

# City Water Resilience Framework

Designing for Freshwater Resilience

**Dr Mark Fletcher & Alexa Bruce**





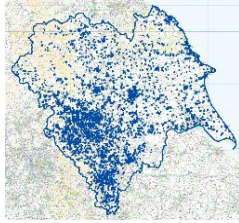
***Resilience** is the capacity of individuals, communities and systems to **survive**, **adapt**, and **grow** in the face of **stress** and **shocks**, and even transform when conditions require it.*



# Starting point... the water cycle



# Governance across the Water Cycle eg Yorkshire



## Yorkshire Water

- Key assets types include: water and wastewater Treatment works, water distribution networks, sewerage, abstractions, pumping stations, outfalls and reservoirs.
- Geographical distribution of assets is fairly even across Yorkshire although there is a cluster in the Leeds-Bradford and Sheffield urban areas.



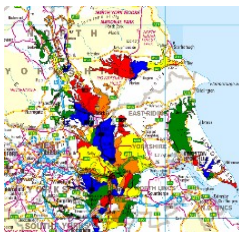
## Environment Agency

- Involved in the natural components of the water cycle.
- Key assets include: flood defences, weirs, abstractions, pumping stations and reservoirs.
- Fairly even spread across Yorkshire with clusters of assets around areas liable to flood, e.g. lower Aire Valley and River Hull.



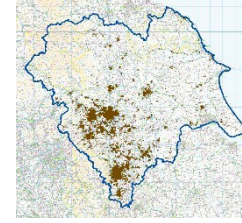
## Canal & River Trust

- Key assets include: canals, locks, reservoirs and fish passes.
- Majority of the CRT assets are in the South of the county in fairly discrete corridors
- Historically distributed between trading towns in South & West Yorkshire and Lancashire.



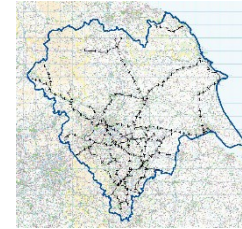
## Internal Drainage Boards

- Key assets include: pumping stations (owned and/or operated).
- Map shows the area of responsibility of the Internal Drainage Boards.
- There are 42 IDBs within the Yorkshire Water area. Typically distributed through low lying areas, e.g. Vales of Mowbray, York, Pickering, and along River Hull



## Local Authorities

- Key assets types include: highways drainage, pumping stations, outfalls and reservoirs.
- Majority of the assets are situated in the West and South of the Yorkshire region and in particular around the urban centres of Leeds, Bradford and Sheffield.



## Network Rail

- Key assets include: railway drainage infrastructure.
- The assets are located along 1,387 km of railway lines, mainly in the West and South of the county in fairly discrete corridors.
- Network Rail (NR) core function is the management and maintenance of railways. Their influence on the water cycle is limited.



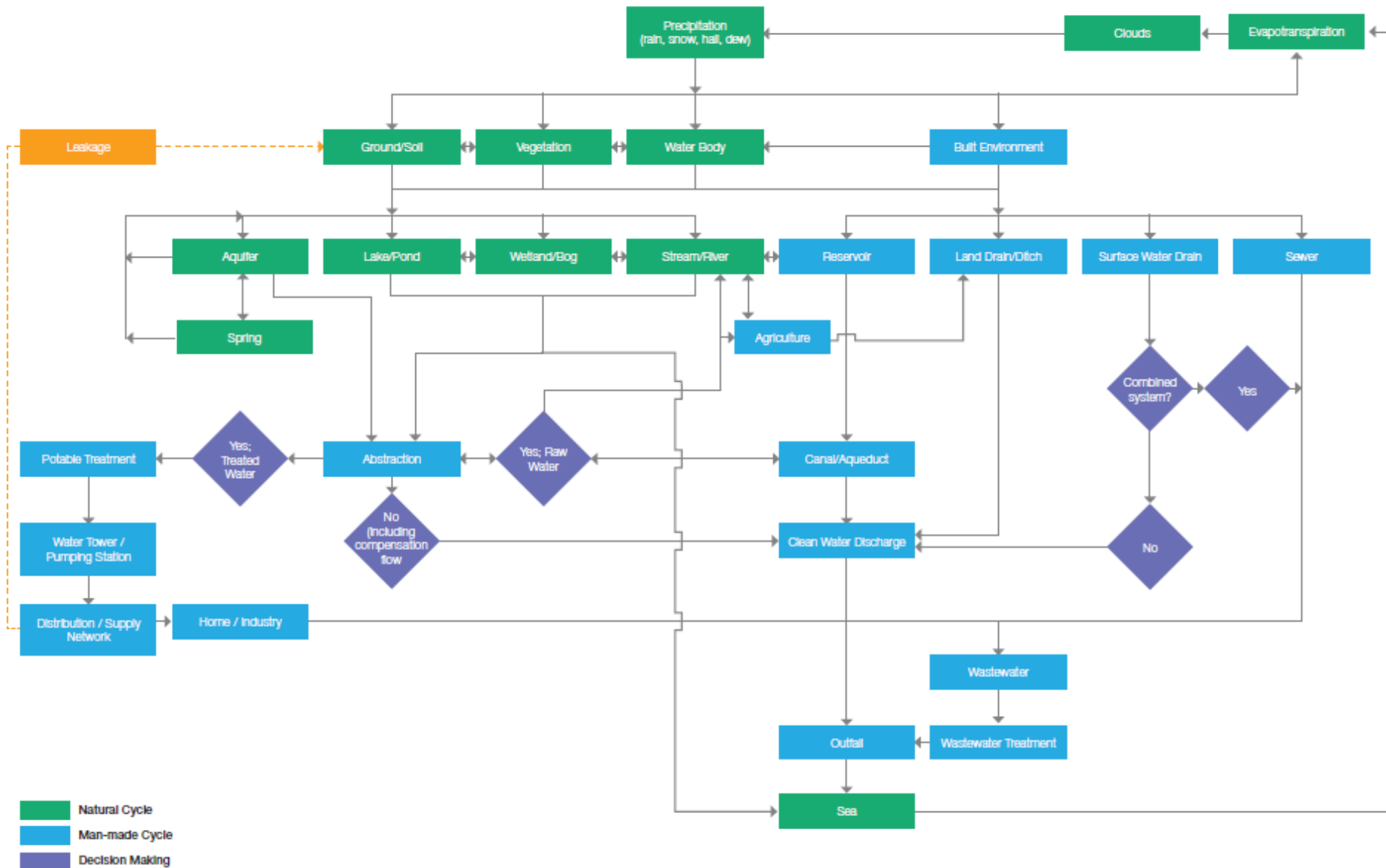
## Highways Agency

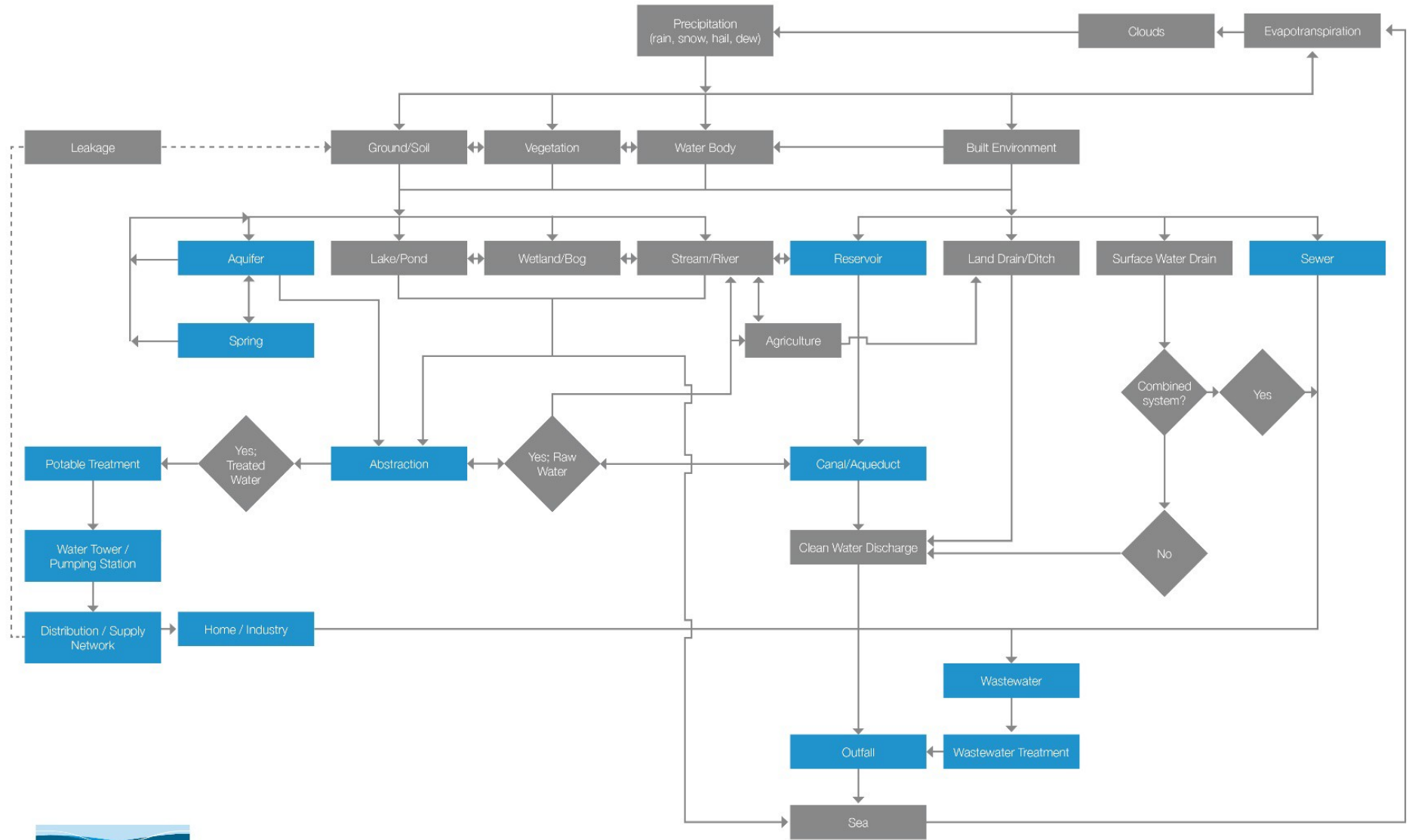
- Key assets include: motorways and major trunk roads drainage infrastructure.
- The assets are located along 654 km of roads, mainly in the West and South Yorkshire in fairly discrete corridors.
- HA core function is the management and maintenance of roads. Their influence on the water cycle is limited.

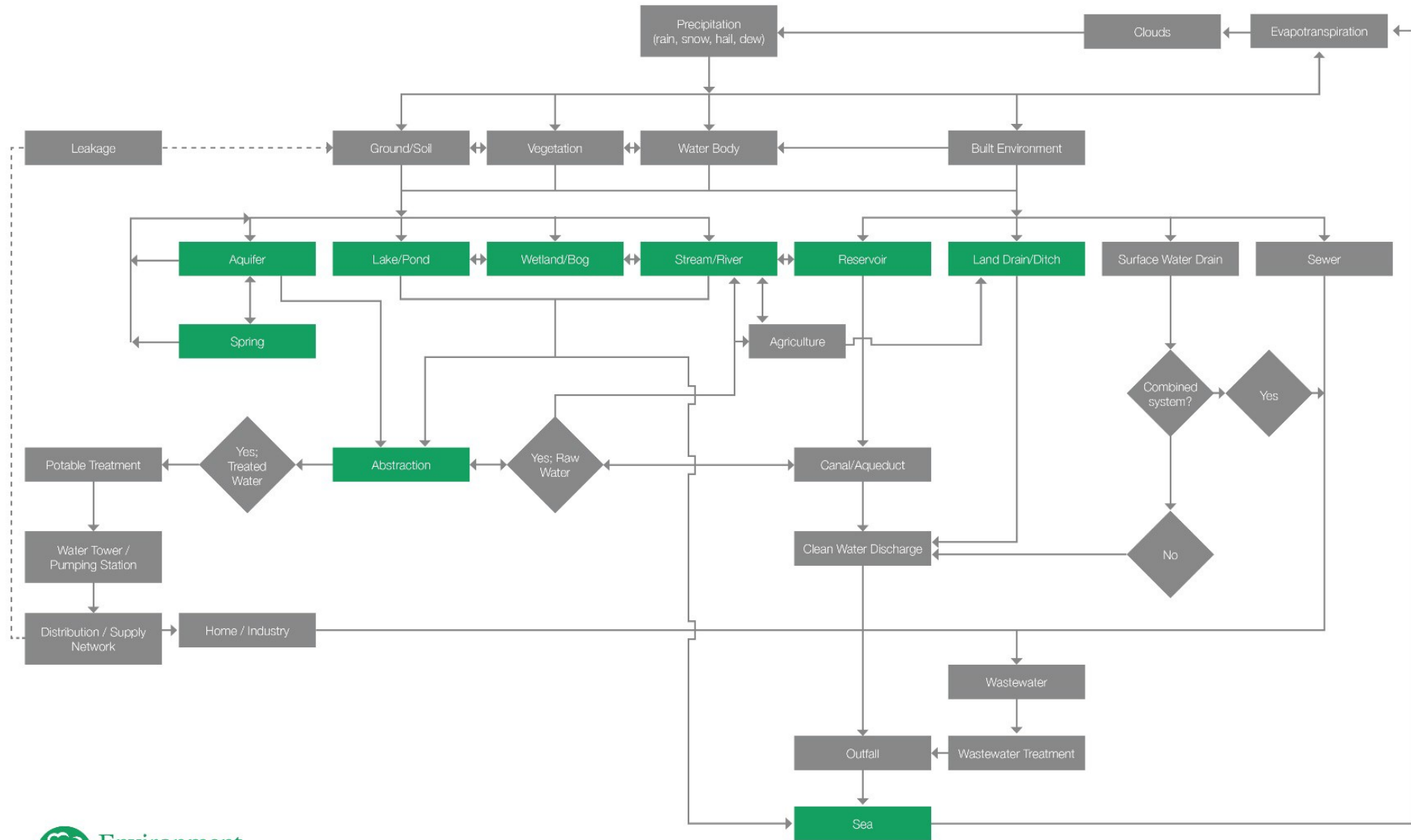
## Private Owners

- In addition there are a series of private owners of assets that may be of strategic interest.

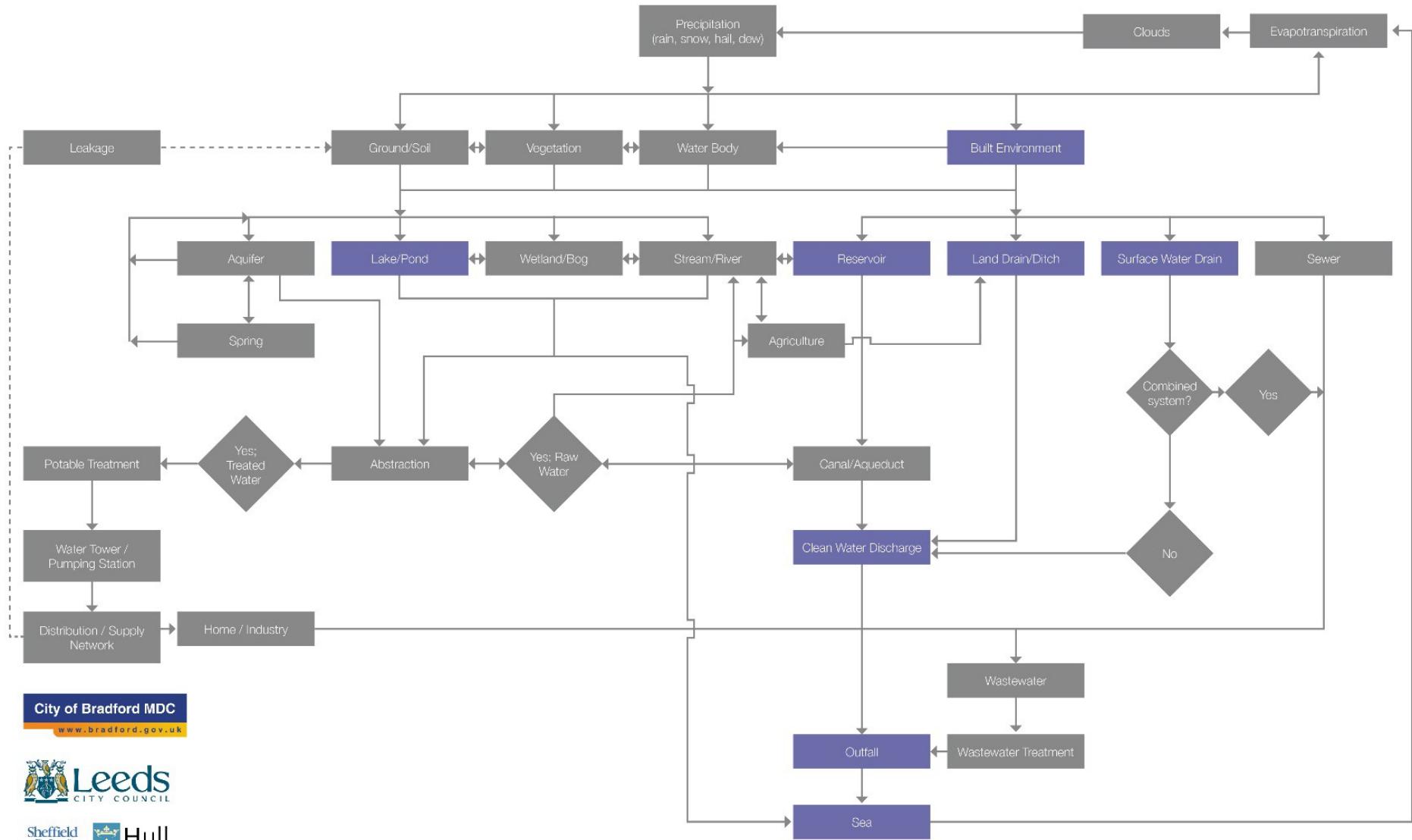












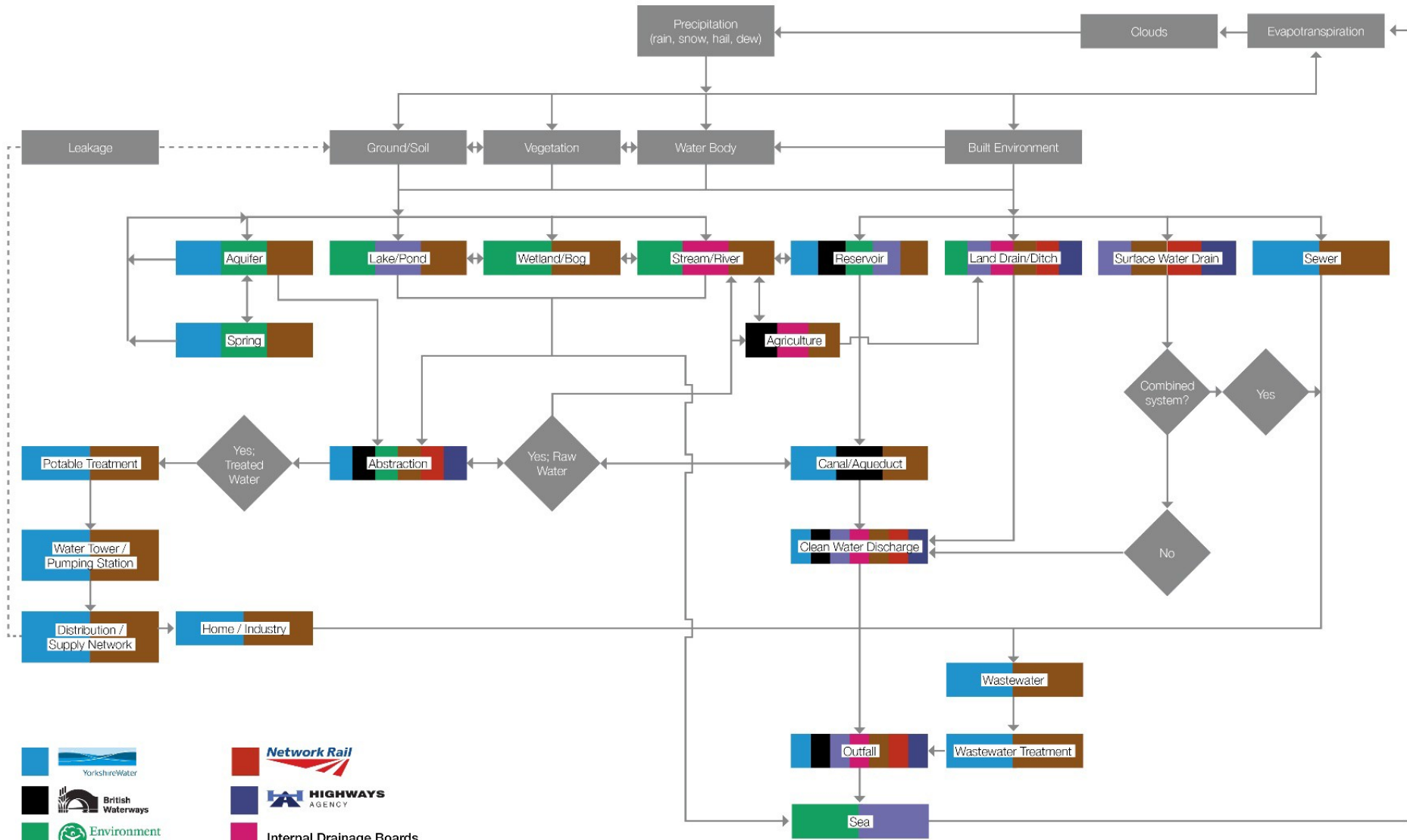
City of Bradford MDC  
www.bradford.gov.uk

Leeds  
CITY COUNCIL

Sheffield  
City Council

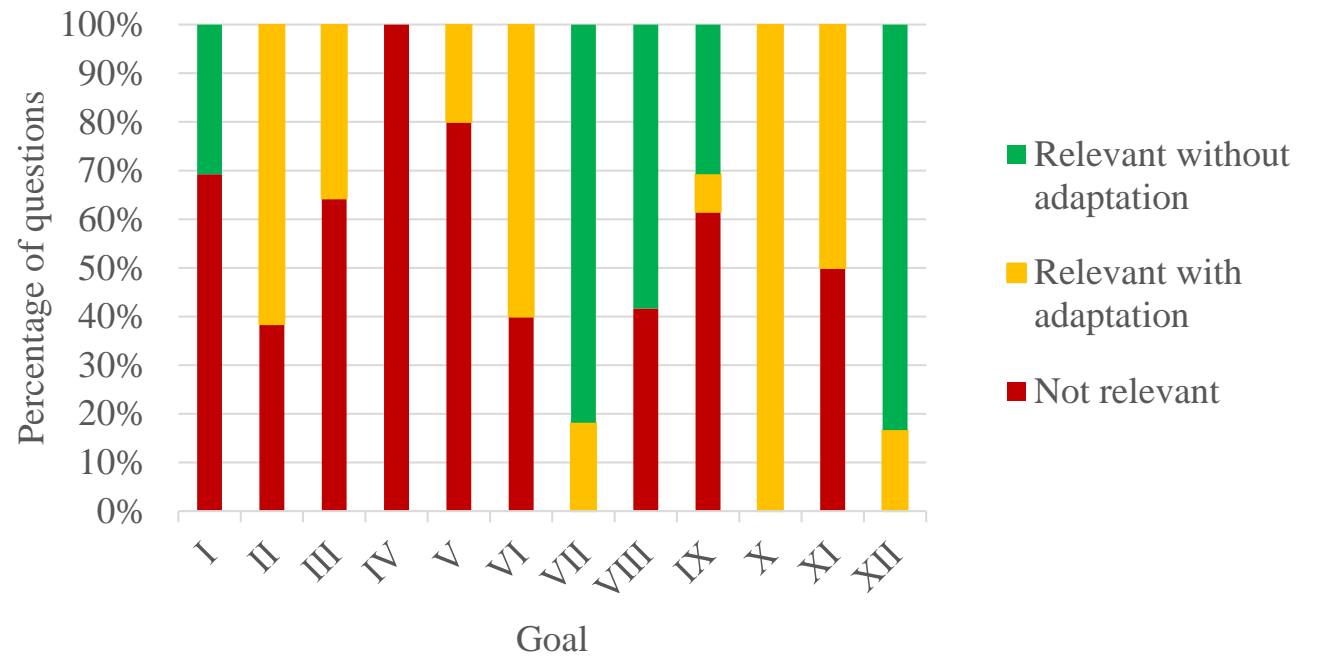
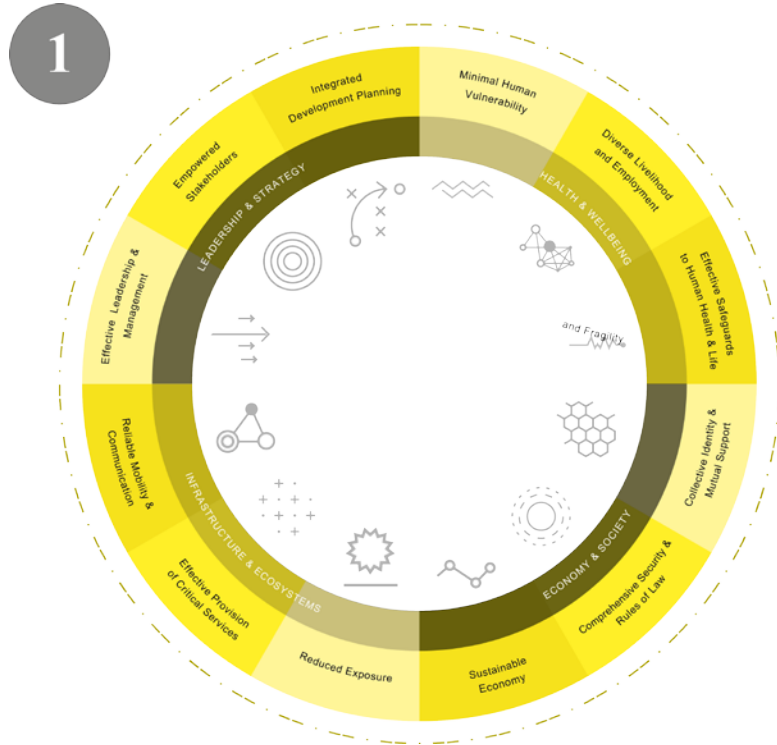
Hull  
City Council

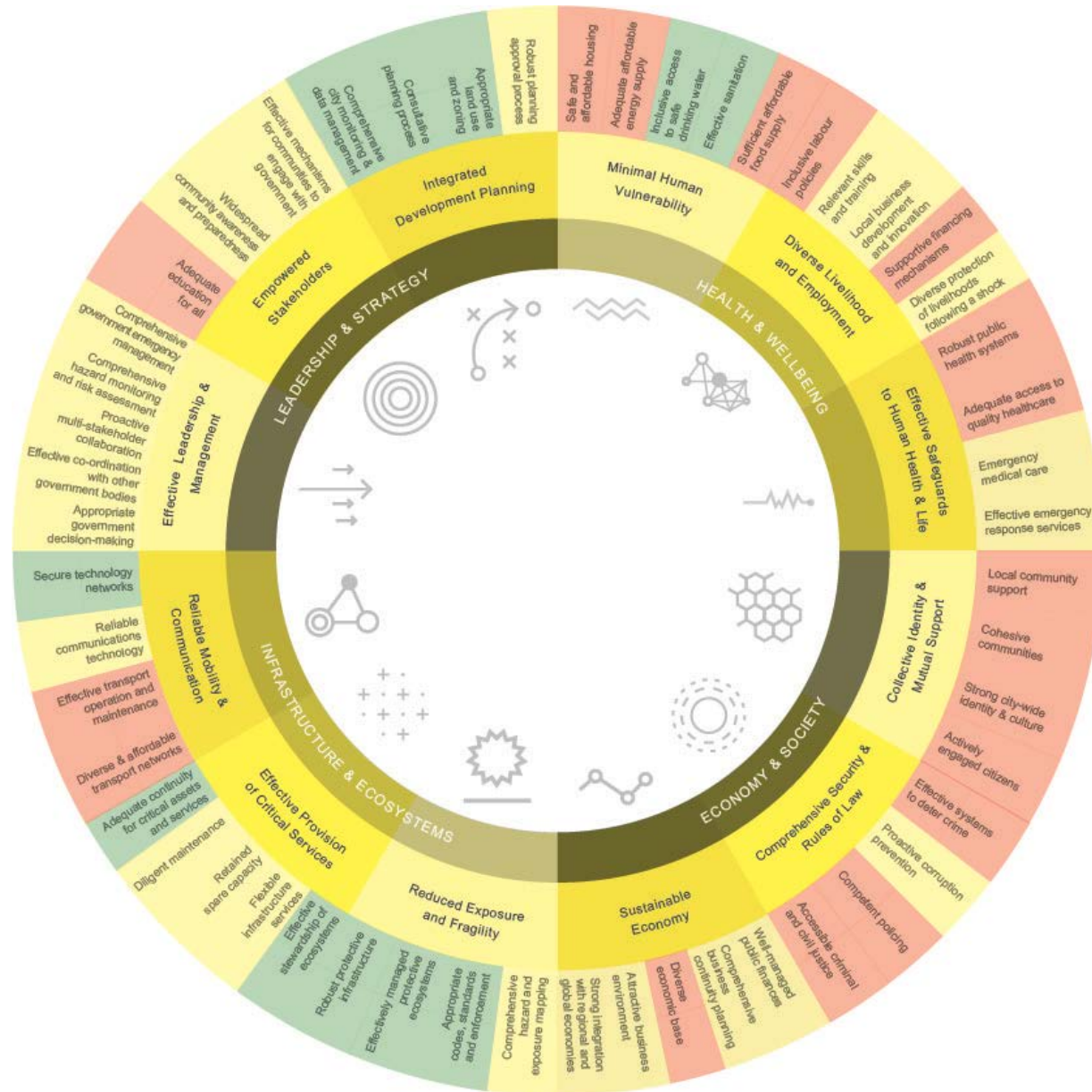




# City Resilience:

How does the urban water system contribute to the resilience of the city?





The definition of **urban resilience** provided by the City Resilience Index holds when applied to the question of **urban water resilience** – to a point.



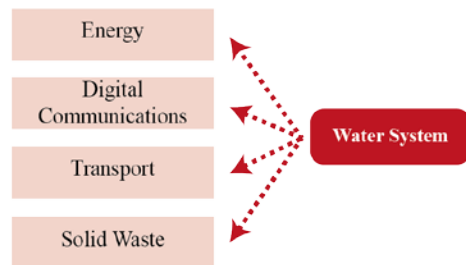
# A system of systems



**City Resilience:**  
a) How does the water system contribute to the resilience of the city?

## (Inter)dependency

- b) Upon what other critical infrastructure does the resilience of the water system depend?
- c) Are there additional factors central to human managed and/or urban water systems that are fundamental to resilience?



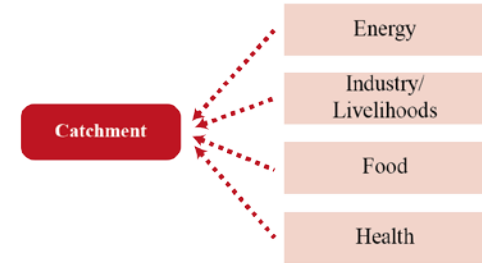
## 2 Catchment Resilience:

a) How does the catchment contribute to the resilience of the water system?



## (Inter)dependency

b) What other fundamental elements of city resilience are dependent upon the resilience of the catchment?



# City Water Resilience Framework

Our hypothesis –

- **Urban resilience** cannot be achieved and sustained **without urban water resilience**.
- **Urban water** resilience cannot be achieved and sustained without (Basin-scale) **freshwater** resilience.
- **Freshwater** resilience cannot be achieved and sustained without **urban water** resilience (esp. in Basins with major cities).
- Addressing **urban** and **Basin**-level freshwater resilience jointly/compatibly yields a **greater resilience dividend**.



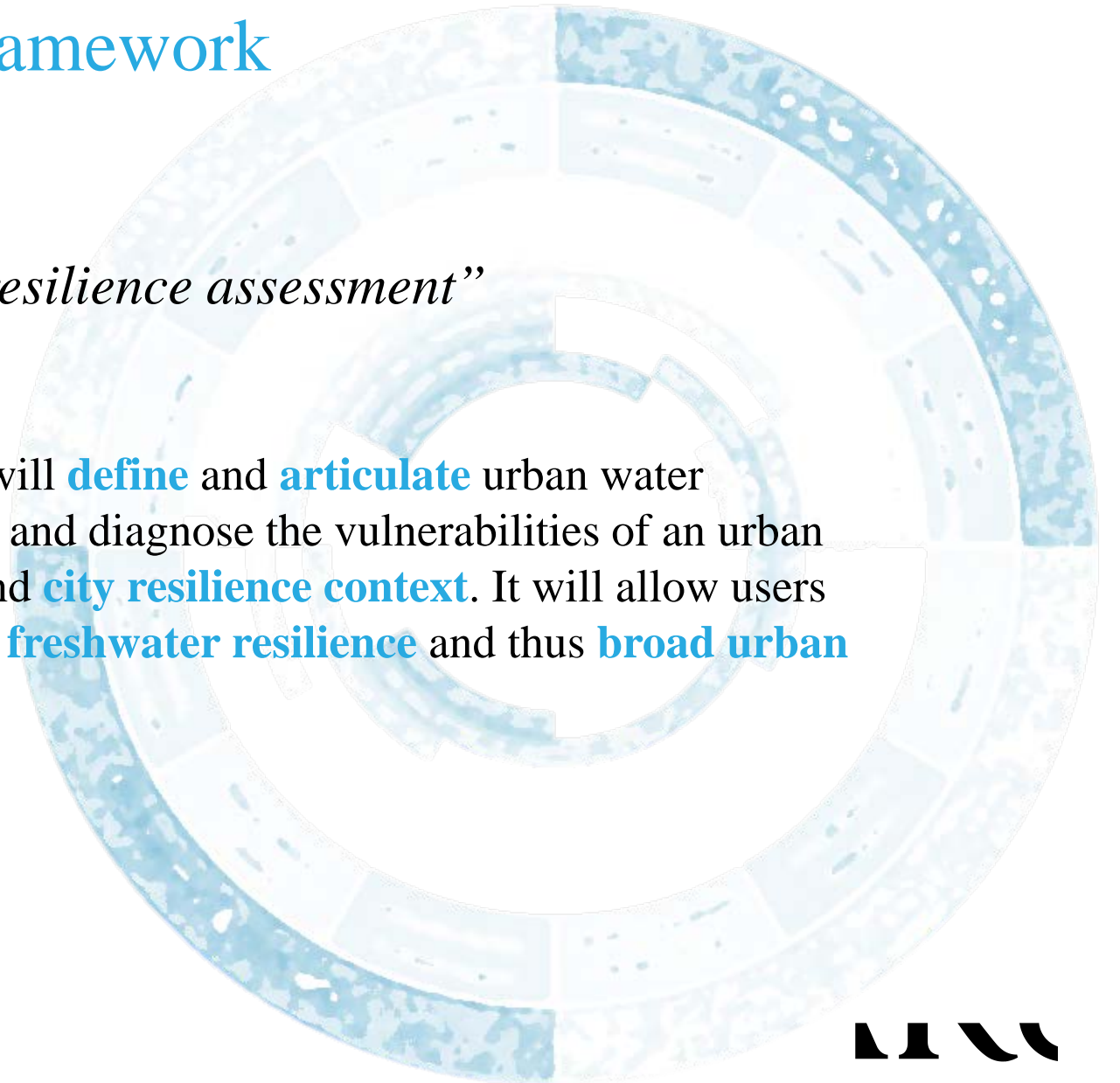
# City Water Resilience Framework

## **Vision:**

*“The **global standard** for water resilience assessment”*

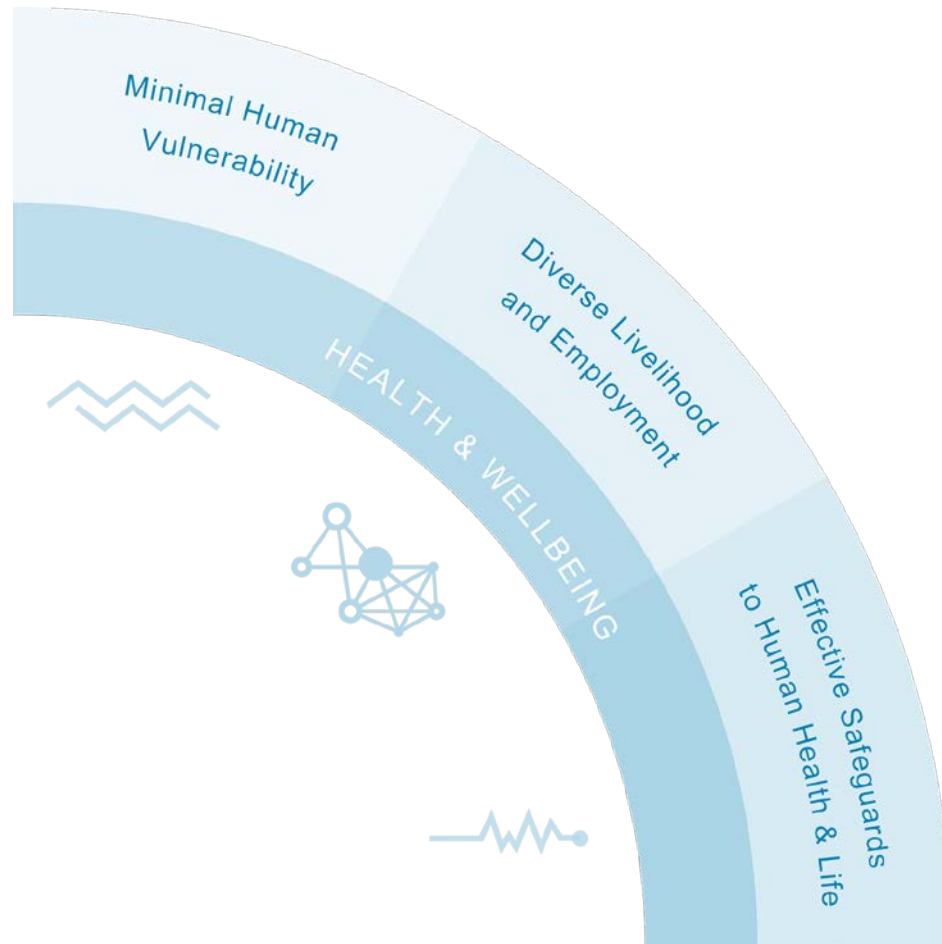
## **Value:**

The City Water Resilience Framework will **define** and **articulate** urban water resilience and allow users to understand and diagnose the vulnerabilities of an urban water system within an empirically sound **city resilience context**. It will allow users to systematically plan for **strengthened freshwater resilience** and thus **broad urban resilience**.



The goals redefined...

## Health & Wellbeing



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### 1 Minimal human vulnerability

- Access to water and sanitation
- Minimum standard of protection from flooding
- Social equity in access to WASH

### 2 Diverse livelihoods and employment

- Water accessibility for livelihoods (industry, agriculture etc.)
- Capacity of those employed in the water sector (skills and training)
- Diverse protection of livelihoods following a shock, i.e. adequate insurance cover.

### 3 Effective safeguards to human life and health

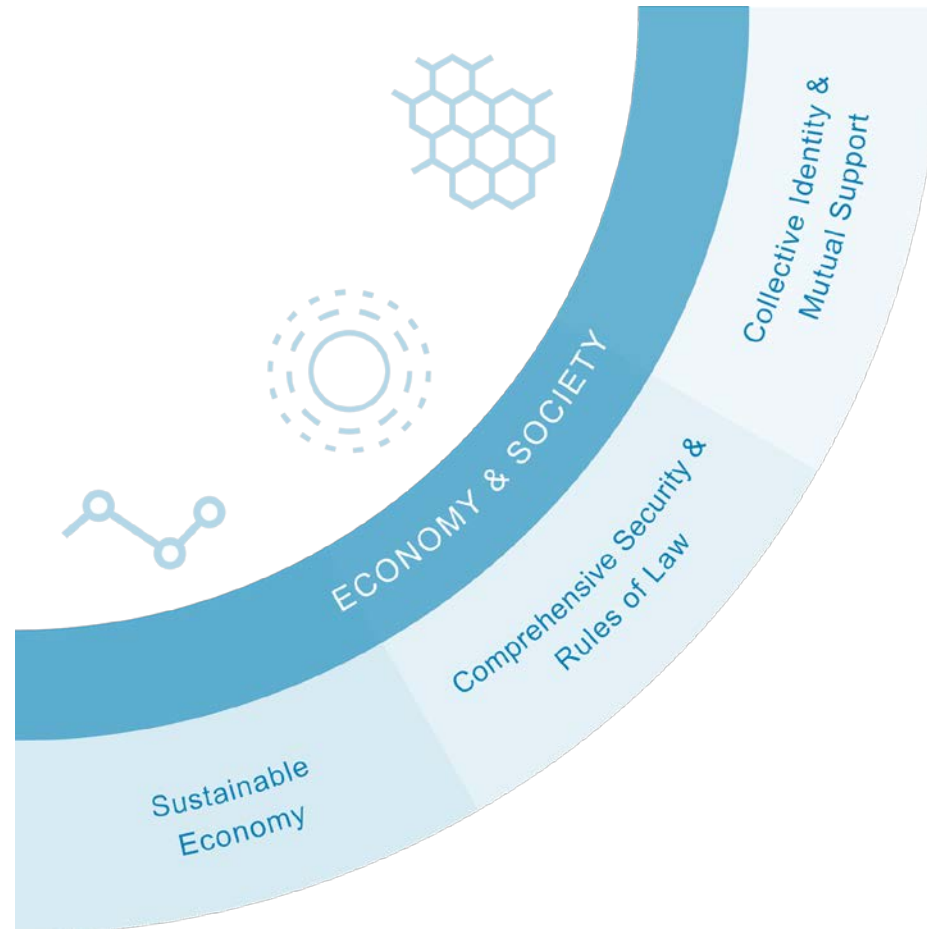
- Effective response to extreme events, i.e. floods and droughts
  - Robust public health systems – effective mitigation of water-related disease
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# The goals redefined...

## Economy & Society



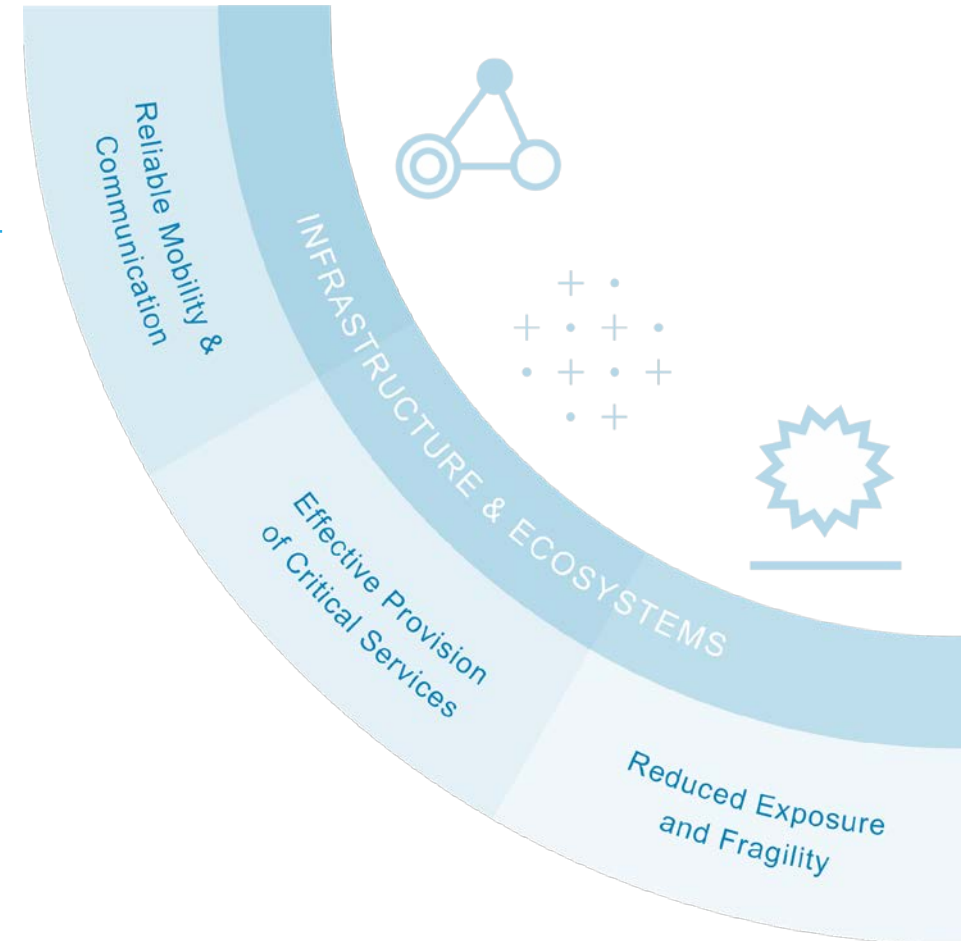
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- 4 **Collective identity and community support**
    - Consumer engagement by service providers
    - Water body associations
    - Water user committees
    - Access to water bodies
  - 5 **Comprehensive security and rule of law**
    - Management of non revenue water (illegal connections)
    - Enforcement of:
      - ✓ Water allocations and rights
      - ✓ Hygiene and sanitation laws
      - ✓ Planning laws in relation to development in flood risk areas
      - ✓ Environmental standards
      - ✓ Protected areas
    - Proactive corruption prevention
    - Effective management of trans-boundary/ conflict water agreements
  - 6 **Sustainable economy**
    - Adequate funding streams in place (pricing mechanism)
    - Access to finance (e.g. water utility Moody's rating)
    - Well managed public finances
    - Affordability of water for citizens
    - Natural capital accounting/ inclusion of ecosystem services in CBA
- 



The goals redefined...

## Infrastructure & Ecosystems

- 7 **Reduced exposure and fragility**
  - Comprehensive understanding of hazards, i.e. floods & droughts
  - Appropriate codes and standards
  - Infrastructure that appropriately works in concert with natural processes
  - Effectively managed ecosystems including:
    - ✓ Ecological health of water bodies
    - ✓ Maintenance of environmental flows
    - ✓ Understanding of the state of natural capital
  - Effective leakage management
  - Effective demand management
- 8 **Effective provision of critical services**
  - Adequate and sustainable water resources
  - Effective maintenance of water infrastructure (inc. flood risk)
  - Effective stewardship of ecosystems
  - Adequate head room in water and wastewater infrastructure
  - Adequate continuity for critical assets
- 9 **Reliable mobility and communications**
  - Reliable communications technology
  - Secure technology networks
  - Smart networks (water & wastewater)
  - Early warning systems in place
  - Access and continuity of water mobility



The goals redefined...

## Leadership & Strategy

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- 10 Effective leadership and management**
- Transparent and inclusive decision making
  - Integrated and autonomous government bodies
  - Effective co-ordination and communication across areas of responsibility
  - Long term strategic planning of water infrastructure
  - Long term strategic planning for the natural environment
  - Effective outcomes based regulatory regime
  - Comprehensive emergency management in event of floods or drought
  - Adaptive flood risk management
  - Comprehensive stakeholder engagement and collaboration
- 11 Empowered stakeholders**
- Widespread community awareness and preparedness
  - Effective and proactive consultation processes
  - Widespread citizen awareness of water challenges
- 12 Integrated development planning**
- Comprehensive monitoring and data management
  - Integrated water, wastewater, flood risk and environmental management plans
  - Aligned planning policy that takes water into account early on
  - Appropriate land use, zoning and spatial planning
- 



# So what?

Now that water system vulnerabilities are understood, what can be done about it?

Now?

In the next 10 years?

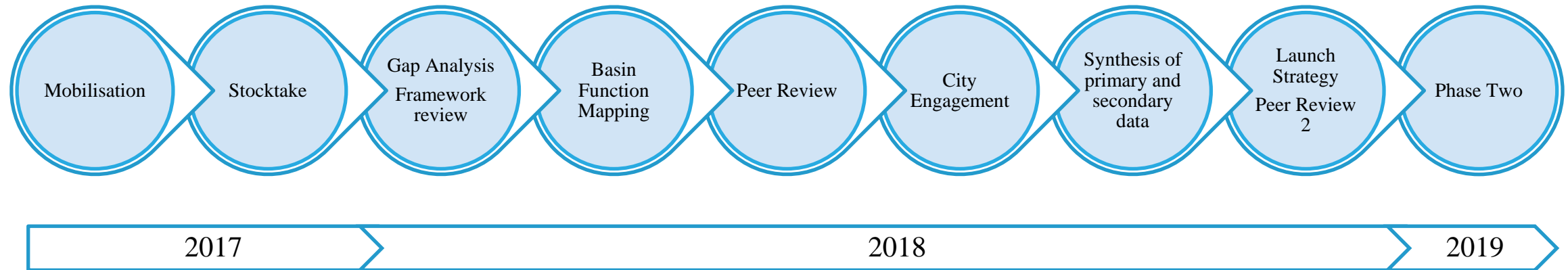
In the next 30 years?

Is there something that is not vulnerable now but may become so in the future?



2050

# Project plan



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