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Significance of rainwater and reclaimed water for sustainable urban water use

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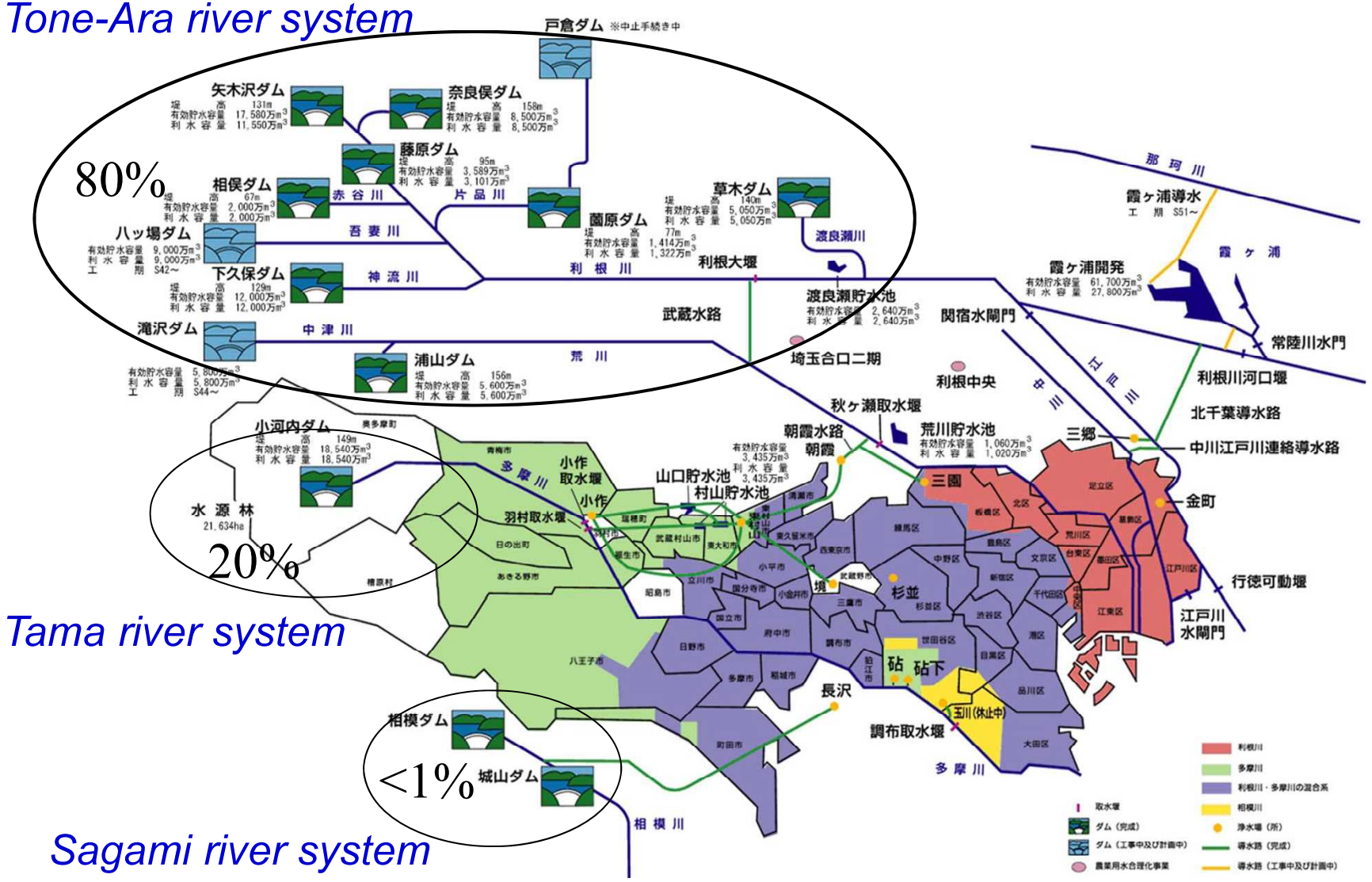
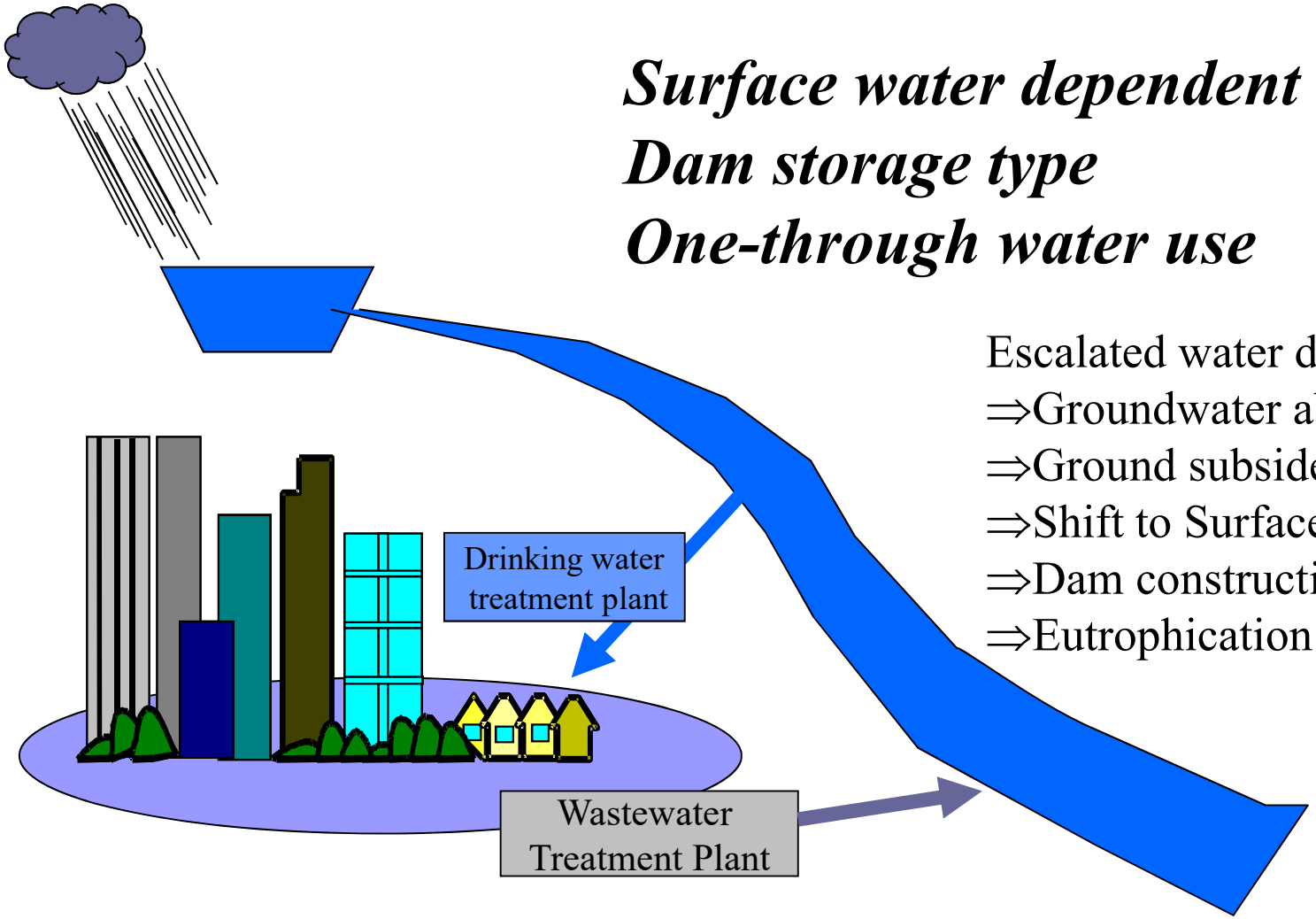
Outline

- Introduction
  - Water resource and use in Tokyo
  - Concern about the sustainability of urban water use
- Research on rainwater and reclaimed water use
  - Evaluation of water safety considering virus contamination
  - Evaluation of water quality stability by microbial regrowth
  - Energy consumption of water reclamation and supply
- Summary

Water resource and water supply in Tokyo



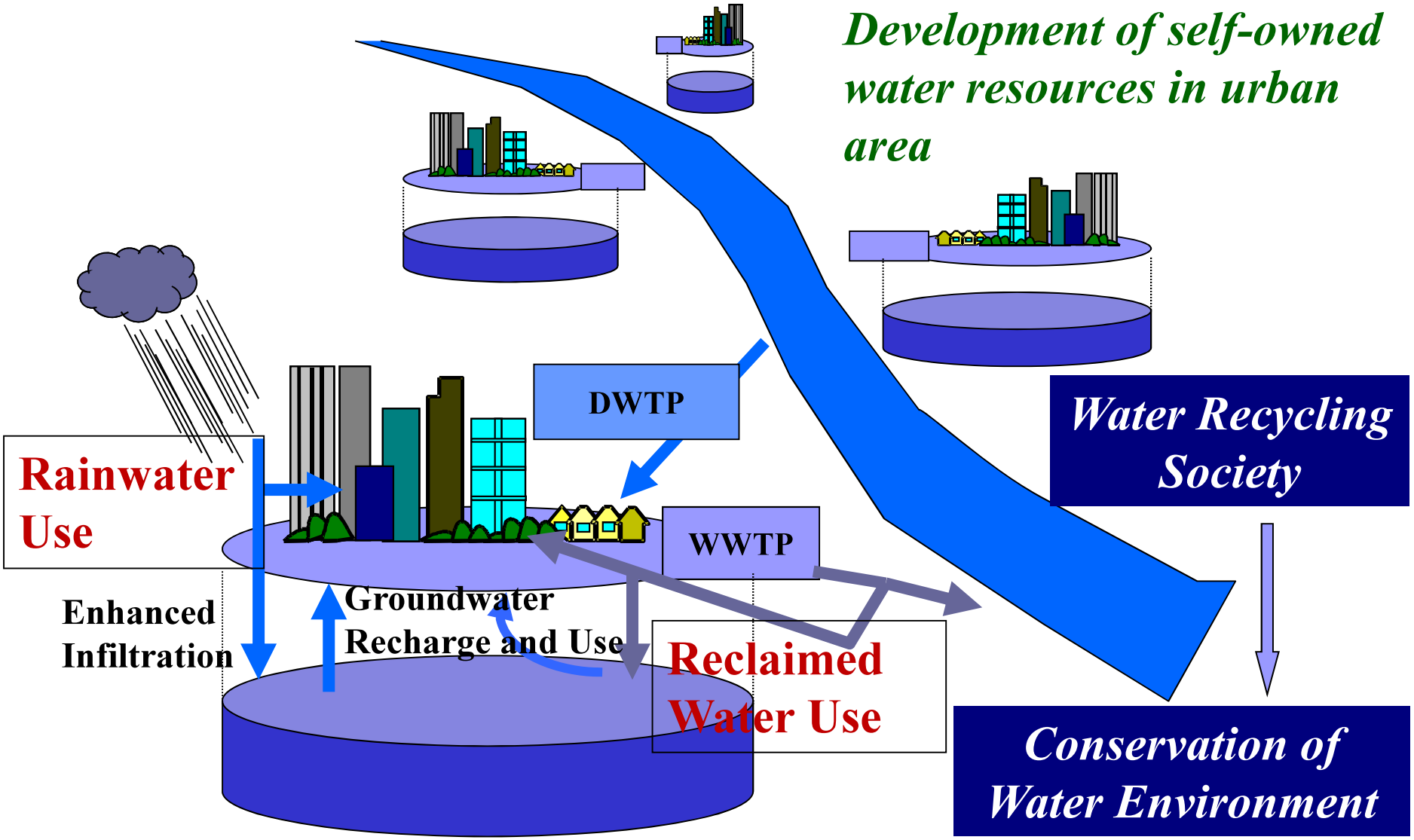
Conventional Water Resource Development and Urban Water Use in Japan



Surface water dependent
Dam storage type
One-through water use

Escalated water demand
⇒Groundwater abstraction
⇒Ground subsidence
⇒Shift to Surface water
⇒Dam construction
⇒Eutrophication problems

Watershed-based Sustainable Urban Water Use

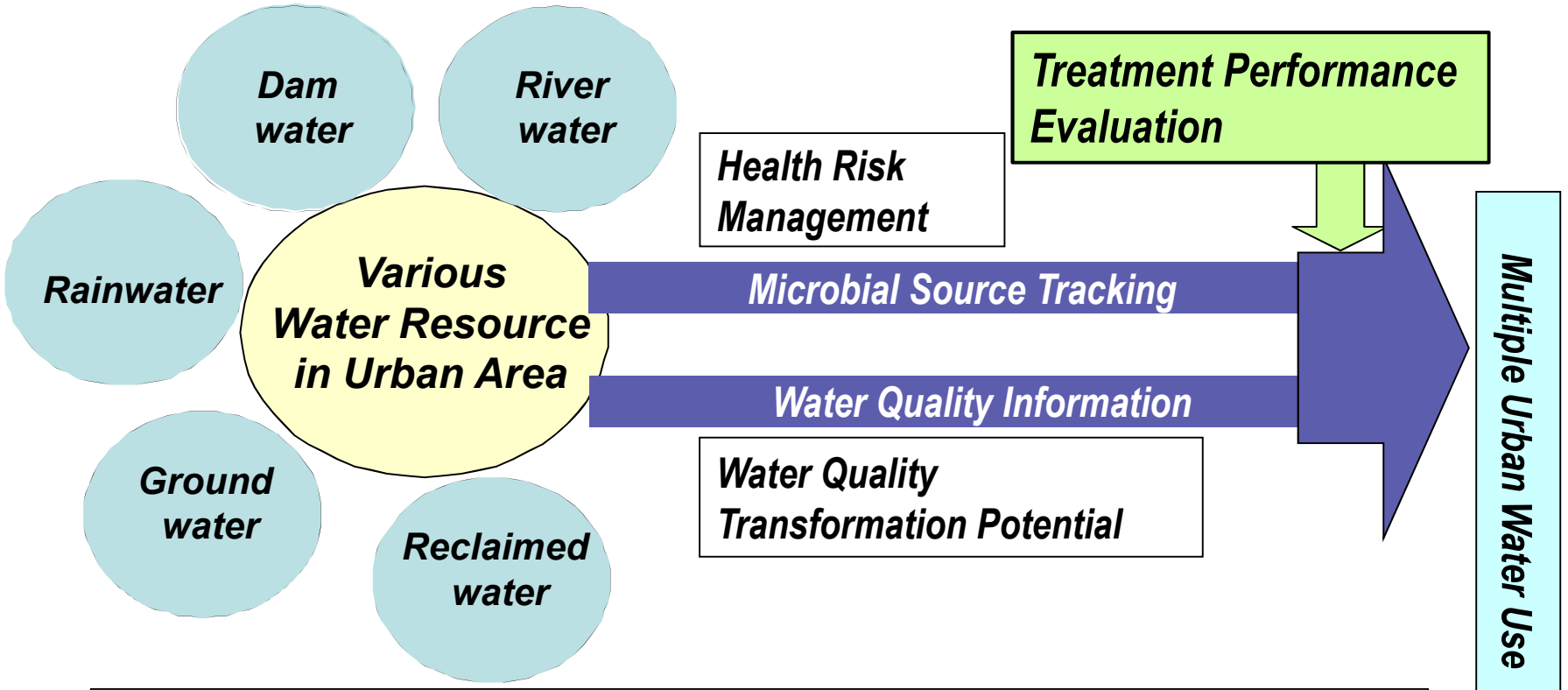


Concern about safe and stable urban water use

- Climate change would accelerate localization of available water resources and consequently it would become more difficult to keep stable water supply.
- To assure the safe and stable urban water supply, we must reexamine the availability of “rainwater”, “groundwater”, and “reclaimed water” as well as surface water.
- *It is necessary to develop novel evaluation approaches for risk and stability of water quality and devise methods for designing water use, considering environmental cost evaluation and preferences of various water users.*
- *Well-balanced urban water use systems should be established considering climate change in the future.*

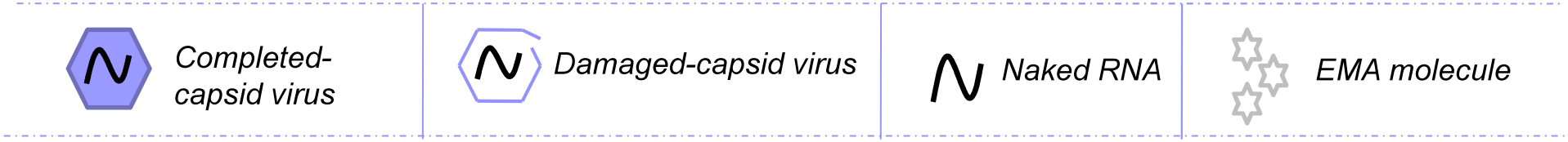
WQ evaluation of water resources in urban area

Evaluation of water safety considering virus contamination

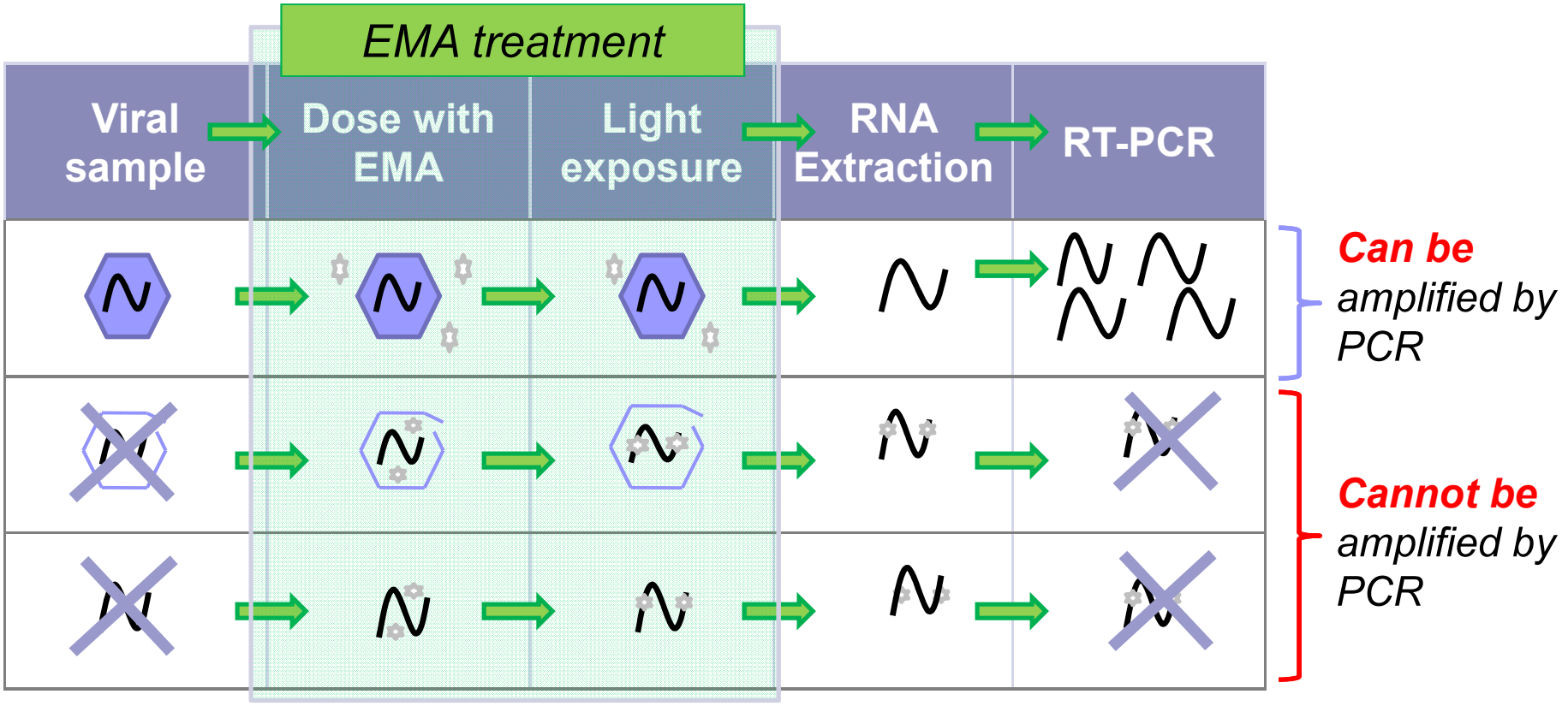


Evaluation of water quality stability by microbial regrwoth

Application of Ethidium Monoazide coupled with quantitative PCR method (EMA-PCR)

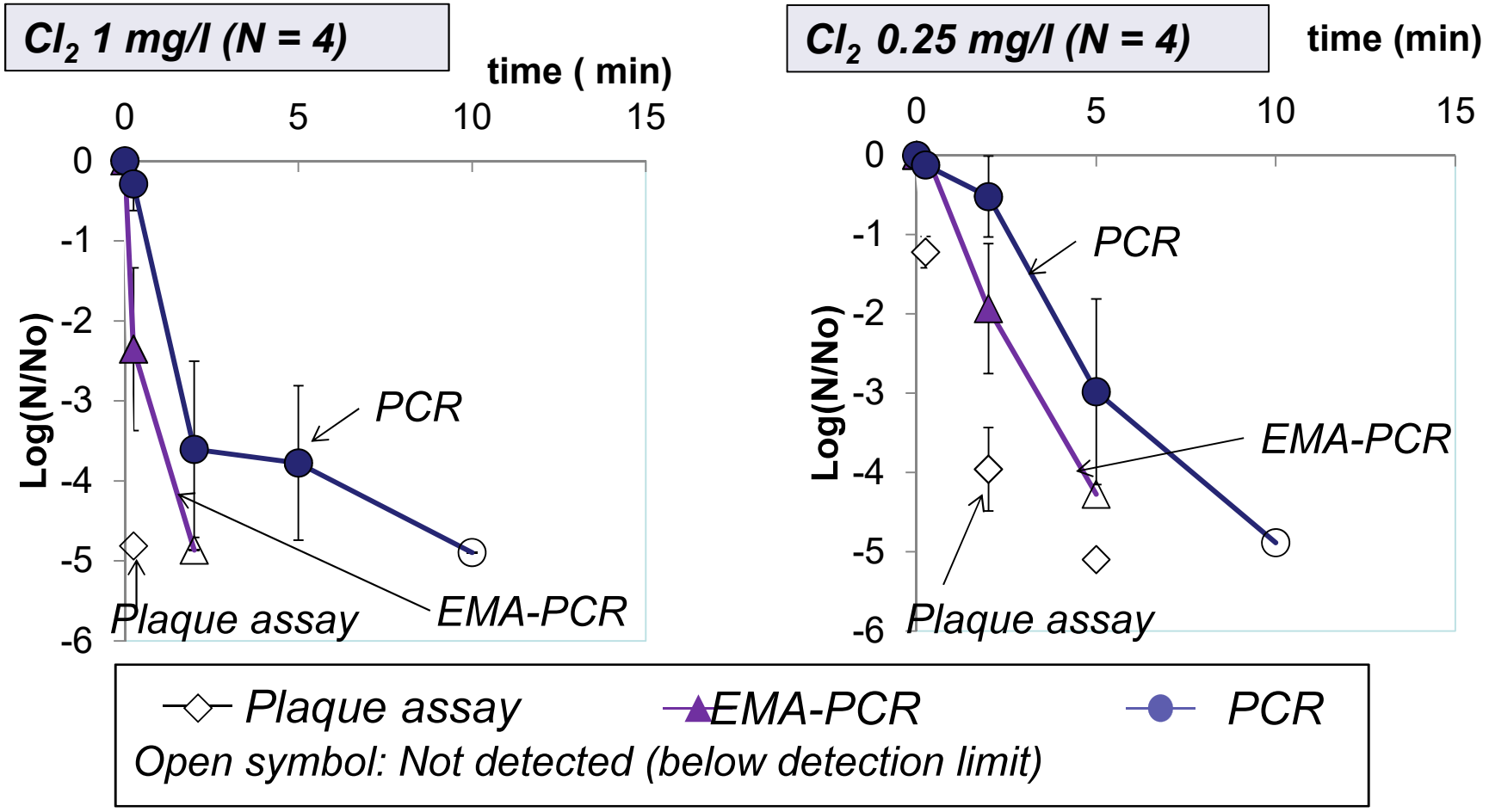


EMA treatment can exclude detection of RNA from damaged virus

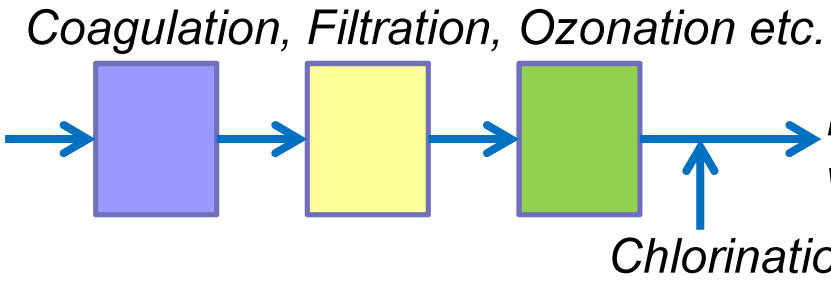


EMA-PCR was able to reflect the integrity and damage of virus capsid

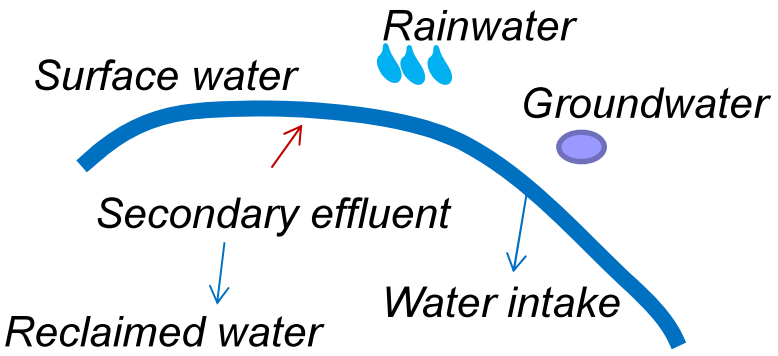
Inactivation test of poliovirus by chlorination



Evaluation of water quality stability



Removal and formation of biodegradable organic matter (BOM)



Evaluation of various water resources

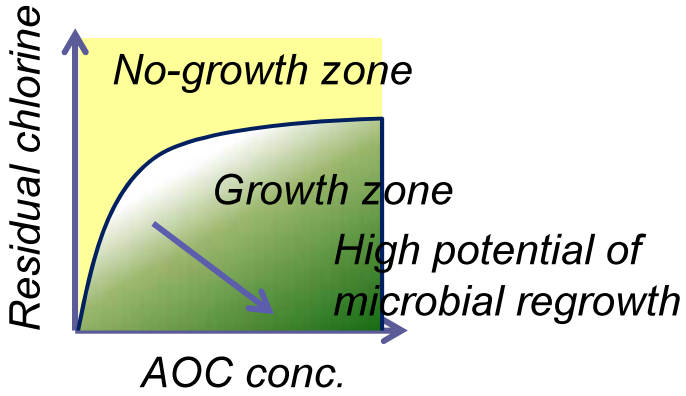
→ Water quality stability can be evaluated by microbial regrowth

1) Determination of BOM

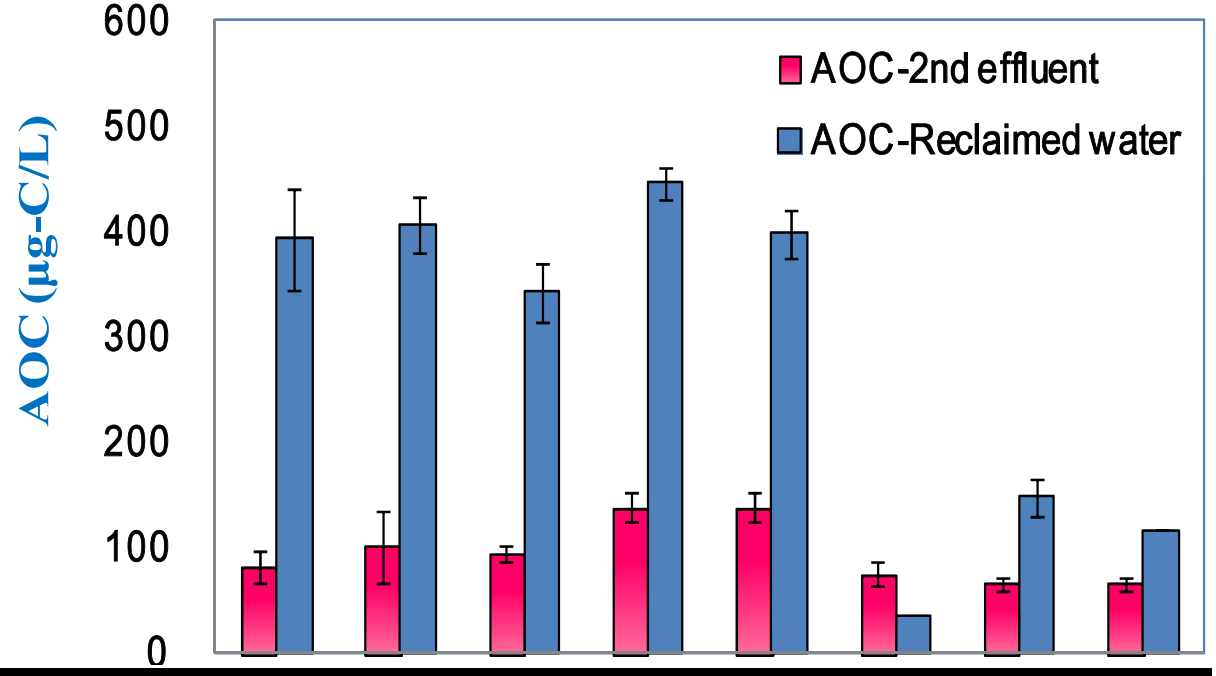
- AOC (Assimilable Organic Carbon)
- BGF(Bacterial Growth Fingerprint)

2) Analysis of BOM by FTMS

- Molecular level composition



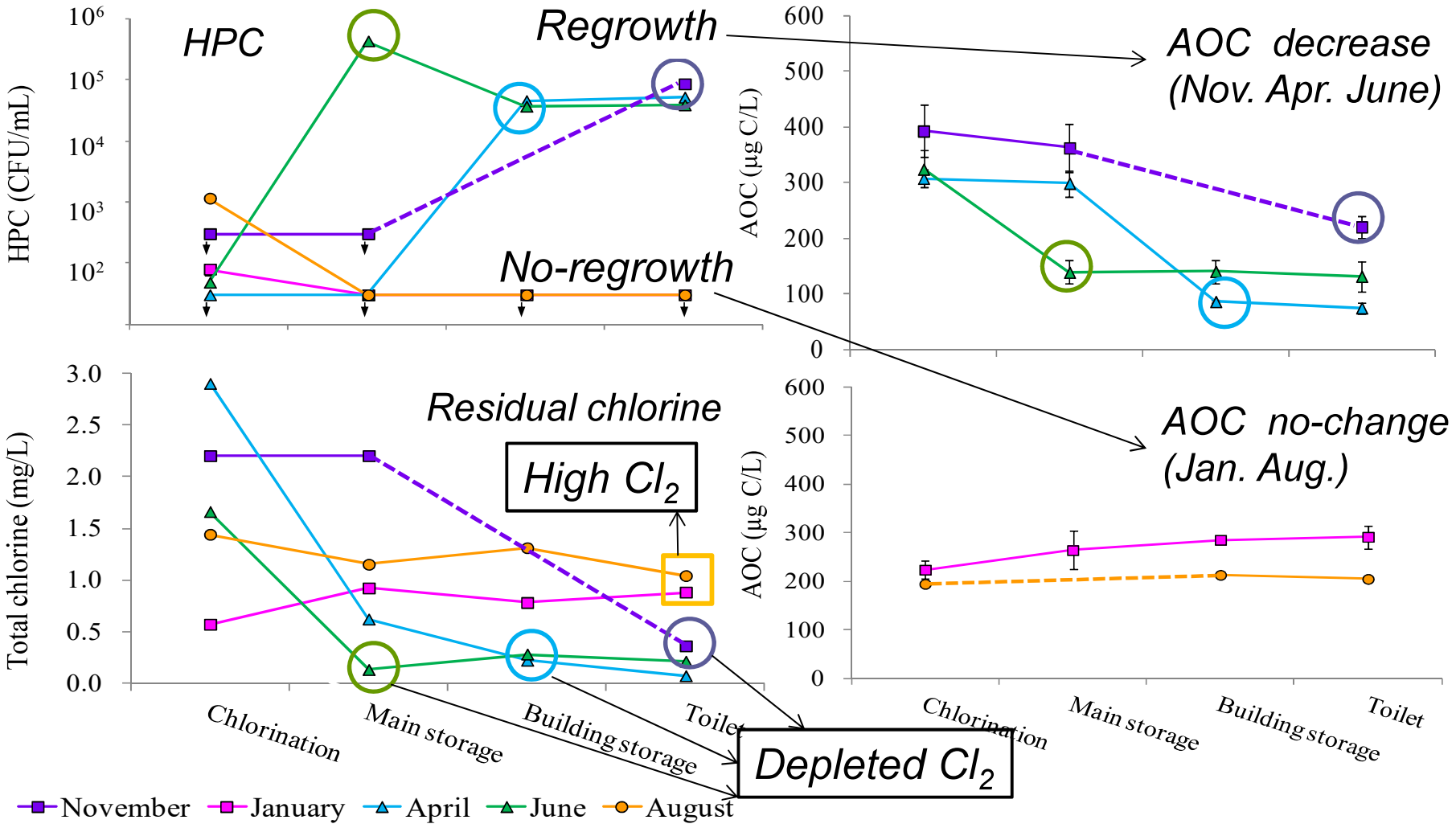
Change of AOC during reclamation process



Process	A	B	C	D1	D2	E1	F1	F2
Coagulation	✓				✓		✓	✓
Sand filtration	✓					✓	✓	✓
Biofiltration		✓	✓	✓	✓			
Ozonation	✓	✓	✓	✓	✓			
Microfiltration				✓	✓			
Reverse osmosis						✓		
Activated carbon							✓	✓
Ultraviolet							✓	✓
Post chlorination	✓	✓	✓	✓	✓	✓		✓

- ***High AOC in ozonated water***
- ***Remarkable AOC formation by ozonation***
- ***Low AOC after reverse osmosis (RO) membrane treatment***
- ***Increased AOC by UV radiation treatment***

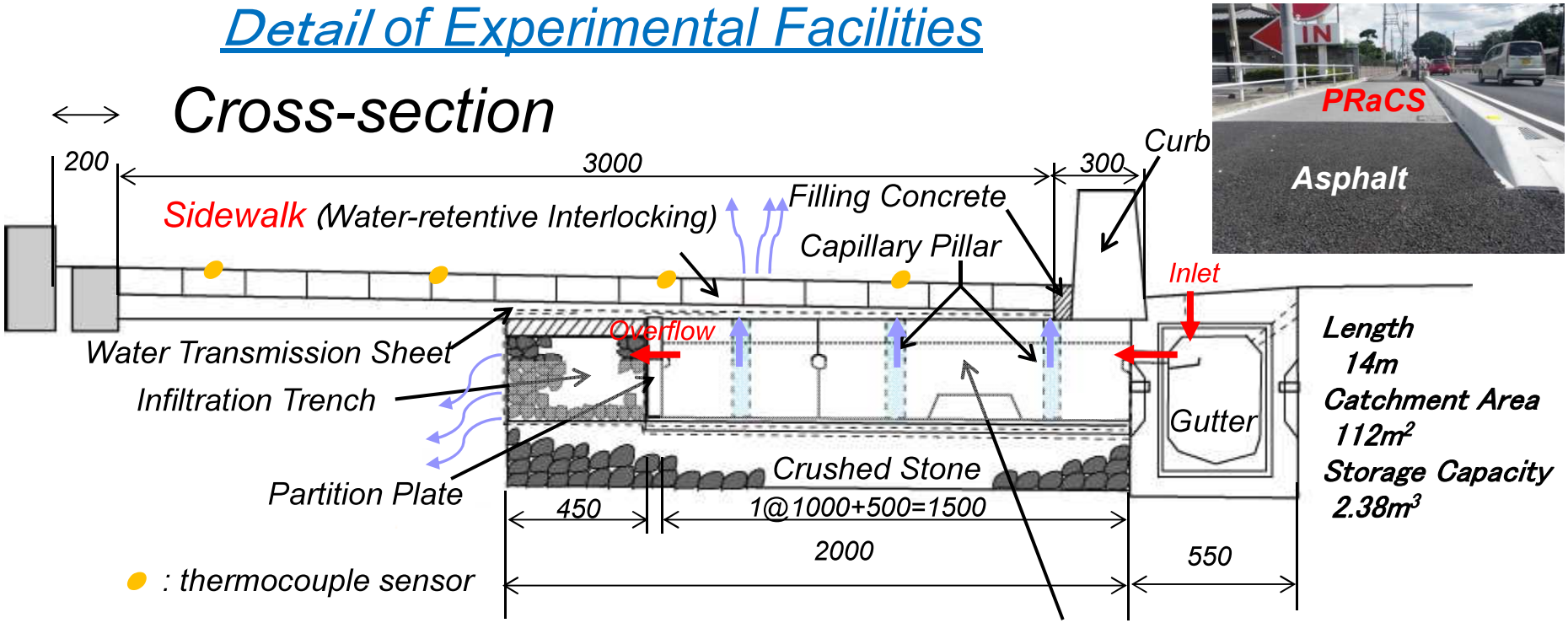
Water quality change in distribution system



Regrowth was observed under depleted Cl_2, while AOC was decreased

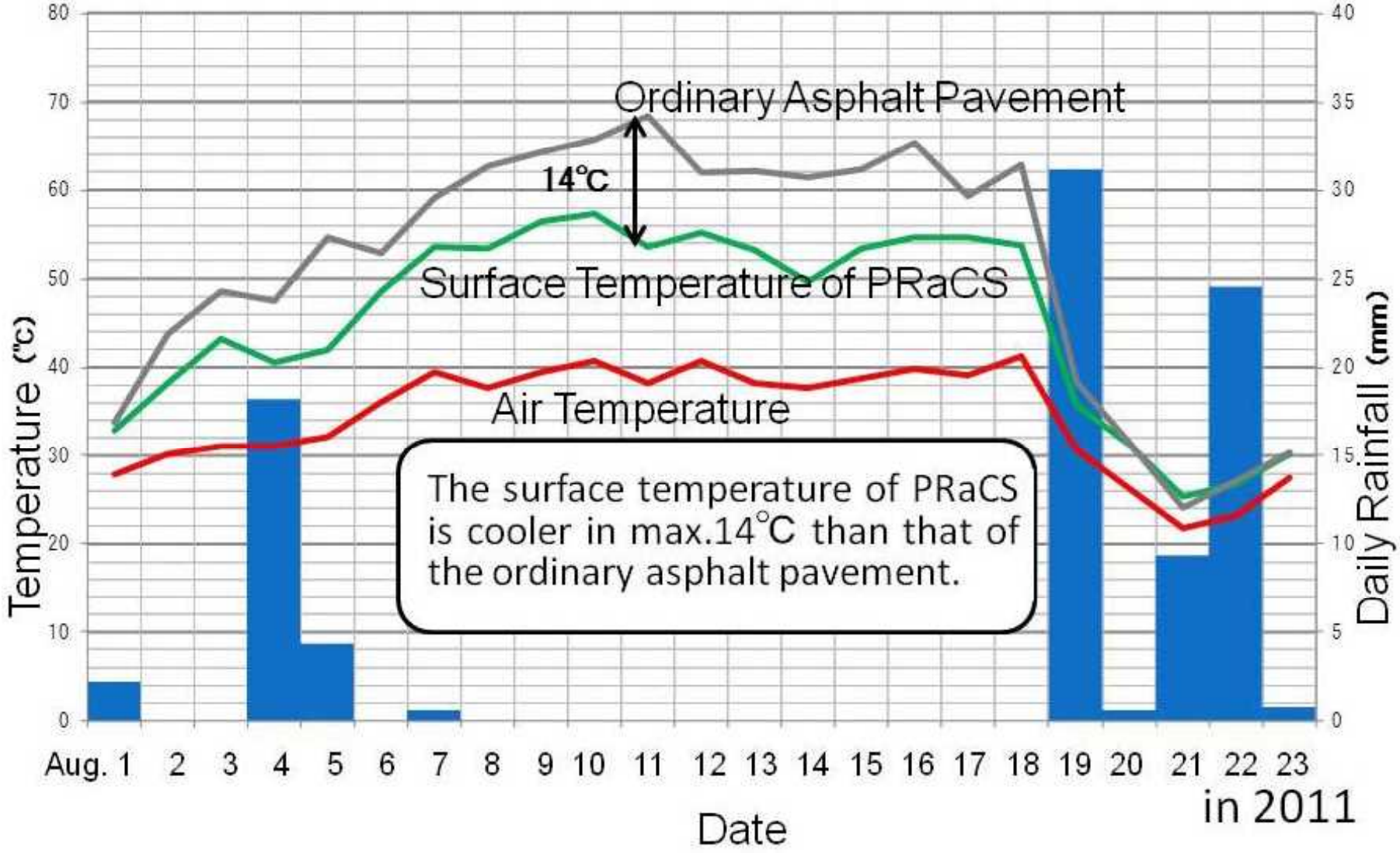
Newly Developed Rainwater Harvesting Facilities in Road for Control of Flood and Heat Island Phenomenon Pavement of Rainwater Cyclical System (PRaCS)

Detail of Experimental Facilities

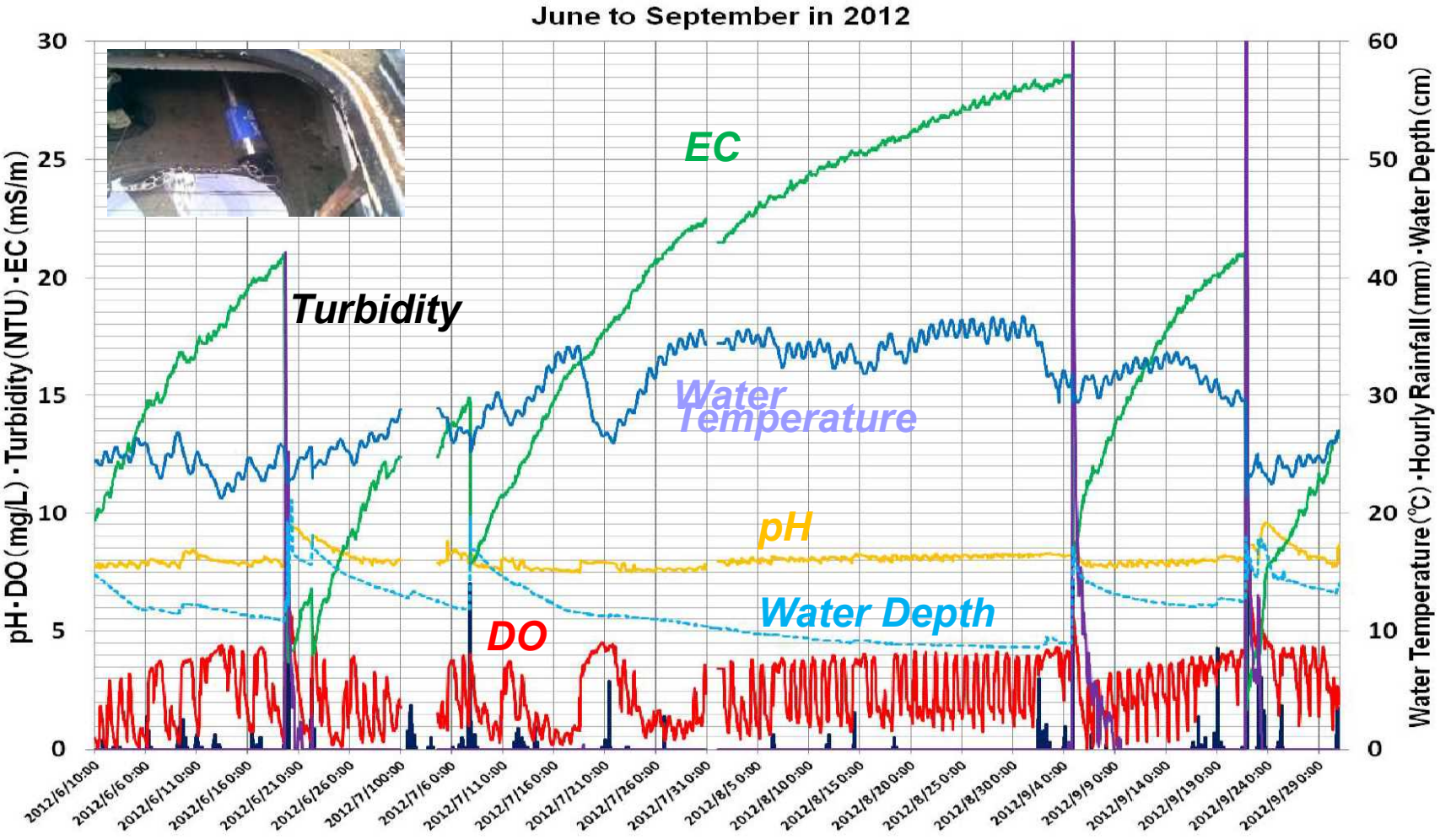


Storage Tank with supporting platforms and impermeable sheets

Reducing effect of road surface temperature

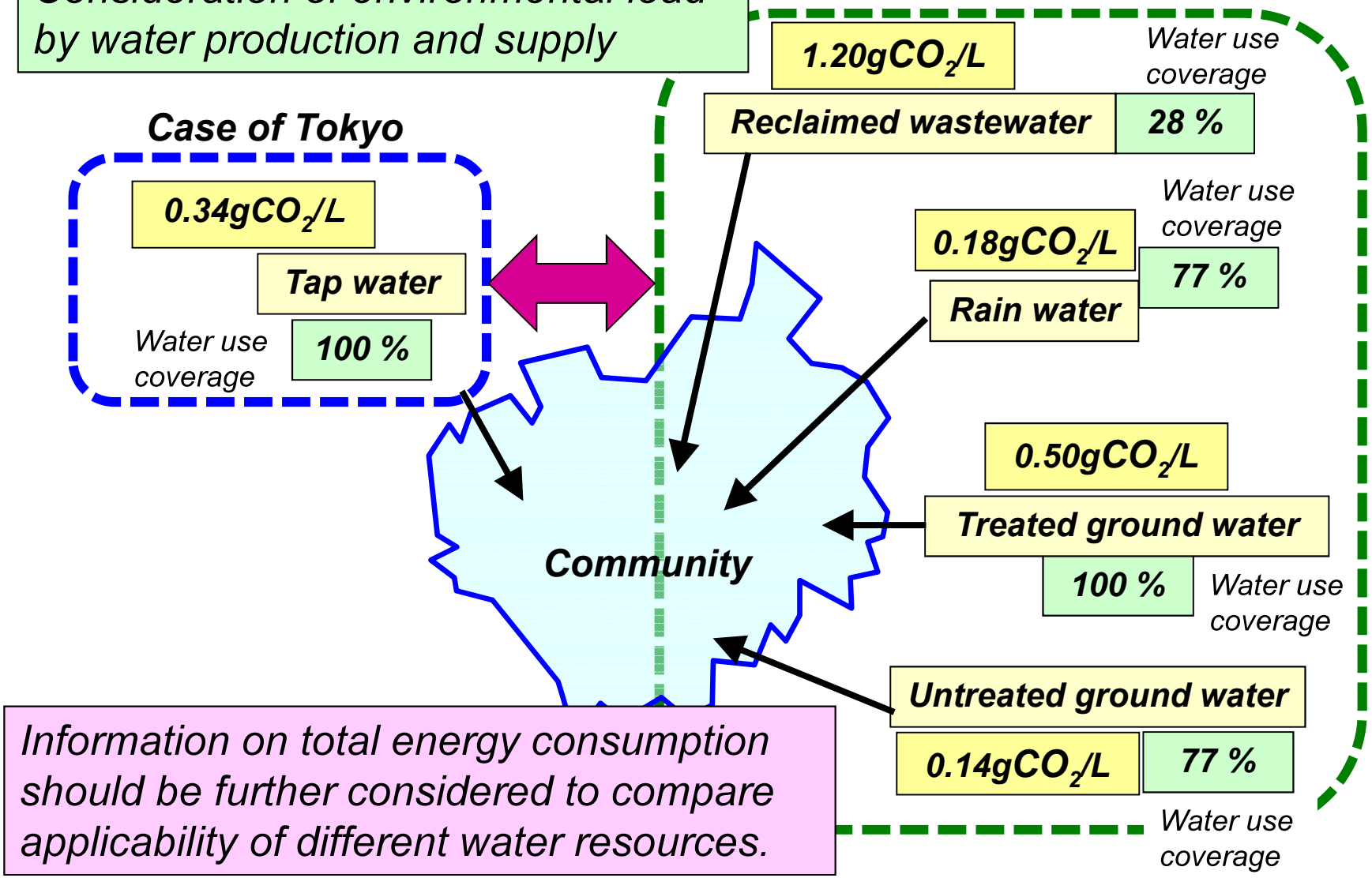


Water quality change in stored road runoff (July to Sep. in 2012)



Comparison of CO_2 emission for different water resources

Consideration of environmental load by water production and supply



Information on total energy consumption should be further considered to compare applicability of different water resources.

Summary

- ***Rainwater and reclaimed water have been applied to meet the increased water demand in urban area. From the viewpoint of sustainable water use, they have been recognized as precious urban self-owned water resources. They can be applied for multiple purposes of miscellaneous water use.***
- ***In order to promote the rainwater (roof and road runoff) use, water quality should be managed to secure the safety and aesthetic appearance. Therefore, we have to pay attention to possible contamination in rainwater and proper control of water reclamation if necessary. For the purpose, WQ standard and WQ control method ology should be established based on available treatment and operational technology.***
- ***As well as WQ, we also have to consider the necessary energy consumption to produce and supply the alternative water, comparing with current water supply system. In this aspect, rainwater and runoff water is very prospecting, although amount variability is expected very high in the future.***

English 日本語

CORE RESEARCH FOR EVOLUTIONAL SCIENCE AND TECHNOLOGY
Research Area: Innovative Technology and System for Sustainable Water Use

Research Project

Development of well-balanced urban water use systems adapted for climate change

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Development of well-balanced urban water use systems adapted for climate change

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CREST
Core Research for Evolutional Science and Technology

CREST Research Project:
Development of Well-balanced Urban Water Use Systems Adapted for Climate Change

Project outline

Outline of Development of well-balanced urban water use system adapted to climate change

This project aims to reexamine the current urban water use system and propose a new one adaptive to the future climate change. In the new system, each water resource is properly allocated to each water use by considering the balance between water supply and demand. This requires information on available amount and detailed quality of various water resources. Two river watersheds; Ara river, Japan and Hon river, Vietnam, are selected as research fields. They are located both in Asian monsoon area but are on different phases in economic and demographic growths. We are pursuing urban water use strategies suitable for each watershed from various angles.

Scheme of the project

Development of well-balanced urban water use system adapted to climate change

http://www.recwet.t.u-tokyo.ac.jp/crest2009/english/index.html

Thank for your attention

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Watershed-based Sustainable Urban Water Use