

低衝擊開發技術(LID)國際研討會

台灣綜合治水策略-國土規劃管理措施

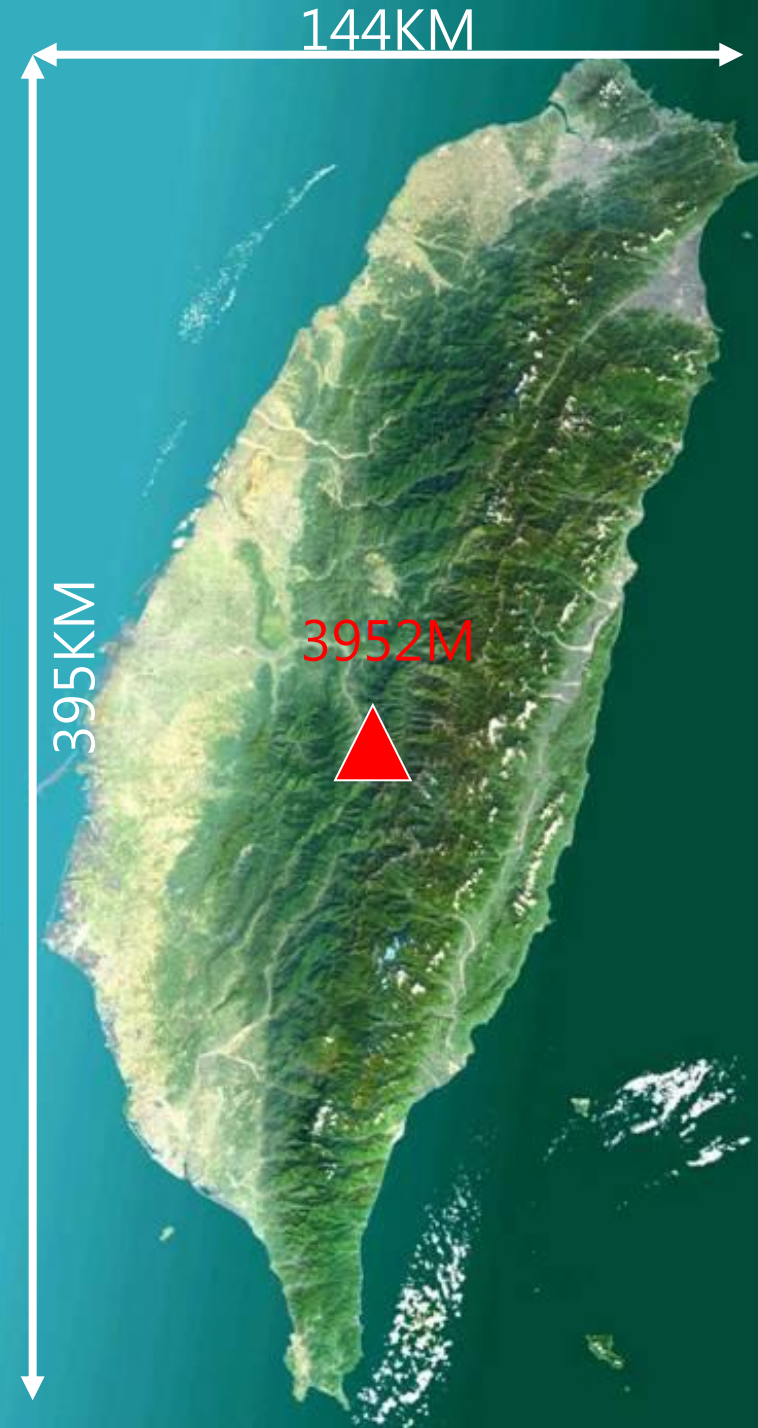
Integral Flood Management in Taiwan
- National Land Planning and Management Measures



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TAIWAN

- Area : 36,188KM² (37% plain, 63% hills and mountains)
- Population: 23 million
- Rainfall: 2500 mm / year (78% in rainy season)
- 3.5 typhoons / year
- Almost 1,000 felt earthquakes / year
- Almost NT\$ 12.8 billion loss due to natural disasters per year
- Enlisted as one of the most vulnerable regions to natural disasters by U.N.



Variance of Annual Rainfall in Recently 50 Years

Rainy Years

Rainfall (mm)

1953年
3,180mm

1972年
3,240mm

1990年
3,144mm

1998年
3,322mm

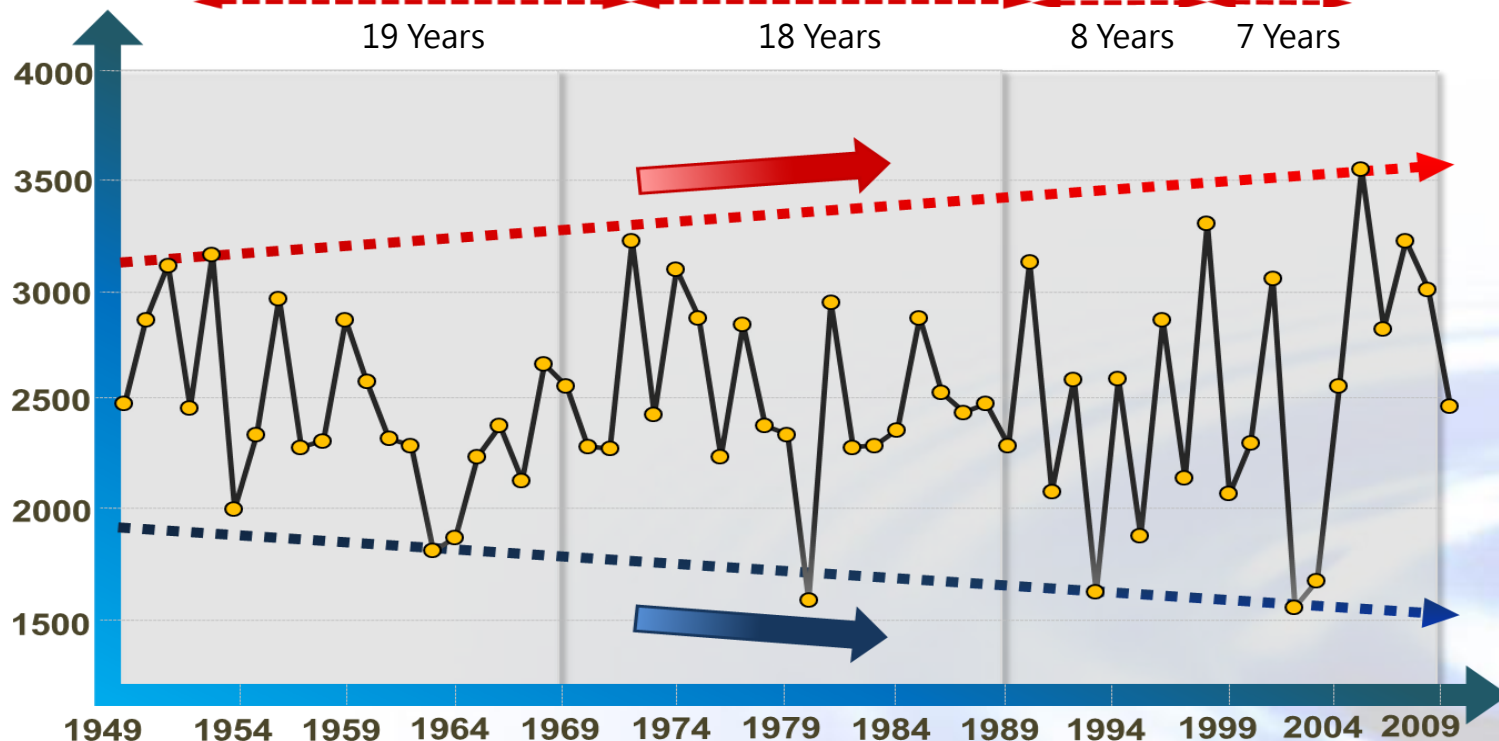
2005年
3,568mm

19 Years

18 Years

8 Years

7 Years



Draught Years

Rainfall (mm)

1963年
1,830mm

1980年
1,605mm

1993年
1,645mm

2002年
1,572mm

17 Years

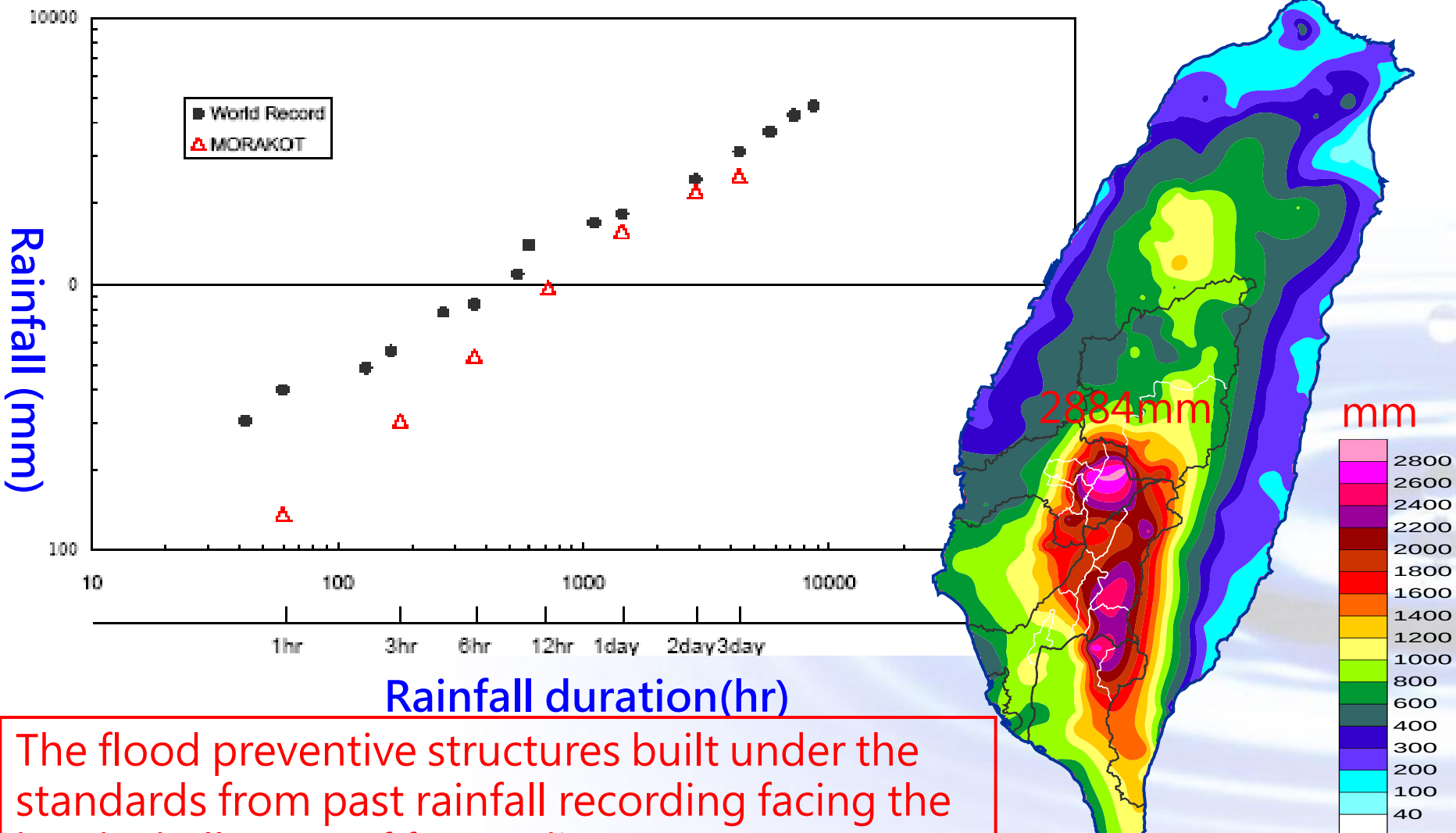
13 Years

9 Years

The increasing variance of annual rainfall increasing the difficulty of flood prevention and water resource management

Comparing the Rainfall of Typhoon Morakot in 2009 with World Record

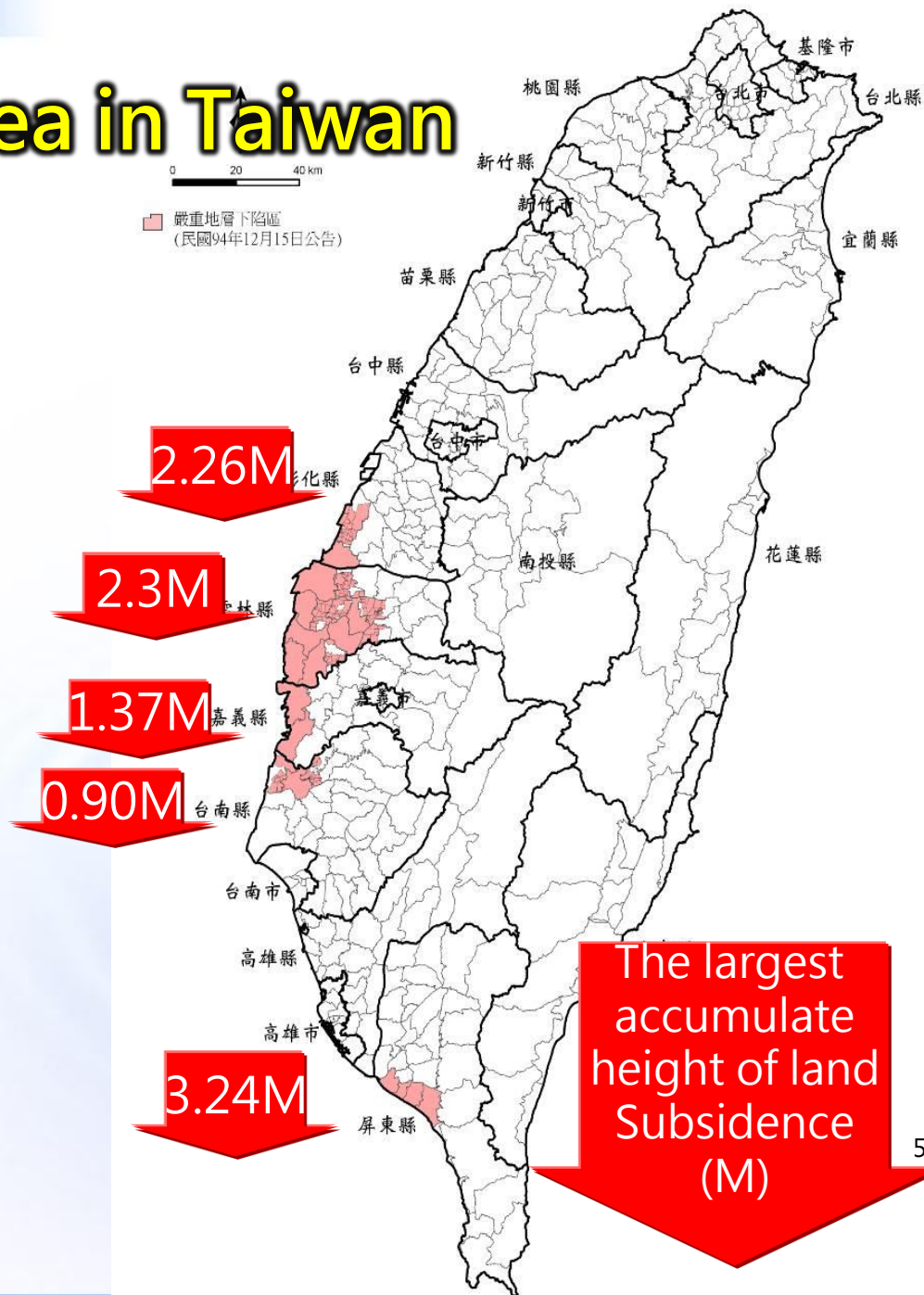
Accumulate Rainfall in 3 days



The flood preventive structures built under the standards from past rainfall recording facing the harsh challenges of future disasters

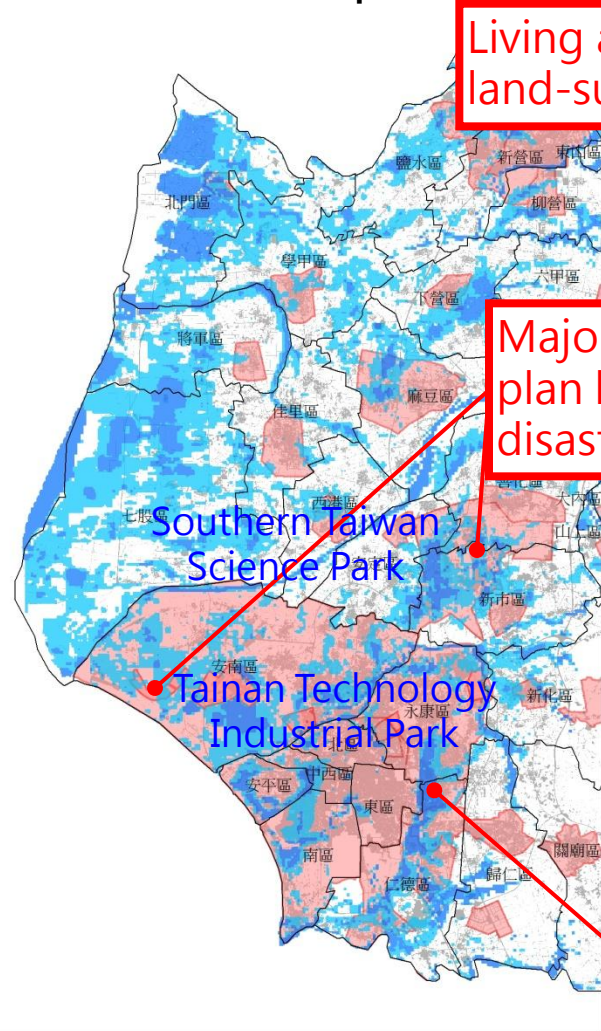
Land-Subsidence Area in Taiwan

- ◆ Located at Changhua, Yunlin, Chiayi, Tainan and Pingtung
- ◆ Mostly in southwestern coastal low lands
- ◆ Total area of 1277.86 KM²
- ◆ Due to the groundwater overdraft for agriculture and aquaculture

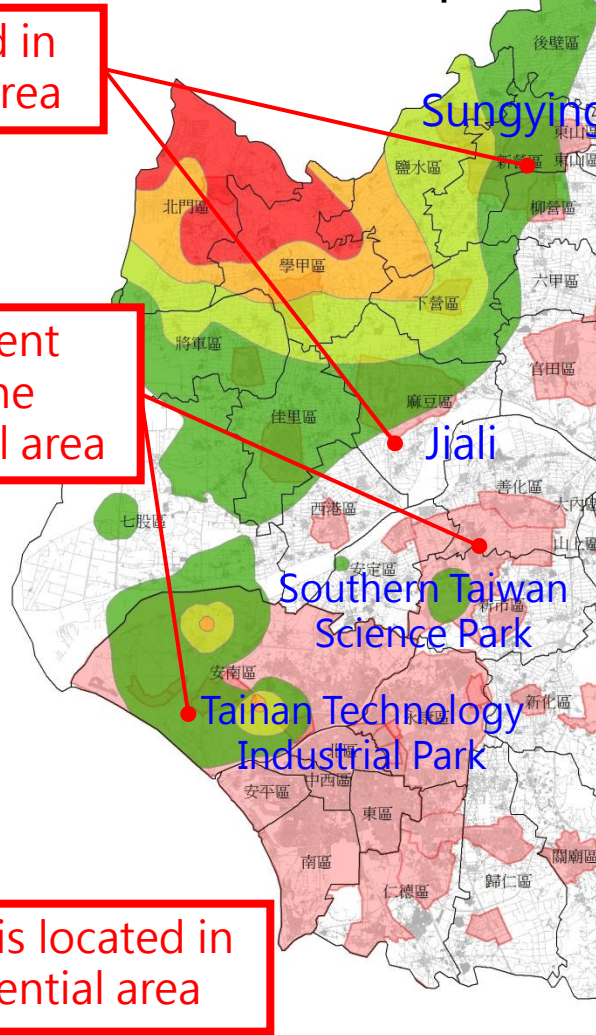


Urban Development in Disaster Potential Area

Flood Potential
vs. Urban Development



Land-Subsidence vs.
Urban Development



Legend

- Administrative Region
- Urban Planned Districts
- Built-up Areas

Flood Potential Area

Inundation Depth

- 0.3~1 m
- 1~2 m

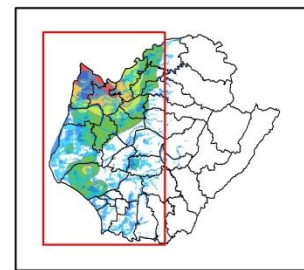
Land-Subsidence Area

Land-Subsidence Depth

- > 20 cm
- 15~20 cm
- 10~15 cm
- 5~10 cm

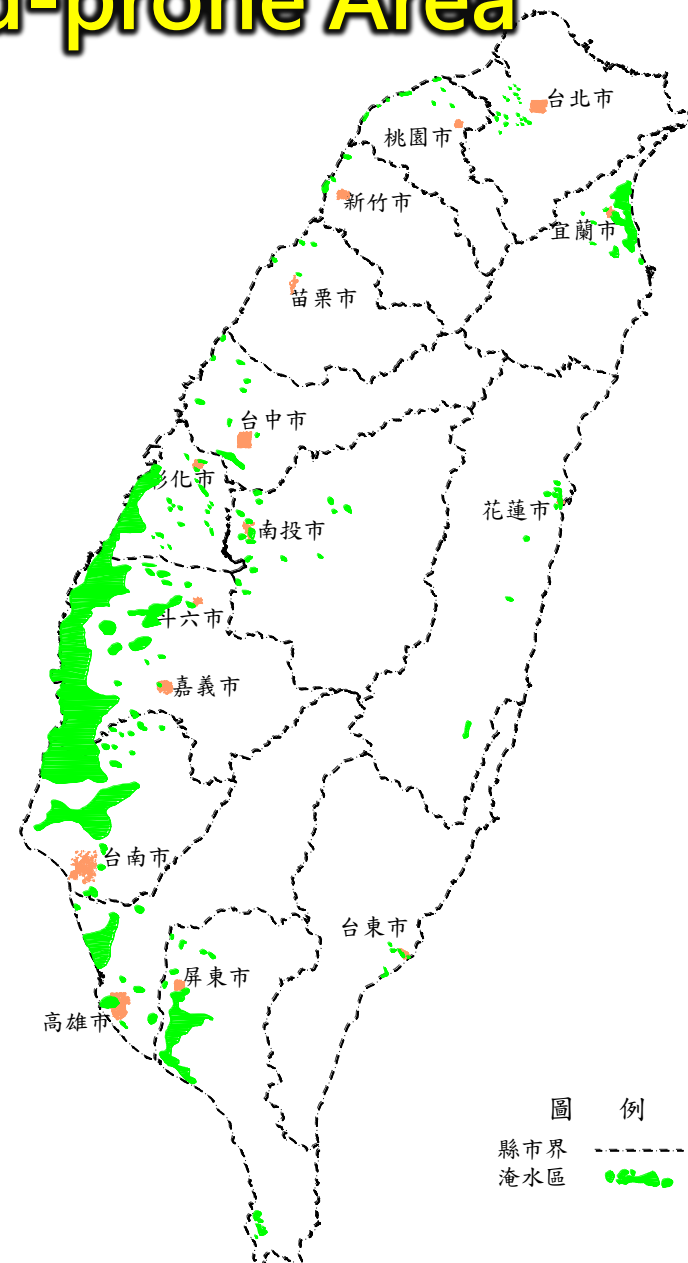


0 10 20 40 60 KM



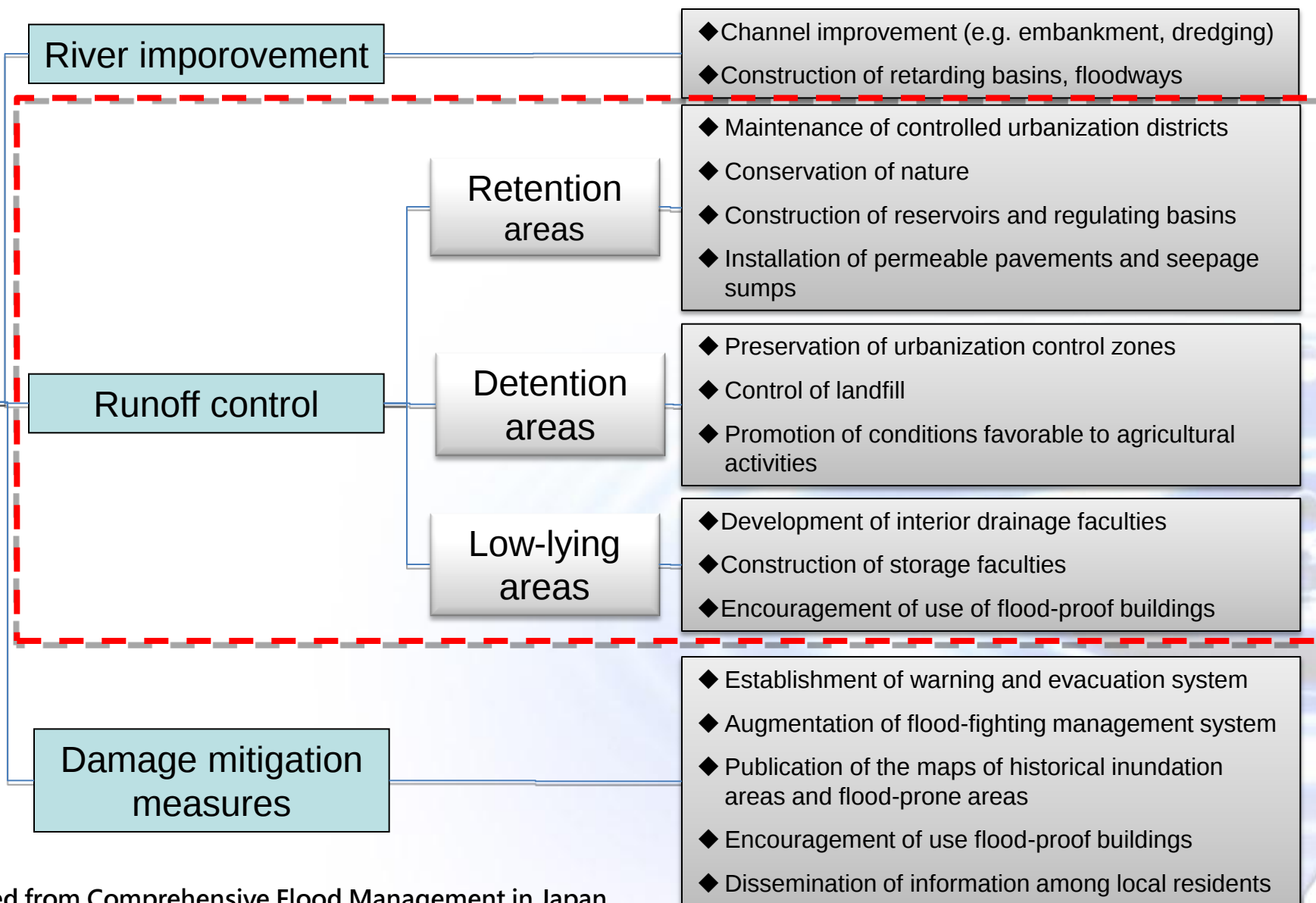
Regulation Project of Flood-prone Area

- ☉ "Regulation Project of Flood-prone Area " promoted actively form 2006 to 2014
- ☉ Flood-prone area of 1,150 KM², 8% of plain area in Taiwan
- ☉ Flood-prone areas mostly in southwestern coastal low lands
- ☉ Weak natural draining conditions worsened by land subsidence
- ☉ NT\$ 80 billion invested to improve the draining situation in low lands
- ☉ Including 35 rivers and 244 drainage system

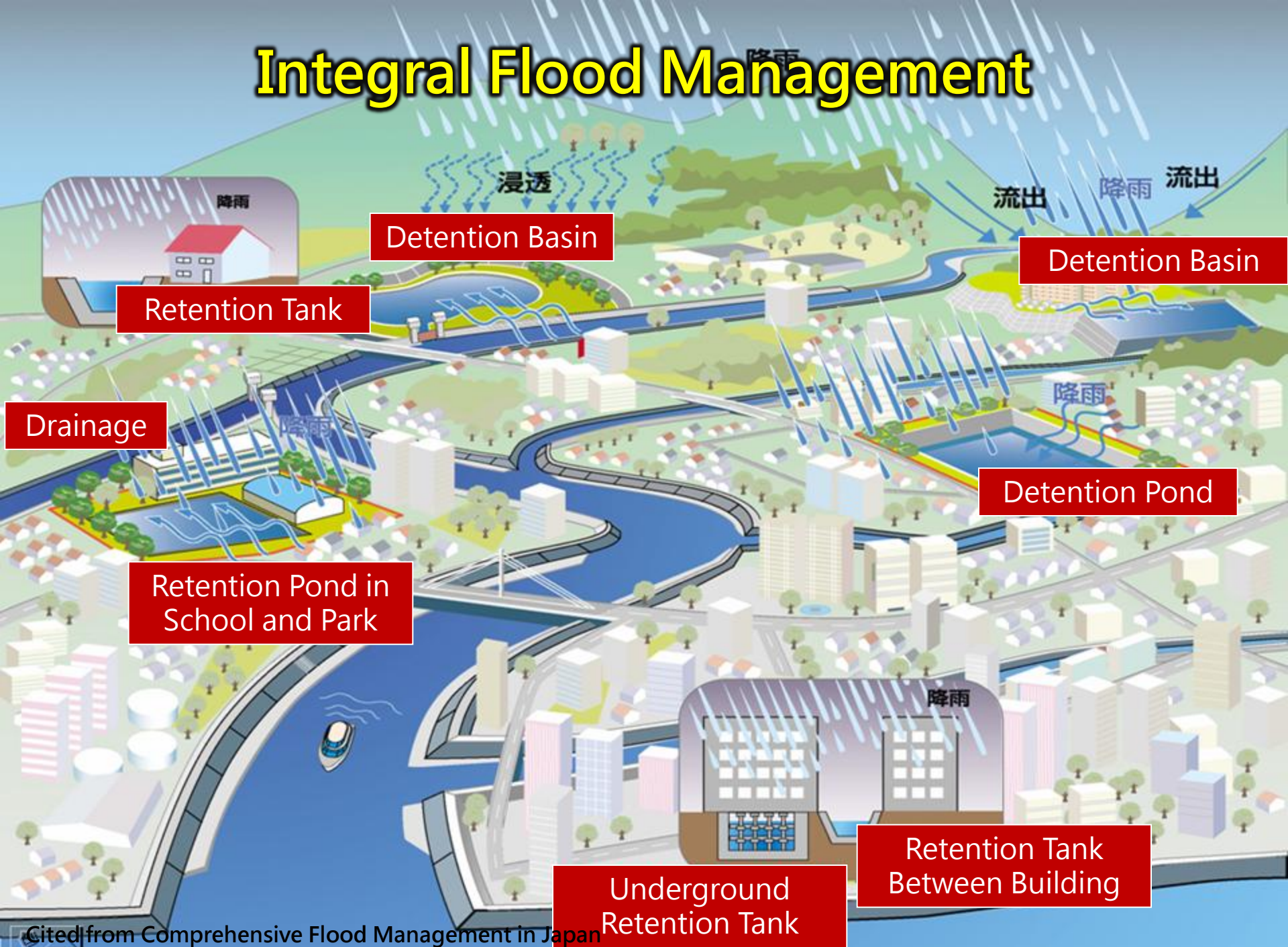


Integral Flood Management Measures

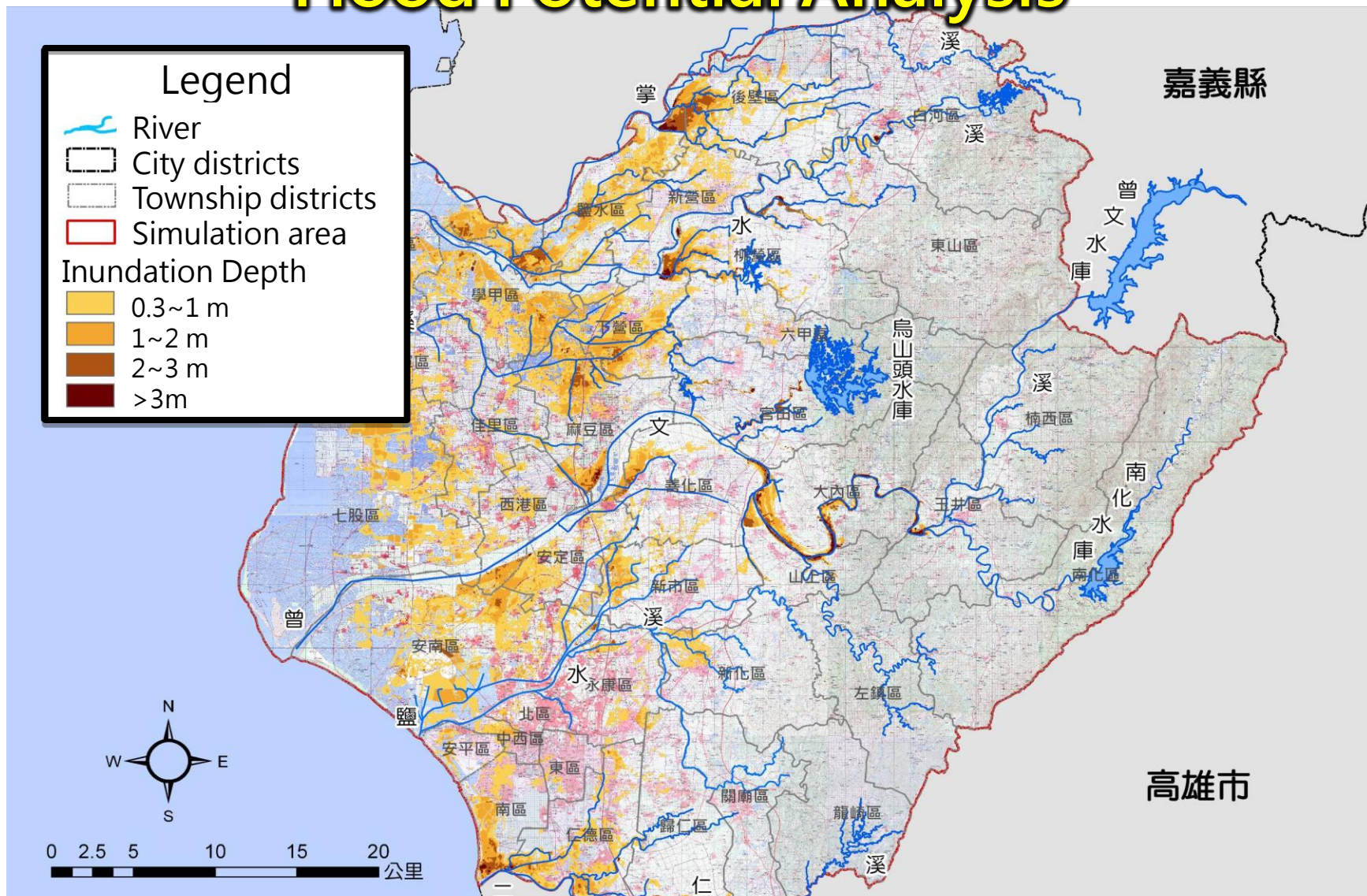
Comprehensive Flood Management Measures



Integral Flood Management

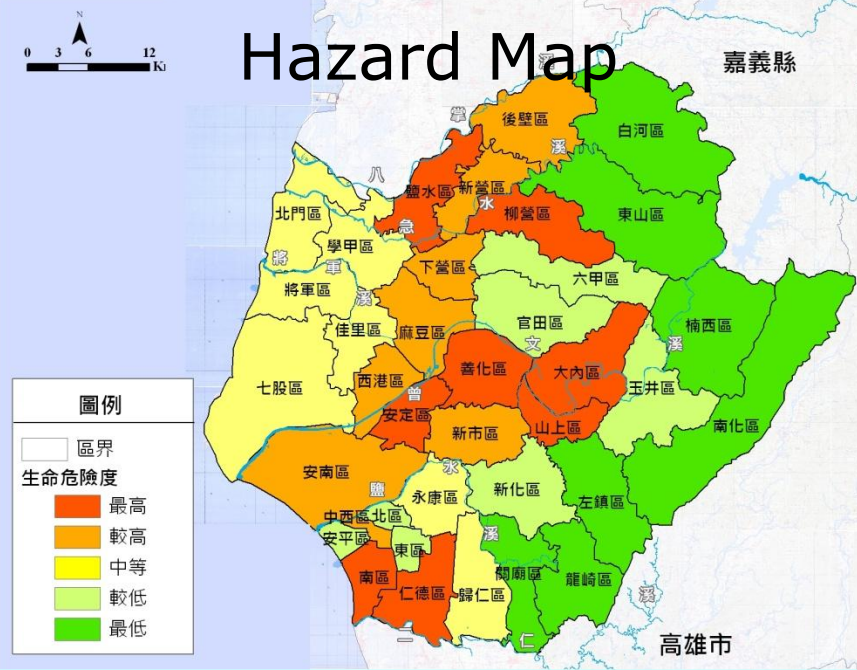


Flood Potential Analysis

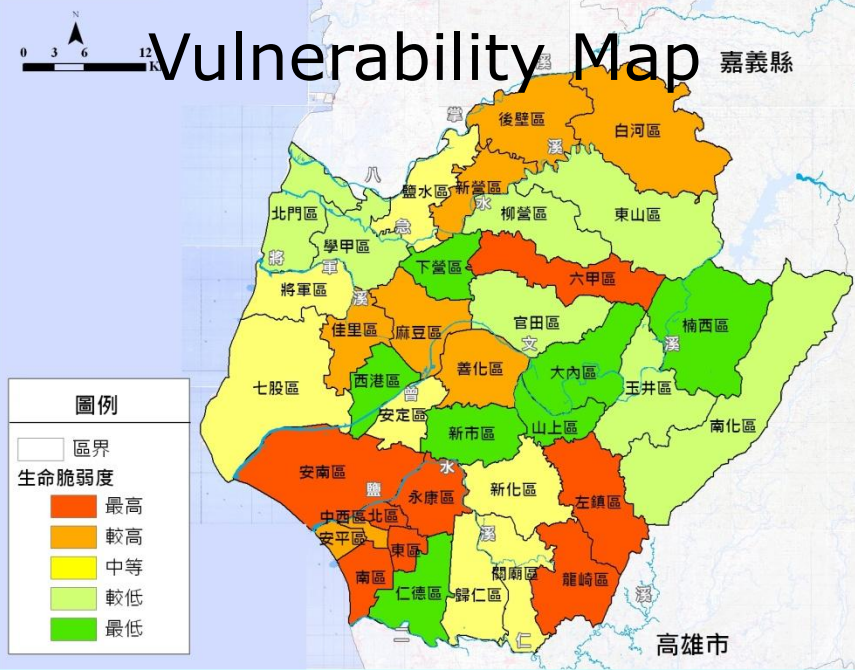


Identifying the flood potential area by flood simulation

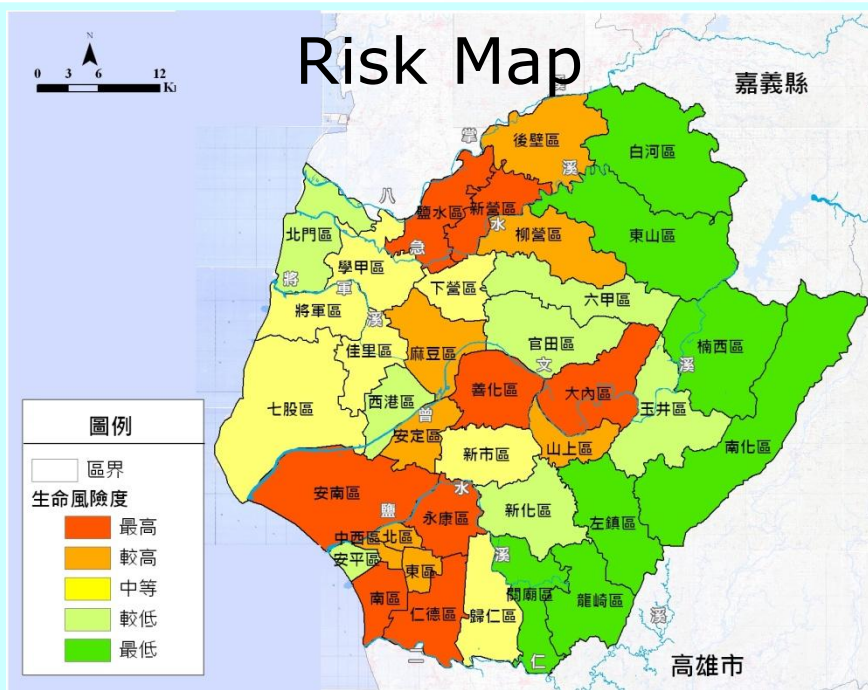
Hazard Map



Vulnerability Map



Risk Map



Understanding the flood risk by risk analysis

Land Management in Flood Potential Area

Considering the environment and disaster restriction during space planning process

Drafting different land management strategies according different disaster risk

Disaster Risk Area

Storm surge submerged area
Flood potential area
Land-subsidence area

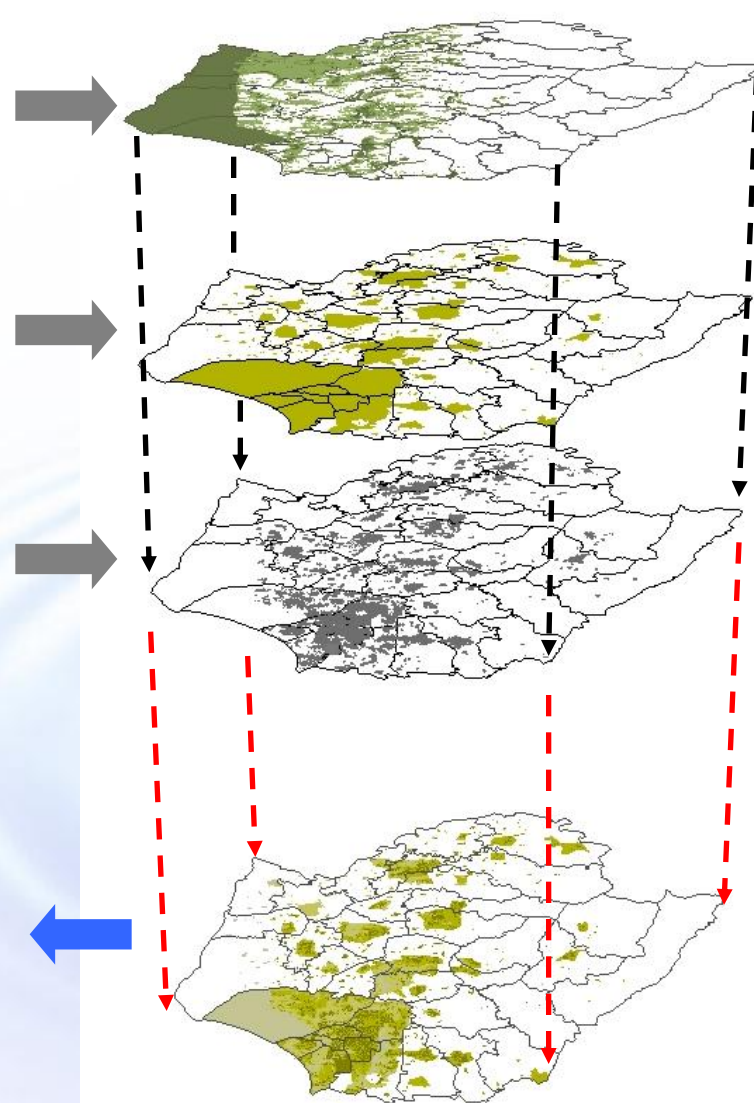
Planned Development Area

Urban planned districts
Non-urban land
Industrial district

Built-up Area

Land Management Zooming

Built-up zone (Type I)
Development zone in low disaster risk (Type II)
Development zone in middle disaster risk (Type III)
Development zone in high disaster risk (Type IV)



Integral Land Management strategy

National land Planning Framework

Regional planning

Overall review of urban planned districts

Case altering

Zoning/
Urban design control

Non-urban land use control / development permit examination

Building technique regulation

Land Management Strategy

Avoiding the development in disaster potential area

Land elevation management

Systematic integration of urban detention spaces

Zoning altering for increasing the detention spaces

Decreasing the intensity of land use

Increasing urban detention spaces

Increasing urban permeability spaces and facilities

Rainfall harvesting and retention facilities

Land Management Measures

■ Built-up Zone (Type I)

- Urban renewal / Land replotting
- Increasing detention and permeability facilities in open spaces
- Establishment of the detention and rainfall harvesting facilities in exciting building sites

■ Development zone in low disaster risk (Type II)

- Growth management planning
- Staged development

■ Development zone in middle disaster risk (Type III)

- Zoning adjusting
- Performance zoning

■ Development zone in high disaster risk (Type IV)

- Limitation of development activities by high standards
- Prohibition of development activities
- Transfer of development right

Avoiding the Development in High Disaster Potential Area

排水路

Non-urban Land

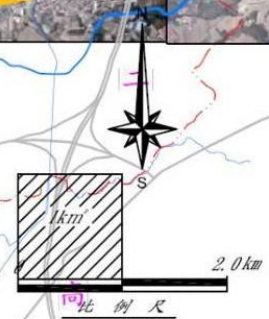
- Not used as extended urban planned districts
- Altering the land use as agriculture or conservation
- Floodplain zooming

Southern Taiwan Science Park

Urban Planned Districts

- Altering the land use as agriculture or conservation

High Flood Potential Area



Land Elevation Management



BEFORE

Usual

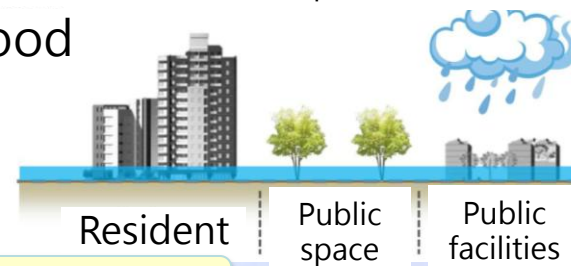


Resident

Public
space

Public facilities

Flood



Resident

Public
space

Public facilities

AFTER

Usual

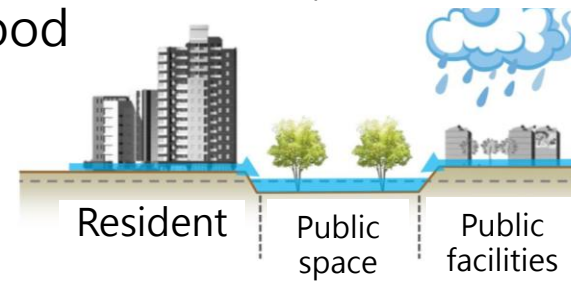


Resident

space

Public facilities

Flood



Resident

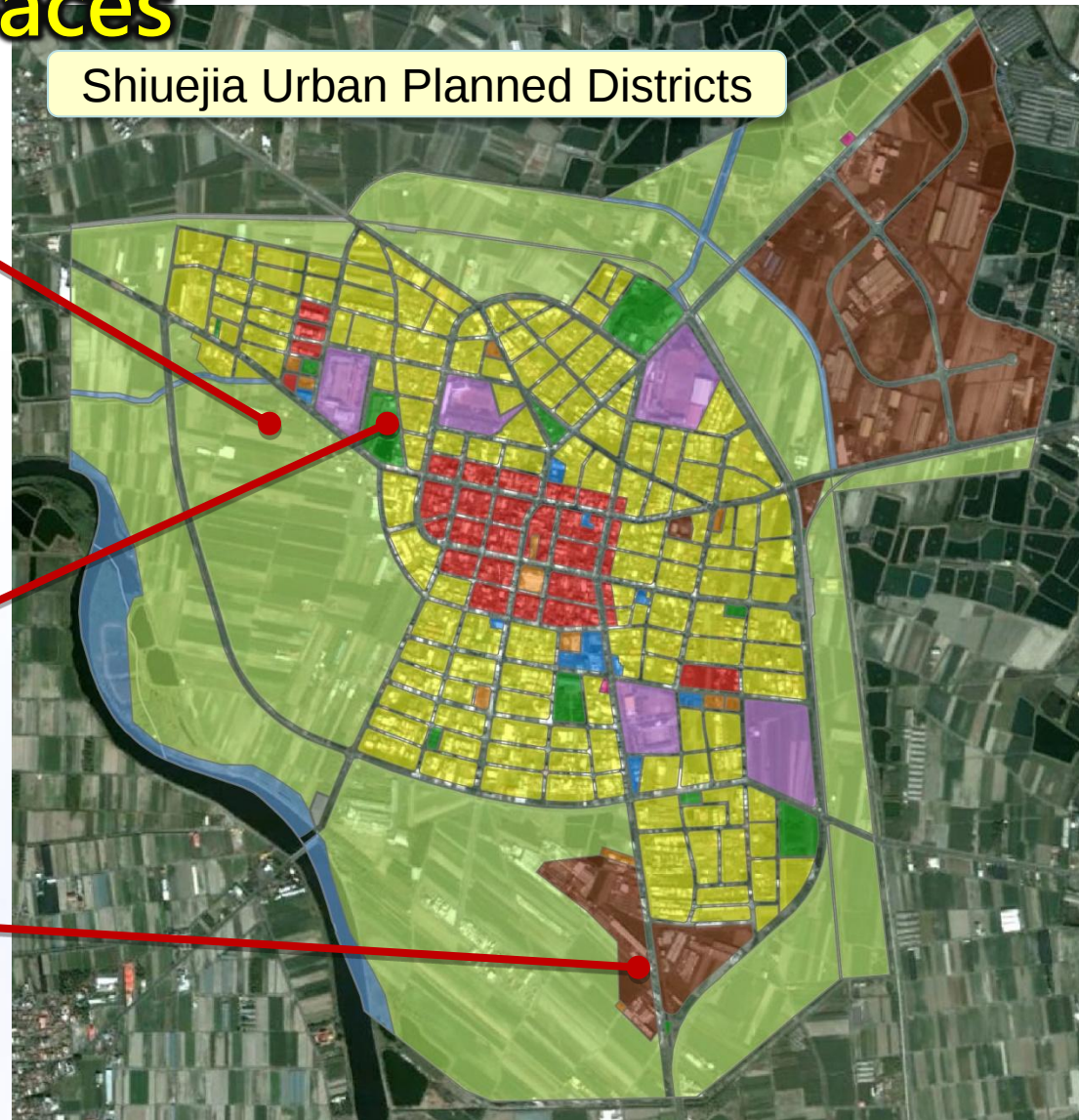
space

Public facilities



Zoning Altering for Increasing the Detention Spaces

- Altering the conservation and agriculture district for detention spaces
- Using public facilities land for detention spaces
- Altering the unused district for detention spaces



Decreasing the Intensity of Land Use

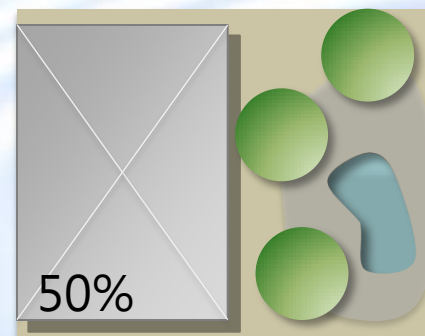
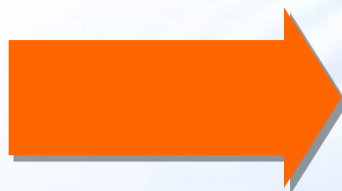
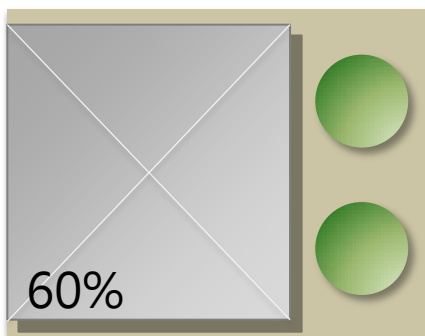
Residential district :60%
Commercial district :80%
Industrial district :60%
Authority district :50%
Educational district :50%
Parking tower :80%

...

Reducing
building
coverage
ratio

Residential district :50%
Commercial district :70%
Industrial district :50%
Authority district :40%
Educational district :40%
Parking tower :70%

...



Adjusting the intensity of land use in high disaster potential area to reduce the intensity and density of activities and increase the open space

Increasing Urban Detention Space

● Utilization of Public Facilities Land

- Establishment of detention spaces in open public facilities (parks, schools, squares, parking lots)



● Utilization of statutory Open Space

- Increasing the permeability and vegetation of building site



Retention pond

Permeability surfacing

Vegetation of open space

Rainwater harvesting for watering

Increasing Urban Permeability Spaces and Facilities



- Increasing the permeability and vegetation of open space
- Increasing permeability surfacing
- Using sidewalk and road divider for collecting the runoff of road

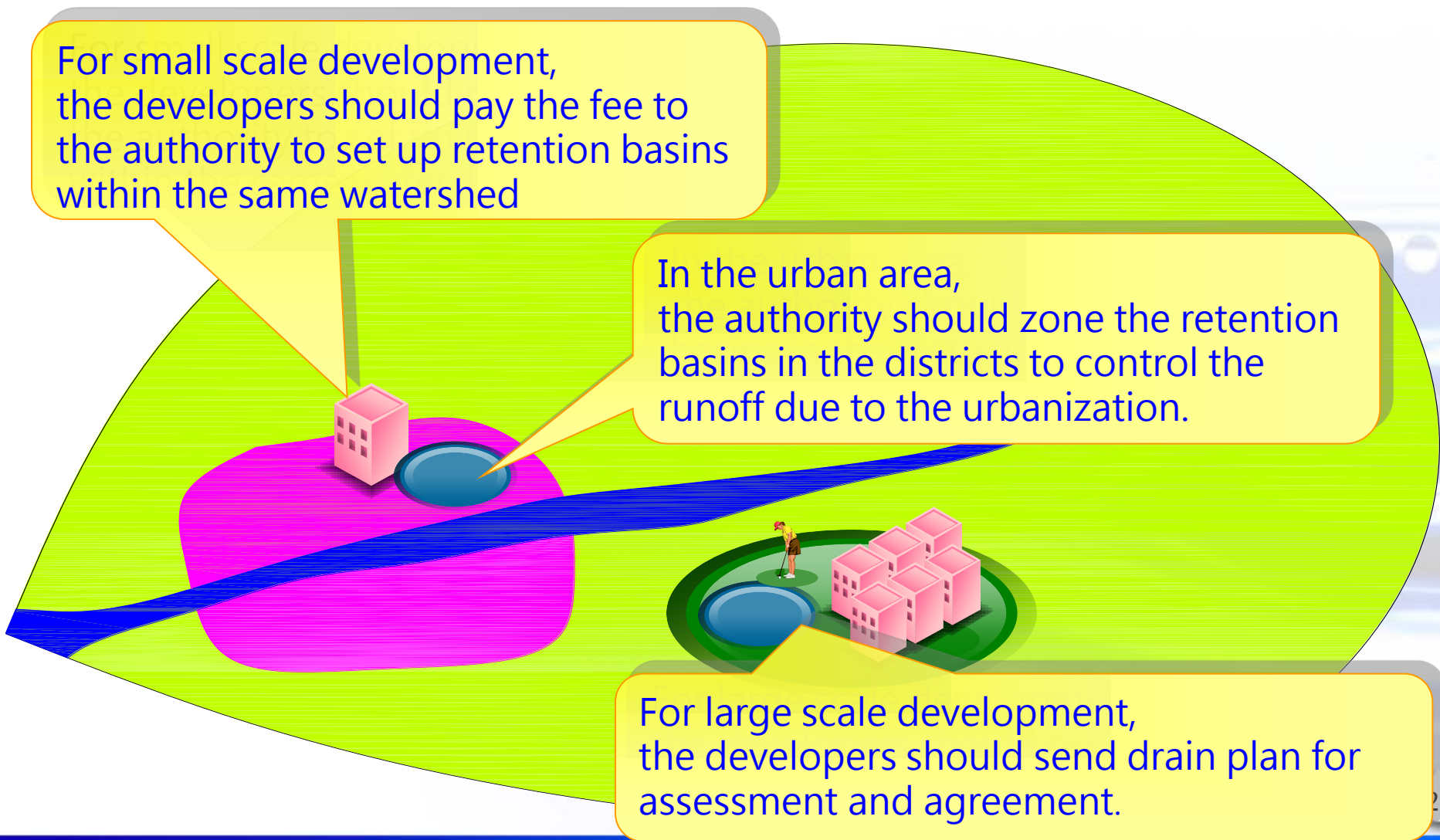
Runoff Control in Watershed

"the peak amount after the development should not surpass the peak amount before the development"

For small scale development, the developers should pay the fee to the authority to set up retention basins within the same watershed

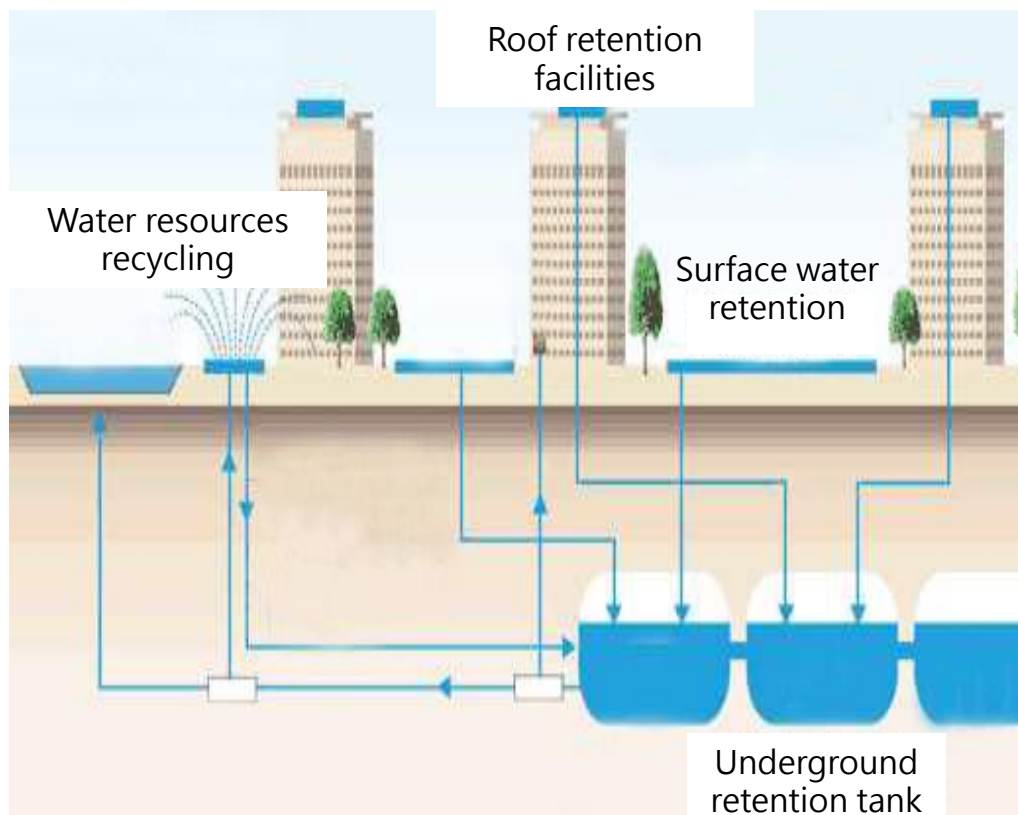
In the urban area, the authority should zone the retention basins in the districts to control the runoff due to the urbanization.

For large scale development, the developers should send drain plan for assessment and agreement.



Rainfall Harvesting and Retention Facilities

- Rainfall retention tanks
- Green roofs and facades for water retention



資料來源:行政院經濟建設委員會, 2010, 氣候變遷對水資源之衝擊與調適策略

Rainwater Storage Solutions <http://rainwaterstoragesolutions.com/index.html>

花博亮點知多少 <http://mag.nownews.com/article.php?mag=13-87-2691>



經濟部水利署

Dention Basins in Taiwan

52 Planned
10 Construction, 35 Completion



Kaoshitan, Chiayi
嘉義內田考試潭



Sigu, Chiayi
嘉義四股



Baishuihu A1, Chiayi
嘉義白水湖A1



Baishuihu A2, Chiayi
嘉義白水湖A2



Nangongguan, Yunlin,
雲林南公館



Lide, Tainan,
台南立德



Basin D, Southern Taiwan
Science Park 南科D池



Sanshe, Tainan
台南三舍



Dahu, Taipei 台北大湖

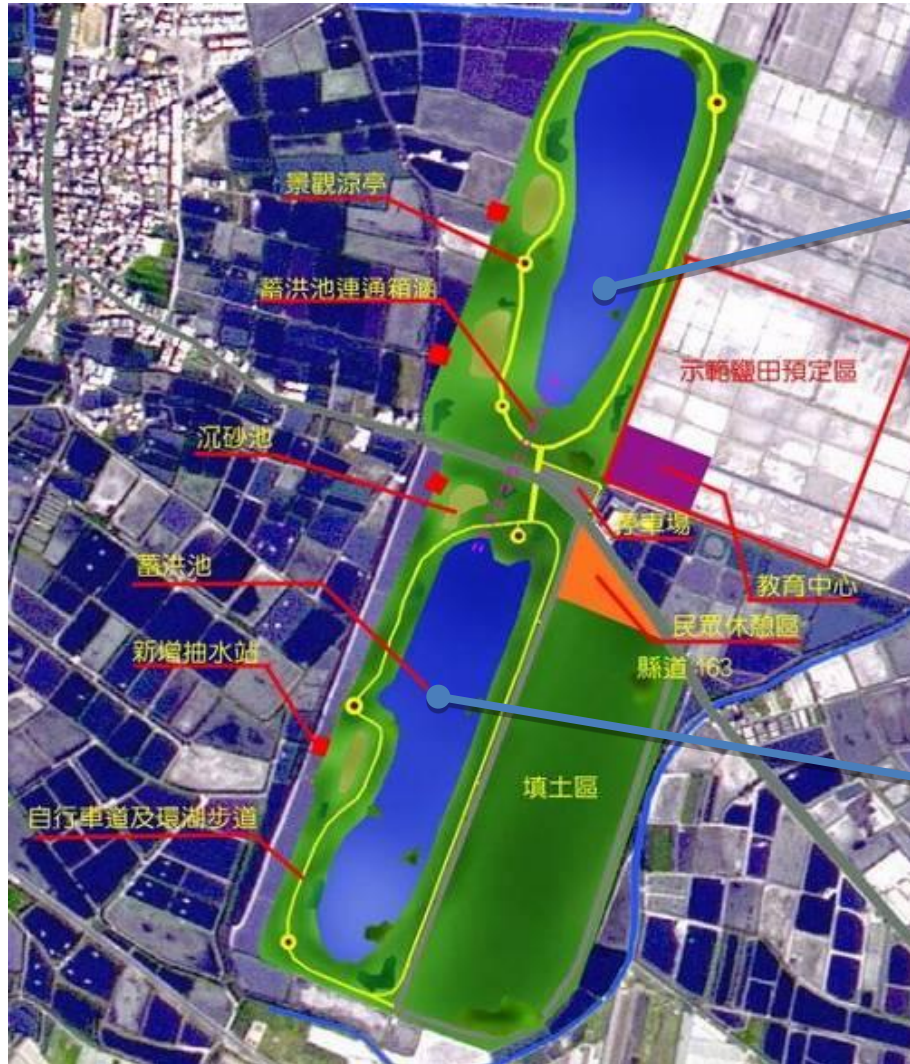


Gaoshanding, Yangmei 楊梅高山頂



Tainan Metropolitan Park 台南都會公園

經濟部
Xinwen, Chiayi



34ha



42ha



C 5ha



Southern Taiwan Science Park

B 15ha



E1 18.7ha
E2 7ha



A 5ha



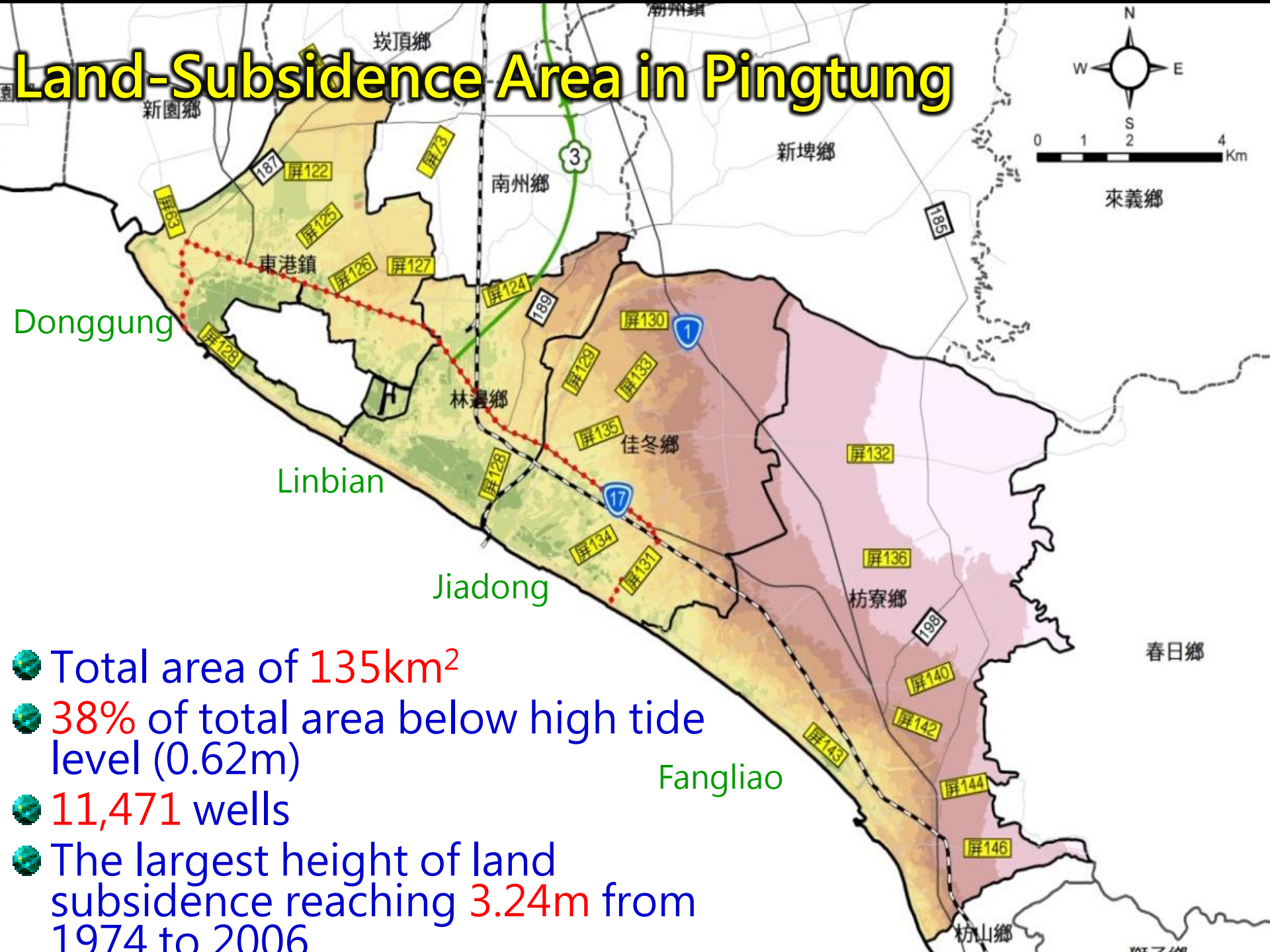
F 14ha



D 20ha



Park Area = 1,038 ha



Land-Subsidence Area in Pingtung

Donggung

Linbian

Jiadong

Fangliao

- Total area of **135km²**
- **38%** of total area below high tide level (0.62m)
- **11,471** wells
- The largest height of land subsidence reaching **3.24m** from 1974 to 2006

Land Use Management



Integrated Flood Control

Diversion ditch

東港鎮

Diversion ditch

林邊鄉

溪

佳冬鄉

Super dike

枋寮鄉

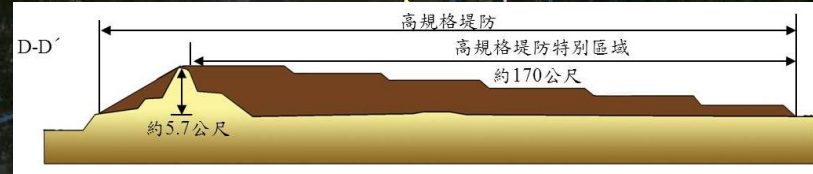
溪

Wetlands

Retention basins

Diversion ditch

Communities flood proofing



圖例

嚴重地層下陷地區

國道

省道

縣道

鐵路

濕地滯洪池

截流溝

台17線外環道路

高規格堤防

低地聚落防護



Water Resource Management

Forest recreation area

林後四林平地森林遊樂區

大潮州地下水補注湖

Groundwater recharge lake

Groundwater recharge lake

林業育成

Taking river water by wells

傍河取水

南和圳伏流水

Taking subterranean stream by weir

Aquaculture zone

圖例

- 嚴重地層下陷地區
- 國道
- 省道
- 鐵路
- 養殖漁業生產區

0 1,500 3,000 4,500 公尺



Industrial Restructuring



圖例

- 嚴重地層下陷地區
- 國道
- 省道
- 鐵路
- 養殖漁業生產區
- 有機養殖區
- 綠能產業區
- 調節池
- 輸水管線

Life with water

High-return period
flood

Thank You for Your Attention

