



# Sustainable Urban Water Environmental Systems in Northern China under the Concept of Decentralization and Reuse

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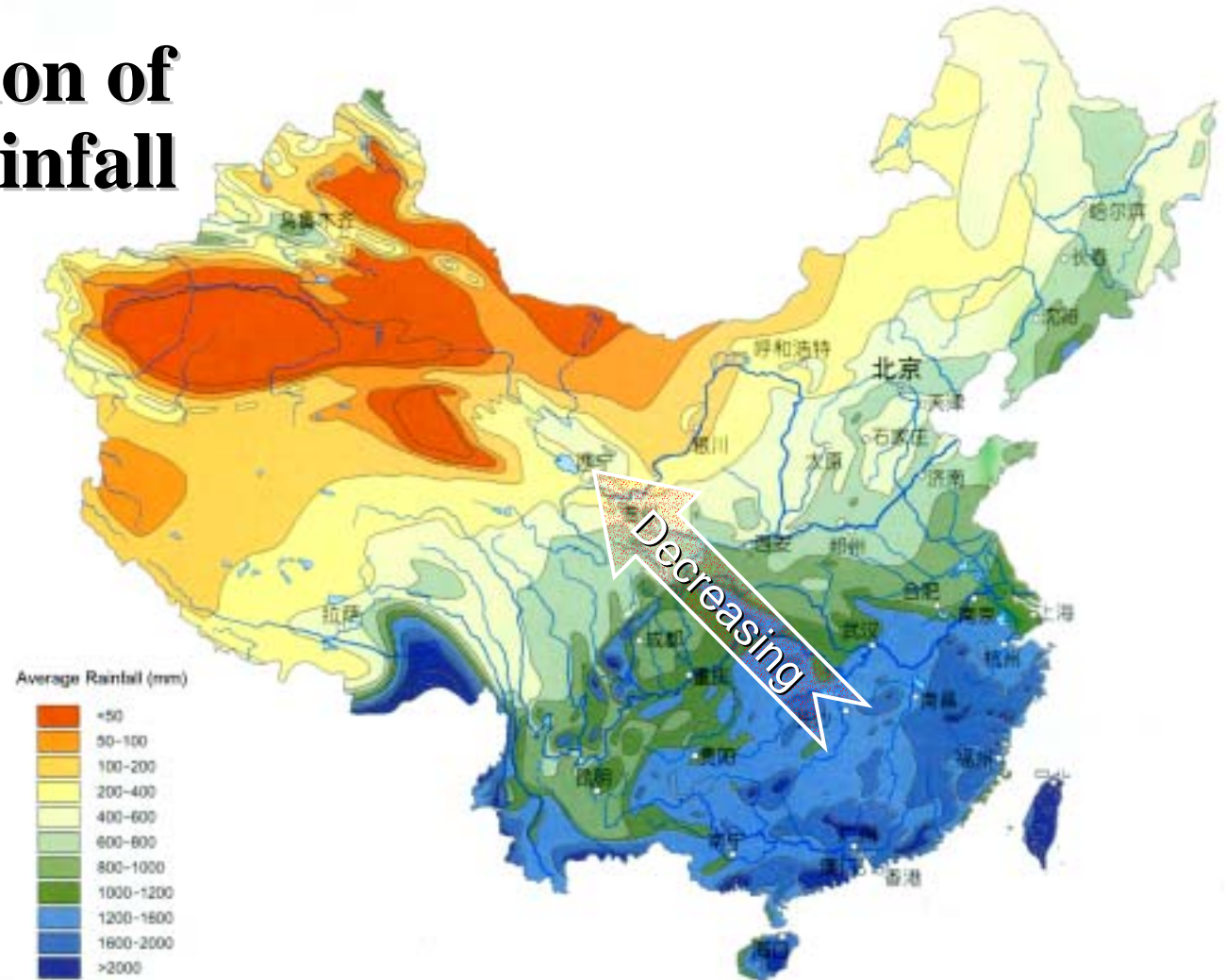
# Outline of the presentation

- **Water shortage and needs for wastewater reuse in Northern China**
- **Configuration of *Sustainable Urban Water Environmental System* under the concept of decentralization and reuse**
- **Case studies in Xi'an**
  - ✓ **Case 1: a college**
  - ✓ **Case 2: a residential area**
  - ✓ **Case 3: a newly developed district**
- **Summary and conclusions**



# Water shortage and needs for wastewater reuse in Northern China

- **Distribution of annual rainfall in China**





# Water shortage and needs for wastewater reuse in Northern China

## ● Associated problems

- ✓ **Over-extraction of groundwater**
- ✓ **Decrease of river base flow**
  - **The Yellow River and its tributaries**
- ✓ **Water pollution**
  - **In the whole country, about 40% of the surface water cannot be used as source water for drinking water supply**
  - **In the northern basins, the percentage is as high as 55-70%**



# Water shortage and needs for wastewater reuse in Northern China

## ● Needs for wastewater reuse

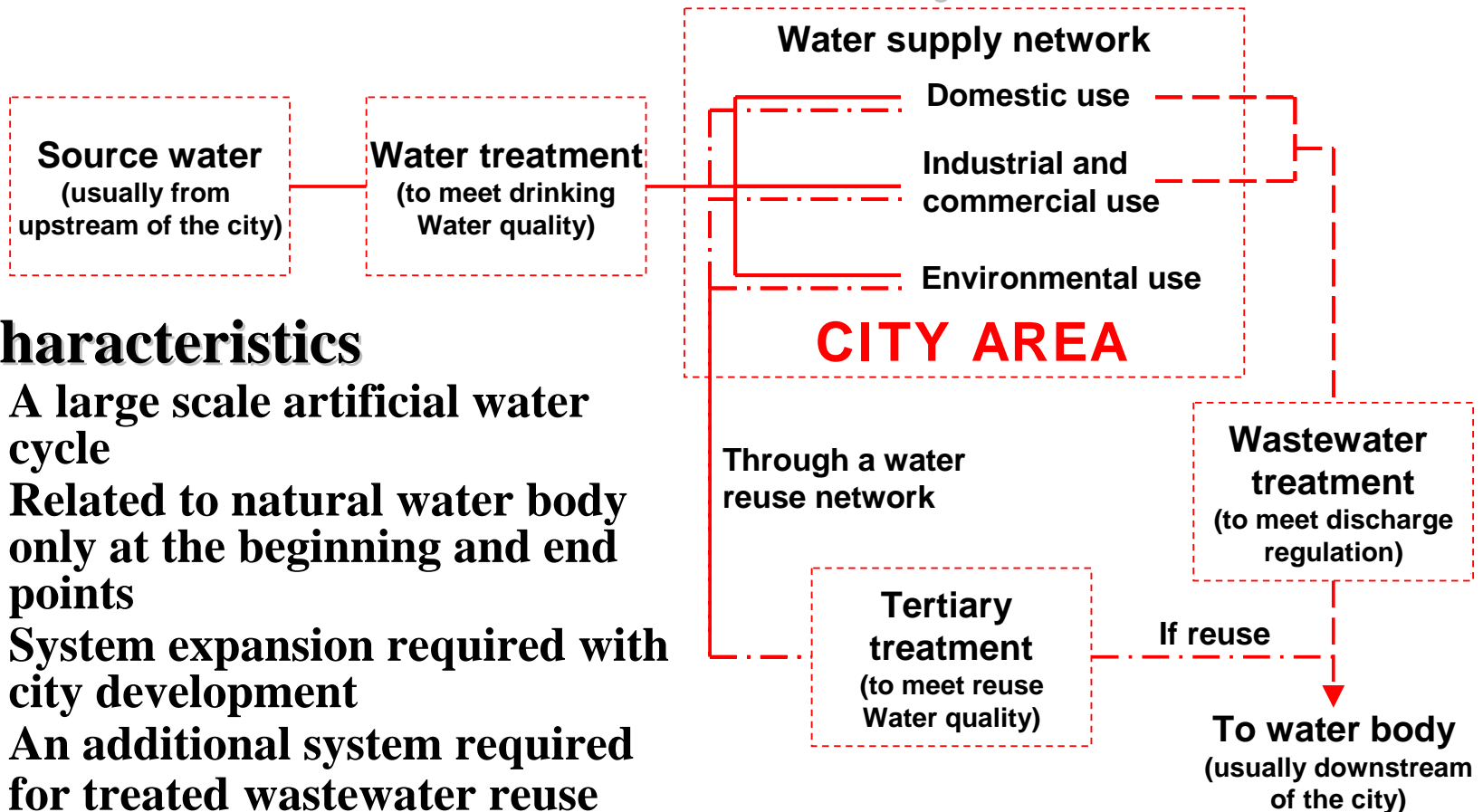
- ✓ **Potential of wastewater as a water resource**
  - In 2005, total domestic wastewater treated was more than 11 billion m<sup>3</sup>
- ✓ **Projected water shortage in more than 400 cities**
  - About 6 billion m<sup>3</sup> per year
- ✓ **Increasing needs of water reuse for urban environment**
  - Gardening and forestation
  - Restoration of urban water bodies
  - Artificial lakes and ponds

*- Especially important in the northern cities*



# Configuration of a Sustainable Urban Water Environmental System

## ● Conventional urban water system



### Characteristics

- ✓ A large scale artificial water cycle
- ✓ Related to natural water body only at the beginning and end points
- ✓ System expansion required with city development
- ✓ An additional system required for treated wastewater reuse



# Configuration of a Sustainable Urban Water Environmental System

## ● Centralization vs. decentralization

### ✓ Centralized systems

- A collection system covering the whole service area
- Long distance transfer of the collected wastewater
- A distribution system with long distance transfer for treated wastewater reuse

### ✓ Decentralized systems

- Independent collection system covering a small service area
- Onsite treatment and onsite reuse
- Long distance transfer of both the collected wastewater and the treated wastewater is avoided



# Configuration of a Sustainable Urban Water Environmental System

## ● General considerations on SUWES

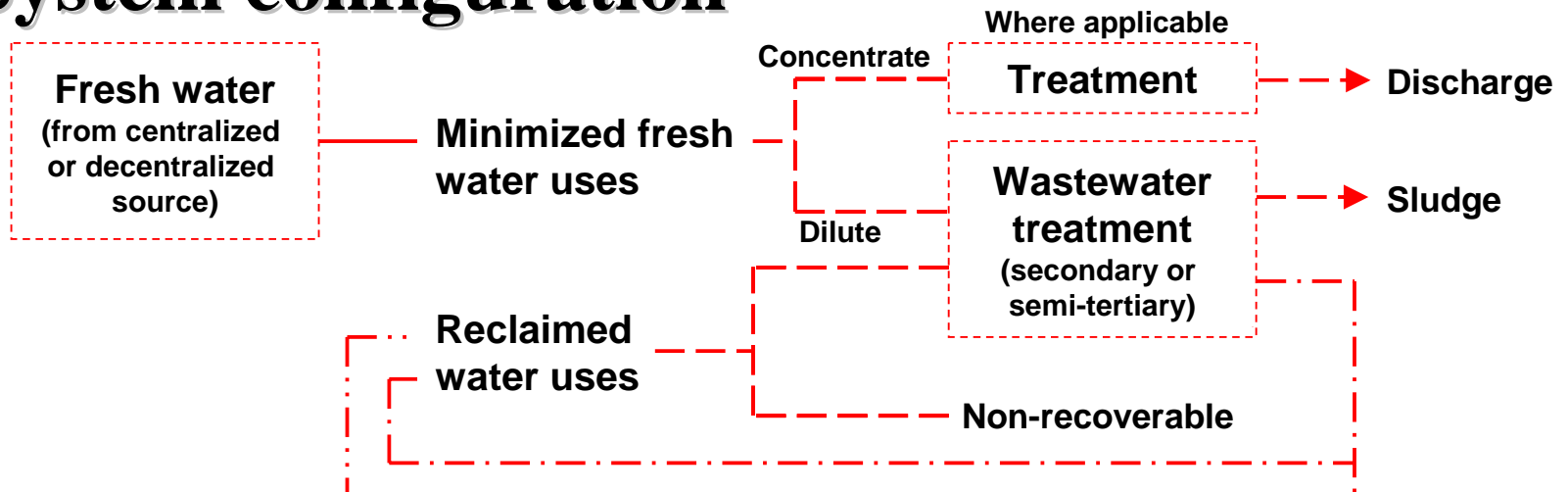
- ✓ Minimization of fresh water supply and maximization of treated wastewater reuse
- ✓ Decentralization as the basic philosophy of system design
- ✓ Priority given to environmental reuse of the treated wastewater
- ✓ Introduction of the “principles of ecological design” to system configuration
  - *Follow nature’s example*
  - *Moderate and efficient resource use*
  - *Appropriate technology*
  - *Green living inspiration*





# Configuration of a Sustainable Urban Water Environmental System

## ● System configuration



## Characteristics

- ✓ Onsite wastewater treatment and onsite reuse
- ✓ Source separation where applicable
- ✓ Utilization of natural or artificial lakes (ponds) for water quality polishing where applicable
- ✓ Minimized discharge from the system

Natural or artificial water body  
(tertiary treatment or polishing)

Where applicable



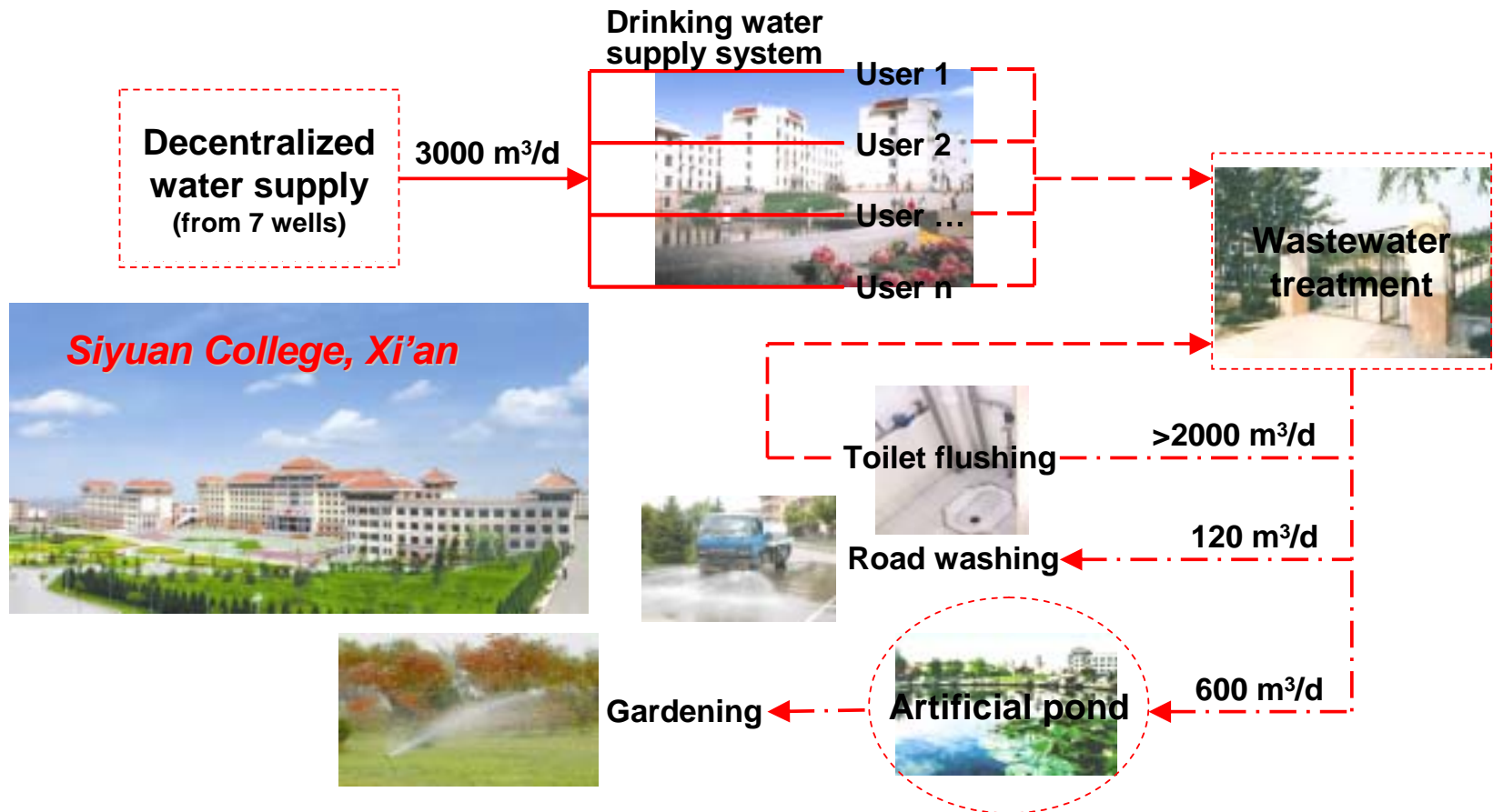
# Case study 1: A college with zero discharge of wastewater

## ● General condition

- ✓ **Location:** Xi'an suburban area, on top of a hill
- ✓ **Population:** about 25000 students all living in the campus
- ✓ **Available water source:** away from city water supply network, only groundwater available
- ✓ **Service area:**
  - Total 87 hectares
  - Green coverage about 45 hectares
- ✓ **Constraints:**
  - Groundwater withdraw can only support drinking water supply
  - Far away from the city drainage system

# Case study 1: A college with zero discharge of wastewater

## ● System composition





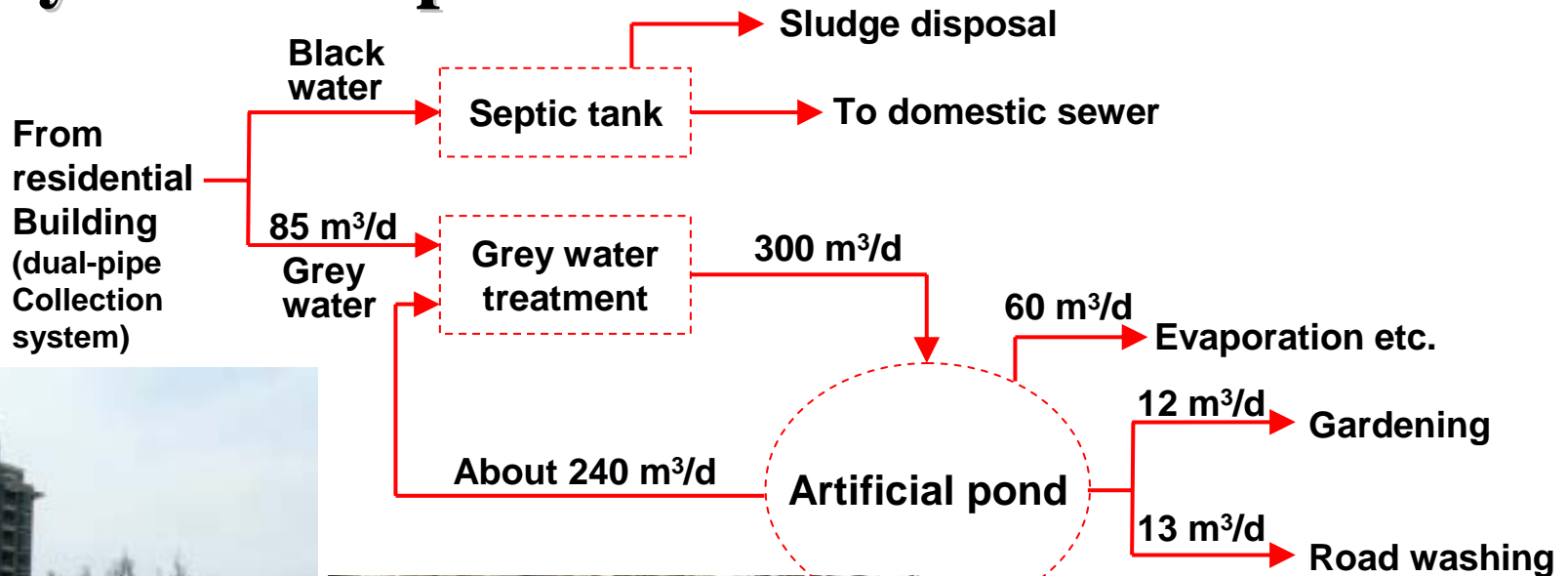
# Case study 2: A residential area with grey water for environmental reuse

## ● Requirement of system design

- ✓ A pilot project supported by local government for grey water treatment and reuse for a newly developed residential area in Xi'an urban area
- ✓ Environmental use (artificial ponds, gardening etc.) as the main purpose of wastewater reuse
- ✓ Basic data:
  - Served population: 400 households, 1200~1600 people
  - Green belt area: 6400 m<sup>2</sup>
  - Artificial pond surface: 6500 m<sup>2</sup>

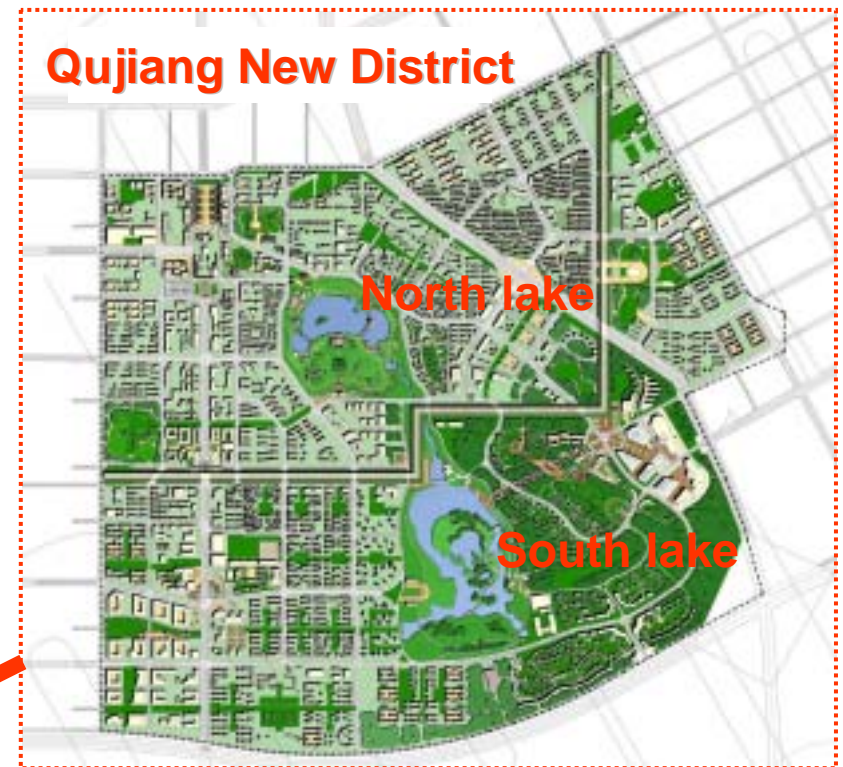
# Case study 2: A residential area with grey water for environmental reuse

## ● System composition



# Case study 3: a newly developed district as an independent water district

## ● Location map



Total area: short term 15.88 km<sup>2</sup>  
long term 47.00 km<sup>2</sup>



# Case study 3: a newly developed district as an independent water district

## ● Characteristics of the district

### ✓ Large water area

- North lake: water surface as 20 hectares (restored)
- South lake: water surface as 45 hectares (under restoration)

### ✓ High green coverage: about 47%

### ✓ Rich with historical remains

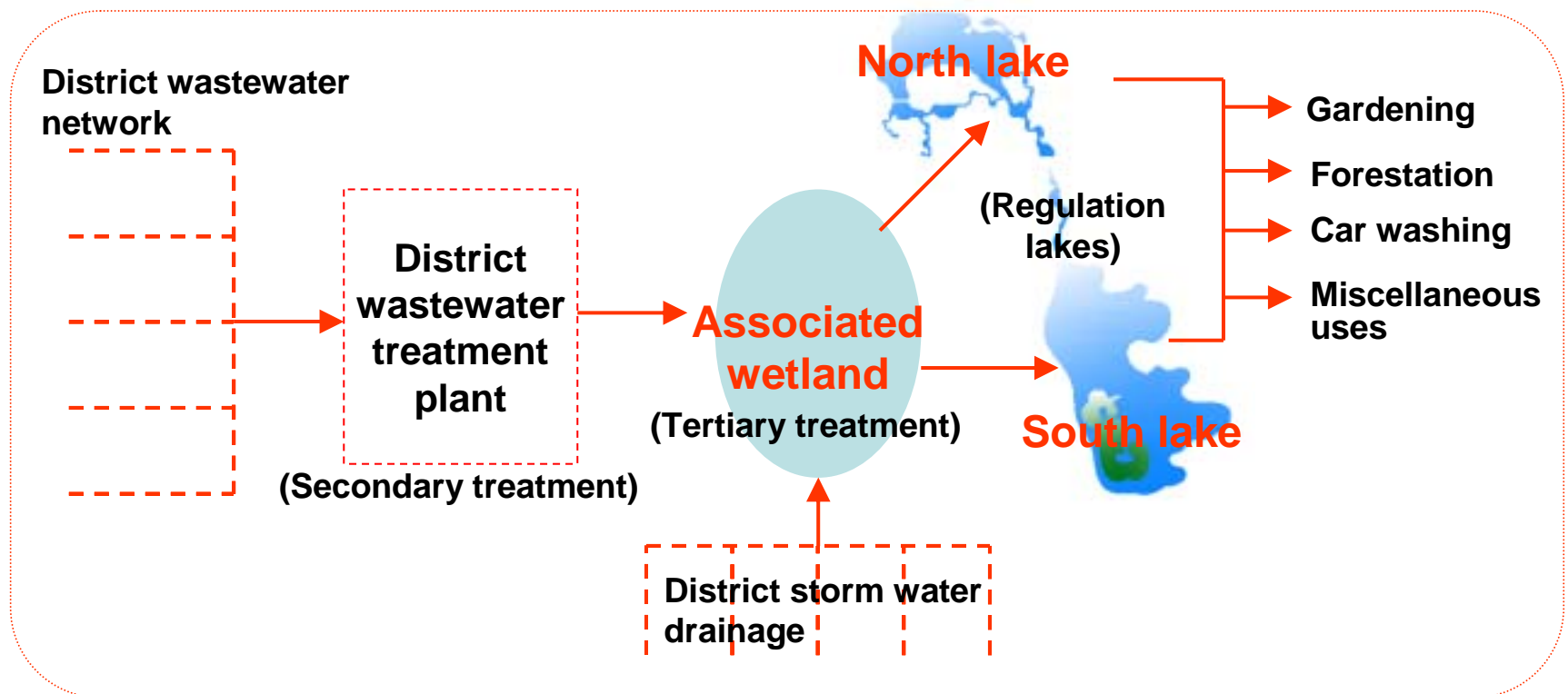
### ✓ Tourism as the main industry in the future

### ✓ Problems to solve

- Water source for lake water replenishment
- Construction of environment and ecology friendly water and wastewater system

# Case study 3: a newly developed district as an independent water district

## ● Configuration of an independent water district







# Summary and conclusions

- **A sustainable urban water environmental system may have the following characteristics**
  - ✓ **Minimization of fresh water supply and maximization of treated wastewater reuse**
  - ✓ **Decentralization as the basic philosophy of system design**
  - ✓ **Priority given to environmental reuse of the treated wastewater**
  - ✓ **Introduction of the “principles of ecological design”**
- **Such a system may be suitable for urban area in northern China to mitigate water shortage and improve urban environment**
- **Several cases have provided examples of such systems**

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*Thanks !*

*Sunset at the north lake of  
the Qujiang New District*