

***Quantitative study on the effectiveness of
a flexible sewer system in disaster
prevention and environmental issues***

Nara Prefectural Office, Japan

Hiroaki SHIRAYANAGI ○

Urban Environment Systems Division, Department of Engineering,

Setsunan University, Japan

Yukisada KITAMURA

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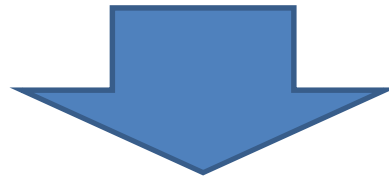
Story

- *Conditions and problems about a sewer system in Japan and in the target area*
- *Framework and effects of a flexible sewer system suggested by our study*
- *Quantitative evaluation by using a new system*
- *Conclusion*

1. Conditions and problems in Japan

Background

- Due to the massive population increase and industrialization in the late 20th century, Japan built up its infrastructure.



- Today, however, the capital for infrastructure maintenance and renewal has dramatically declined due to the recent low birth rate, aging population.

Sewer system

- These conditions have results in a sewer system that is expensive and not operating near its full capacity.

Rainwater drainage system

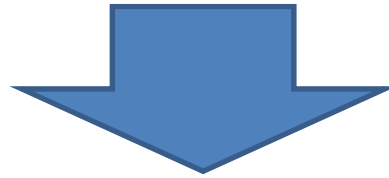
- Global climate change has increased the risk of a natural disaster, such as local flooding due to torrential rain.



- The capacity of the rainwater drainage system in Japan is insufficient.

Purpose

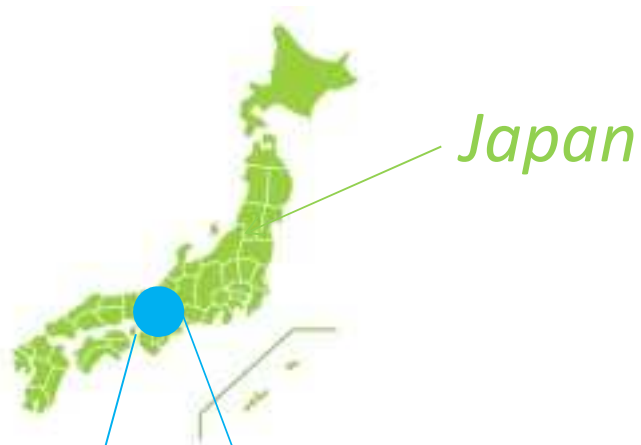
- Underground space is not being used effectively in urban sewage systems.



- We suggest the strategic implementation of a flexible sewer system that can handle both sewage and rainwater drainage.
- We show the impact of a flexible sewer system on environmental issues and disaster prevention.

2. Conditions and problems in the target area

Location



Nagaokakyo City is in the
Kyoto Prefecture, Japan

The population density for
inhabitable land is about
7,000 persons/km².




Kyoto Prefecture

Nagaokakyo City

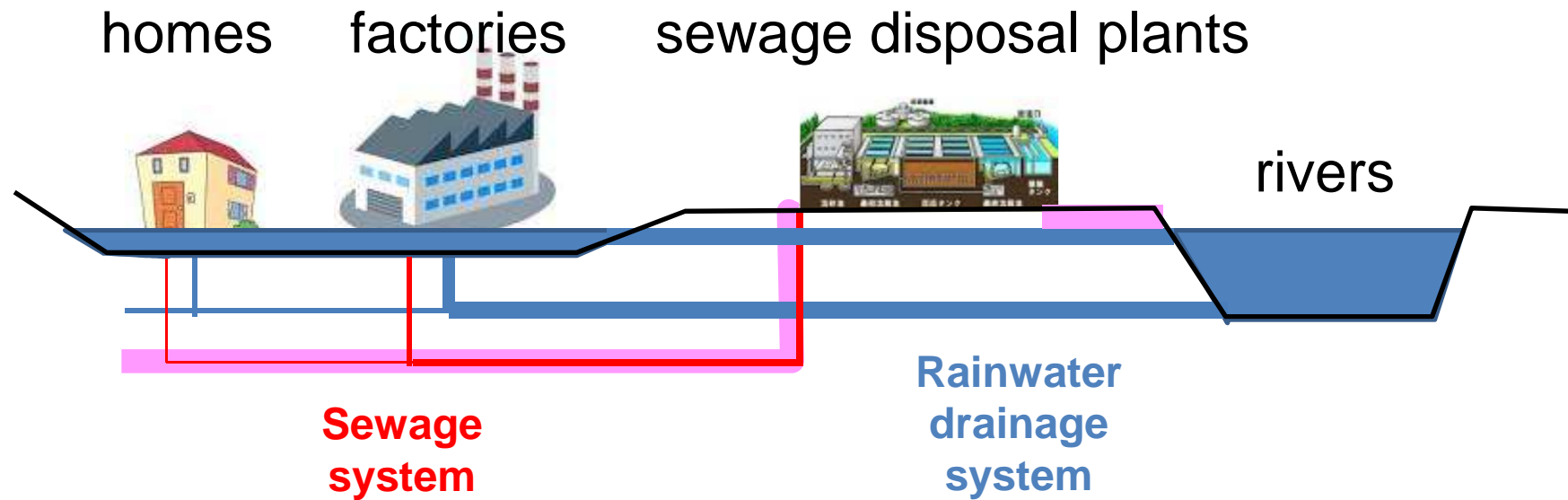
Sewage business

- Start : 1974
- Length of tubes : 217.9km
- Diffusion rate : 99.3% (1, April, 2013)
- The amount of drainage from homes and factories has drastically decreased due to a decline

Disaster in a heavy rain

- The probable maximum precipitation
 - 53.1mm/hr (return period : 5 years)
 - 61.6mm/hr (return period : 10 years)
 - Records in a heavy rain
 - 76.5mm/hr in July,2008
 - 96.0mm/hr in August, 2010
- 
- The damage from local flooding by a heavy rain is often occurred.

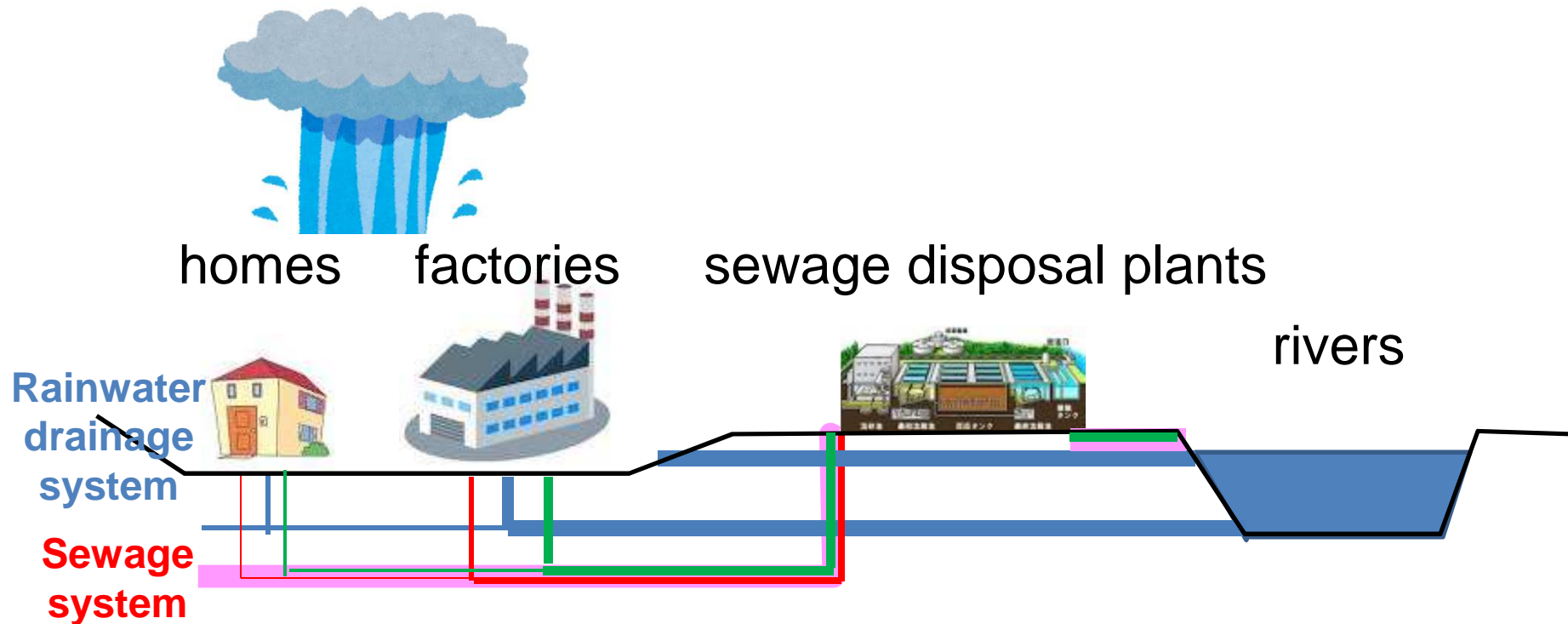
Two systems



Sewage system and rainwater drainage system are separated spatially.

3. Framework and effects of a flexible sewer system

Disaster prevention

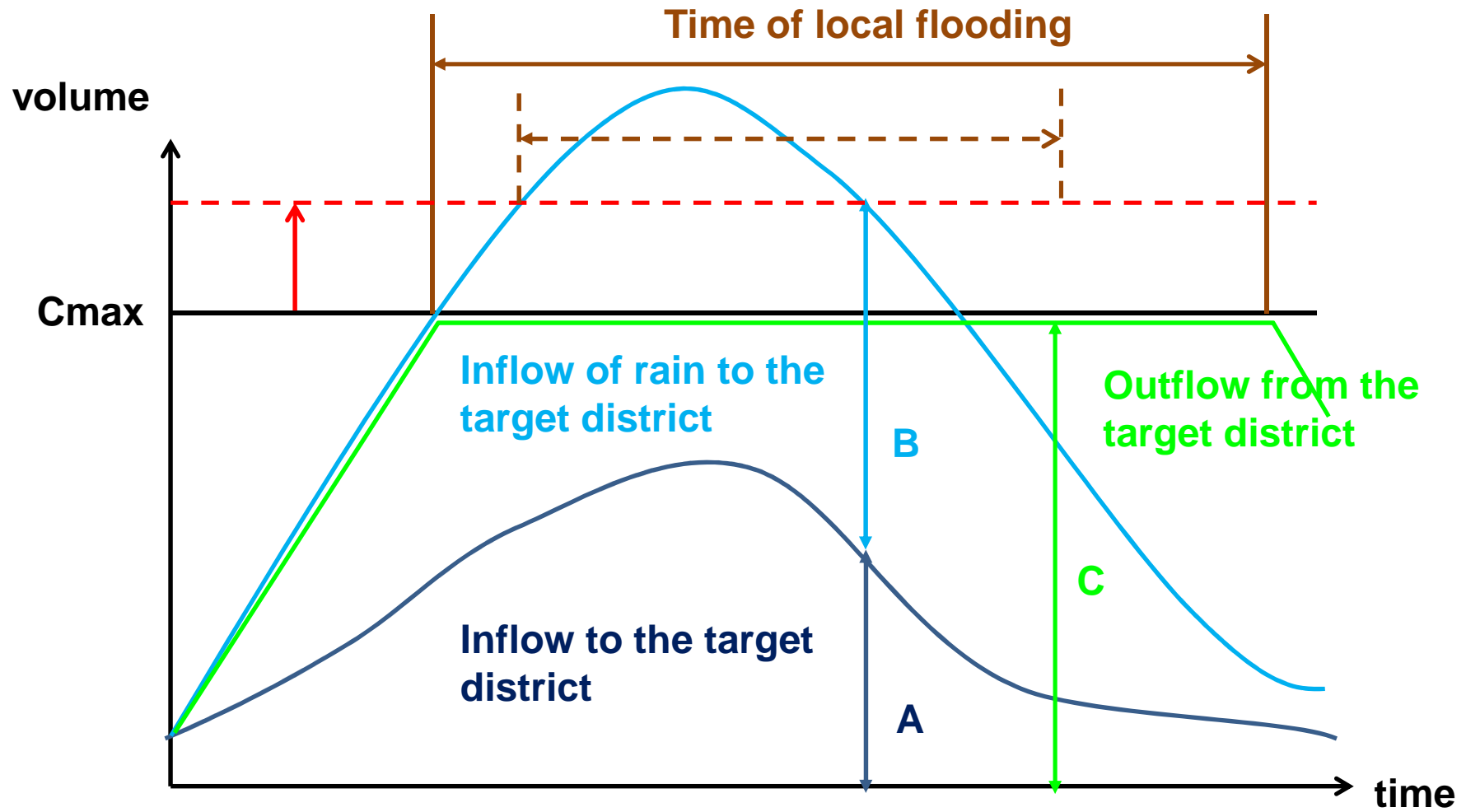


Using the currently unused space of sewage system

→ Allowing rainwater to flow into the sewage system

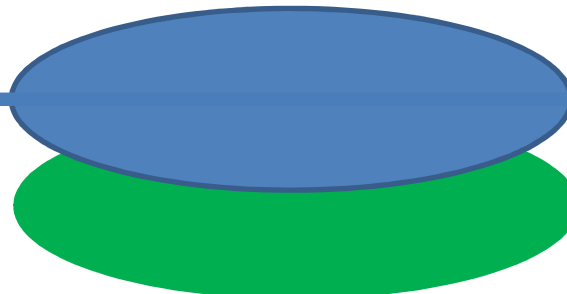
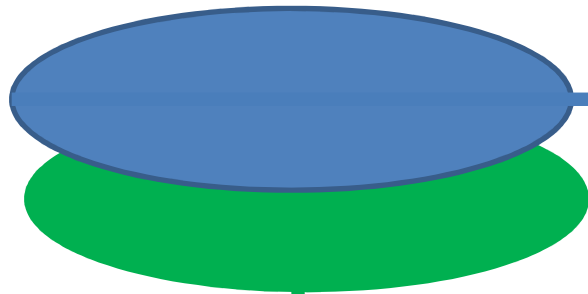
⇒ increasing the capacity of rainwater drainage system and decreased damage from local flooding

Hydrograph Analysis



District B-2

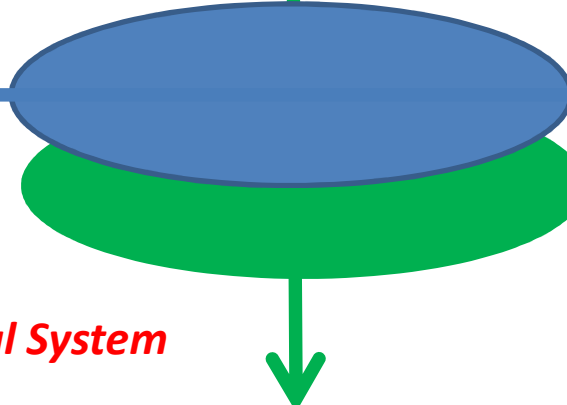
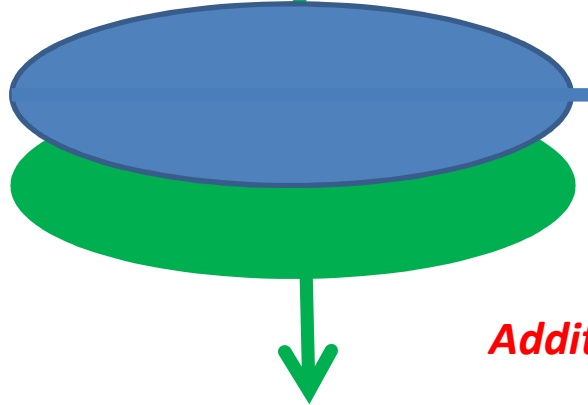
District B-1



Rainwater drainage system B

District A-2

District A-1



Established System

Rainwater drainage system A

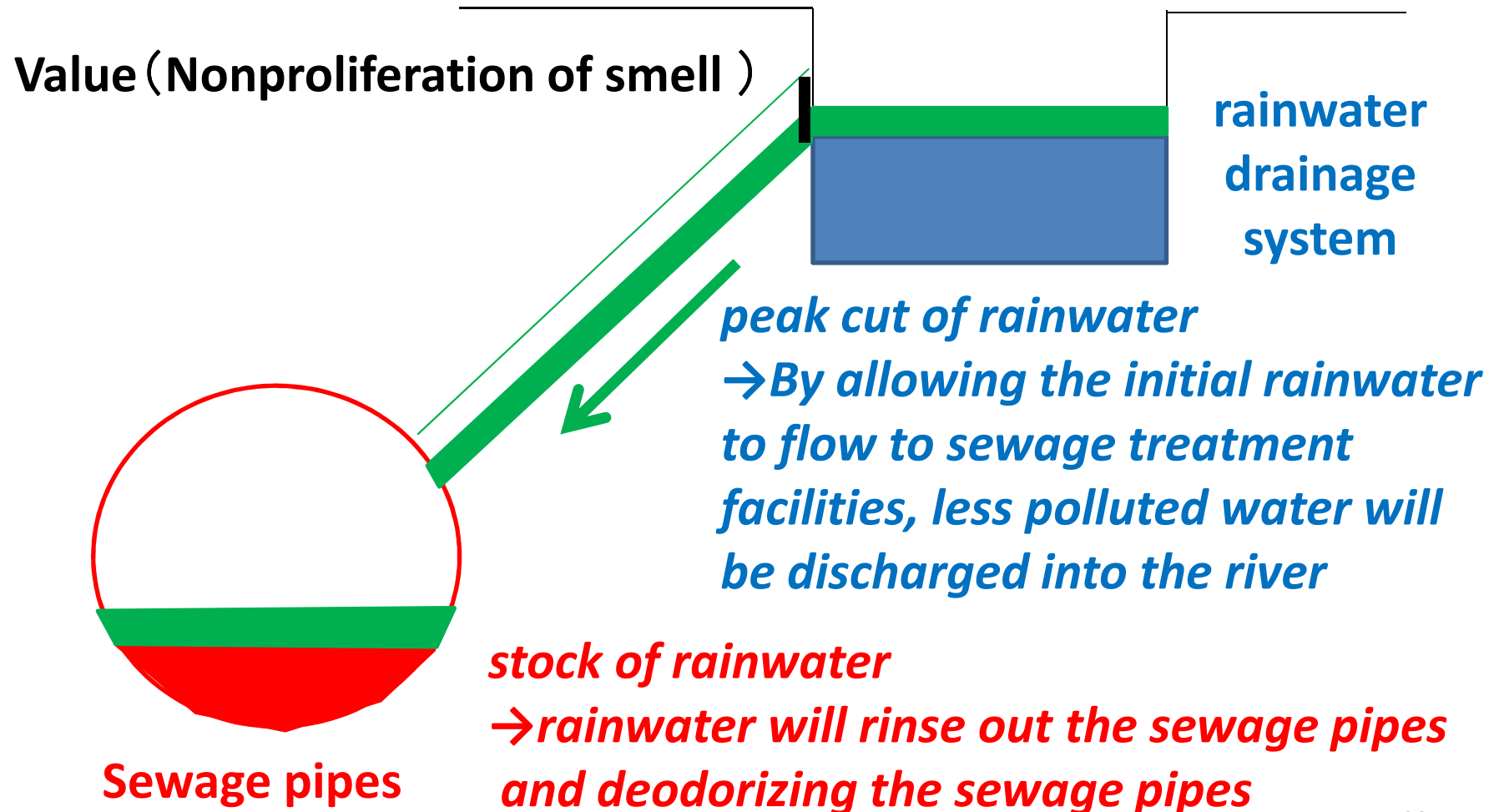
Additional System

Rainwater drainage system 2
into sewage facilities

Rainwater drainage system 1
into sewage facilities

By controlling multiple rainwater drainage systems within a district, decrease damage from local flooding

Environmental Issues



***4. Quantitative evaluation
by using a new system***

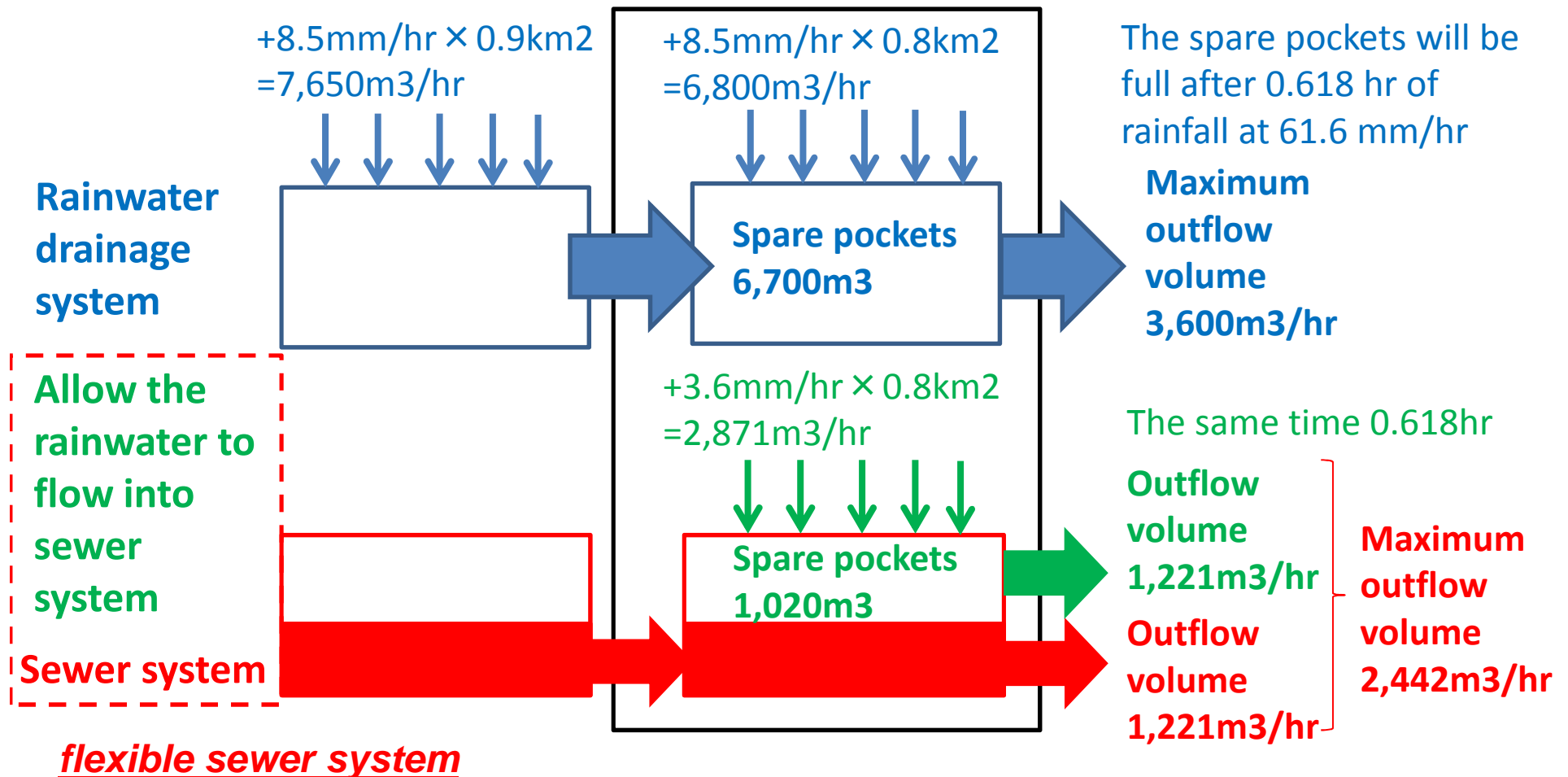
Increased capacity

53.1mm/hr → 61.6mm/hr → 65.2mm/hr

+8.5

+3.6

Target district



The possibility of occurring flood damage

- Occurring flood damage

 - before using flexible sewerage systems

 - rain: 61.6mm/hr

 - frequency: 0.0916 times/ year

- Occurring flood damage

 - after using flexible sewerage systems

 - rain: 65.2mm/hr

 - frequency: 0.0717 times/ year

→ The possibility of occurring flood damage is

decreasing 21.4% by using flexible sewerage systems

in the target area.

5. Conclusion

In summary

- We propose a strategy involving a flexible sewer system as an economically feasible long-term solution, and demonstrate its impact on environmental issues and disaster prevention using a target area in Japan.

Institutional and technical hurdles

- It is important to readjust the various relevant authorities because the rainwater drainage and sewer systems should be considered as one single entity.
- It is important to exercise the proper management and policies because the Intelligent Rainwater and Sewage Systems (IRSS) should be adopted in consideration of environmental issues and disaster prevention.

***I deeply appreciate
your attending.***