm/h

已完成区域以灰色表示
Nonstructural solution 1

- Facilitate citizen evacuation to reduce damages
  - “Tokyo Amesh”; highly accurate rainfall gauge system

April 2016: Upgrade to the latest radar
  - Display mesh: 500 m ⇒ 150 m
  - Rain strength: 8 levels ⇒ 10 levels

April 2017: distribution of smartphone version
  - Better usability and visibility
  - GPS function to display the current location
Nonstructural solution 2

- Publication of flood maps in corporation with river administrators
- In case of Kanda River with most floods, Japanese record high rainfall intensity was used

**Target rainfall**

Before revision: 2000 Tokai Torrential Rain
- Maximum rainfall: 114 mm/h
- Total rainfall: 589 mm

After revision: assumed maximum precipitation
- Maximum rainfall: 153 mm/h
- Total rainfall: 690 mm

Flood map for Kanda River basin (revised)
Thanks for your attention.

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