SEWERAGE SYSTEM FLOOD CONTROL ADAPTED TO CHANGE OF THE ENVIRONMENT IN YOKOHAMA CITY

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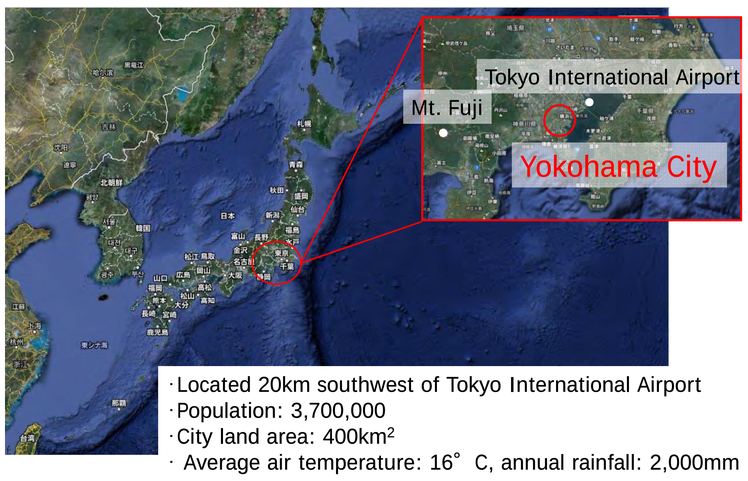
Abstract

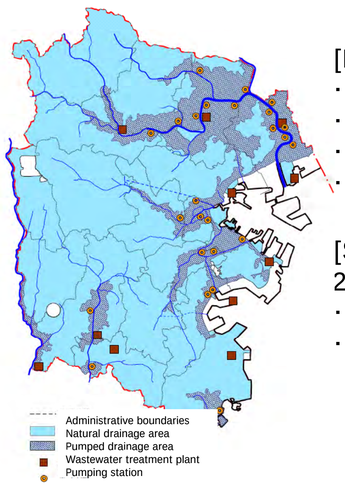
Yokohama City began to take sewerage system urban flooding countermeasures and to undertake other measures to respond to rapid urbanization and other changes of the environment in the 1950s.
New challenges are now being created by global warming and the risk of flooding will continue to rise in the future.
To respond to this, the city prepared the Yokohama City Sewage System Planning Guideline 2010 and the Stormwater Management Plan and reviewed flood countermeasure efforts, and standards and specifications.
My presentation will explain the contents of past urban flood countermeasure initiatives and the contents of stormwater management planning.

Introduction to Yokohama City



- Located 20km southwest of Tokyo International Airport
- Population: 3,700,000
- City land area: 400km^2
- Average air temperature: 16° C, annual rainfall: 2,000mm

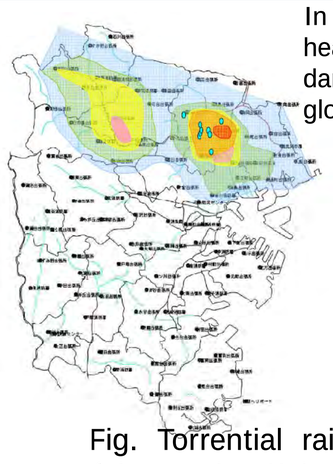
Sewerage System of Yokohama



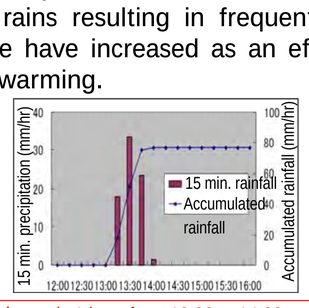
[Major stocks]
- Wastewater treatment plants: 11
- Pumping stations: 26
- Total pipe length: 11,700km
- Total assets：25 billion pond

[State of construction (March 2012)]
- Sewered population (%): 99.9%
- Rainfall trunk sewer provision rate
  5-year probable rainfall (50mm/hr) 65%
  10-year probable rainfall (60mm/hr) 56%

Present Challenges



In recent years, sudden short localized heavy rains resulting in frequent flood damage have increased as an effect of global warming.



Rains only 1 hour from 13:00 to 14:00
Time: 76.5 mm/hr
Maximum 15 min. precipitation: 33.5 mm

Fig. Torrential rainfall on July 29, 2008 (observed at Kohoku branch office)

New Development

In 2010,
We have reviewed the past measures completely and established the Yokohama city Sewage System Guideline

(Photo)
Planning Guideline

Contents of the Planning Guideline
- Targets and initiatives concerning sewage system measures (wastewater treatment, reconstruction, flood countermeasures, etc.)
- Standards and specifications setting facility scale

As flood countermeasures,
promotion of comprehensive “stormwater management planning”

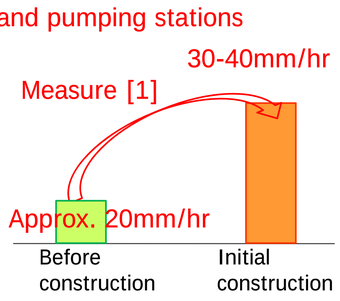
Past Urban Flood Countermeasures

Capacity has been approved in stages in response to environmental change and to needs.

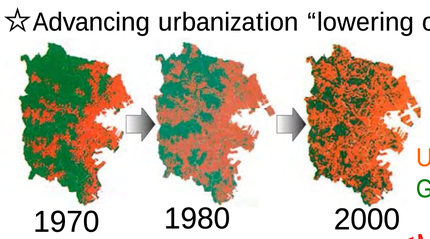
☆Occurrence of large-scale flood damage caused by light rainfall

Photo: a flood occurring in 1966

<Measure [1]>
Construction of trunk sewers and pumping stations



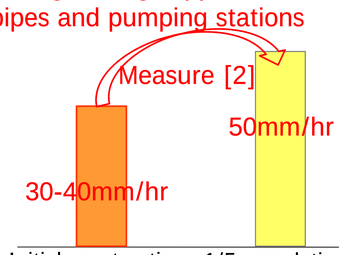
☆Advancing urbanization “lowering of retention functions”



Urbanization (orange area)
Greenbelts (green area)

Photo: a flood occurring in 1970 (in front of Yokohama City Hall)

<Measure [2]>
Strengthening supplemental pipes and pumping stations



Stormwater Management Planning

Aiming to improve safety in response to flood risk

In addition to building physical facilities, taking soft measures and promoting self help

Efficient construction	Minimizing flood damage	
Construction of physical facilities	Soft measures	Self help
Drainage facilities (pipes, etc.) / Restricting runoff of rainfall (storage etc.)	Hazard map of inundation etc.	Sand-bags etc.
Improvement level: 5 years, 10 years (standard)	Improvement level not stipulated	

Construction of Physical Facilities [1]

Example)
Revising the design stormwater runoff calculation formula
In order to respond to new challenges such as localized heavy rainfall,
everything including branch pipes will be planned and designed based on rational formula.

(Past standards)
- Planning and designing only trunk pipes with drainage area of 0.2km^2 or higher based on rational formulae
- Planning and designing branch pipes based on an empirical formula

⇨ Priority on trunk pipe construction

Planned quantity of rainfall runoff calculated by a rational formula = quantity based on an empirical formula ×1.4 to 1.6
⇒ A rational formula makes it possible to lay larger section pipes (Capacity up)

At this time, the renewal of flood damage locations and deteriorated pipes is accompanied by improvement of capacity based on a rational formula.

(Example of improvement of capacity coordinated with renewals.)

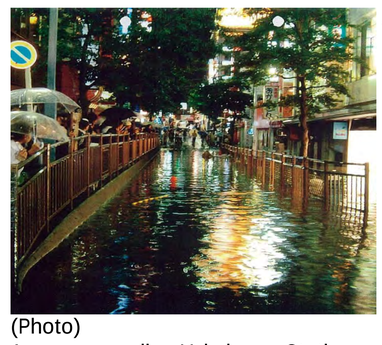
Deteriorated pipes

Removal

Replacing pipes (improving capacity)

Construction of physical facilities [2]

Example) Efficient construction by selection and concentration, “Raising the improvement level reflecting regional characteristics”



(Photo)
Area surrounding Yokohama Station
Flood damage in Oct. 2004

Area surrounding Yokohama Station
“Highest level of risk in the city”
- One of Japan’s largest railway terminals
- Concentration of population and urban functions
- Low ground
- Massive flood damage in 2004
  Hourly rainfall of 74mm/hr during flooding

The standards are 50 and 60mm/hr, but the aim is response to 74mm/hr to prevent the recurrence of flooding.

Restricting Runoff of Rainfall

Example) Installing stormwater infiltration inlets
Installed to reduce flooding by improving stormwater infiltration functions.

Indoor stormwater infiltration inlet
- Installed by private citizens
- Subsidy system
  Newly installed: 100GBP/inlet

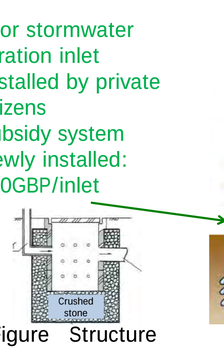


Figure Structure

Connecting stormwater infiltration inlet
- Installed by administrative body
- 1,000 inlets/year

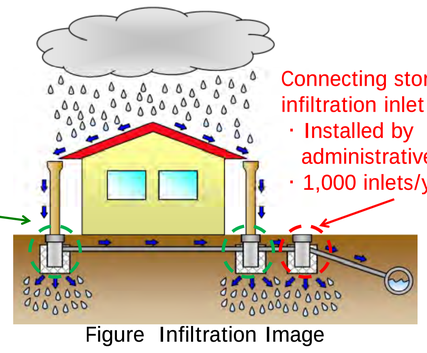


Figure Infiltration Image

Soft Measures

Example) Hazard map of urban inundation (completion predicted for 2014) The map shows predicted flood districts based on flood simulations to improve the disaster awareness of citizens.

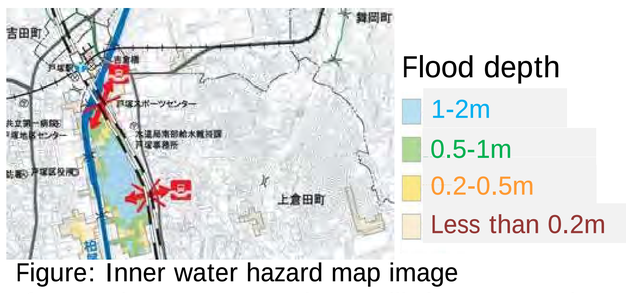


Figure: Inner water hazard map image

※In the future, improvement plans will be prepared and preventive maintenance type flood countermeasures will be promoted for predicted flood districts.

Conclusion

In the past, urban flood countermeasures have been taken to adapt to change of the environment.
In the future, the risk of flooding will continue to rise under the impact of global warming.
And finances will be limited.
Under harsh conditions,
we will promote stormwater management planning
in cooperation with the citizens in order to create a city resistant to flooding.