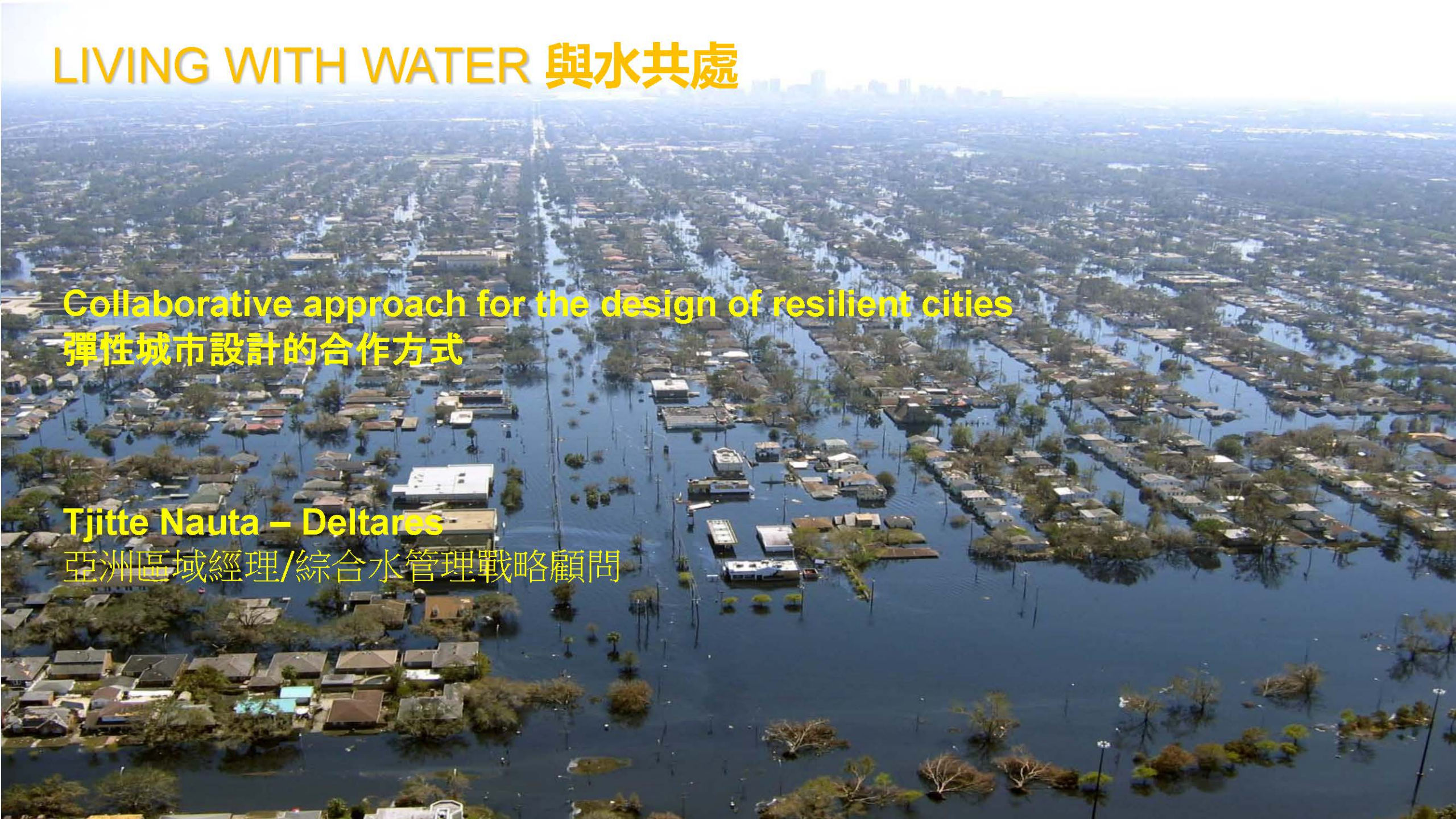
LIVING WITH WATER 與水共處



Collaborative approach for the design of resilient cities
彈性城市設計的合作方式

Tjitte Nauta – Deltares
亞洲區域經理/綜合水管理戰略顧問

The Dutch Water Research Institute 荷蘭水利研究院

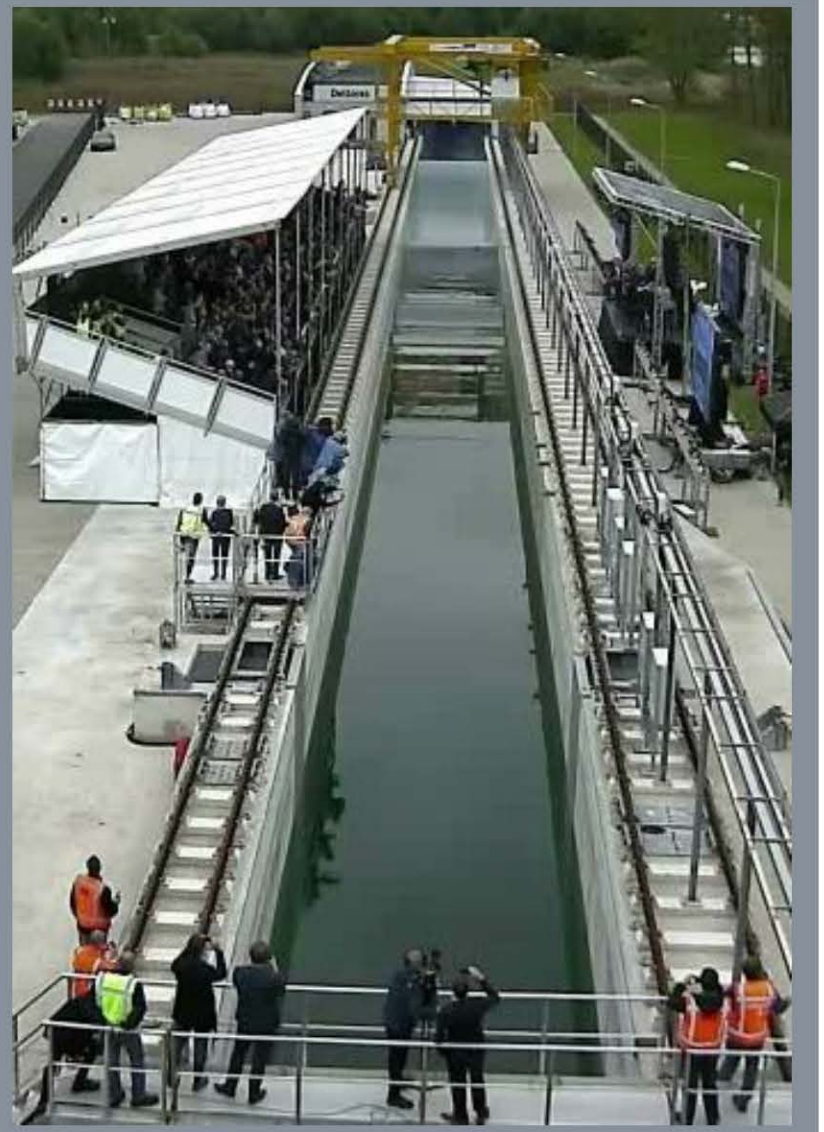
Deltares
Enabling Delta Life

Deltares is an **independent and internationally operating research and specialist consultancy institute**, incorporating advanced expertise on water and infrastructure.

三角洲研究院是一家獨立的國際化研究和專家諮詢機構，融合了水和基礎設施方面的高級專業知識

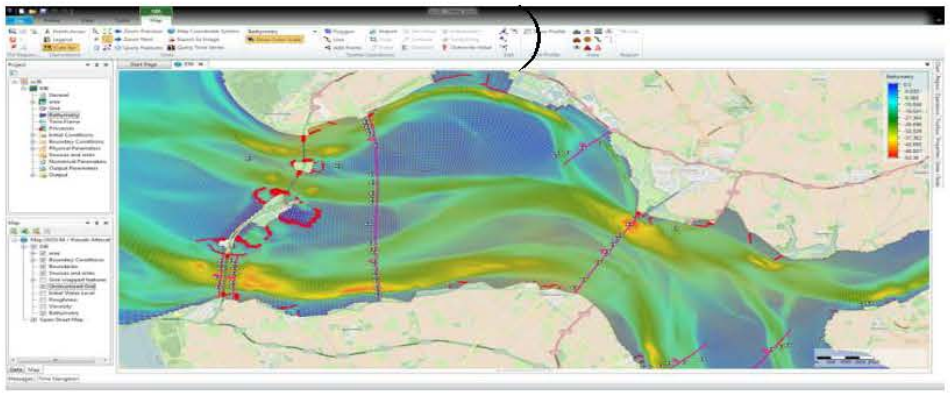
Deltares is at the forefront in the development, distribution and application of expert knowledge and software for **safe and sustainable development and preservation**.

三角洲研究院在開發和應用專業知識和軟體來維護安全和可持續發展方面處於前沿。



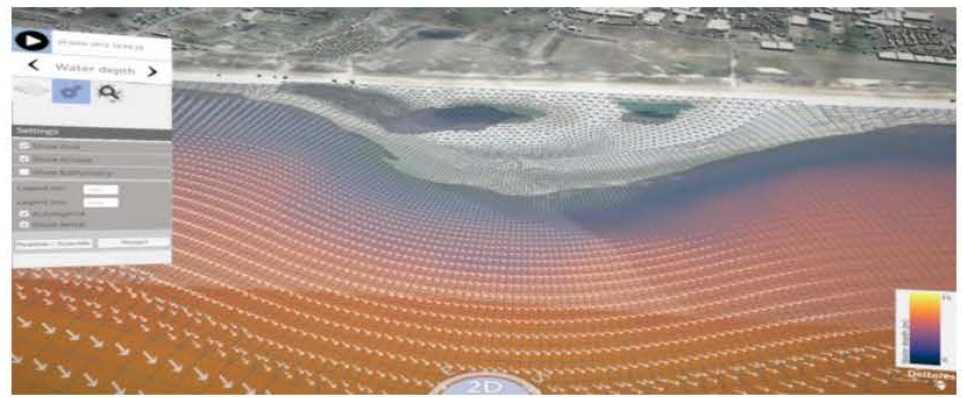
The Dutch Water Research Institute 荷蘭水利研究院

Specialist advise（專業建議



Knowledge sharing（知識共用）

Research（科研）



Collaboration（合作）

Collaborative approach for the design of resilient cities 彈性城市設計的合作方式

適應輔助工具
Adaptation Support Tool

現代社會運作的發條
CIrcle - The clockwork that makes modern society tick

適應的背景情況 Context for Adaptation

氣候變化 Climate change:

- 降雨強度增大 Increase rainfall intensity
- 氣溫增高 Increase in temperature
- 海平面升高 Sea level rise
- （乾旱增多）(Increase in drought)

人口持續增長和都市化進程

Continuous population growth and urbanization

- 土地使用的改變導致 Land use change leading to
  - 滲透減少和徑流增加
    Reduced infiltration and increased runoff
  - 城市熱島效應增加
    Increased urban heat island effect
- 需水量增大 Increased water demand
- 三角洲城市土地下沉 Land subsidence in delta cities

為當前或過去形勢而設計的城市 => 翻新

Cities designed for current or past conditions => retrofitting

氣候適應 – 利益相關者管理
Climate adaptation – Stakeholder engagement

最大化

- 洪水 Flooding
- 熱應力 Heat stress
- 乾旱 Drought

最大化 Maximizing:

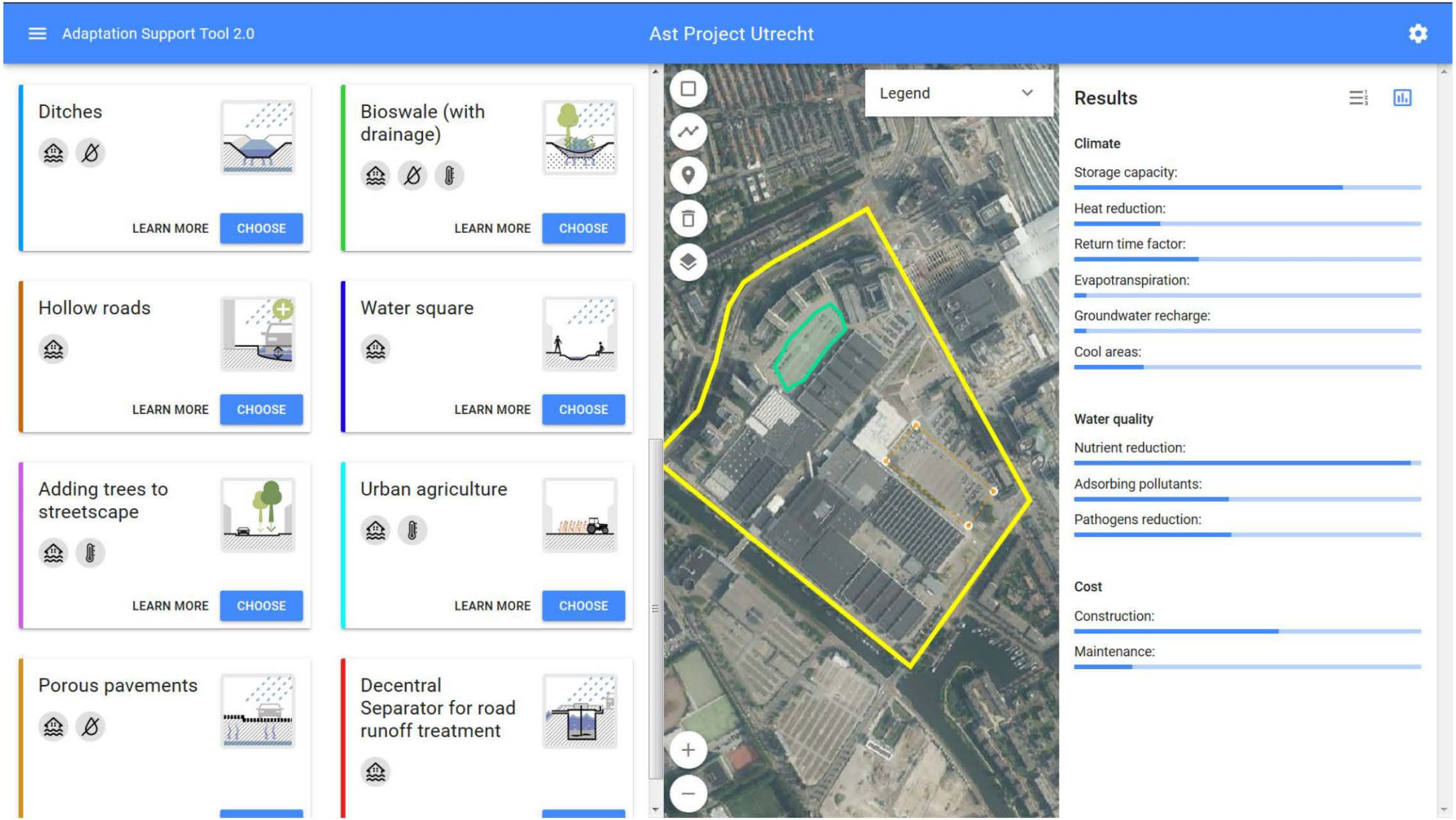
- 居住性 / 城市重建
  Livability / urban regeneration
- 健康潛能 Health potential
- 可持續的經濟發展 Sustainable economic development

在現行城市中氣候適應包含了很多利益相關者：
In existing cities climate adaptation involves many stakeholders:

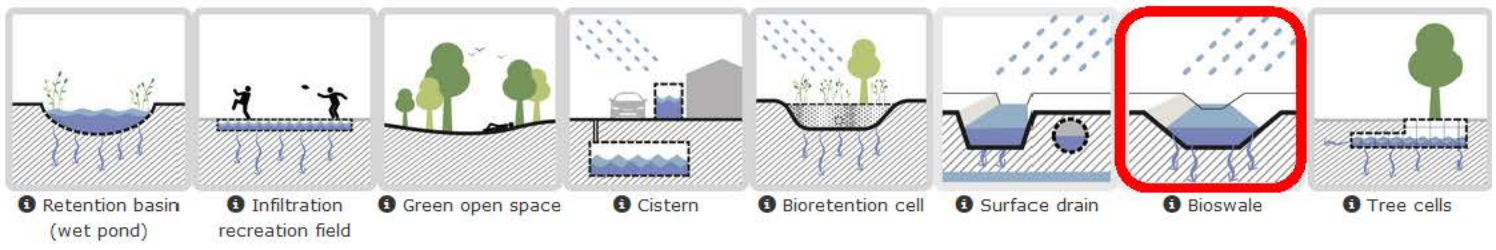
例如：城市規劃者，污水排水部門，道路部門，景觀設計者，專案開發者，房產企業，等等
e.g. urban planners, drainage departments, road department, landscape designers, project developers, housing corporations, etc.

共同創造是利益相關者管理的一部分
Co-creation as part of stakeholder engagement

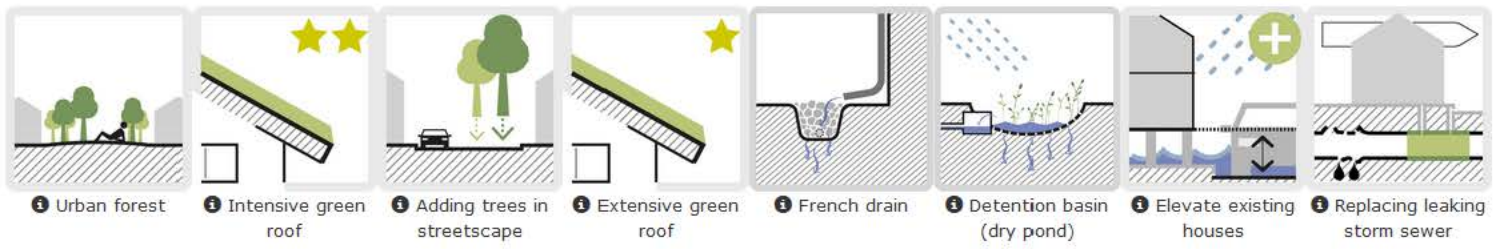
適應輔助工具 2.0 - 使用者介面



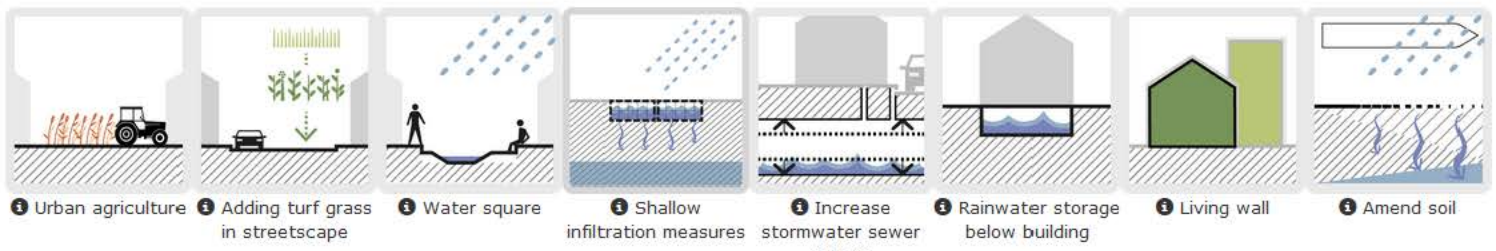
適應輔助工具 2.0 - 70種適應測量方法



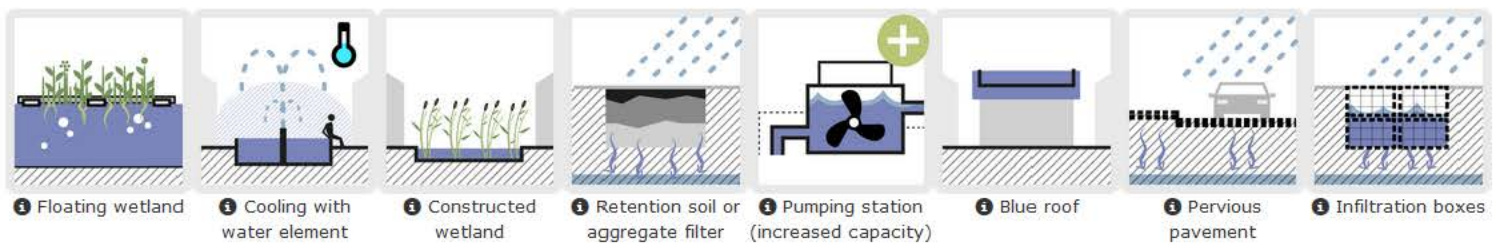
Retention basin (wet pond) | Infiltration recreation field | Green open space | Cistern | Bioretention cell | Surface drain | Bioswale | Tree cells



Urban forest | Intensive green roof | Adding trees in streetscape | Extensive green roof | French drain | Detention basin (dry pond) | Elevate existing houses | Replacing leaking storm sewer



Urban agriculture | Adding turf grass in streetscape | Water square | Shallow infiltration measures | Increase stormwater sewer system | Rainwater storage below building | Living wall | Amend soil



Floating wetland | Cooling with water element | Constructed wetland | Retention soil or aggregate filter | Pumping station (increased capacity) | Blue roof | Pervious pavement | Infiltration boxes

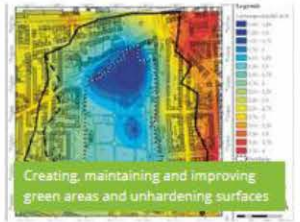
Bioswale (with drainage)

Pluvial flooding | Drought | Heatstress

A bioswale is a ditch with vegetation, a porous bottom and below that a layer of gravel, packed in geotextile with an infiltration pipe/drainpipe. It allows rainwater storage, infiltration and transport while helping to enhance biodiversity and quality of life.

For more information click here

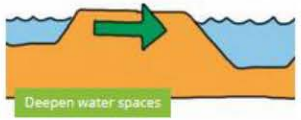
ADAPTATION MEASURES – MANY OPTIONS 適應措施的選擇



Paradigm shift（觀念的轉變）:

- *From **fighting against water** to **living with water***
  從與水鬥爭到與水共存
- *From **civil engineering** to **nature based solutions***
  從土木工程到基於自然的方法

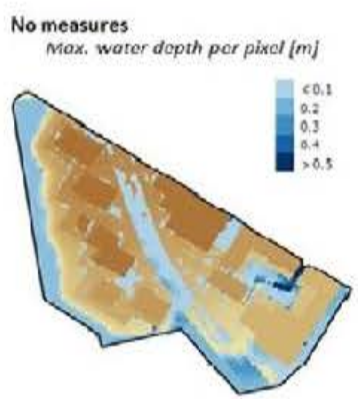
AT ALL SCALES 各種尺度

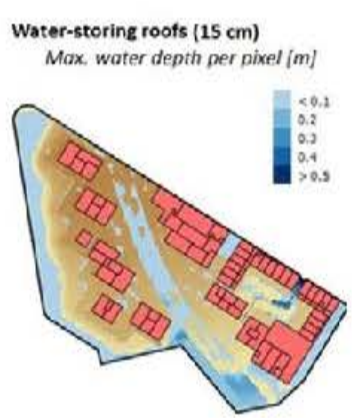


Grey solutions — Hybrid solutions — Blue-green solutions

less space, dike → *more space, no dike*

inflexible, extra investment → *flexible and cost-effective*





城市自然為本的解決方法 - 海綿城市
Urban Nature Based solutions – Sponge cities

城市自然為本的解決方法是指在處理社會問題時對自然可持續的管理和使用

Urban Nature-based solutions (NBS) refers to the sustainable management and use of nature (e.g. Green Infrastructure) for tackling societal challenges.

- 有效的氣候適應 Effective in climate adaptation
- 額外的利益 Additional benefits
- 為綠色添加功能 Adding function to green

實踐中涉及**軟件和硬體工程解決方法**

In practice both **soft and hard engineering solutions**.

烏德勒支中心 - 展示區 - 適應輔助工具
Utrecht Center – Fair area

利益相關者：自治市 + 展覽會
Stakeholders: Municipality + Fair

志向：最綠色、氣候彈性和健康的城市區域
Ambition: Most green, climate resilient and healthy urban area

適應輔助工具曾被用來合作探索潛在的適應測量方法
AST used to collaboratively explore potential adaptation measures

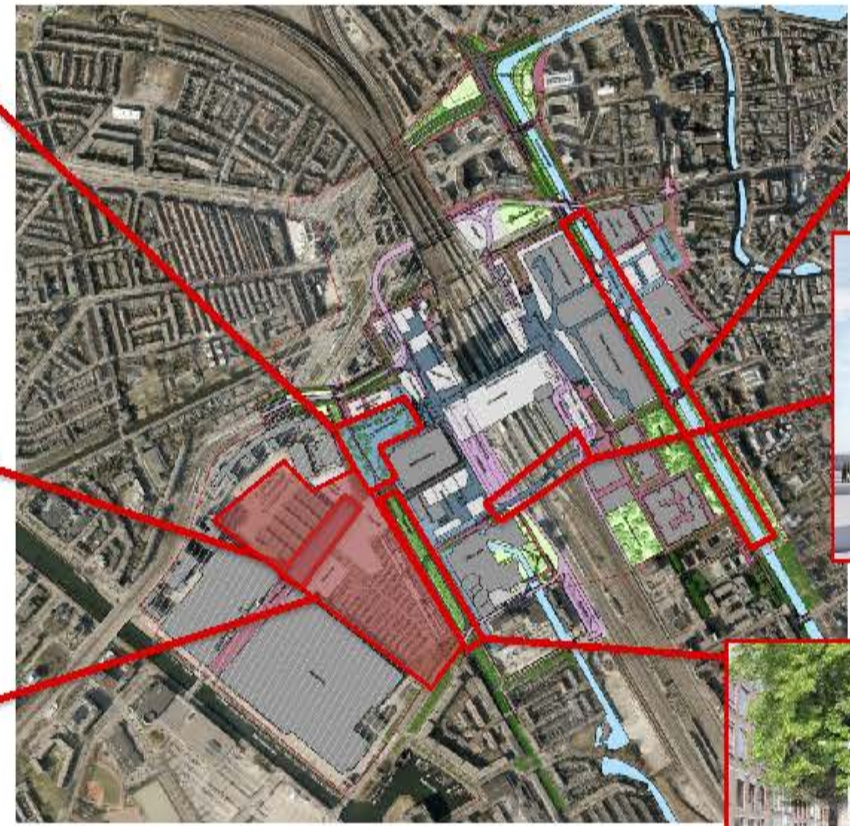
資金：烏德勒支市，展覽會，歐盟
Funding: City of Utrecht, Fair, EU

適應性支援工具：措施的影響評價

Jaarbeursplein

Oranjeplein

Trial allotment

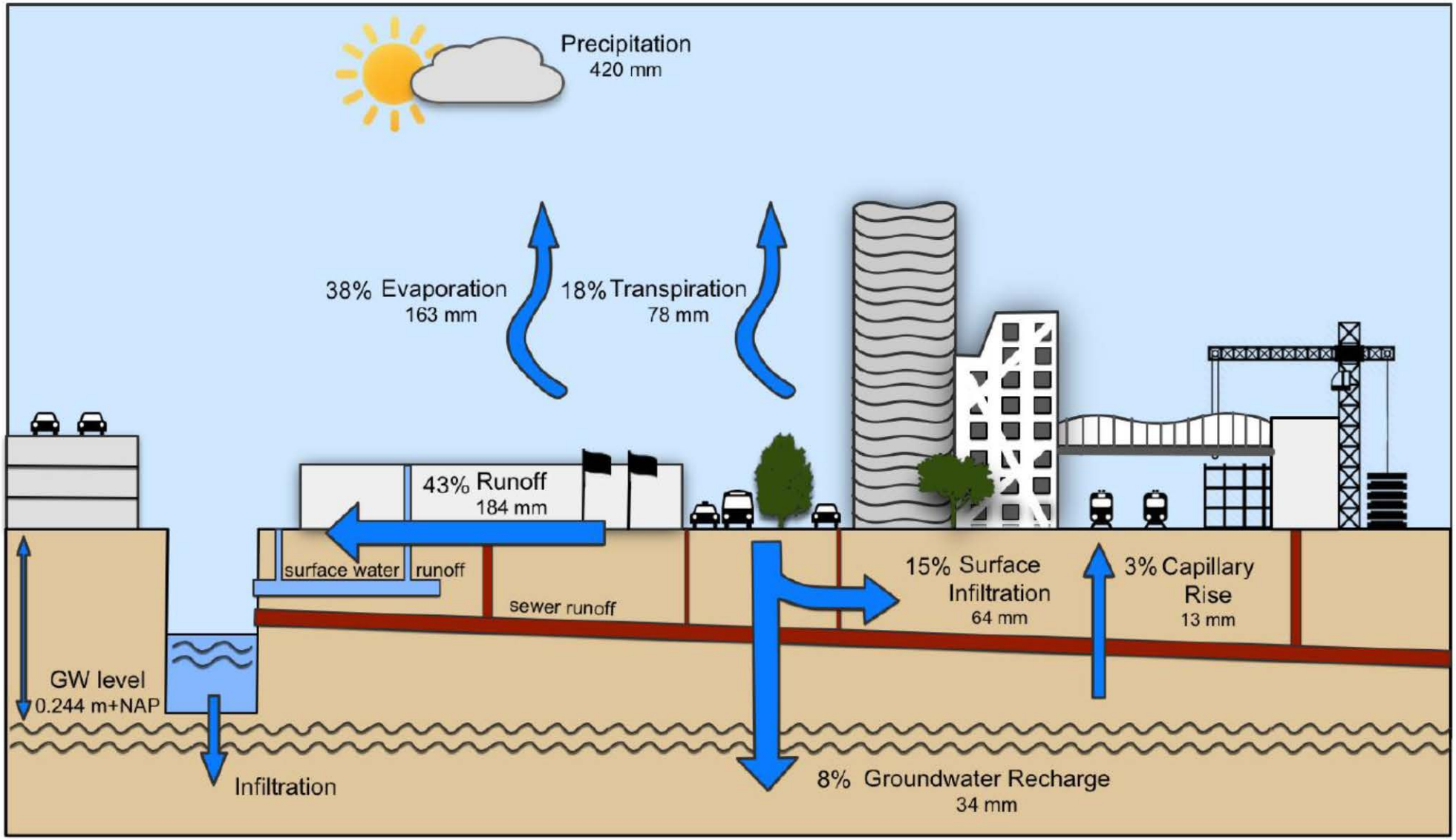


Catherijnesingel

Moreelsebrug

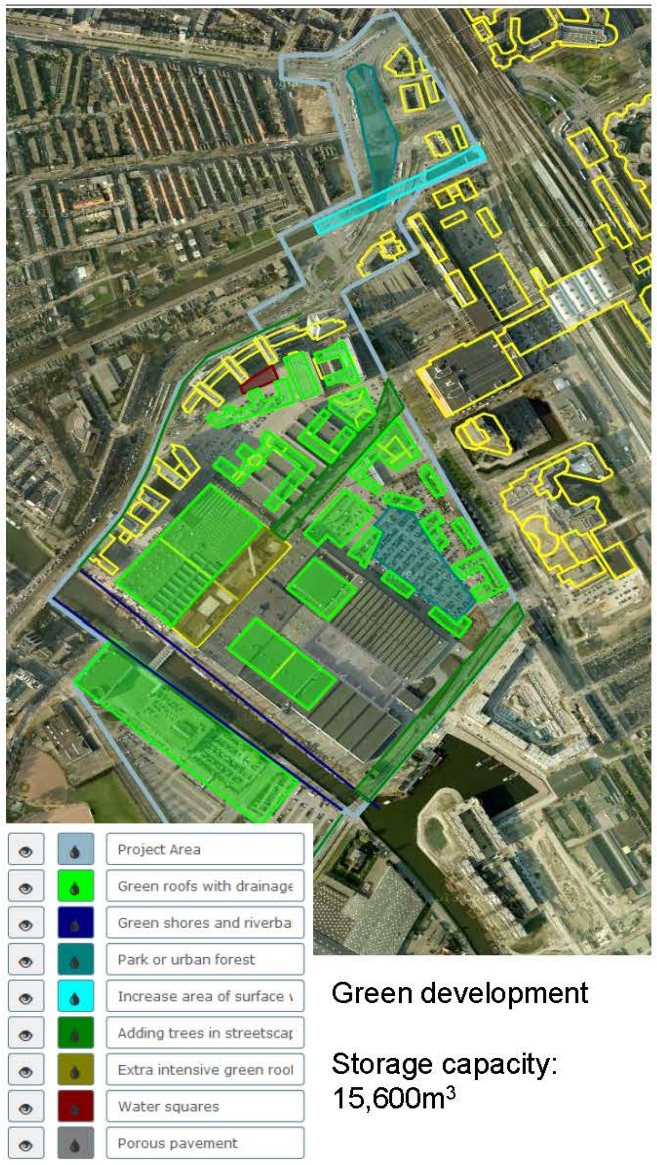
Croeselaan

通過改變水流來增加彈性
Change the water flow to increase resilience



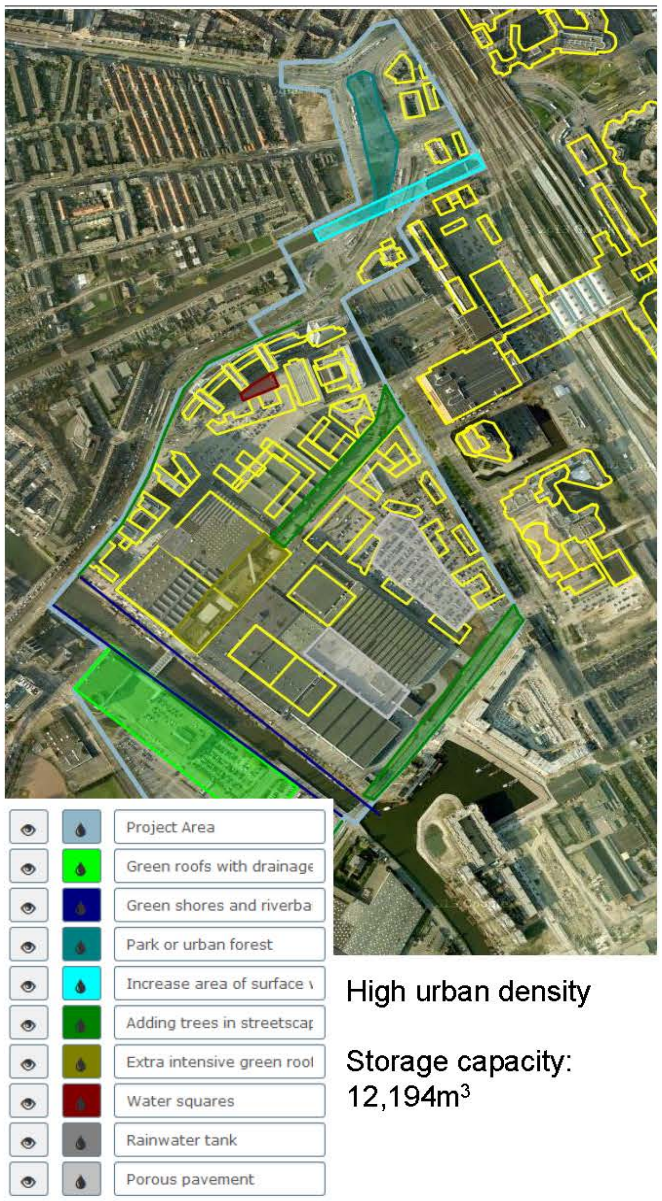
ADAPTATION SUPPORT TOOL 適應性支援工具

ADAPTATION SUPPORT TOOL 適應性支援工具



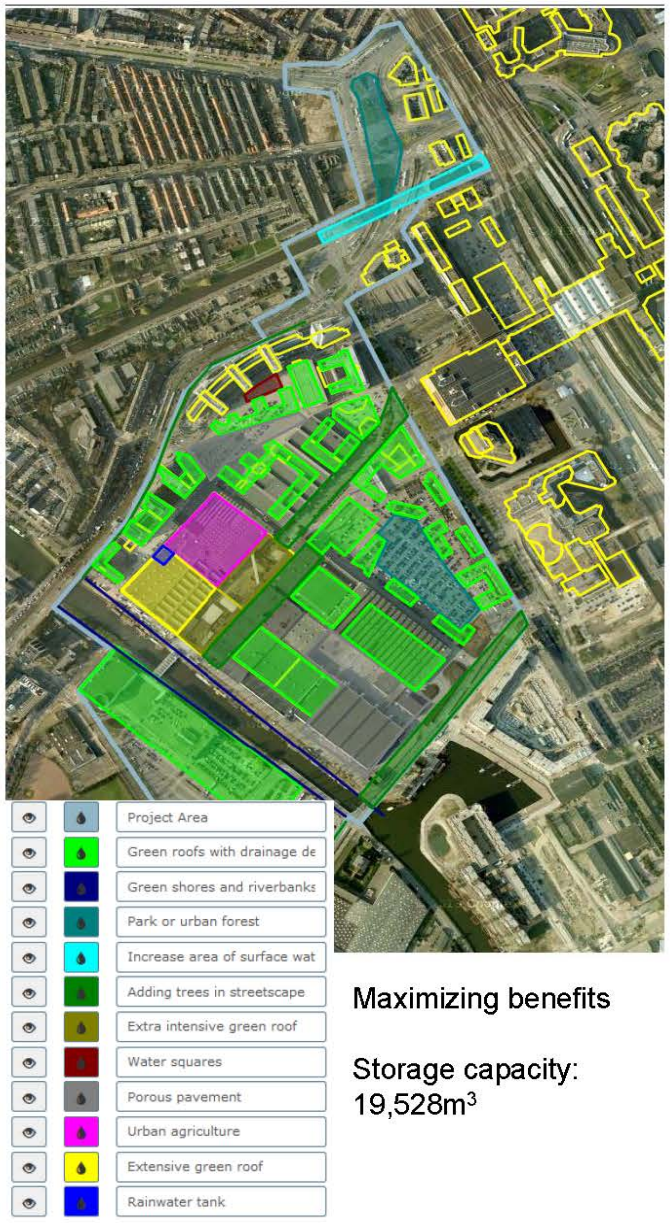
Green development

Storage capacity:
15,600m^3



High urban density

Storage capacity:
12,194m^3



Maximizing benefits

Storage capacity:
19,528m^3

用適應輔助工具進行合作規劃 – 經驗
Collaborative planning with AST - Experience

優勢 Advantages:

共同創造很有效

Co-creation really works

- 設計規劃得到了利益相關者的支持
  Leading to designs that are supported by the stakeholders
- 不同的利益相關者的立場得以明確
  Positions of the different stakeholders can become very clear
- 解決方法基於區域特性
  Solutions are location specific
- 討論圍繞著特定干預的機遇和利益展開
  Discussions are focused on opportunities and benefits of specific interventions

用適應輔助工具進行合作規劃 - AST in the adaptation process

Problem analysis
- Exposure
- Risk

- DflowFM, Heatstress model, …

Exploring adaptation options

- AST

Detailed effect analysis of adaptation measures

- DflowFM, Heatstress model, …

Circle

洪水對關鍵基礎設施的多米諾骨牌效應
Cascading domino effects of floods on critical infrastructures

“關鍵基礎設施”是指一種資產、系統或系統的一部分 …… 對於維護人們的重要社會功能、健康、安全、經濟或社會福祉至關重要。“關鍵基礎設施”的破壞將阻礙上述功能的實現，對成員國產生重大影響。

‘Critical Infrastructure’ means an asset, system or part thereof […] which is essential for the maintenance of vital societal functions, health, safety, security, economic or social well-being of people, and the disruption or destruction of which would have a significant impact in a Member State as a result of the failure to maintain those functions.

資料來源：歐洲委員會（2008年）：2008年12月8日《歐盟關鍵基礎設施認定和安全評估指令》（2008/114/EC 指令）
Source: European Commission (2008): Council Directive 2008/114/EC of 8 December 2008 “on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection.

Circle – 洪水對關鍵基礎設施的多米諾骨牌效應

Cascading domino effects of floods on critical infrastructures

在過去的幾十年中，極端氣候事件發生的頻率和強度越來越大，以超乎想像的方式影響著社會。特別是電力、通信、飲用水和運輸系統等關鍵基礎設施的中斷導致了巨大的且多數情況下持久的社會影響，造成死亡和經濟損失。

Over the past decades, the increasing frequency and intensity of extreme climatic events have impacted the society in unimaginable ways. Particularly the interruptions of critical infrastructures such as electricity, communication, drinking water or transport systems lead to enormous, often long-lasting societal impacts including fatalities and economic losses.

Circle說明利益相關者瞭解關鍵基礎設施系統之間複雜且相互依賴的關係。即使在資料相對較差的情況下，也可以對這些聯繫或因果關係進行研究和急性視覺化處理。

CIrcle helps stakeholders to understand the complex and interdependent relations between critical infrastructure systems. These relations, or causal links, can be investigated and visualized even within the context of a relatively data poor environment.


2003年義大利全國大停電
Blackout in Italy
National Blackout in 2003

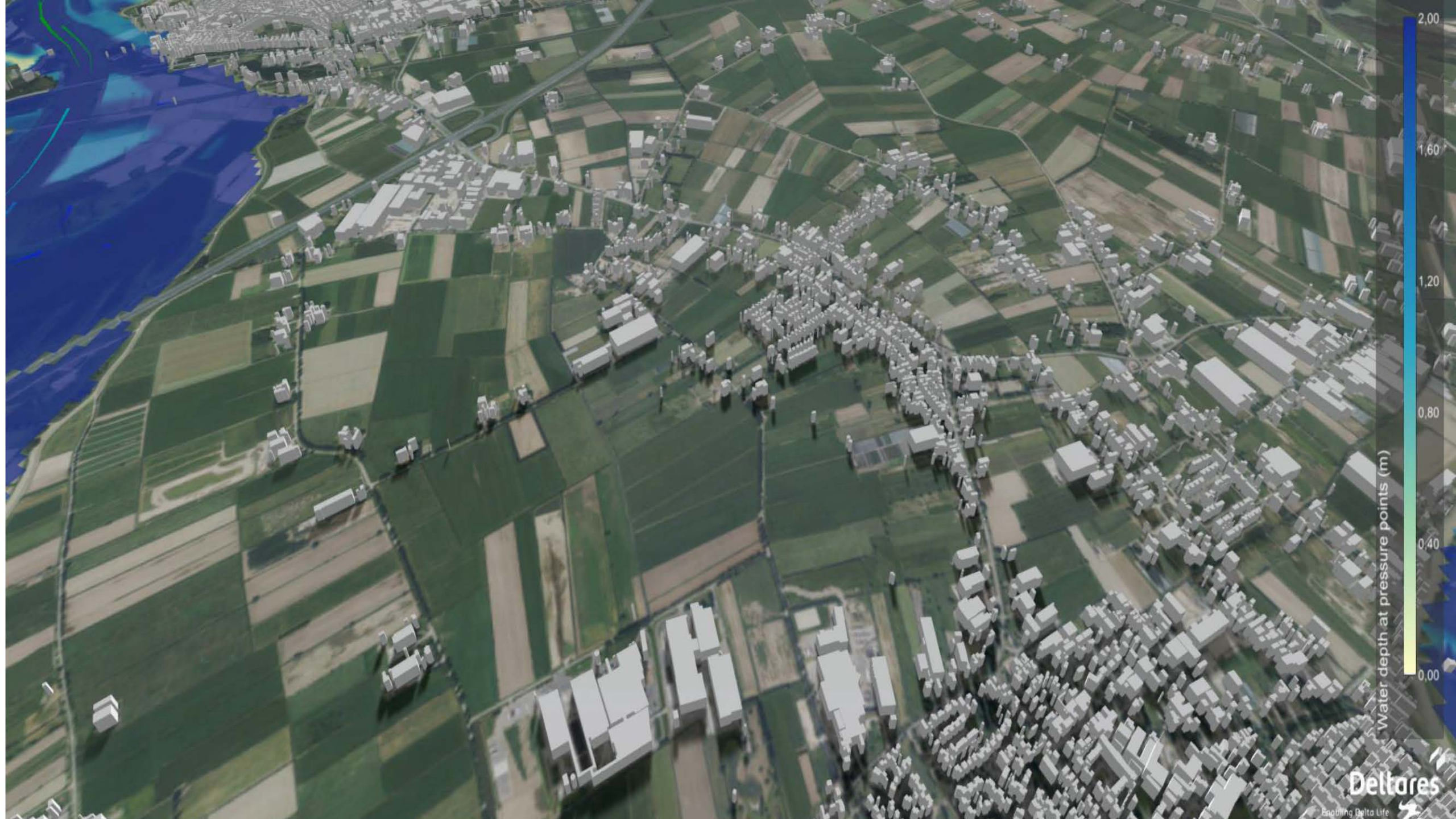

2009
Typhoon Morakot

2011年泰國洪災
Thailand floods 2011

上述事件的共同點？
What do all events have in common?

- 影響小，後果大
  small impact, large consequences
- 中心城市受到嚴重影響
  urban centres are heavily affected
- 有的事件由單一原因引起，有些則是系列因素導致的結果
  there are events with a single cause, but most failure is a combination of causes

→ Embankment breach along regional water system
區域水系的潰壩


2,00
1,60
1,20
0,80
0,40
0,00
Water depth at pressure points (m)
Deltares
Enabling Delta Life

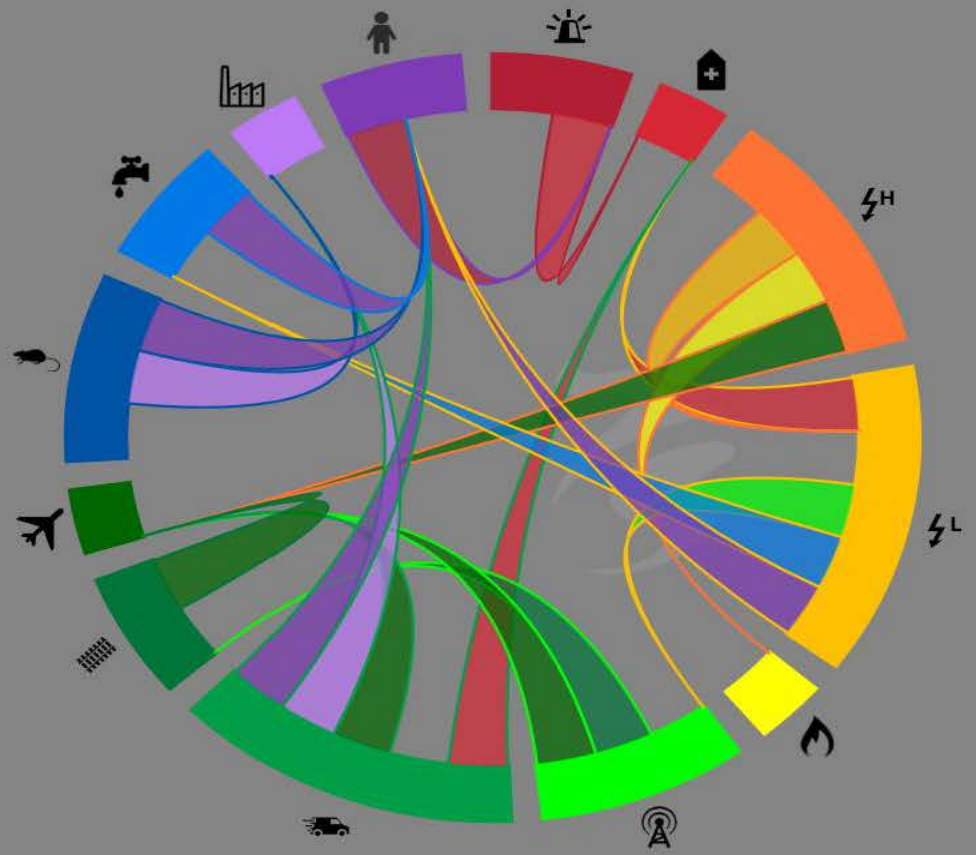

阿姆斯特丹-Waterland
1916年洪災再現
Amsterdam-Waterland
Revisited the 1916 flooding
Knollendam
PURMEREND
Wormer
Jisp
WIJDE
WORMER
PURMER
EDAM
Volendam
Wormerveer
Zaandyk
Zaanen
Assendelft
De Koog
Ilpendam
MONNIKENDAM
Oost Zaandam
W Zaandam
Broek
Landsmeer
Uitdam
Buiksloot
Ransdorp
Durgerdam
Spaarnwoude
Sloter Dyk
AMSTERDAM
Haarlem
Heemstede
Diemen
Pampus
A22
A5
A4
A10
A1
A6
N201
S110
S112

阿姆斯特丹-Waterland
1916年洪災再現
Amsterdam-Waterland
The 1916 flooding

關鍵性基礎設施：與生命和環境的關係及對其影響

CIrcle - Critical Infrastructure: Relations and Consequences for Life and Environment

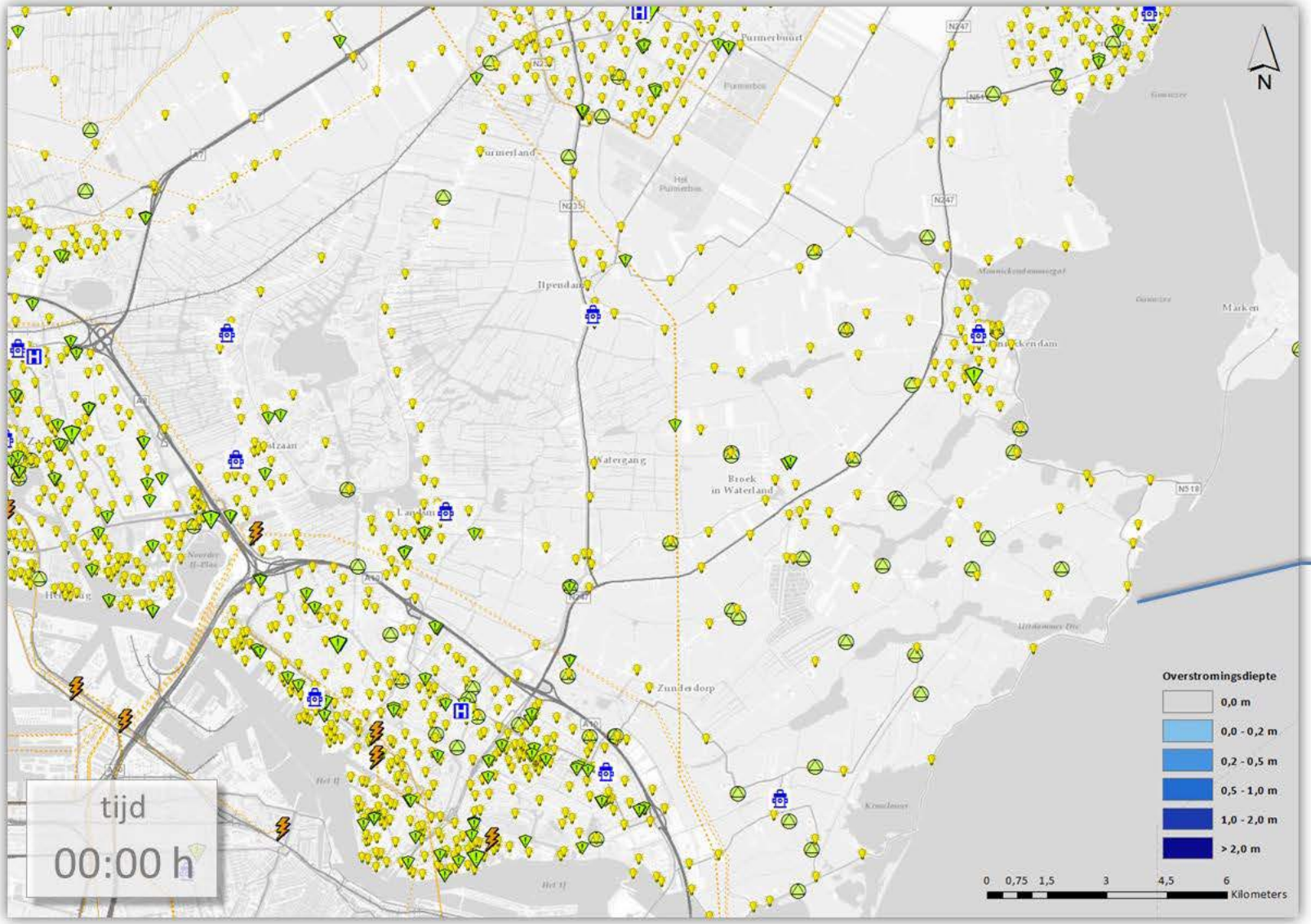
- Emerg. Coord. Centres
- Hospital
- Electricity High
- Electricity Low
- Gas network
- Telecommunication network
- Main roads and tunnels
- Railways
- Airport
- Wastewater
- Drinking water
- Industry
- Citizens



Start

Deltares
Enabling Delta Life

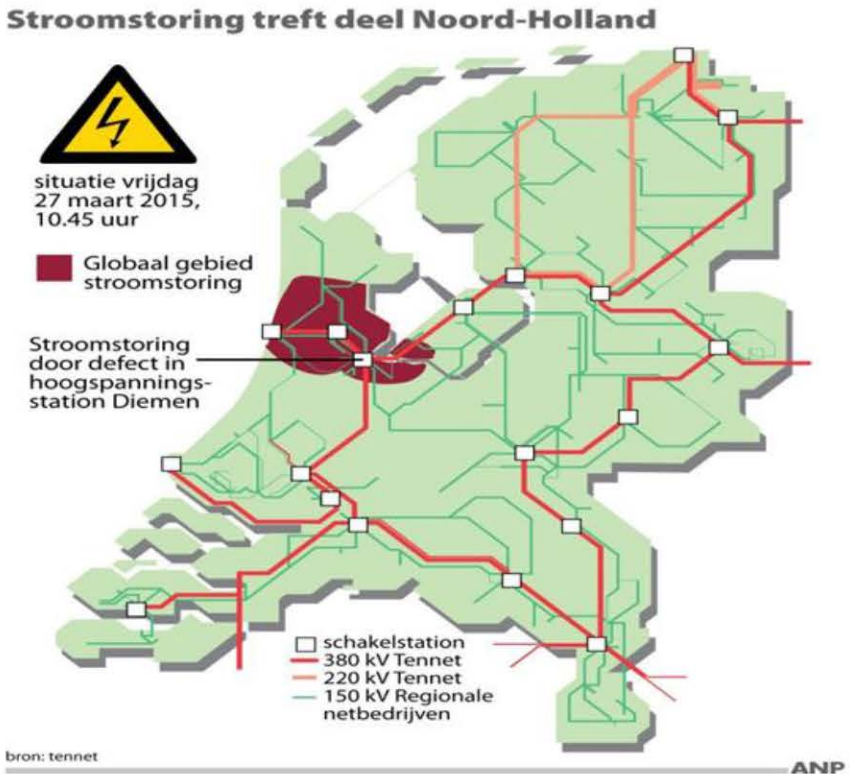
CIrcle case study - Cascading-effects in Waterland 1916 – 2016



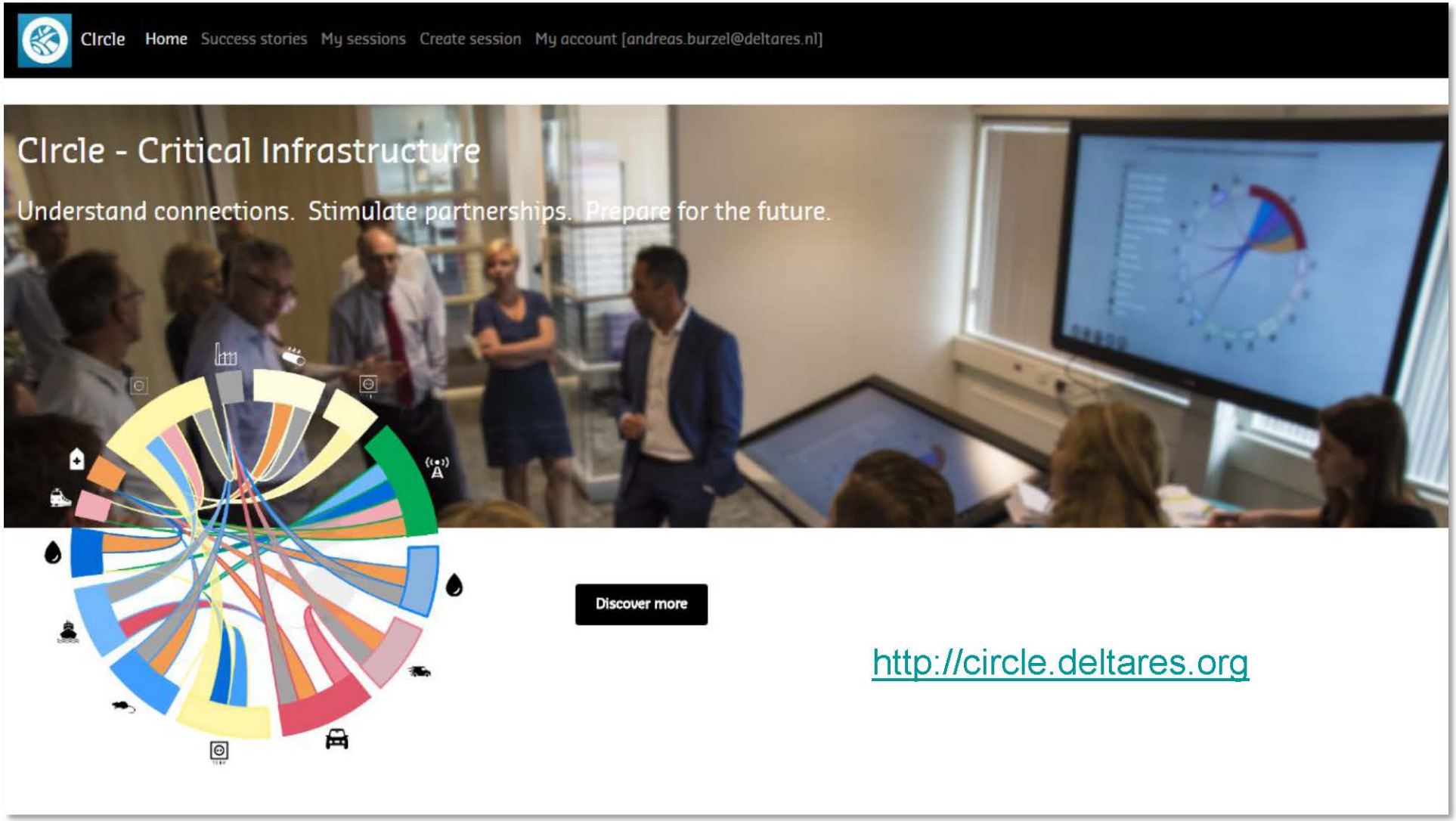
Two dike breaches cause Waterland to flood entirely within 36 hours.

Deltares
Enabling Delta Life

2015年阿姆斯特丹大規模停電
Large Power Outage Amsterdam 2015

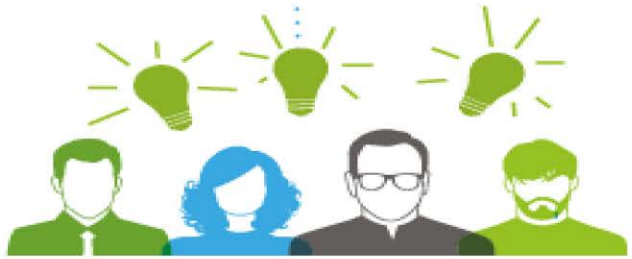


CIrcle 線上 Online – 對社區開放 Open to the Community



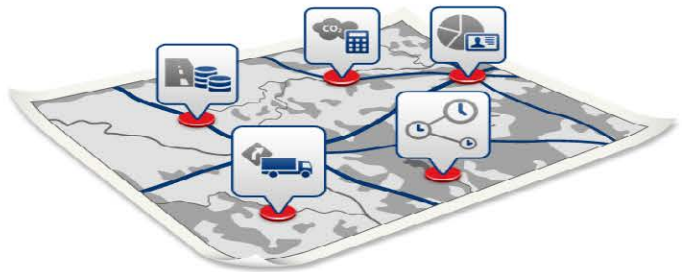
非數位化的Circle　Non-digital CIrcle

貢獻於 Circle contributes to:



意識和概述
Awareness and overview

合作
Collaboration



規劃
Planning

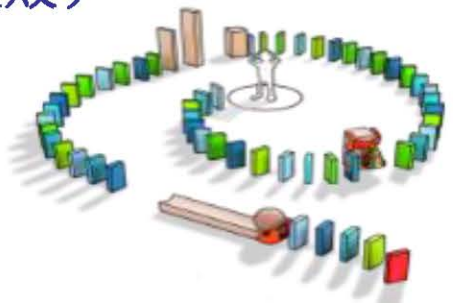
決策
Decision making

制定優先行動
Prioritizing actions

總結 Summary

- “小影響，大後果”事件難以識別
  ‘Small impacts, large consequences’ events are difficult to identify (where, how, etc.)
- 我們很少甚至沒有經歷過關鍵性基礎設施失敗
  We have little or no experience in CI failure
  - 氣候變化 – 極端情形
    climate change – extreme patterns?
  - 失敗的可能性隨複雜性的增加而增加
    likelihood to fail increases with increasing complexity
  - 未來30年，基礎設施的建設量將比自工業化初始以來的建設總量更多
    in the next 30 years more infrastructure will be build than built from the beginning of industrialization
- 更強的意識將帶來更高的韌性
  Awareness can lead to increased resilience

進行災害管理和規劃的完美工具（如果不做計畫，那就是在計畫著失敗）
Perfect tool for disaster management and planning
(“if you fail to plan, you plan to fail”)



感謝關注
Thank you for your attention!

Delft3D FM - Tainan flood (in close cooperation with NTUT, NCHC and FondUS.inc.)