

Smart Water Governance in Taipei

*-Sustainable Strategies
and Action Programs*

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Location of Taipei Basin



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Taipei Energy Hill



Riverside Park



Taipei 101



North Gate

TAIPEI

2017 Universiade



National
Palace Museum



Taipei MRT



YouBike



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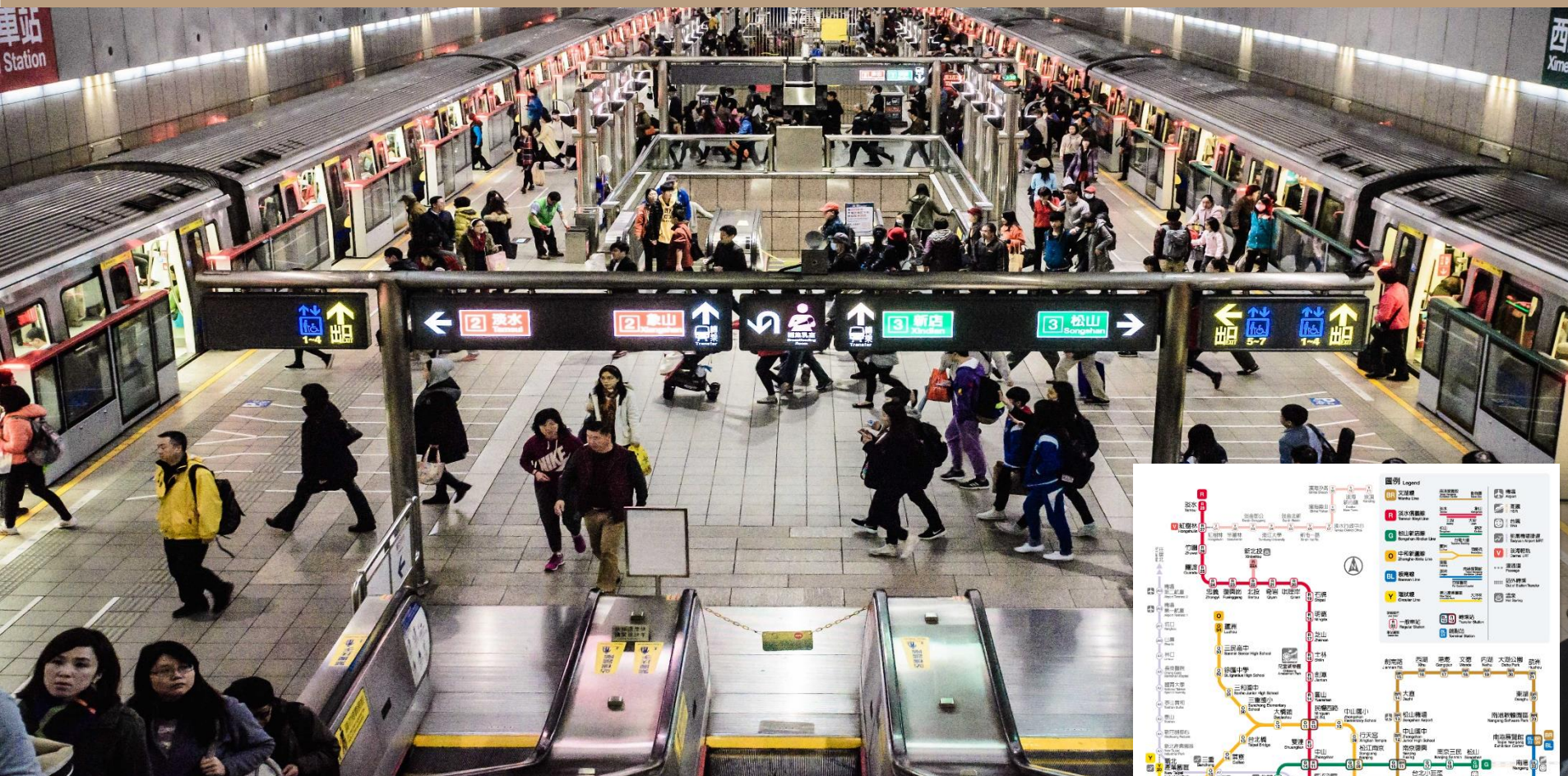


#UNDISCOVERED TAIPEI

#FUNTAIPEI

Safe, Easy & Friendly to Travel

6 major MRT routes, and 131 stations



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The Most Reliable
Metro System in the World

1,630,000 train-km between disruptions in the 2019 record.

6 Lines, 131 Stations, 2.16 million Passengers daily

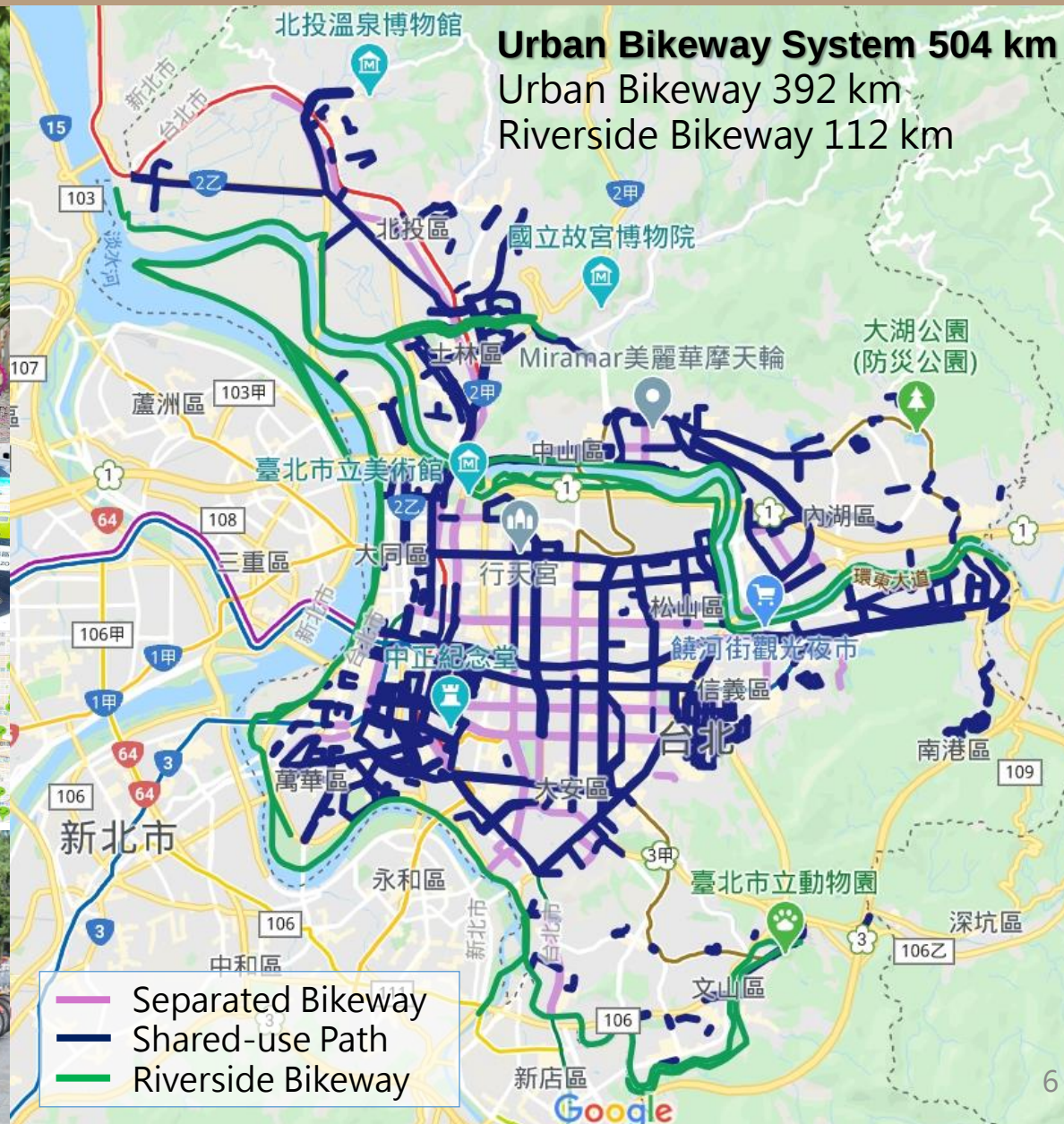


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#FUNTAIPEI

YouBike

The creation of public, municipal, business win-win key model



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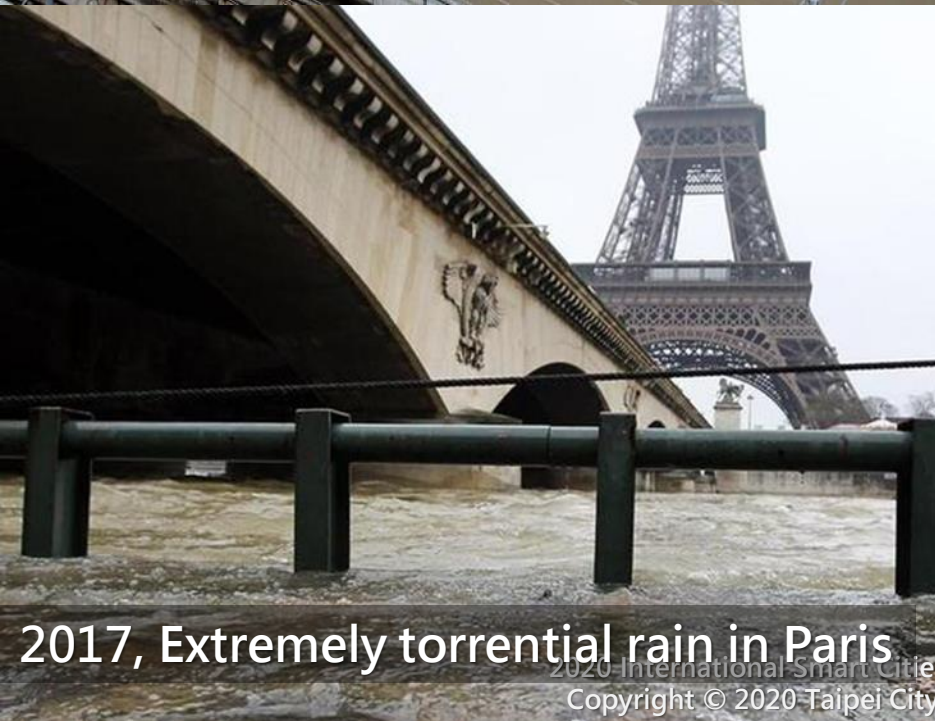




2019, Typhoon Hagibis in Japan



2016, Heat wave in India



2017, Extremely torrential rain in Paris



2016, Five-year drought in California

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0823 Extremely Torrential Rainfall

1小時累積雨量：2018-08-23 00:00 至 2018-08-23 14:30

1	111.5 mm	大寮 (C0V730)	高雄市	大寮區	2018-08-23 11:20
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24小時累積雨量：資料更新時間 2018-08-24 15:40

1	臺南市	楠西區	曾文	★★ 831.5
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熱帶低壓事件 暴雨回顧

2018/8/23 下午 06:33

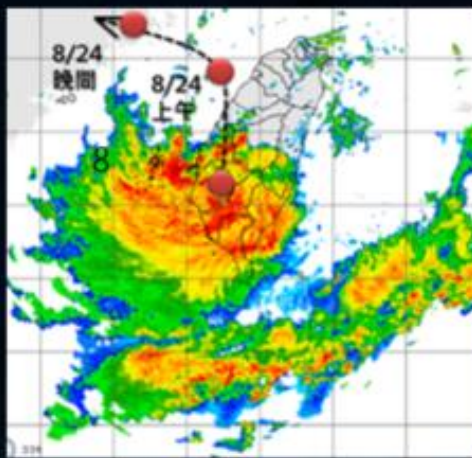
Max. rainfall intensity:
111.5 mm/hr.
831.5 mm/24hrs.

(Source: 天氣風險公司)

時雨量30毫米以下
時雨量31-60毫米
時雨量61-90毫米
時雨量91毫米以上

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太平洋



(Source: 單信瑜教授、
天氣職人-吳聖宇、陳郭正處長臉書)

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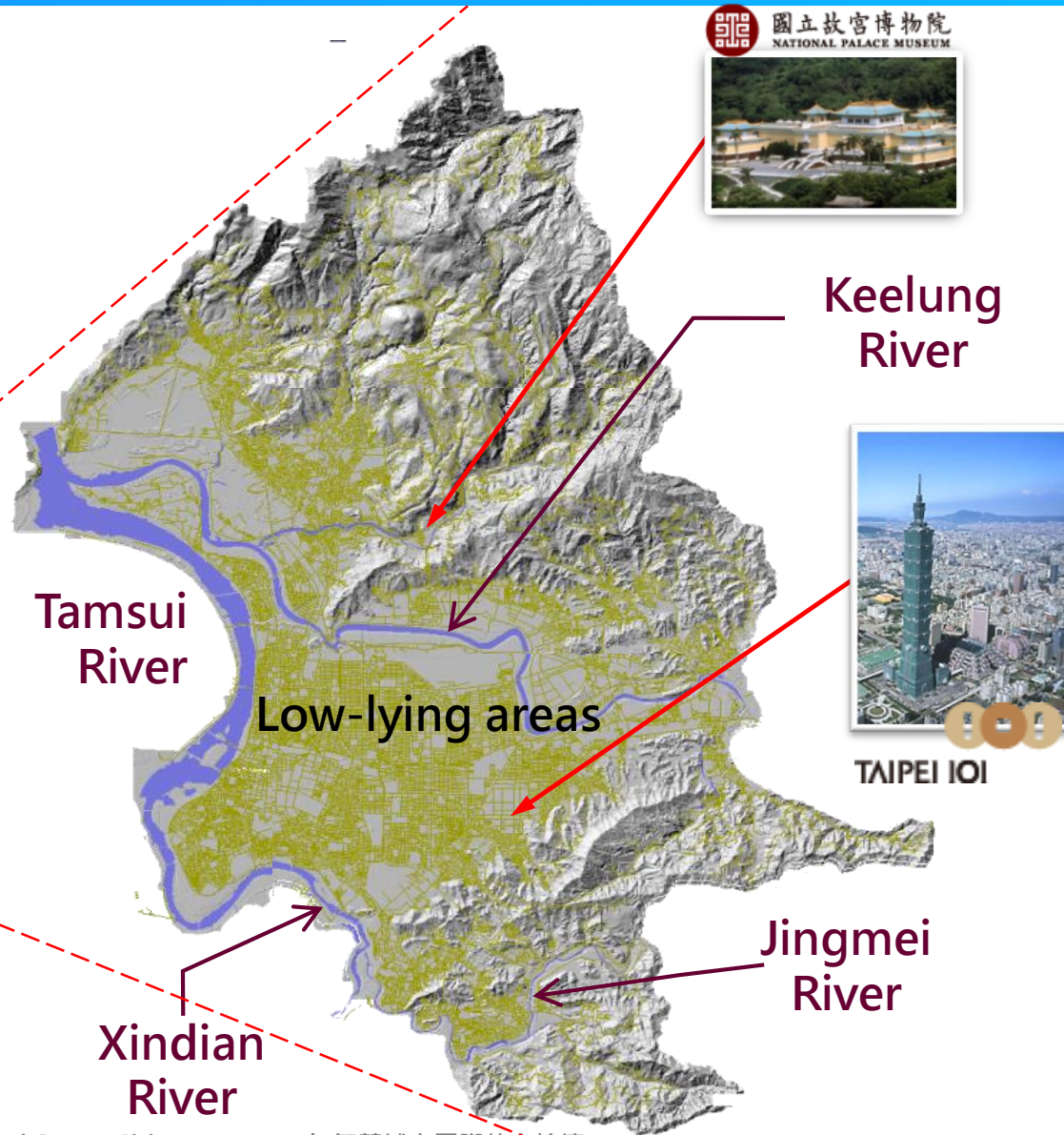
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Taipei City

- **Area: 272 km²**
(55% mountains /45% plains)
- **Population: 2.63 million**
(avg. density 9,670 ppl./km²)
(Da-an dist. 27,000 ppl./km²)
- **Average annual rainfall:**
2,500 mm/yr. (plains)
4,500 mm/yr. (mountains)

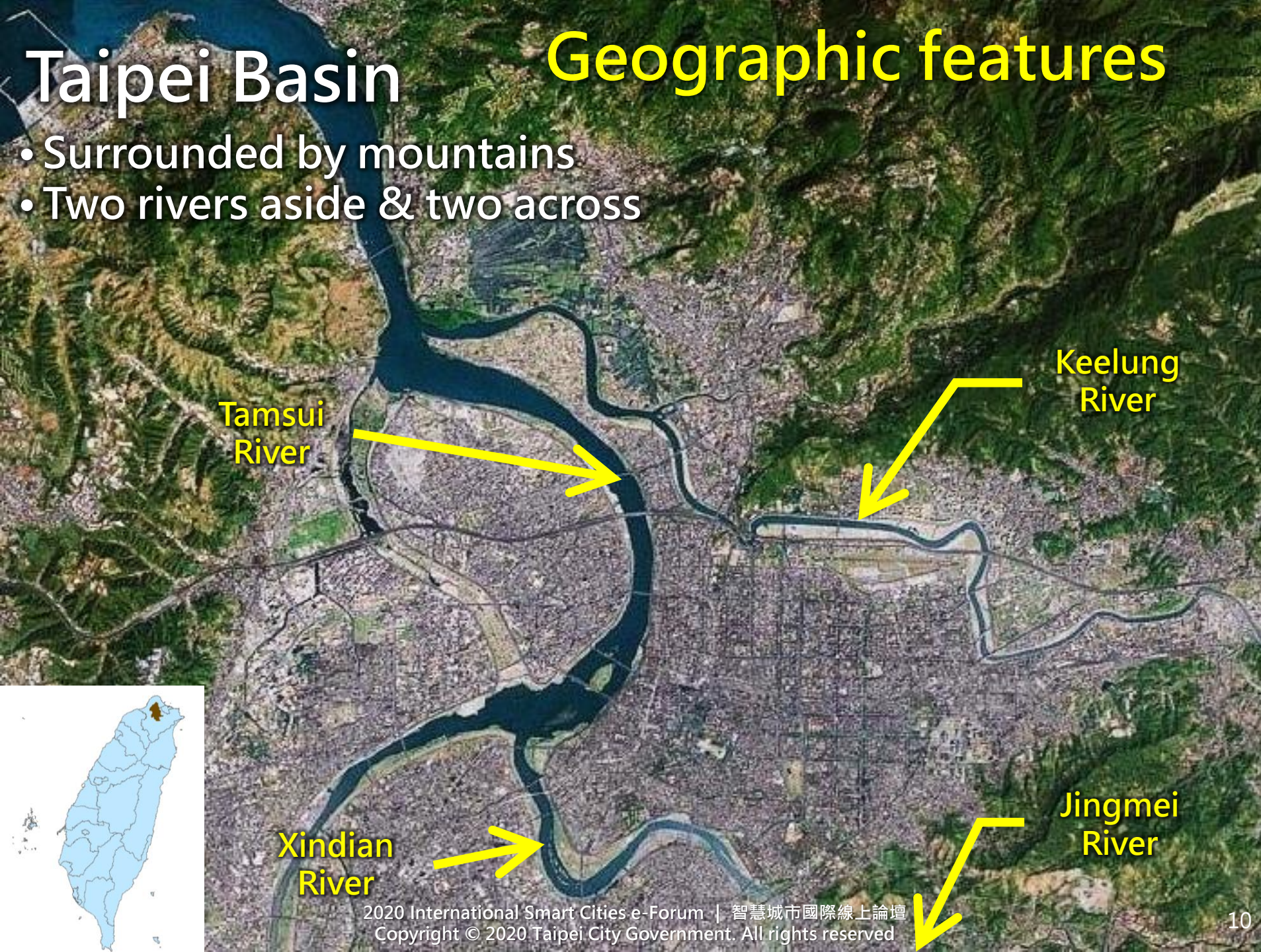
Taiwan



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Taipei Basin

Geographic features

- Surrounded by mountains
- Two rivers aside & two across

Tamsui River

Keelung River

Xindian River

Jingmei River



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"Taipei Metropolitan Flooding Prevention Scheme"

- issued in 1973,
- comprised 3 principal pillars: (Pluvial/River floods)



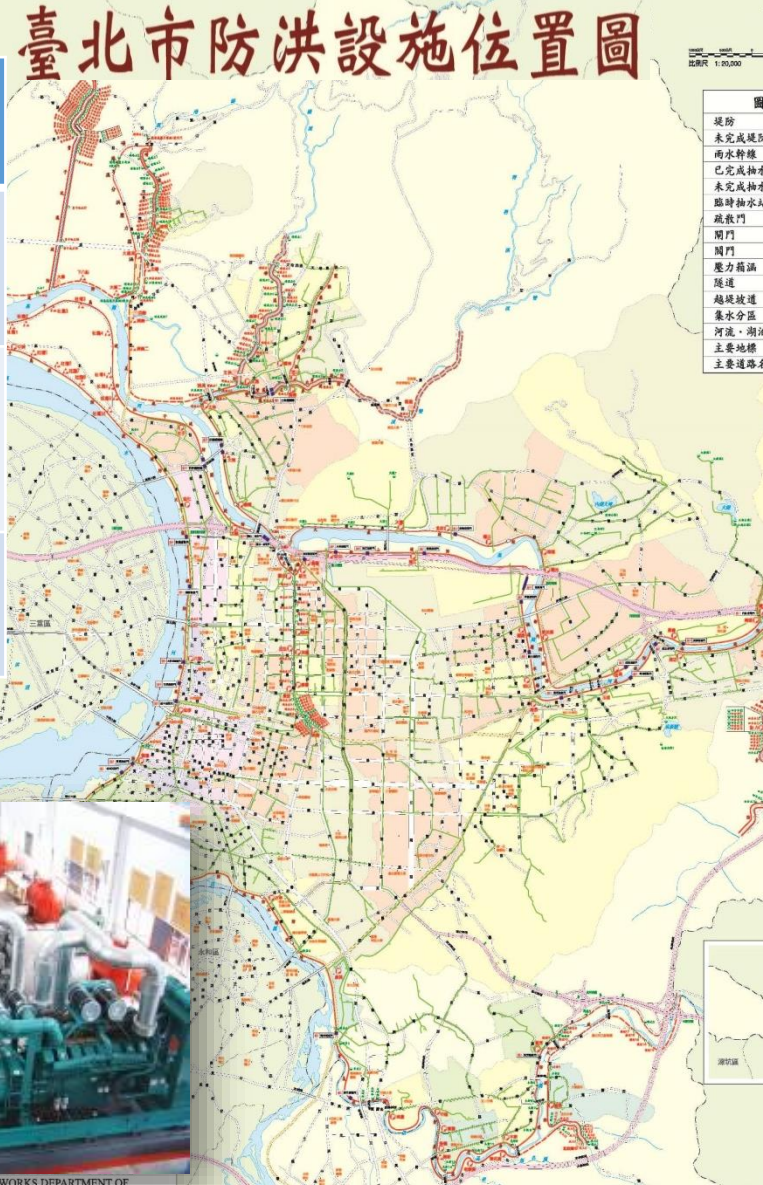
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Taipei Flooding Prevention System

	Design Criteria	Constructed	Completion Rate
Embankment	200-year	109 km	83.2%
Drainage system	5-year <i>78.8 mm/hr.</i>	<i>522 km</i> (Gutter 1,517km)	96.7%
Pumping station	60 mm/hr.	87 stations <i>2,195 cms</i>	89.2%

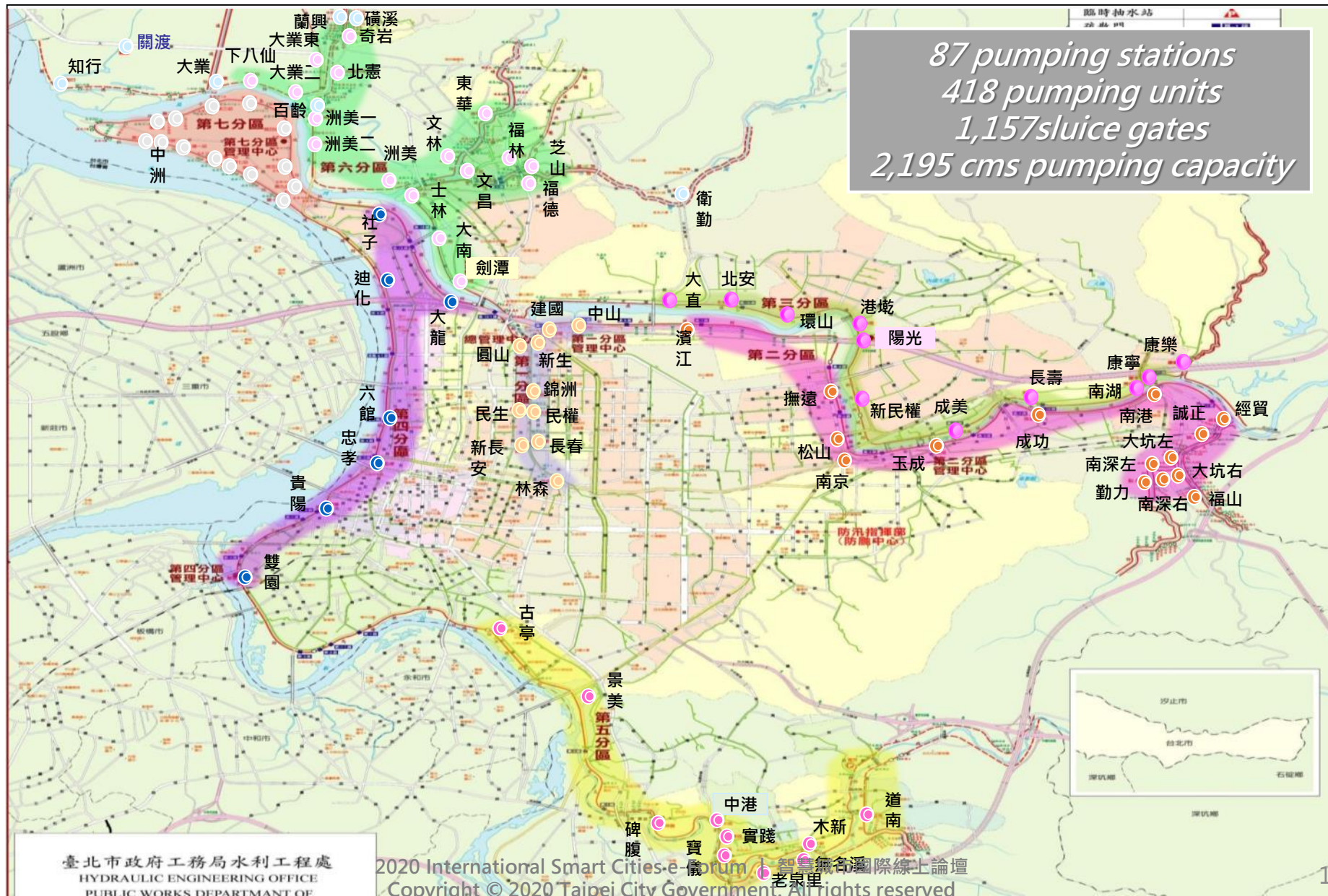


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Rainwater Pumping System



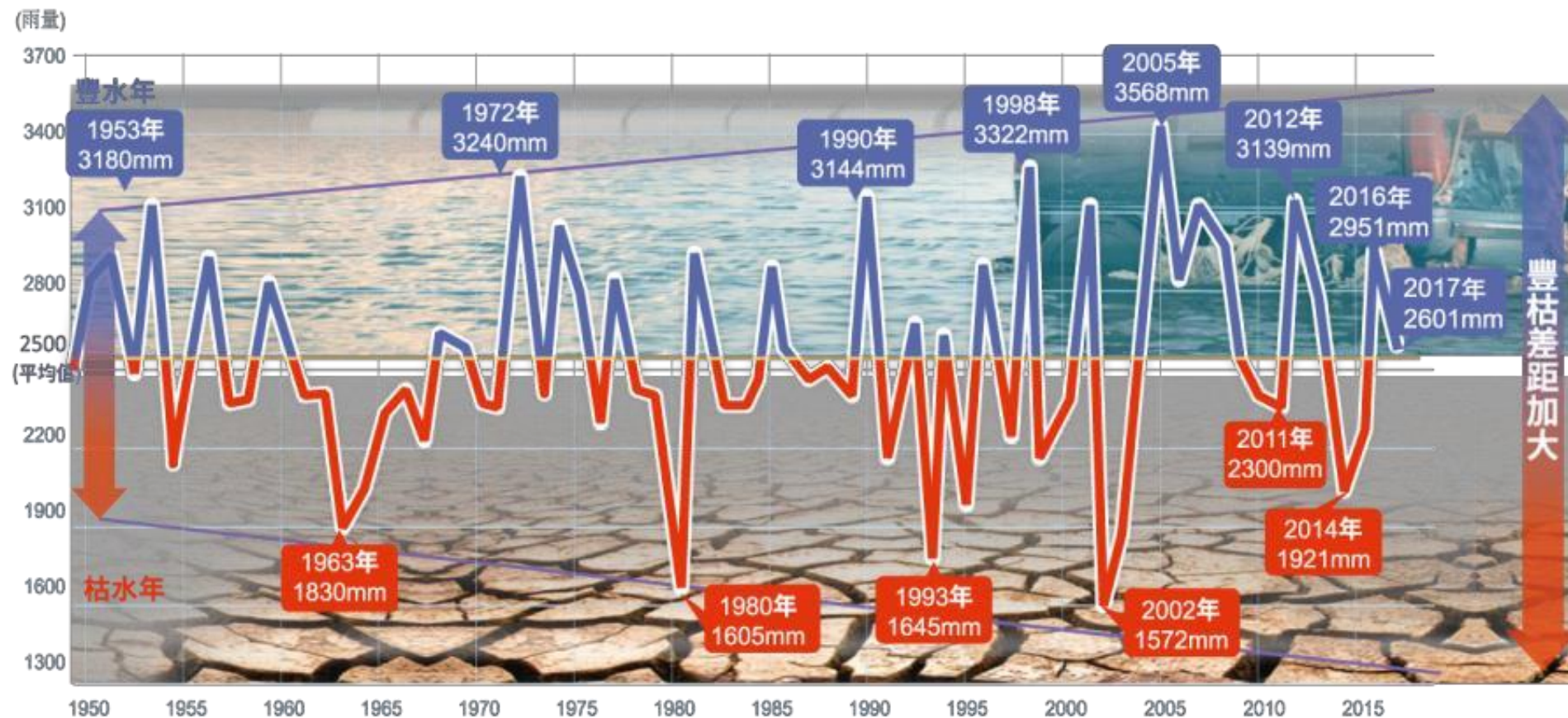
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Trend of Climate Change in Taiwan

Annual average rainfall:
driest/wettest year → more and more frequent and intense!



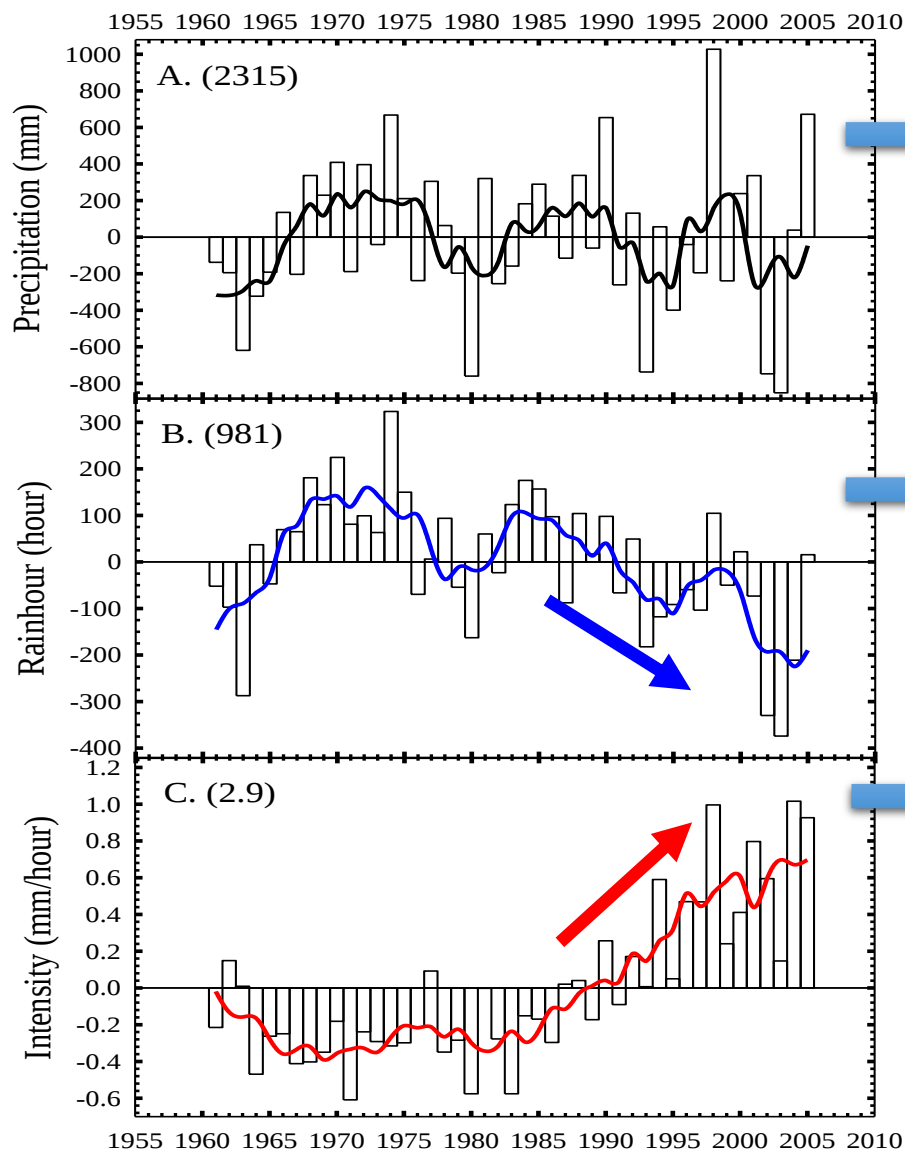
資料來源：經濟部水利署 http://epaper.wra.gov.tw/Epaper_Content.aspx?s=5168F47D924D1FCD

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Precipitation trend in Taiwan for the past 55 years



fluctuated but stayed static!

rain hour shortened!

rapid upward trend!

資料來源：「因應氣候變遷之調適策略」簡報，2010年

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New type challenges

2015. 6. 14
extreme rainfall

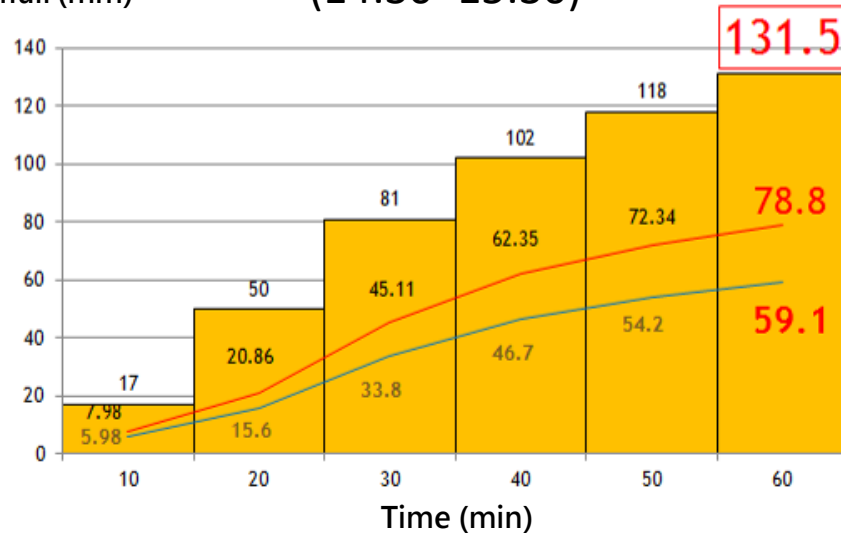
Drainage system design criteria:
78.8 mm/hr.
13.1 mm/10mins

**Max rainfall : 131 mm/hr.
33 mm/10mins**

➡ Beyond the design criteria:
water receded within 30 mins

Gongguan station
(14:30~15:30)

Accumulated
rainfall (mm)



13:10~20 **rainfall coming**
15:11 began waterlogging



14:40~50 **33 mm/10min**
15:33 water depth
24~35 cm



15:30~40 **5 mm/10min**
15:55 water receded

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Outlines

Case 1: e-Patrol & Water Information Integration Platform

Case 2: Smart Rainwater Pumping System

Case 3: Flood Simulation and Early Warning System

Case 4: Sewage Treatment System & Water Resources

Future Outlook and Conclusion Remarks

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Taipei Smart Flood Prevention Scheme

Scheduled maintenance

Riverside Patrol APP

- Riverside Park defects report
- Electronic patrol point

Sewer Patrol APP

- Manhole and structure inspection
- Attached cable inspection

Pumping Station Patrol APP

- Daily equipment inspection
- Routine test report

Embankment Patrol APP

Monitoring



- Rainfall station
- Gauging station



- Storm drainage system monitoring
- River water level monitoring
- Water gate monitoring



GSN VPN
INTERNET



- Water Information Integration Platform
- Taipei Water Information App

Controlling



Pumping Station Automatic controlling System



Water Gate Monitoring controlling System

Forecasting



Urban Flooding Potential Forecasting



River level Forecasting



Taipei city disaster prevention APP



Disaster prevention personnel



Public

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Riverside, Sewer, Pumping Station, Embankment Patrol APP

Scheduled maintenance

Monitoring

Controlling

Forecasting

IoT, ICT,
Easy to control

Paperless,
carbon
reduction

Simple
access
higher
efficient

Big data
management
and analyze

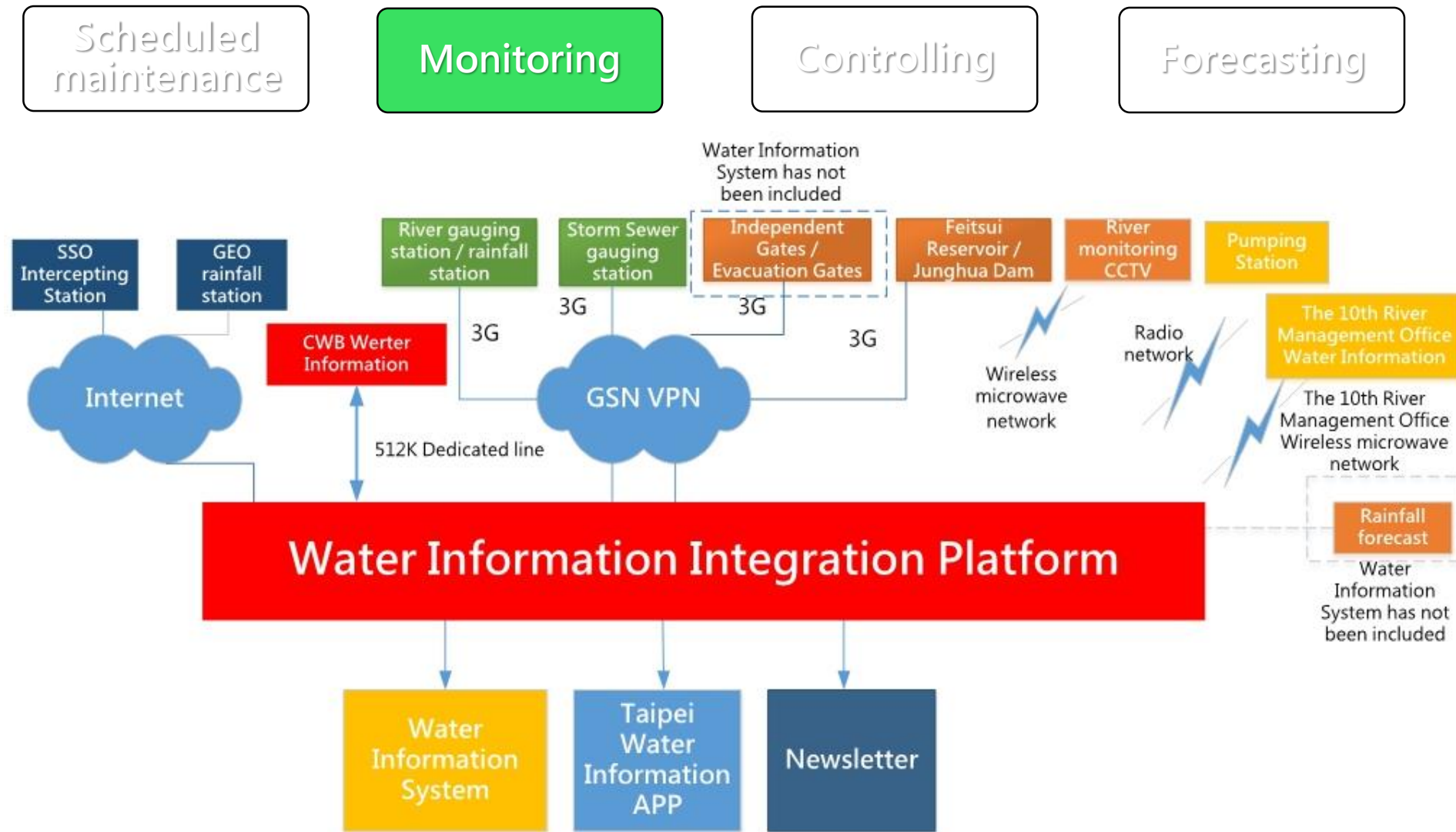


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Water Information Integration Platform



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Water Information Integration Platform

Scheduled
maintenance

Monitoring

Controlling

Forecasting

- ◆ 25 spots of river water level monitoring
- ◆ 156 spots of rain water sewer system water level monitoring
- ◆ 59 spots of CCTV river monitoring



(資料來源: 2018臺北國際水環境高峰論壇)

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Water Information Integration Platform

Scheduled
maintenance

Monitoring

Controlling

Forecasting

River water level
real-time data

Pumping station and
water gate real-time
operation data

Satellite radar
data

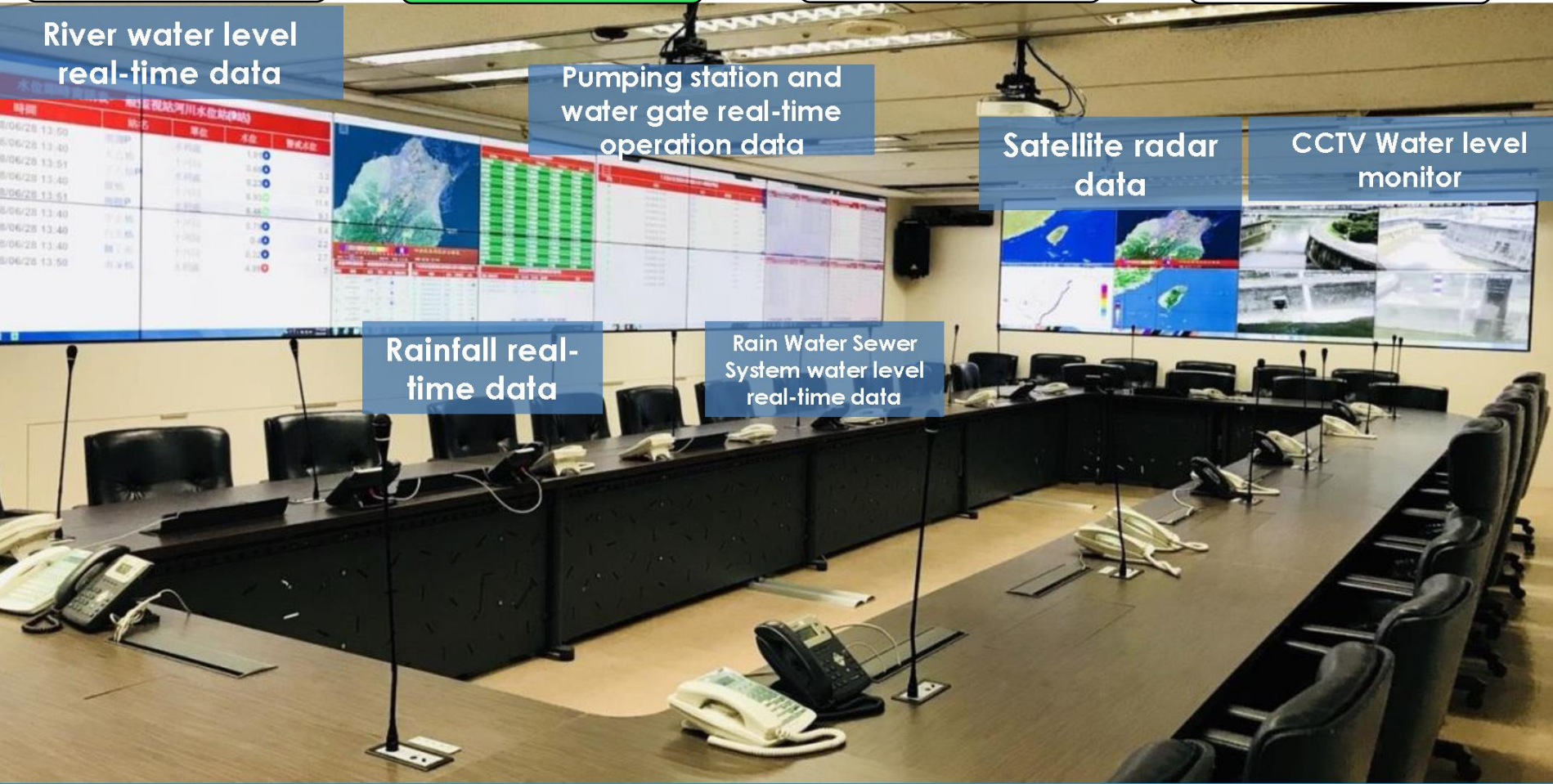
CCTV Water level
monitor

Rainfall real-
time data

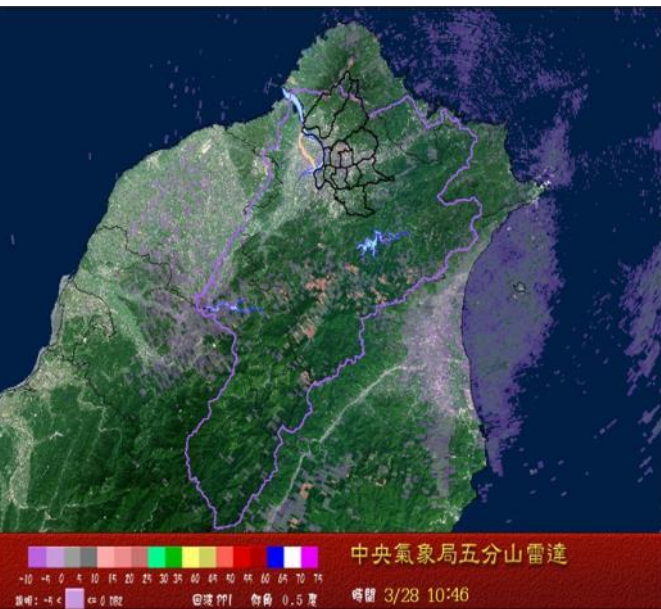
Rain Water Sewer
System water level
real-time data

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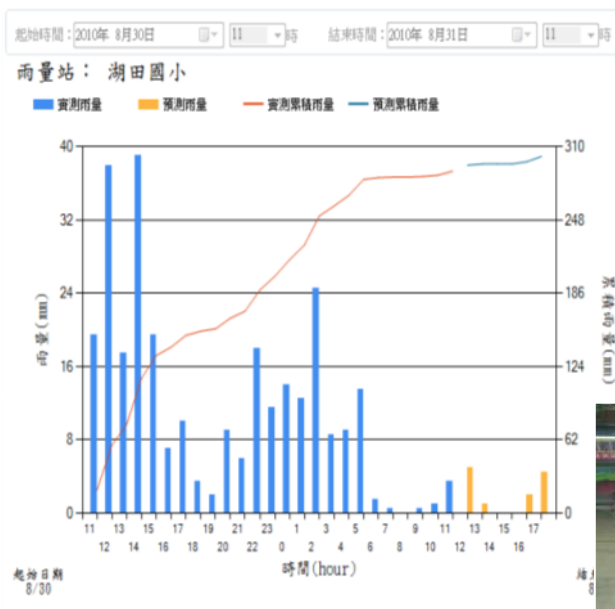
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Water Information Integration Platform



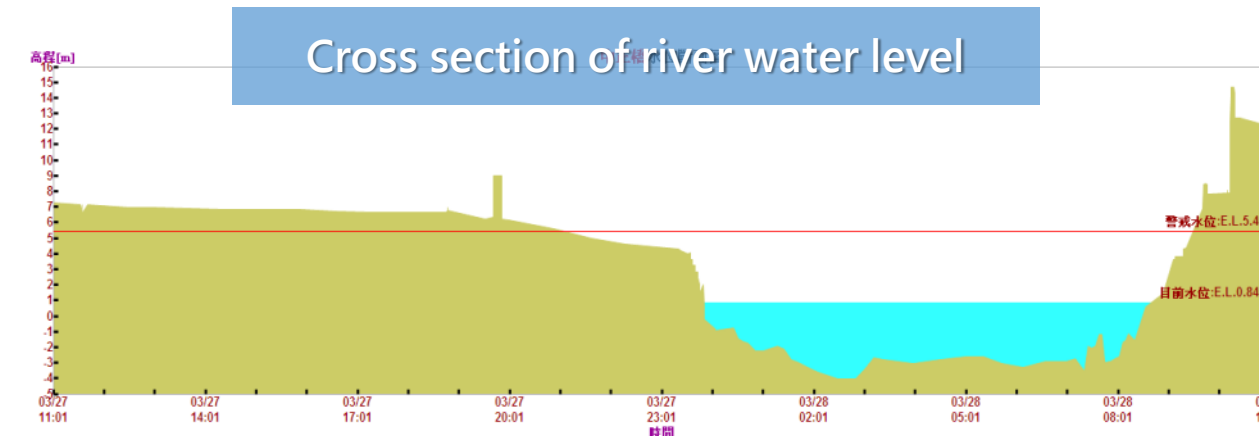
Real-time radar image



Real-time rainfall hydrograph



Real-time CCTV image
↓
Image recognition



Cross section of river water level



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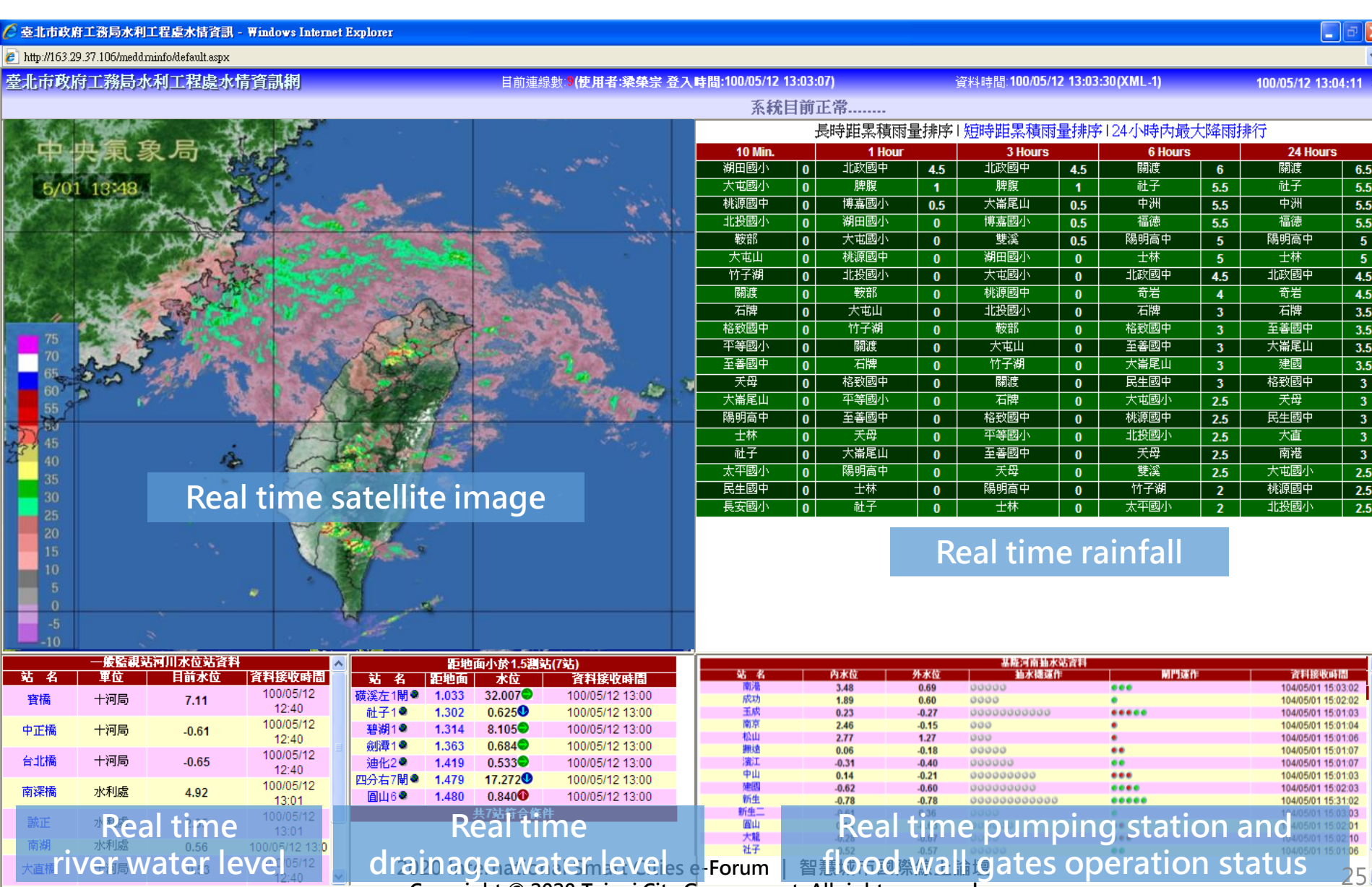
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Water Information Integration Platform

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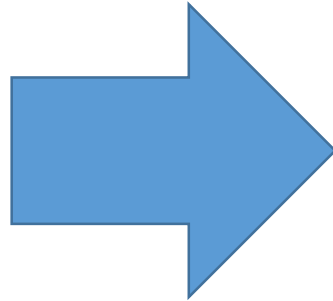


Water Information Integration Platform

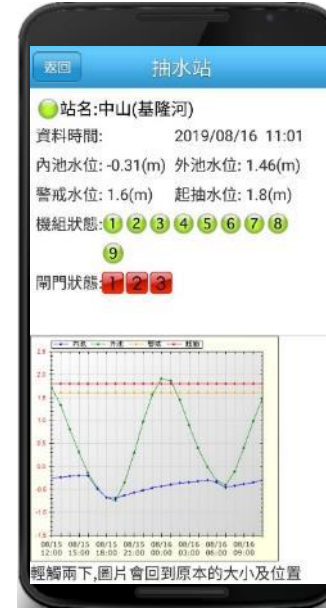


水情資訊APP

Rainfall
River water level
Rain water sewer system
Pumping stations
Radar maps
CCTV video
Mobile monitoring



- 開發水情行動平台



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Outlines

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Future Outlook and Conclusion Remarks

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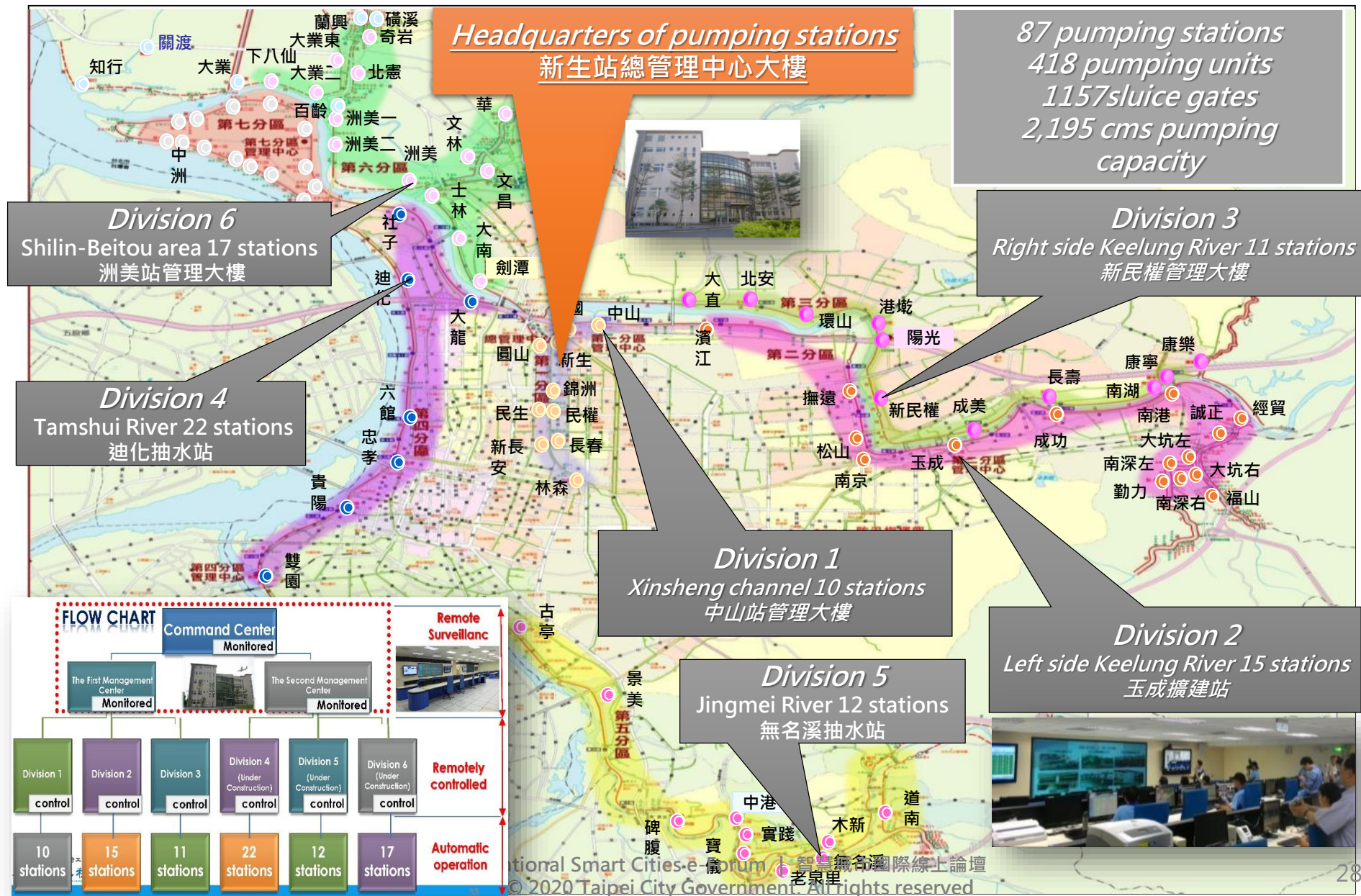
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Smart Rainwater Pumping System

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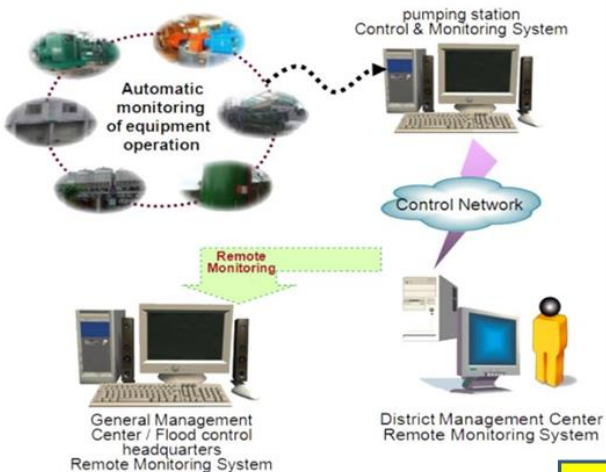
Scheduled
maintenance

Monitoring

Controlling

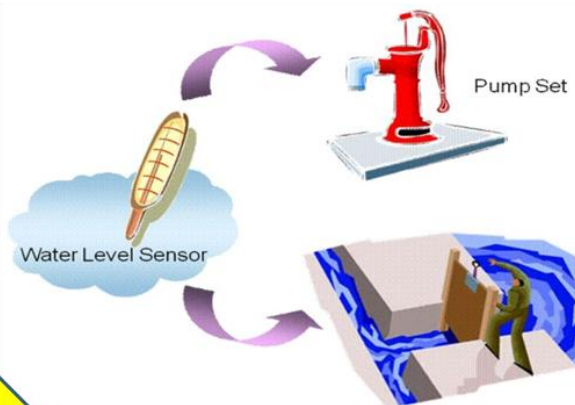
Forecasting

Automatic Control System



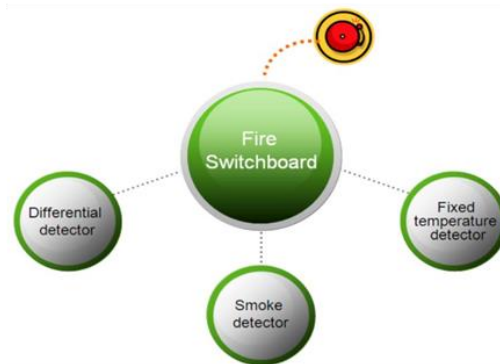
Automatic Operation:

Base on inner water level to start pumping machine



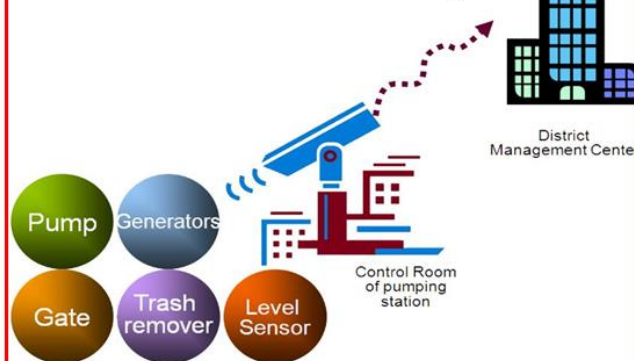
Fire Alarm:

Set up the different detector for alarm which provide prior notification of accidents



Remote Control:

The District Management Center control pumping machine and receive information through internet



Burglar Proof Security:

Set up infrared sensor and camera to ensure safety



Pumping station
Control & Monitoring
system

Automatic
Operation

District Management
Center

Remote
Control

General Management
Center/Flood control
headquarters

Remote
monitoring

效益:

1. Enhancement of flood safety
2. Improvement of maintenance quality

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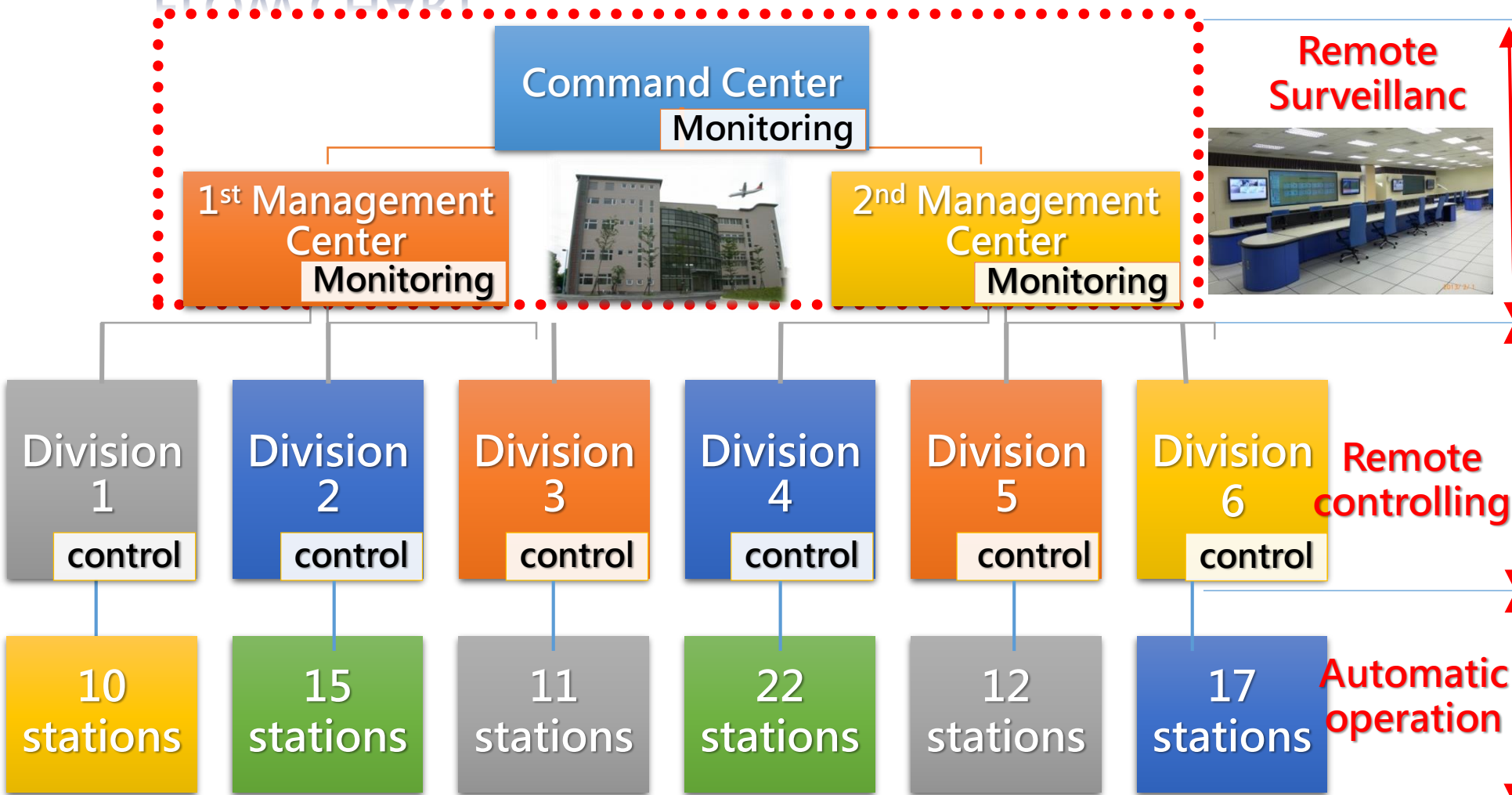
Scheduled
maintenance

Monitoring

Controlling

Forecasting

FLOW CHART



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Scheduled
maintenance

Monitoring

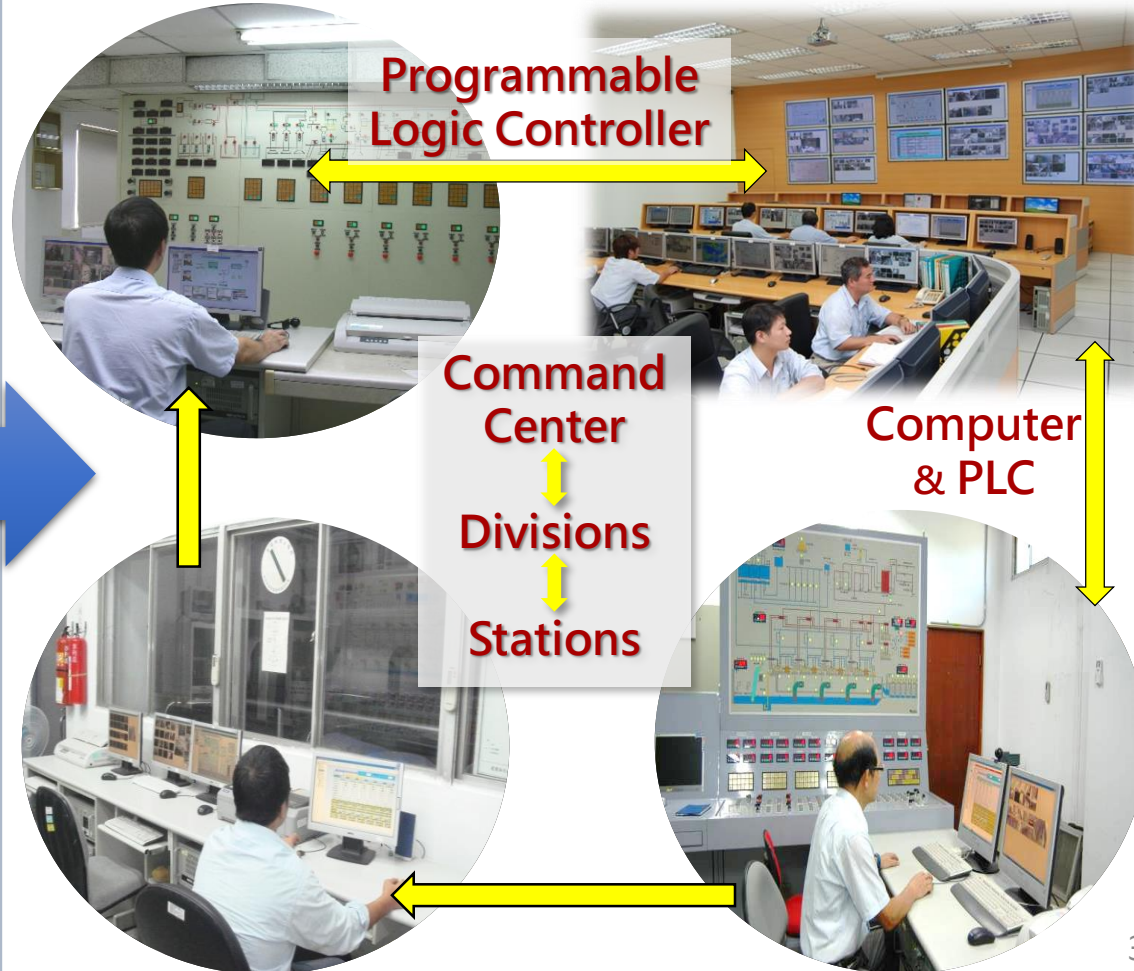
Controlling

Forecasting

Traditional operation:
highly relied on trained
staffs on duty 24 hours



Automatic control System:
optimized operation,
fewer human force needed



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Real-time remote control and monitoring

1. Enhancing operation precision
2. Improving maintenance quality
3. Minimizing manpower requirement

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Scheduled
maintenance

Monitoring

Controlling

Forecasting

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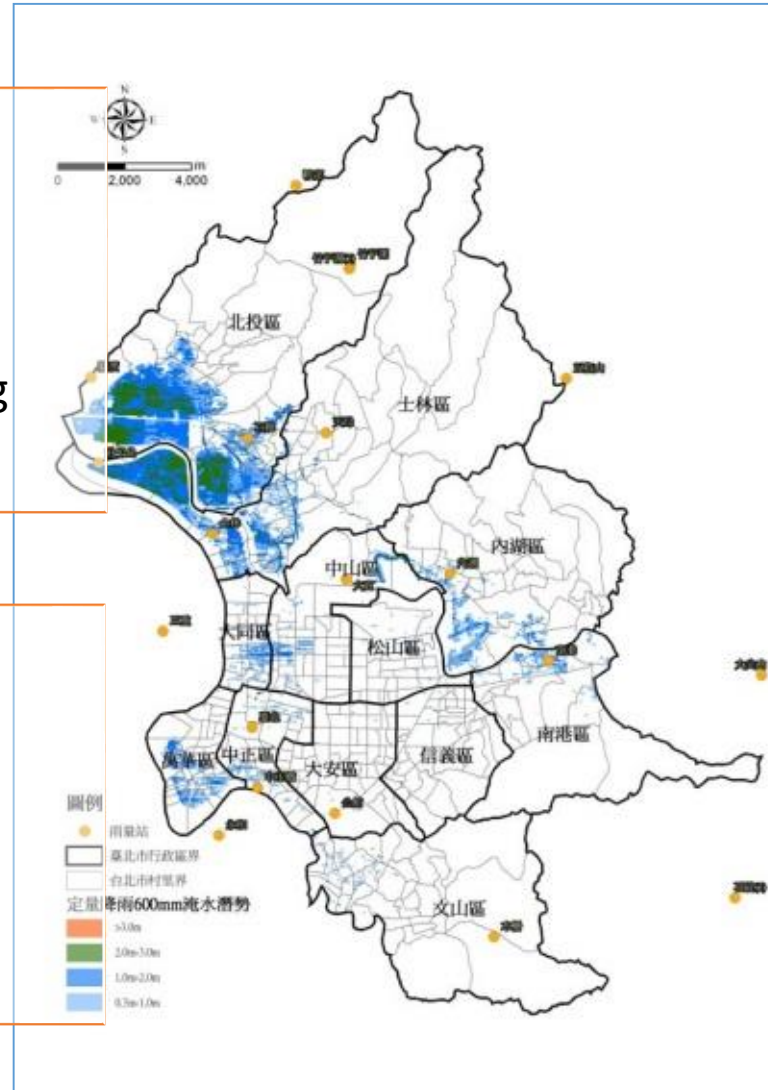
Flood simulation: 600mm/day

Flood Simulation

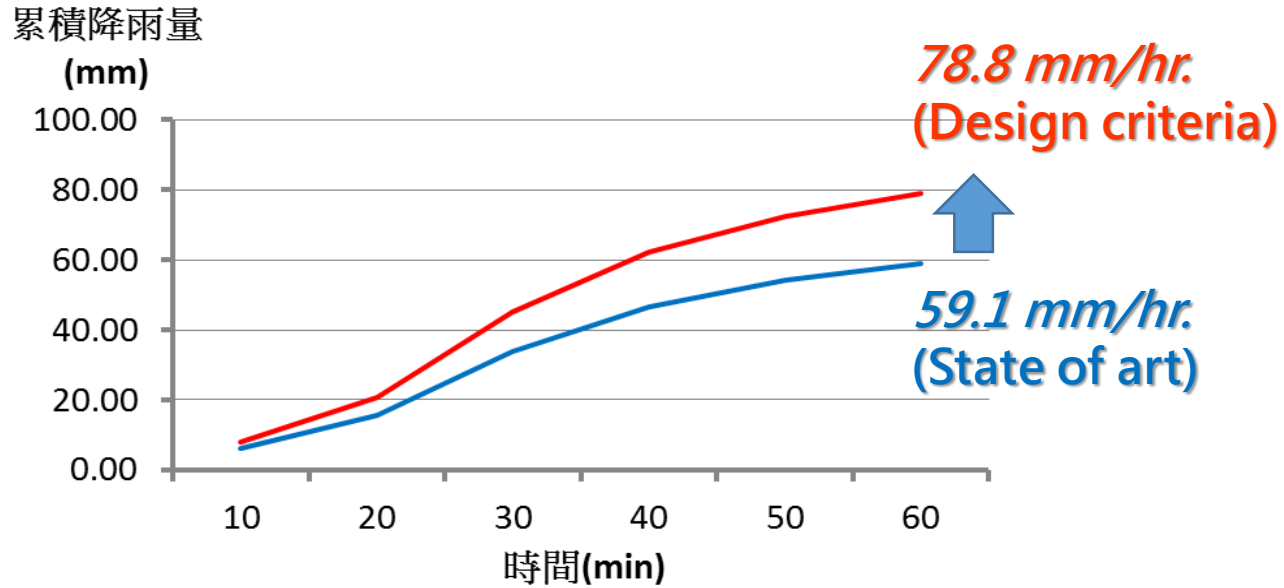
- Simulate the potential disaster of rainstorm flooding
- Simulate the range of river overflowing
Flood hazard preservation program

Forecasting

- Inundation potential forecasting
- Immediate flood level forecasting
Send immediate notification and warning notification



Wenshan District in Taipei



14 June 2015
Torrential rainfall



14 June 2015
Torrential rainfall



12 June 2012
Torrential rainfall

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Wenshan Flood Prevention & Drainage Plan

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Wenshan District and Modeling

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LiDAR DEM 1x1 resolution
63 million grids



Wenshan Flood Prevention & Drainage Plan



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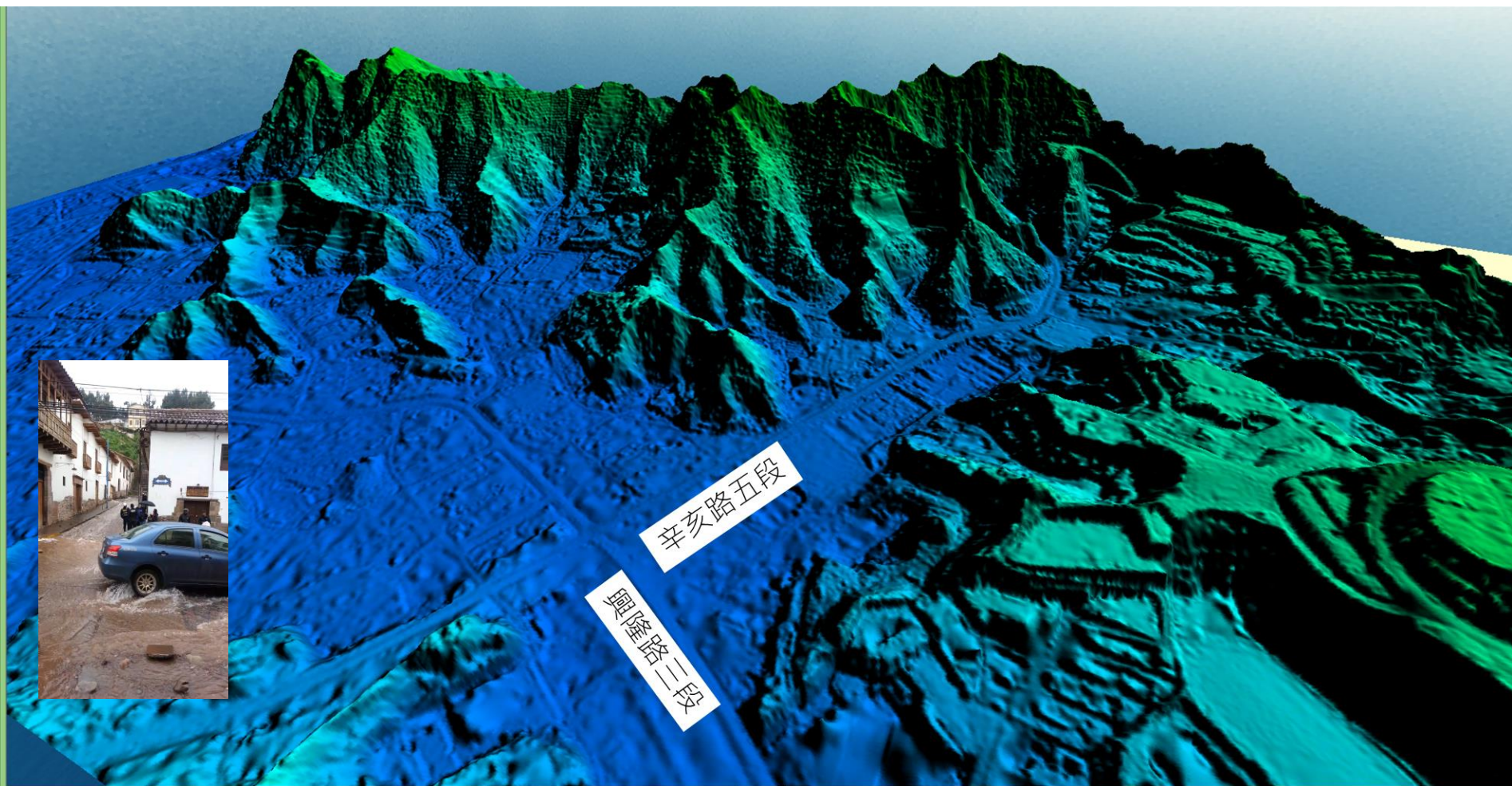
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Wenshan District and 2D Modeling

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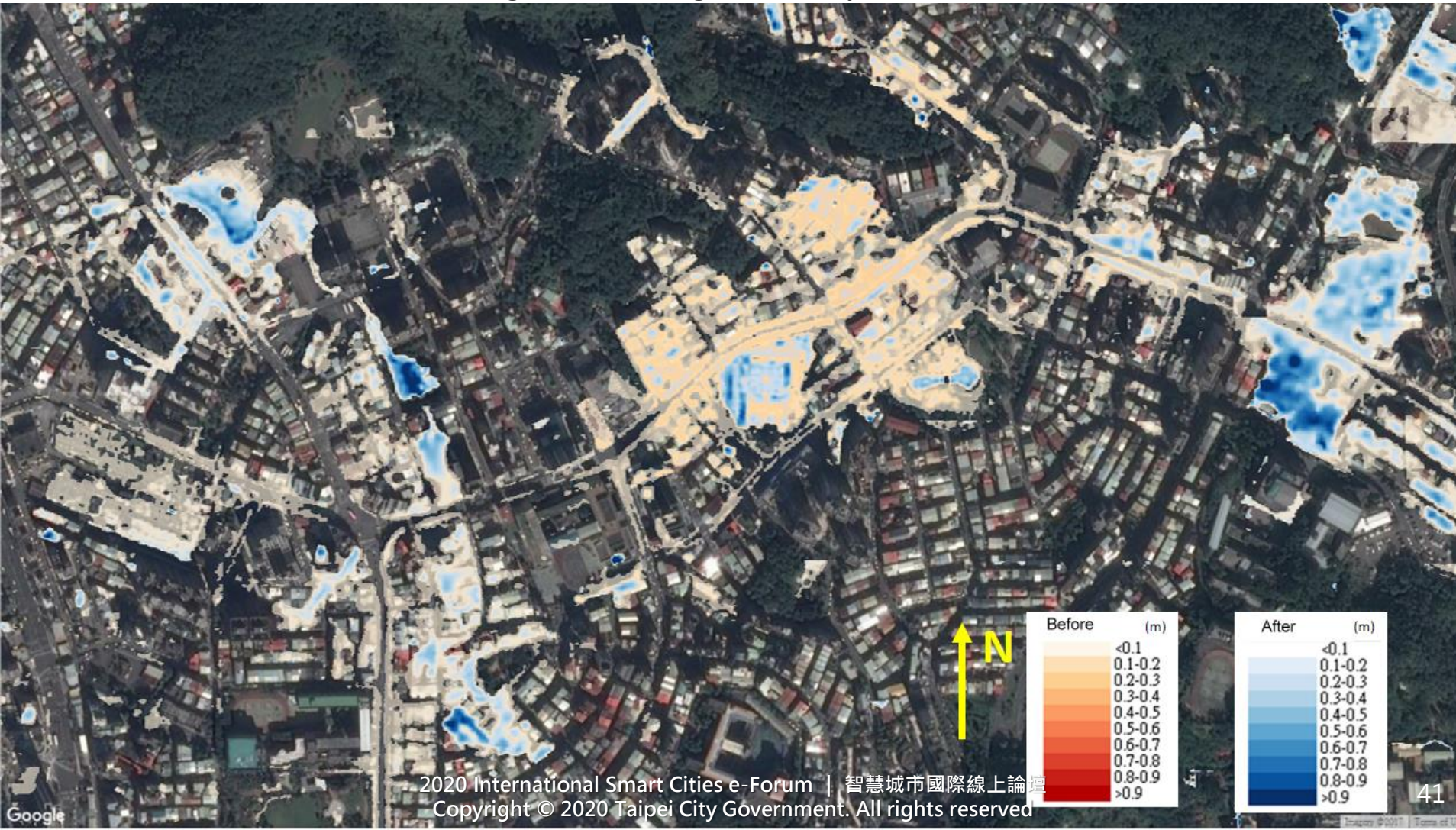
- 局部低窪地形的效應
- 人孔溢流
- 雨水收集效率



Wenshan Flood Prevention & Drainage Plan Performance Evaluation

5-year design rainfall of 78.8 mm/hr. scenario:

1. Detention ponds reaching over 80% in capacity.
2. Diversion tunnel reaching 90% design conveyance.



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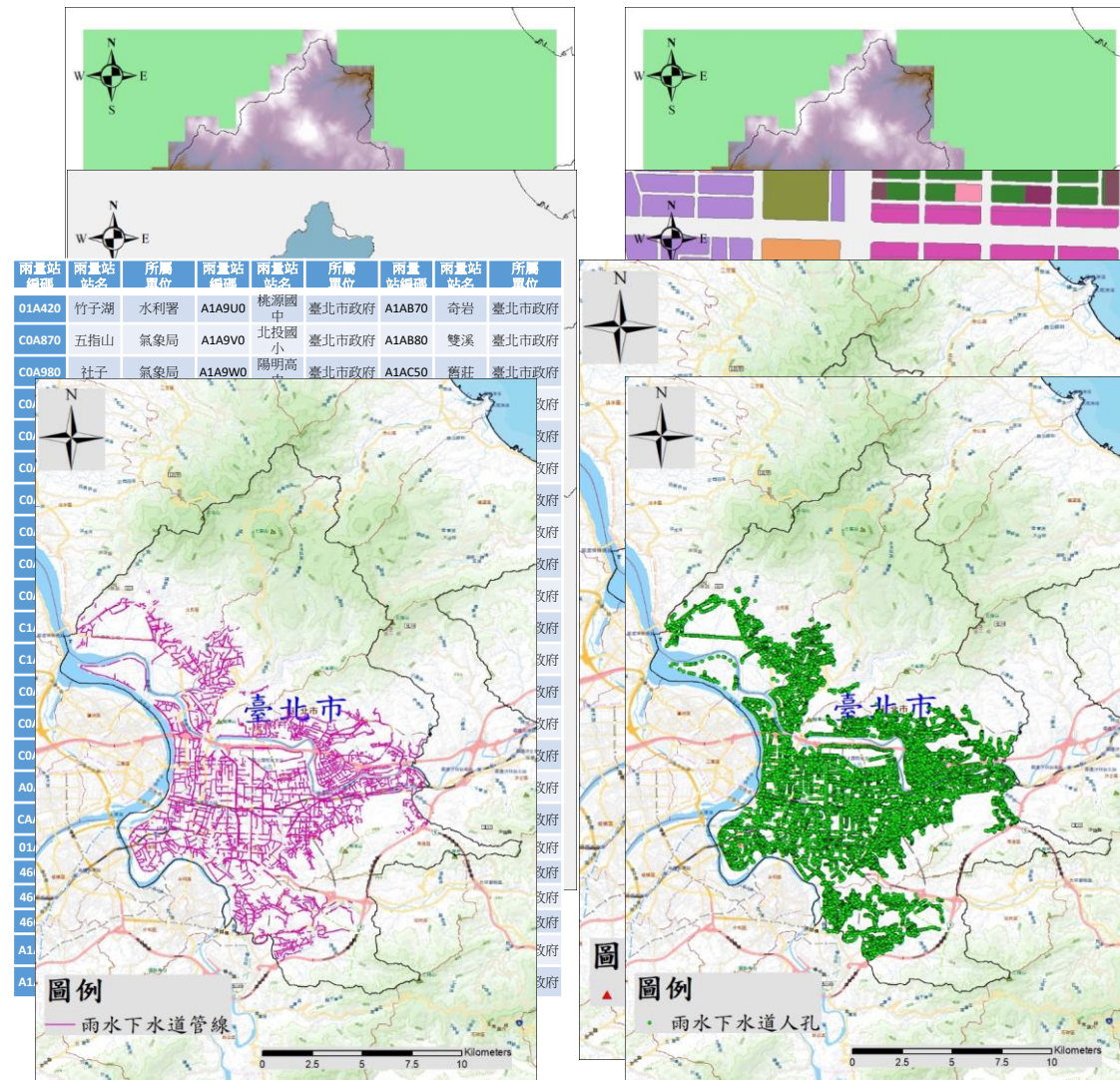
Inundation Forecasting and Early Warning

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Data collection & Modeling

- Geographic Information System
數值地形高程
- Land use information
土地利用資料
- Rainfall data
觀測雨量資料
Real-time 即時資料
Historical 歷史資料
168 rainfall stations
- Rain water sewer system
雨水下水道資料

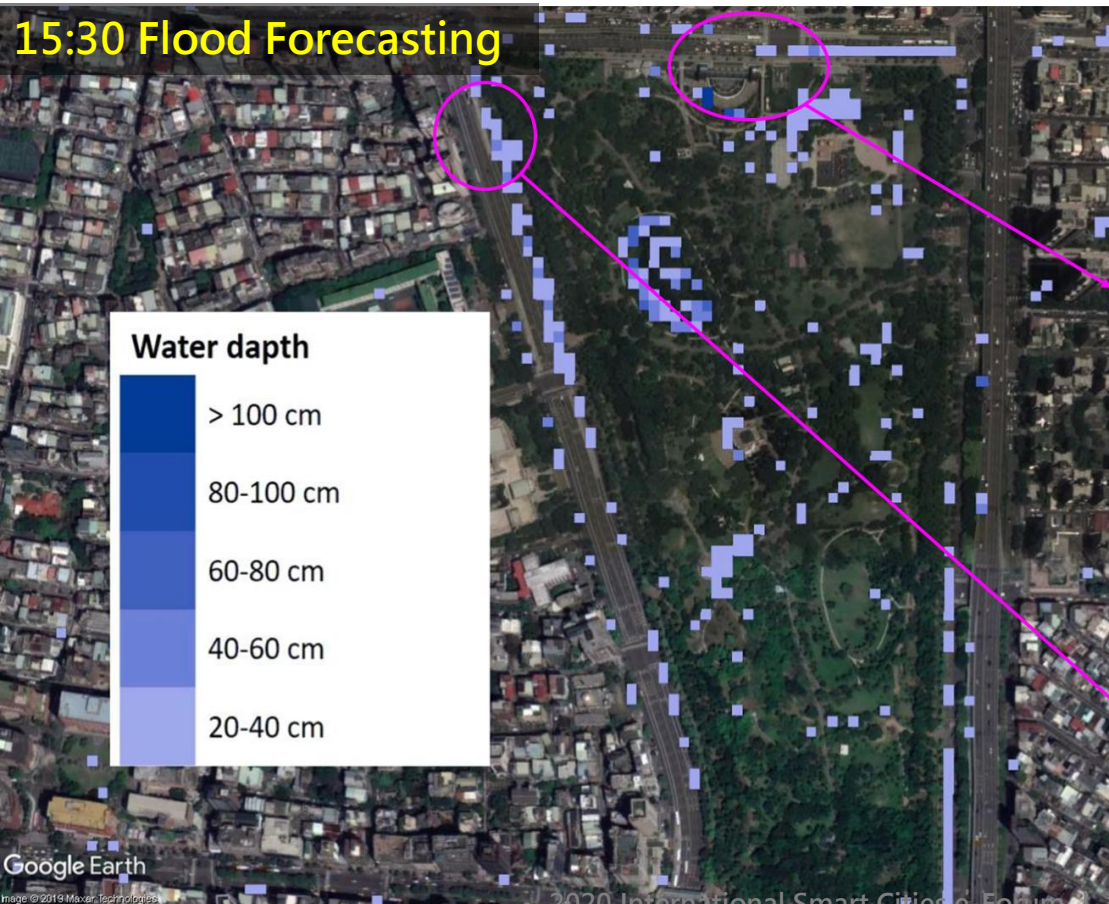


Inundation Forecasting and Early Warning

2019/07/22 15:30 Inundation Forecasting
(2019/07/22 15:30 積淹水預估)

Maximum 60 minutes of rainfall : 136.5 mm (16:10)

15:30 Flood Forecasting



16:10~16:40 Temporary Inundation



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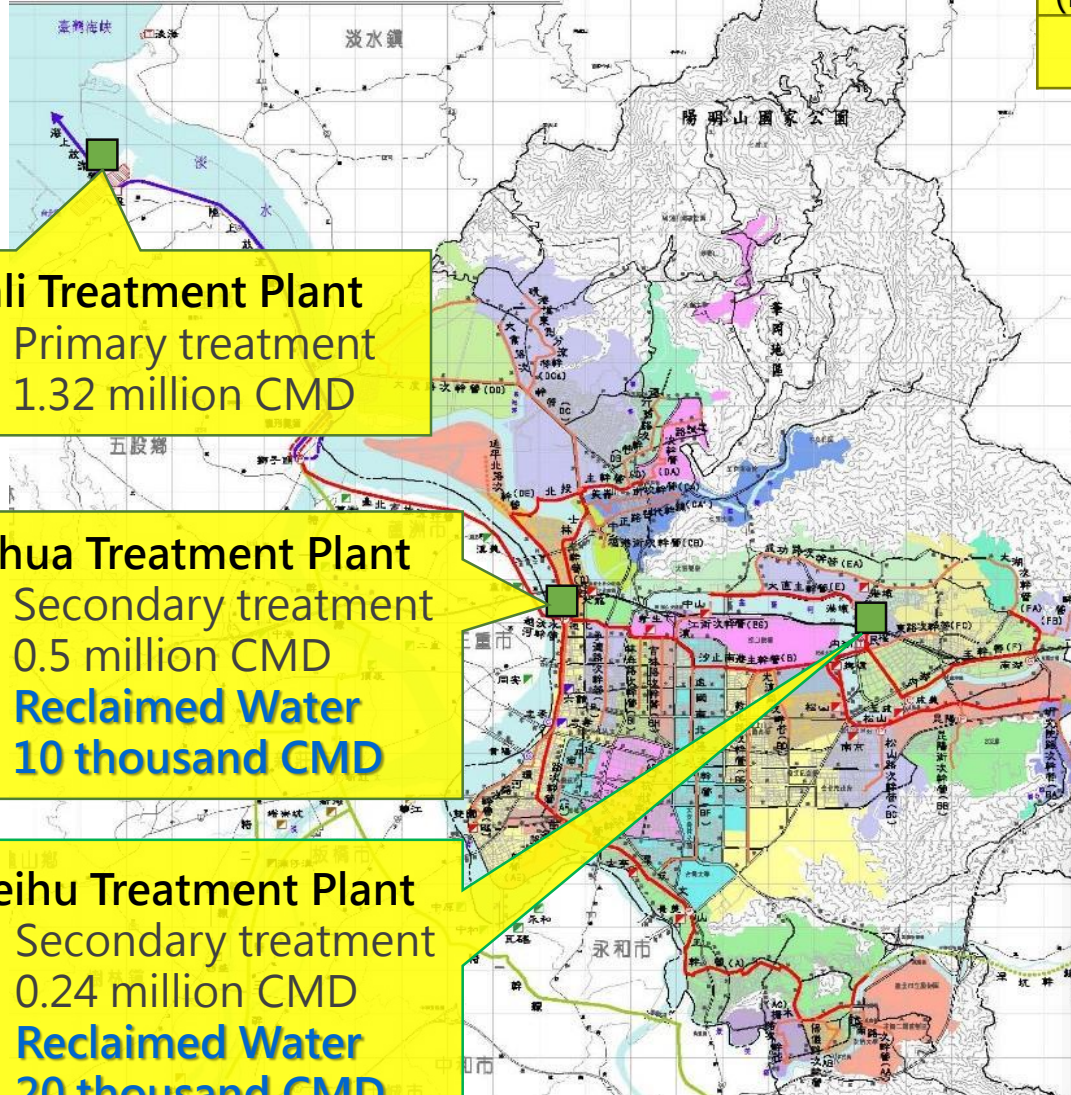
Municipal Sewage Treatment System

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臺北市污水下水道系統圖

臺北市政府工務局衛生下水道工程處 編製
中華民國99年3月



Household connection rate
(No. of Households connected)

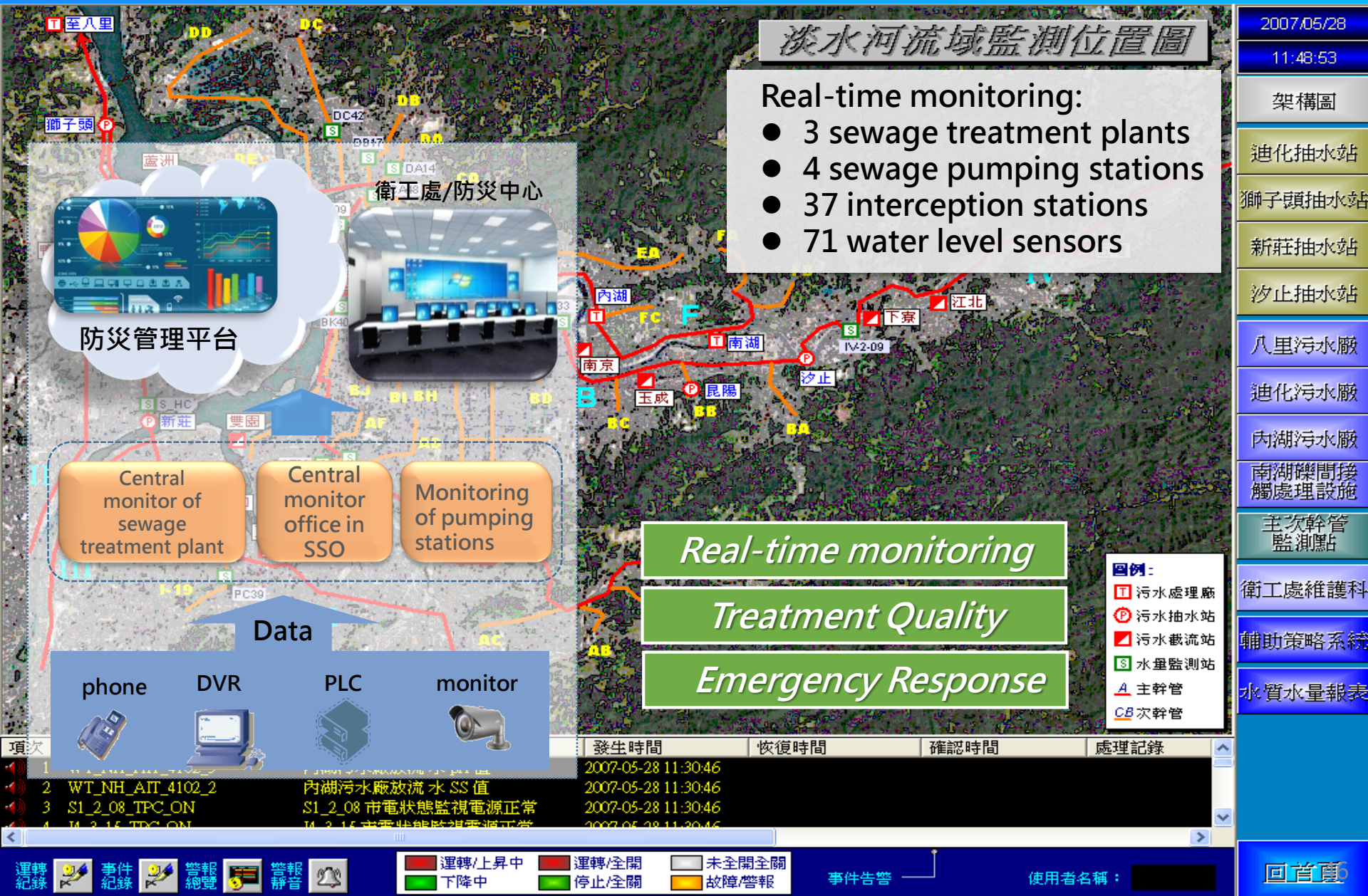
79.55%
(890,406)

Separate system

2,722 km.



Monitoring System for Municipal Sewage Treatment System



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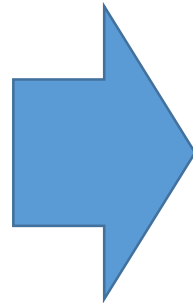
Monitoring System for Municipal Sewage Treatment System



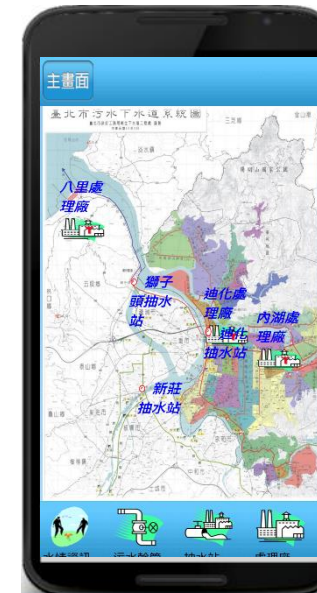
污水監視APP

Real-time Rainfall
Sewer Water Level
Status of Pumping Stations
Interception Stations
Gates of WWTP
onsite treatment facilities
WWTP Out-flow Water
Quality Real-time
monitoring

WWTP: Waste Water Treatment Plant



● 污水處理系統監看平台



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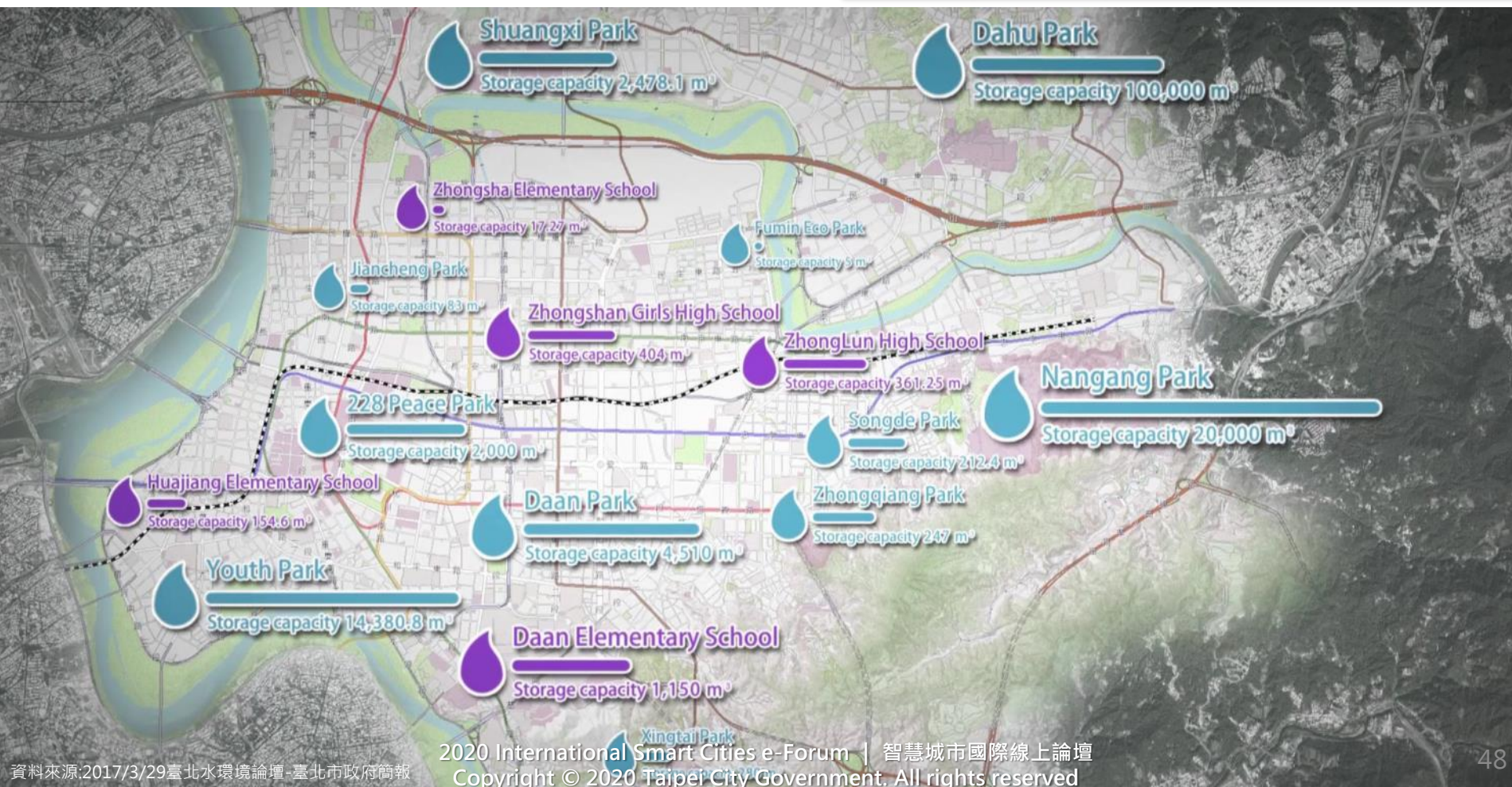


Sustainable Planning- Rainwater reuse

Promote Diverse Rainwater Retention

- Water recycling system in schools and parks (rainwater harvesting)

Symbol	Type	Qty	Total Volume of Water Stores
	Park	75	272,785 m ³
	School	169	9,460 m ³



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Taipei Water & Green Map

Feedback to Policy Design



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Outlines

Case 1: e-Patrol & Water Information Integration Platform

Case 2: Smart Rainwater Pumping System

Case 3: Flood Simulation and Early Warning System

Case 4: Sewage Treatment System & Water Resources

Future Outlook and Conclusion Remarks

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Taipei Integrated Water Resource Information Center

Minsheng Water Resource Recycling Center will be opened in 2022

- Integrated water information: from upstream to downstream, rainfall to underground water, reservoir to waste water treatment, water quantity to water quality...

Water Education Park

- 整合撫遠公園及自來水松山加壓站環境景觀
- 改造及活化民生廠環境

智慧、生態、節能、綠建築

Multifunctional
Commercial
Office Building

Underground Sewage Treatment Plant

- 分擔污水下水道系統污水量
- 提供再生水 **20,000CMD**

全地下化MBR系統示意圖

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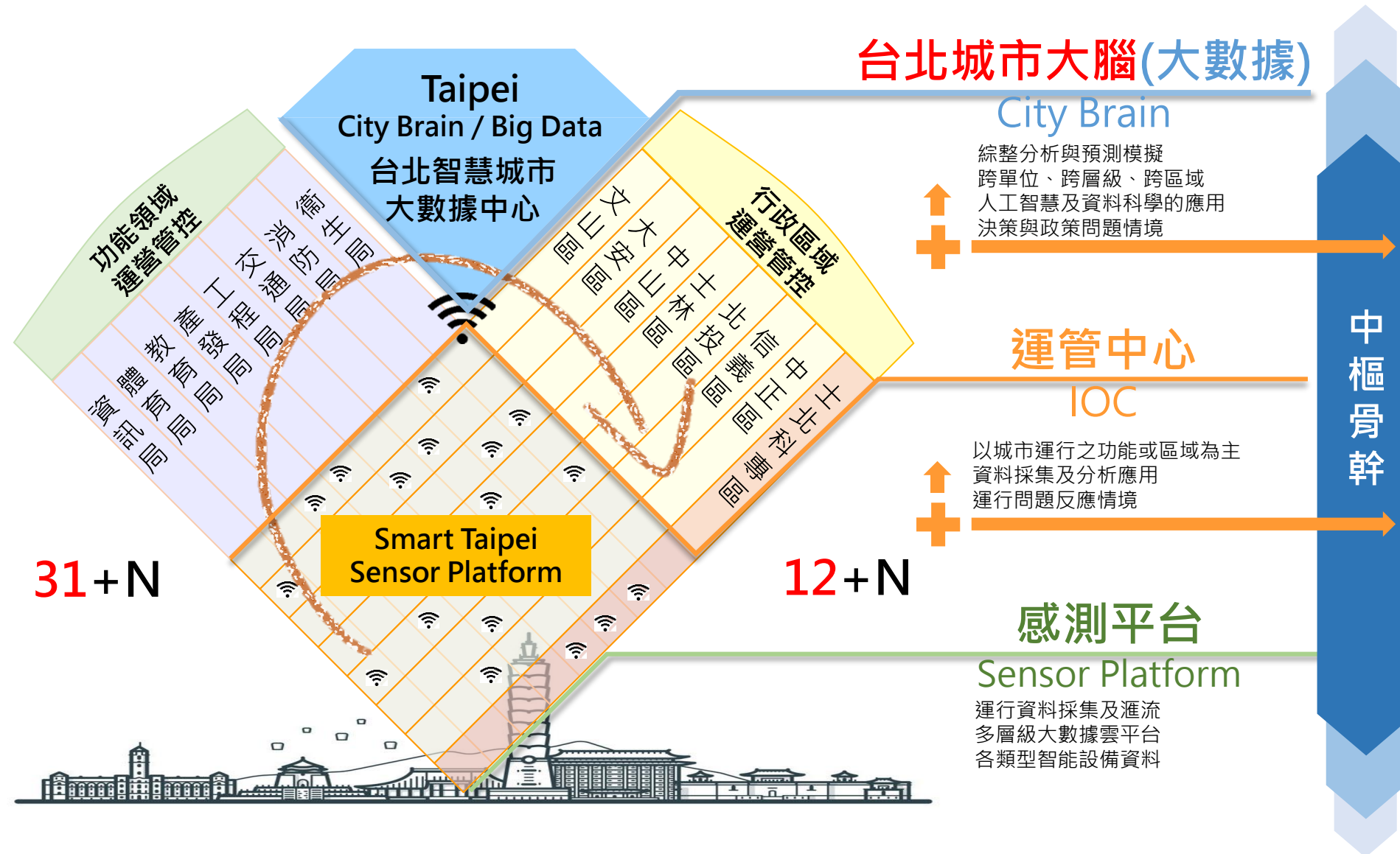
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Taipei City Brain: Big Data Center

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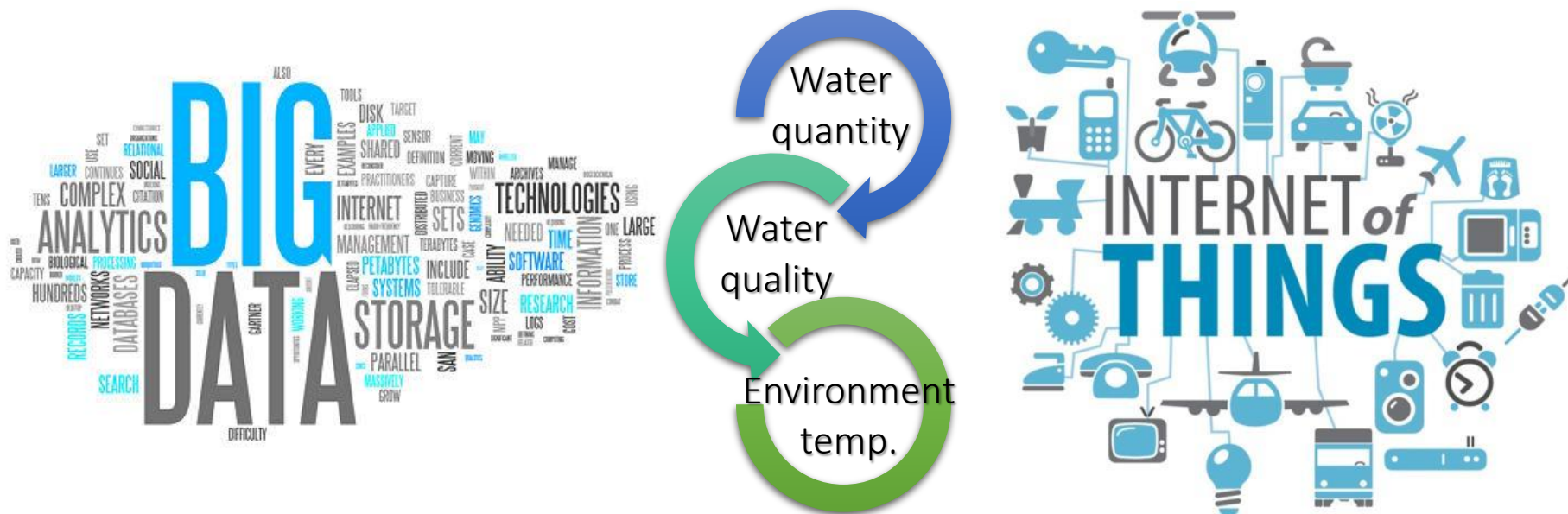
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Conclusion Remarks

"Better information leads to better decisions"

- *With public infrastructure for the water environment developed over the past decades as a foundation, **Taipei** City will continue to apply **smart technologies**, forge ties with **industries**, and strive toward developing an increasingly **ecological, sustainable, and livable city**.*



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Conclusion Remarks

"Better information leads to better decisions"

- *Smart city is not just the application of technology.
It is in the way we engage,
in the processes we institute,
and in the types of partners we bring together.*



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Welcome to Taipei



*Resilient
Adaptive*



*Sustainable
Reusing*



*Vibrant
Livable*



Thank you for Listening

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