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PS 4.1 Nature Based Solutions

Stormwater management and blue-green infrastructure for improved urban forests.

Climate Change Adaptation in Cities - experience from Denmark and Poland

Lars Briggs [1, 2], Iwona Wagner [2, 3], Marzenna Rasmussen [1]

(1) Amphi Consult, Odense, Denmark (2) FPP Enviro, Warsaw, Poland (3) University of Lodz, Poland,

Amphi Consult

FPP ENVIRO

FACULTY OF BIOLOGY AND ENVIRONMENTAL PROTECTION
University of Lodz

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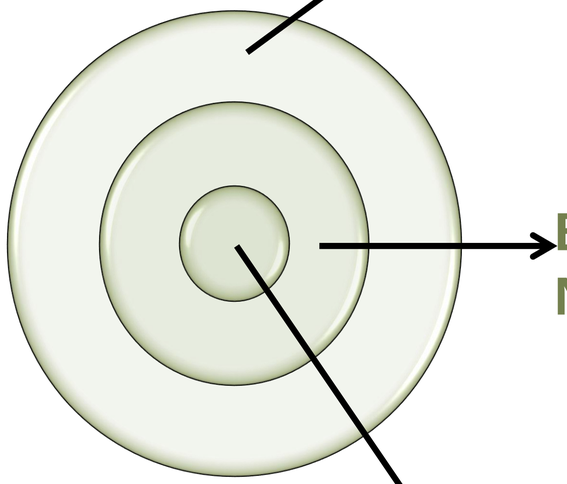
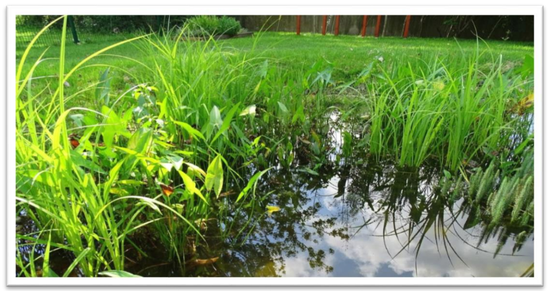
Urban forests along urban gradients



URBAN/NATURAL FORESTS

BLUE-GREEN NETWORKS

SINGLE BGI



How to use
Nature Based Solutions
to suport **urban forests**
in the **urbanisation gradient**
to **adapt to climate change**
and secure
Ecosystem Services?

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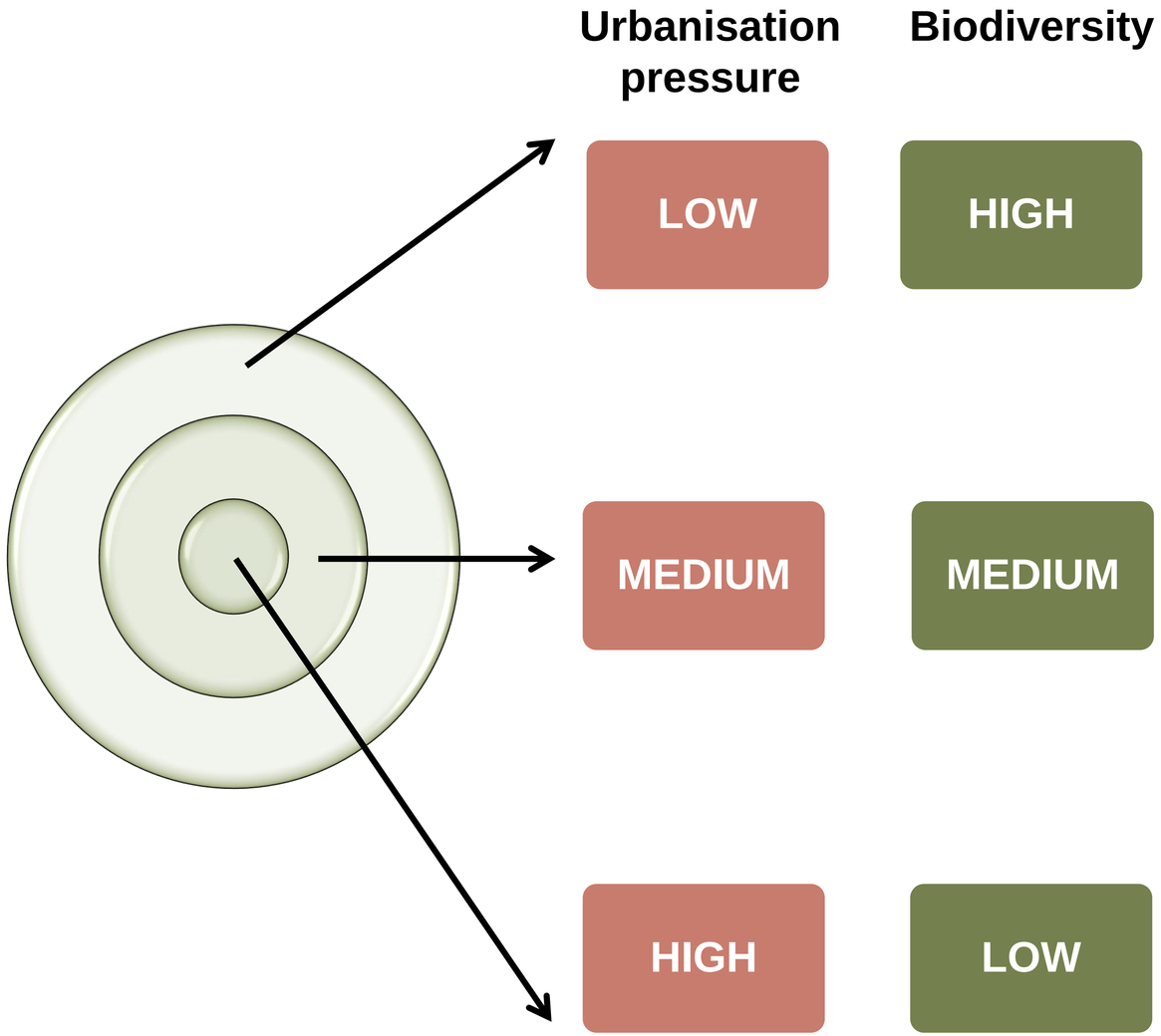
Biodiversity along urban gradient



PRESSURES

- water shortage
- higher temperature
- pollution
- habitat loss, fragmentation, disconnection
- invasive species

BIODIVERSITY EFFECTS

- species extinction
- low genetic and taxonomic diversity
- higher vulnerability of ecosystems to stress

Decreased delivery of Ecosystem Servies

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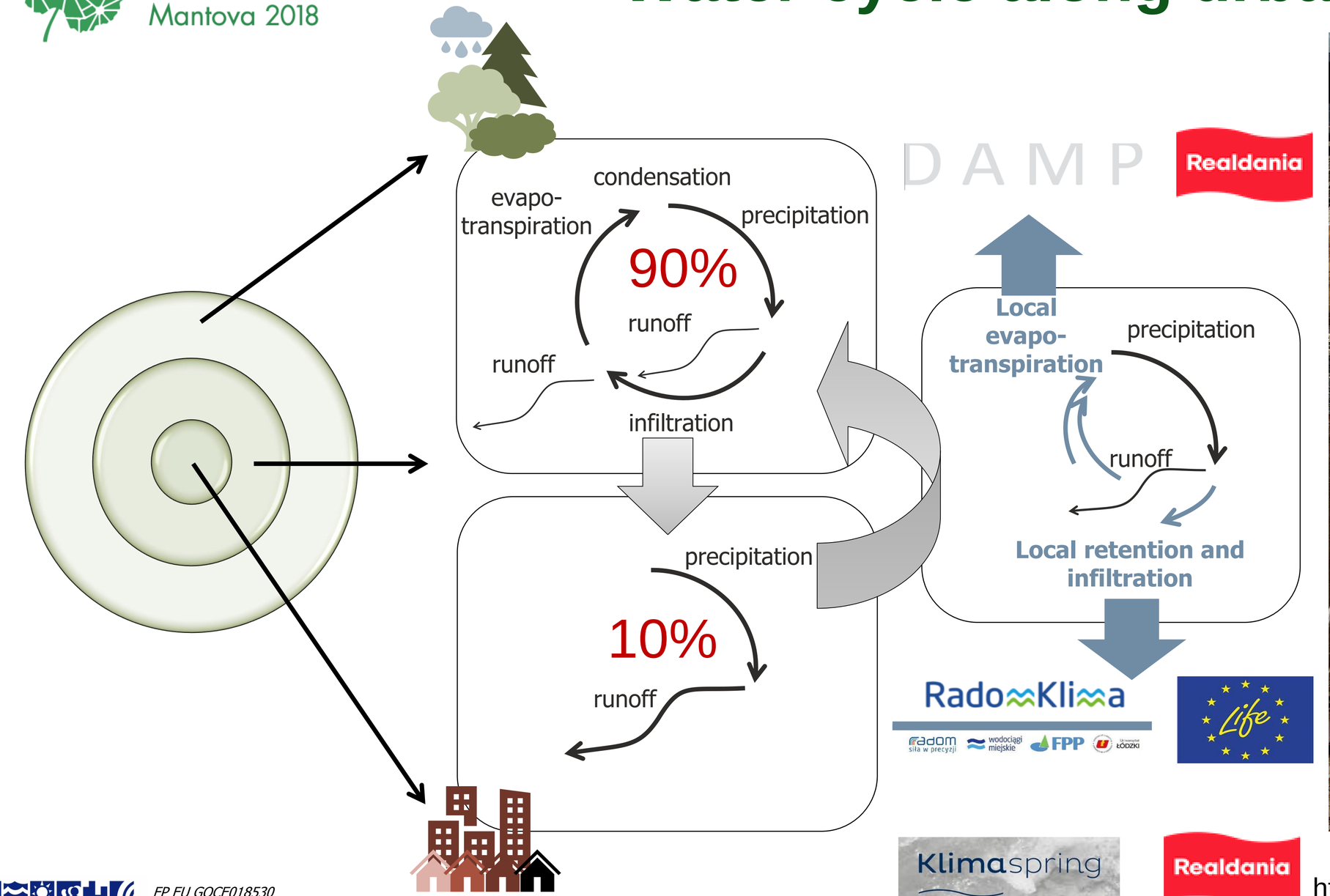
Water cycle along urban gradient



Realdania

RadoKlima

Life

Klimaspring

Realdania

https://web.facebook.com - Zielony żoliborz

SWITCH
FP EU GOCE018530
Grant prezydenta MŁ
(Ed.VII.4346/G-19/2009 z 12.08.2009

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Experiences from Poland

Green Bus Stop in Radom, Poland

Clima Pond in Radom, Poland

River valleys rehabilitation in Radom, Poland

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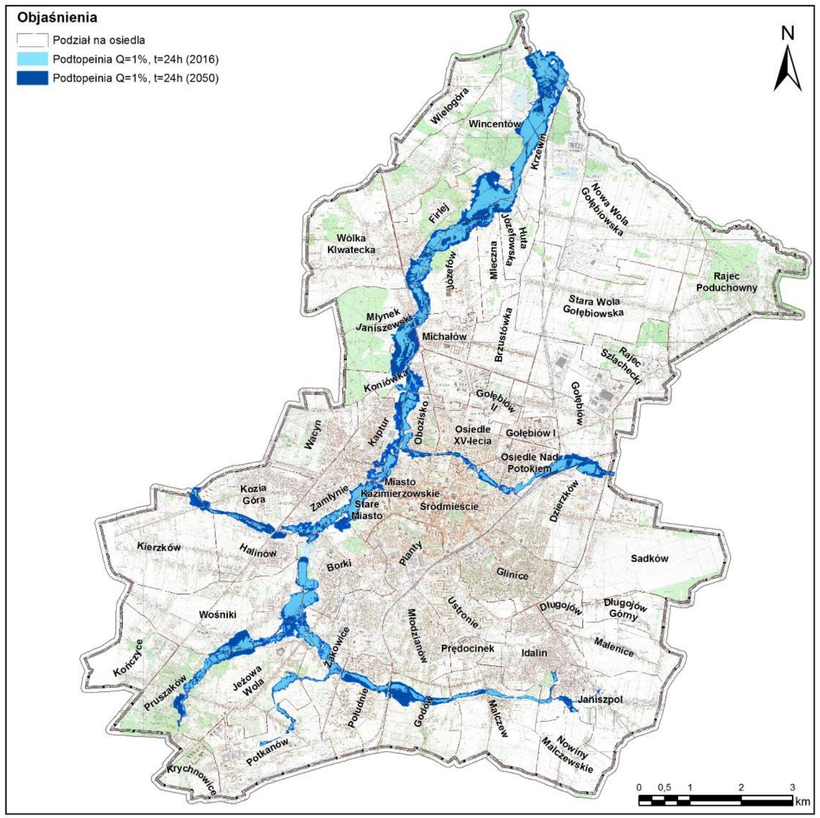
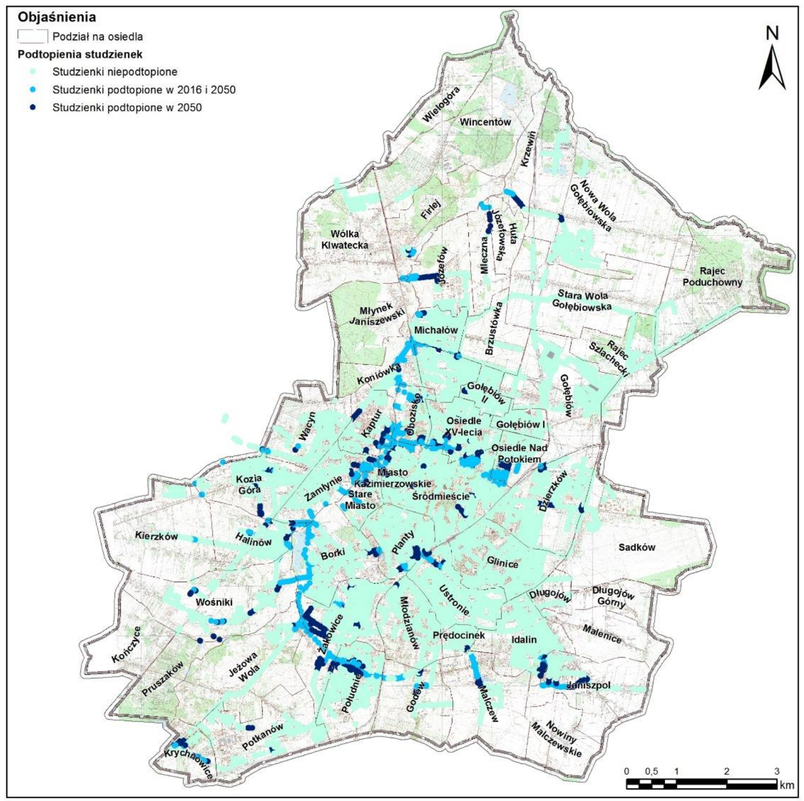
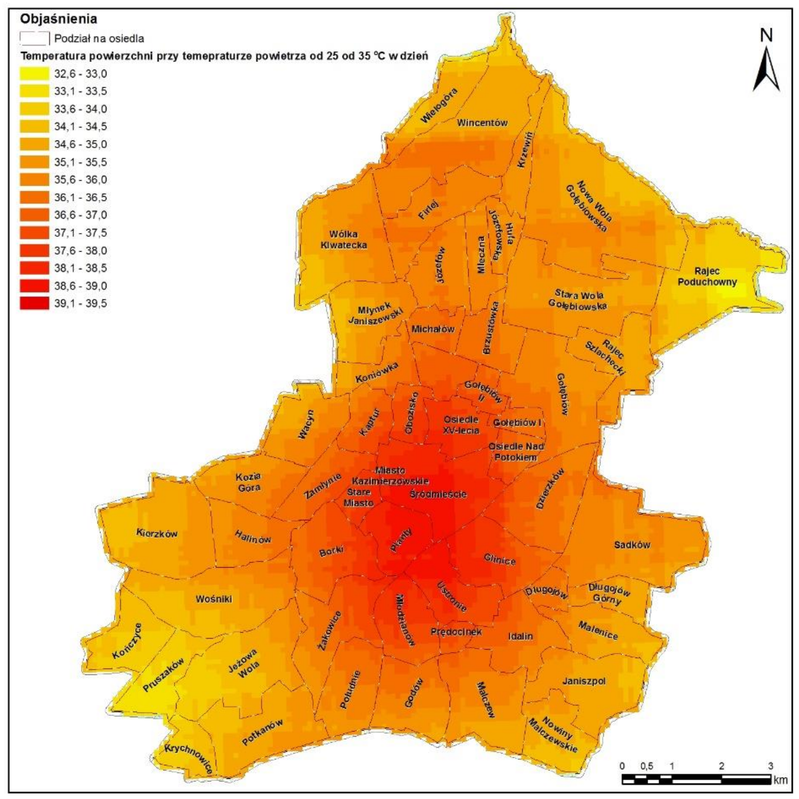
RadoKlima

Adaptation to climate change through sustainable management of water of the urban area in Radom City (LIFERADOMKLIMA-PL)







European Commission
National Fund for Environmental Protection and Water Management in Warsaw

www.life.radom.pl

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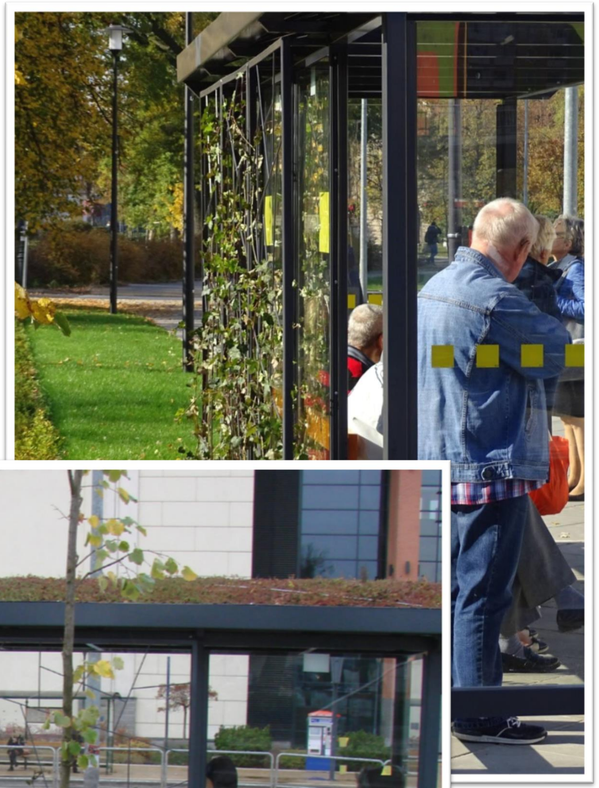
Green Bus stop, Radom, Poland

GREEN ROOF & WALL

- **Surface of green area**
  - 20 m^2 and more
- **Stormwater retention** with runoff coefficient of 0,5:
  - Up to 186,4 dm^3 (17 l/m^2)

GREEN AREAS & TREES WATERING

- **Stormwater retention**
  - c.a. 80 - 250 dm^3
- Stormwater used for **watering trees**
- Stormwater used for **watering city green areas**



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Green Bus stop, Radom, Poland

VARIOUS TECHNOLOGIES FOR UNDERGROUND STORMWATER STORAGE

- innovative design according to the guidelines for adapting cities to climate change
- **watering trees in sealed areas**
- mitigating UHI – even by 7C deg.
- better microclimate and air quality
- increased biodiversity of plants and insects
- more friendly to birds (avoiding collision with glass)
- aesthetics

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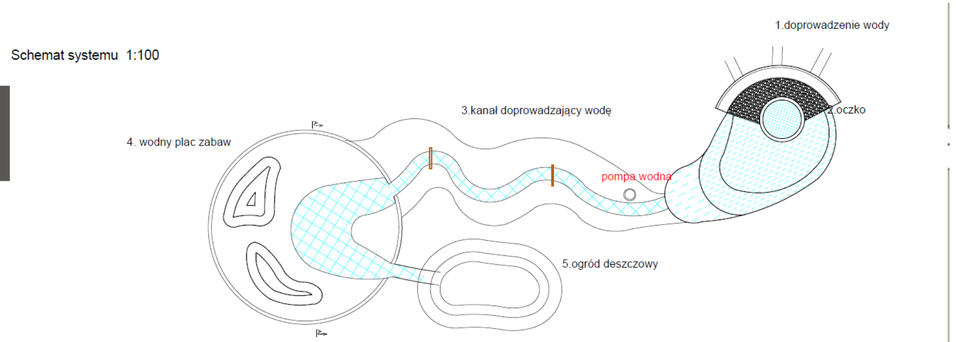
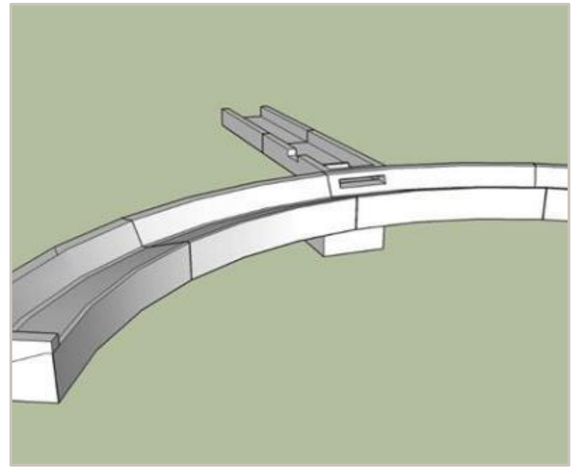
Clima Pond in Radom, Poland

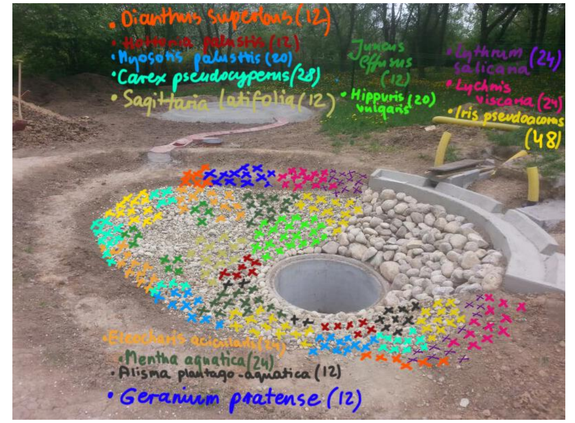
STORMWATER &

- Innovative patented technology (P.419910 z dn. 20/12/2016)
- Hydraulics controll for water retention and biodiversity
- On-site stormwater retention from 225 m^2 of roof and 121 m^2 of pavement, including:

--- drainage from the roof
--- climapond
--- water playground
--- raingarden
--- emergency outflow to the sewage system







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Clima Pond in Radom, Poland

BIODIVERSITY

After 2,5 months:

- Successful establishment of the planted vegetation (only native local species)
- First pioneer species have arrived –mobile insects: dragonflies, Hemiptera and flies;
- Other animal groups observed: mollusks, several species of birds

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Clima Pond in Radom, Poland

PEOPLE

- First Climatic Pre-school in Poland
- Pre-School curriculum on stormwater and climate change
- Demonstration project for decisionmakers
- University students involved in research

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RadomKlima

radom siła w precyzji · wodociągi miejskie · FPP · Uniwersytet Łódzki

Potok Północny, Radom, Poland

Objectives

1. Mitigation of extreme discharges into the city
2. Water purification

Expected results

1. Diverse habitats and biodiversity area of 1,7ha
2. Natural succession towards trees and bushes
3. Recreation place for the neighboring housing quarter

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RadomKlima

radom siła w precyzji · wodociągi miejskie · FPP · Uniwersytet Łódzki

Mleczna river, Radom, Poland

Objectives

1. Friendly space with trees in the city
2. Increasing riverbank/valley water retention and minimizing flooding risk
3. Water purification

Expected results

1. 800 m of restored river with patches of trees in ecotones and floodplain
2. improved ecological corridor into the outskirts of the city
3. Increased biodiversity for amphibians, birds, invertebrates, fish

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Experiences from Poland

Green Bus Stop in Radom, Poland

Clima Pond in Radom, Poland

River valleys rehabilitation in Radom, Poland

Experiences from Denmark

Clima Pond in Aarhus, Denmark

Clima Pond in Middelfart, Denmark

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Clima Pond: design, Aarhus, Denmark

Klimaspring

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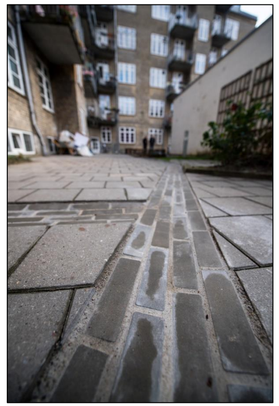
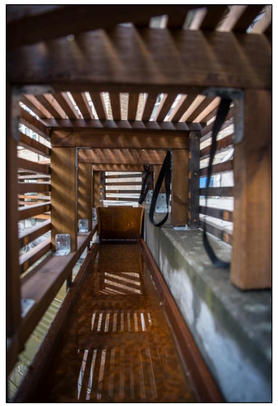
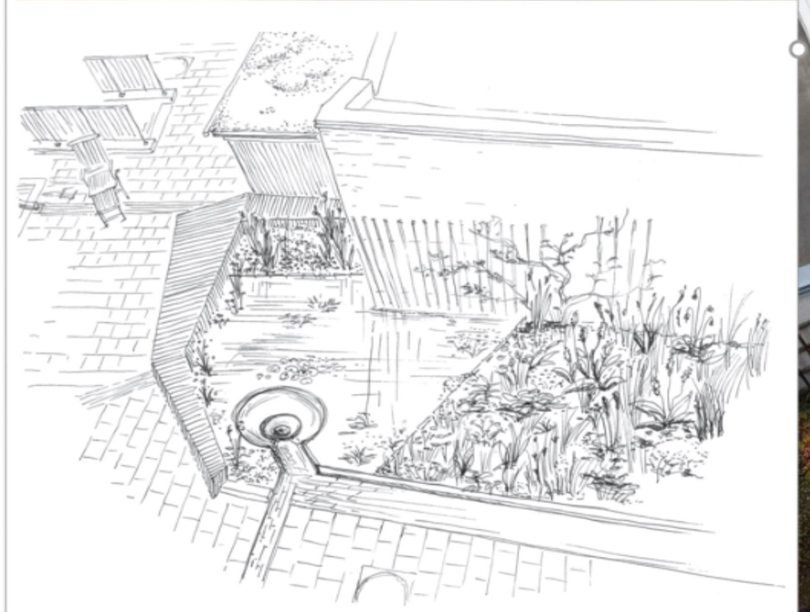
BIO WATER

- Located in dense urban area
- On-site stormwater retention from 340 m^2 of roof
- Habitat for native plants and animals
- Can be used for watering trees
- Cooling effect and flood prevention







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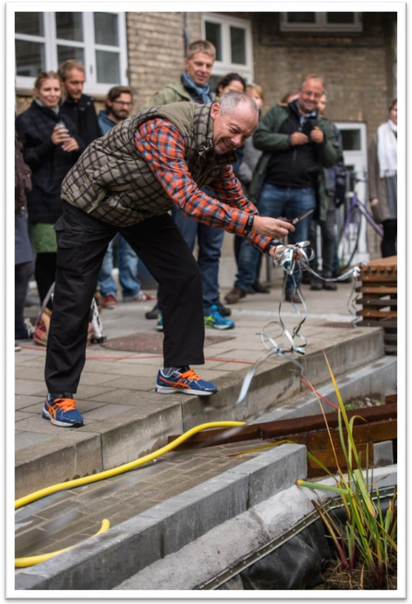
Clima Pond: 3 functions, Aarhus, Denmark

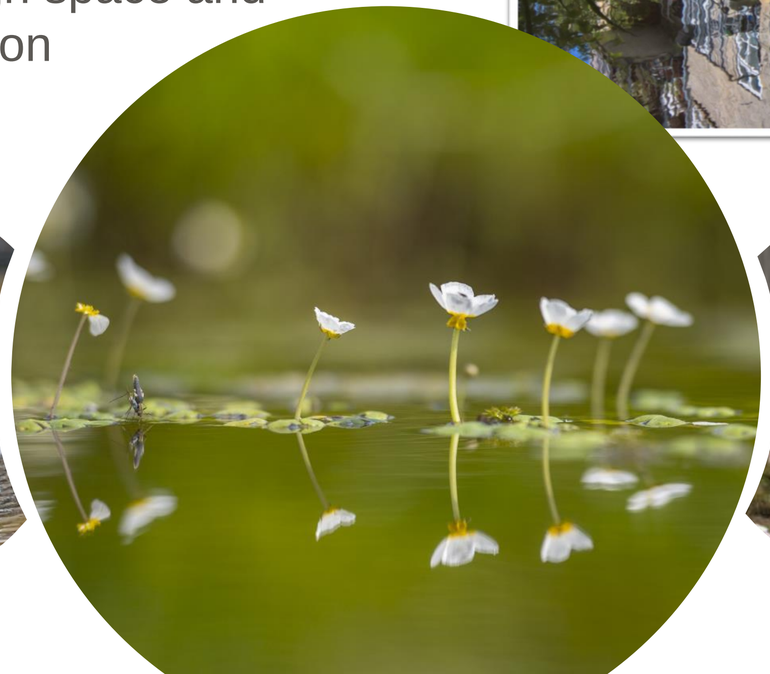
Klimaspring

Realdania

BIO WATER

- Stormwater retention for flood and drougth mitigation - Adaptation to climate change
- Biodiversity spot
- Friendly design space and social integration





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Clima Pond at the biological house in Middelfart, Denmark

BIO WATER

BIOLOGICAL HOUSE

HOUSE:

- Made of recycled materials or materials than can be recycled
- Certified wood from sustainable forestry only

STORMWATER:

- Collects, infiltrates and evaporates roof stormwater locally
- Creates biodiversity pond for native local species

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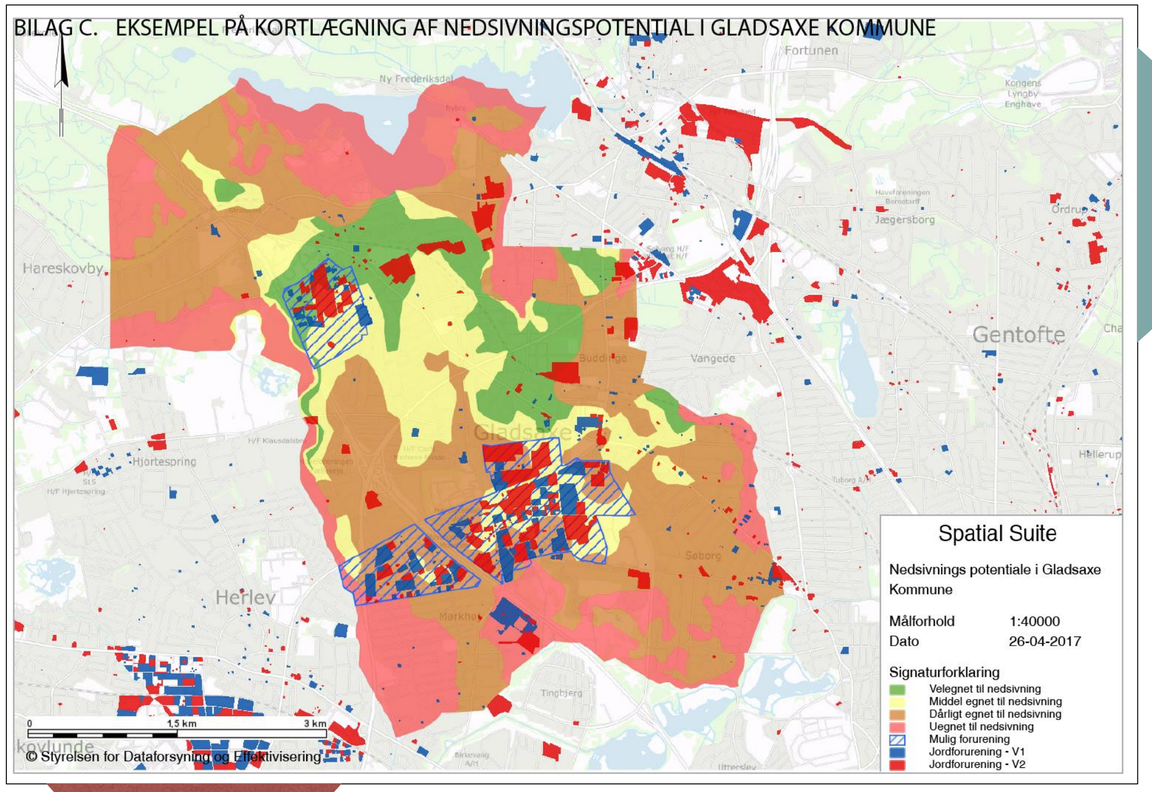
DAMP Project Denmark

Implementing NBS by facilitating evaporation and reusing stormwater for different purposes

Project duration
2017-2021

Key benefitiary
Gladsaxe Municipality



SOLUTION

Stormwater evaporation and transpiration instead of retention and infiltration

CHALLENGES

Infiltration in most areas is not allowed to avoid soil pollution transfer to groundwater (infiltration allowed only in green areas on the map)

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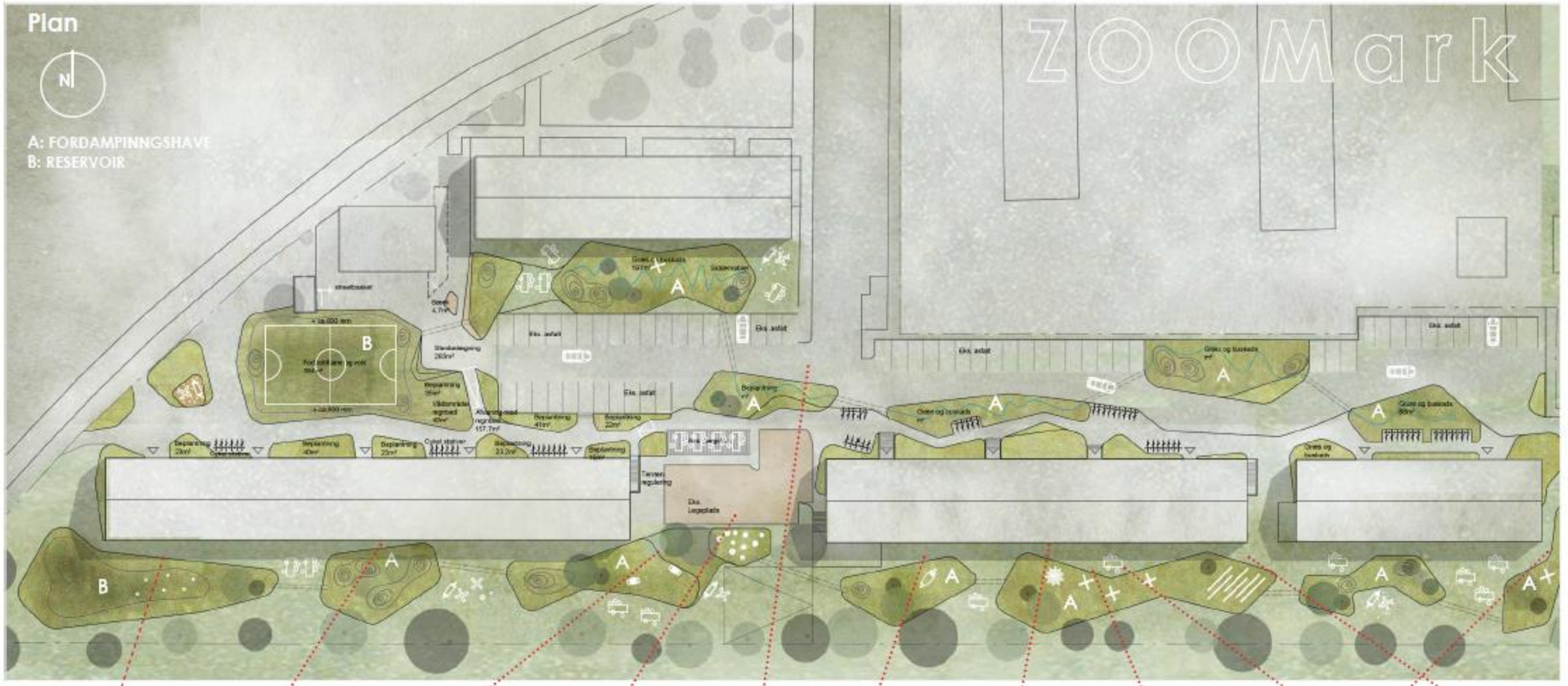
ZOOM arkitekter

Holding rainwater solely by evaporation

DAMP Project Denmark

Evaporating stormwater while providing other services:

- Urban forest for recreation and play
- Enhancing biodiversity
- Urban agriculture
- Peoples participation
- Innovation




LEG MED VAND


NATURLIG BLOMSTER BÆRHAVER


GRILL PLADS


LABYRINT AFLODRET E TOMATPLANTER


VAND I BEVÆGELSE PAPIRBÅDE KAPSEJLADS


HÆNGEKØJER


HYTTE AF KLATRE-PLANTER


LODRET HAVE

FÆLLES URTER


JORDBÆR FELTER

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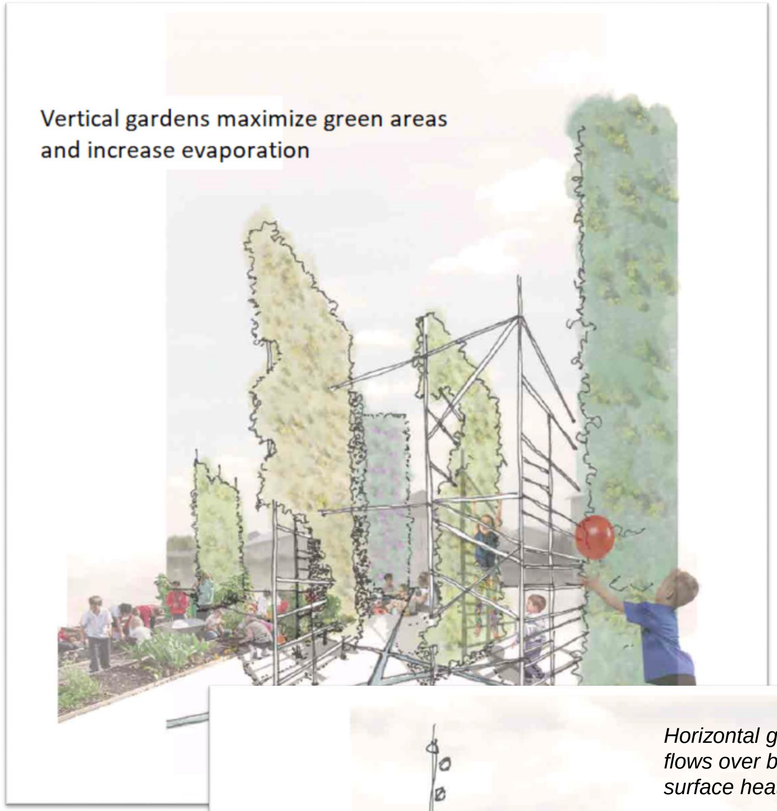
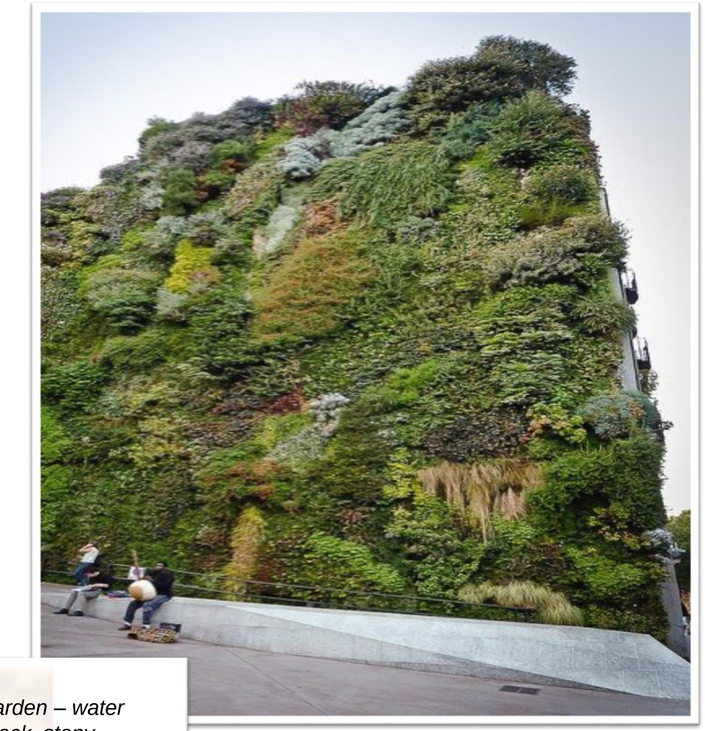
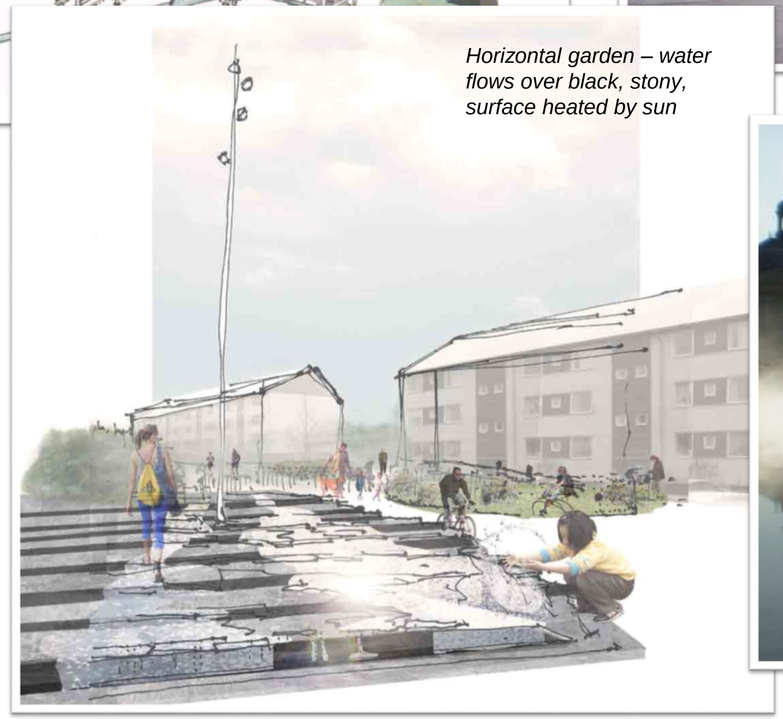
DAMP Project Denmark

STORMWATER EVAPORATION

- Tree and plant species selected for optimal transpiration
- Kinetic processes for enhancing evaporation







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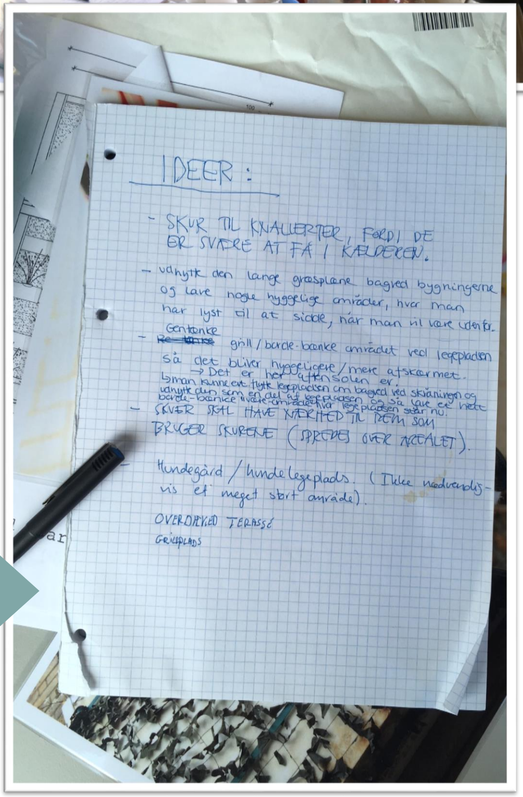
DAMP Project Denmark

PARTICIPATORY & INCLUSIVE PROCESS



Workshop September 2018

Evaporation house – demonstration for the inhabitants

“How does it work?”

Key phase in the project:

Meeting with the inhabitants and incorporateing their ideas into the concept

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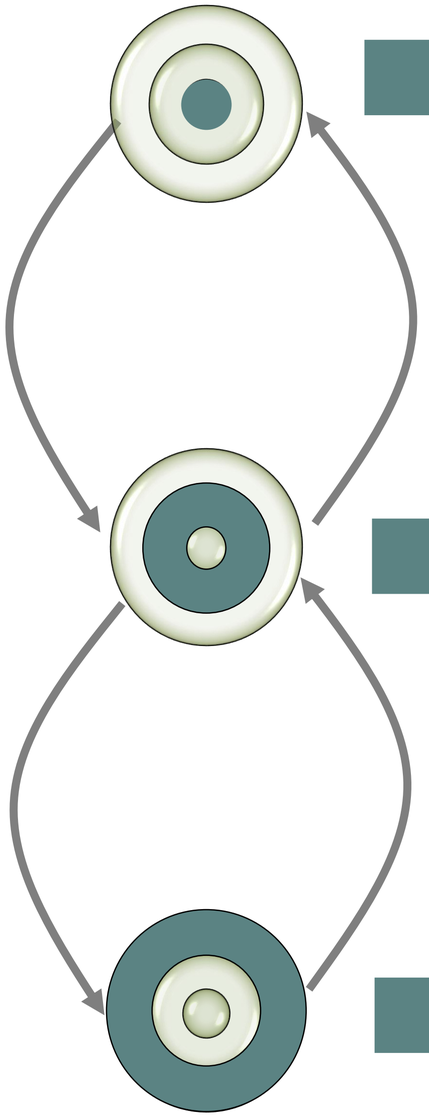
Key actions for Ecosystem Services

and adaptation to climate change



SMALL SCALE INTERVENTIONS
Foundation of novel ecosystems, UGI, NBS, stormwater BMPs

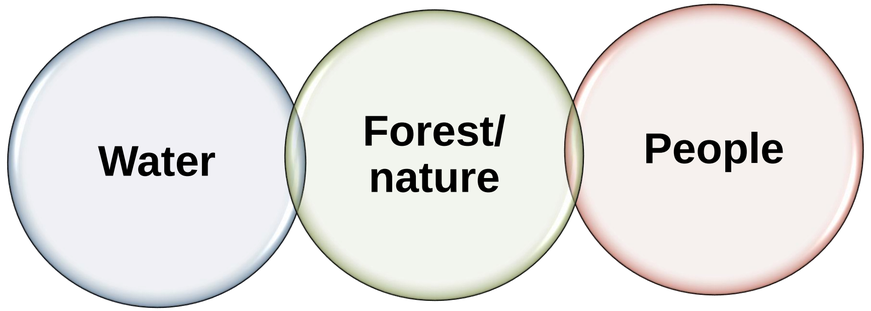
MEDIUM SCALE INTERVENTIONS
Functional support to ecosystem processes

LARGE SCALE INTERVENTIONS
Ecosystem preservation

WATER CYCLE REGENERATION
Increasing water **retention, evaporation, infiltration**
Provides water for trees
Reducing **runoff** and **hydrological stress** to rivers

BIODIVERSITY REHABILITATION
Increasing **habitats connectivity**, and **diversity**

CREATING FRIENDLY SPACE FOR PEOPLE
Reducing **temperature**
Regulating **microclimate**
Improving **air quality**



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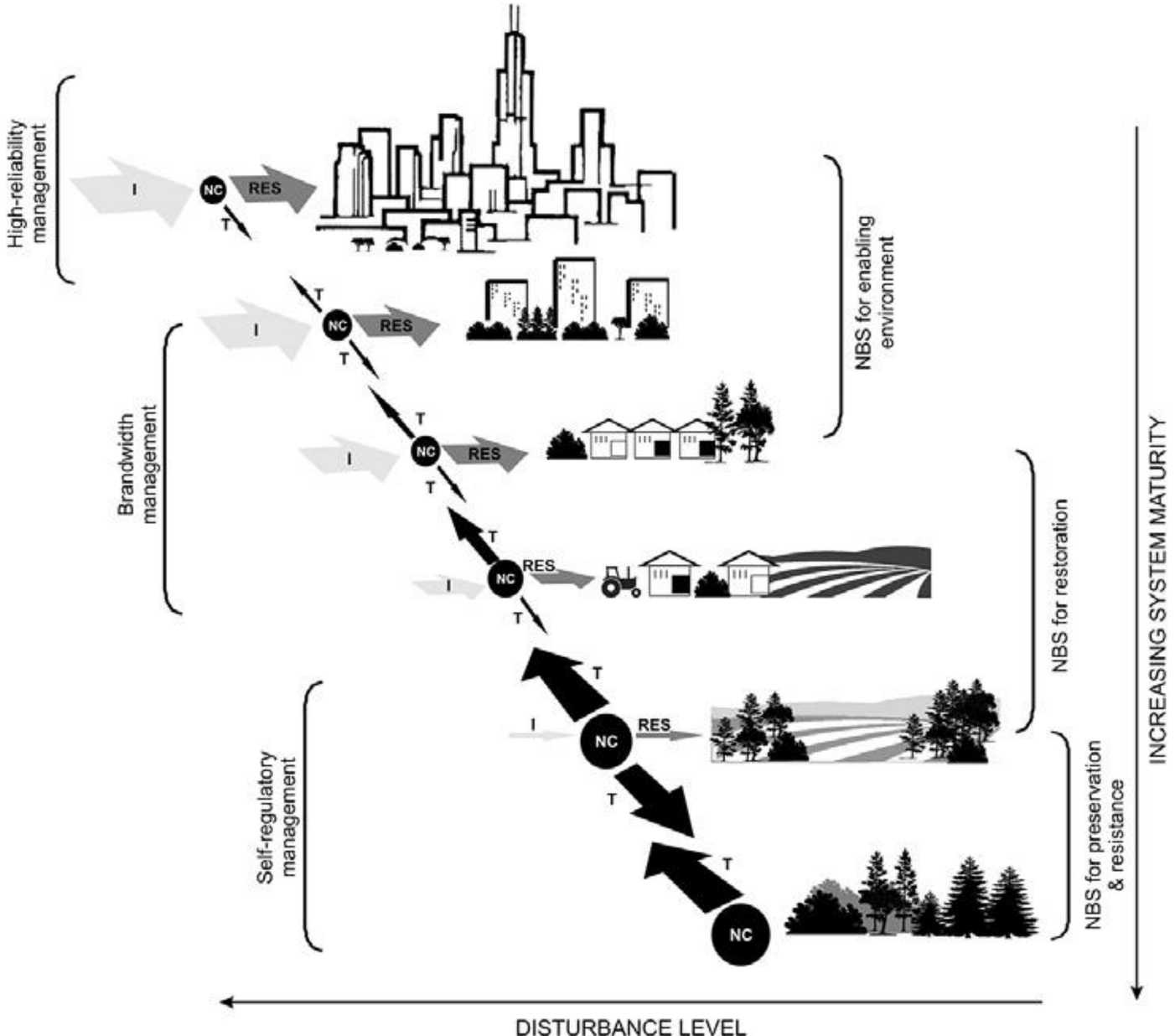
Ecosystem Services in the urban gradient



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journal homepage: www.elsevier.com/locate/scitotenv

From classical water-ecosystem theories to nature-based solutions – Contextualizing nature-based solutions for sustainable city

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Krauze & Wagner, 2018 STOTEN, 2019

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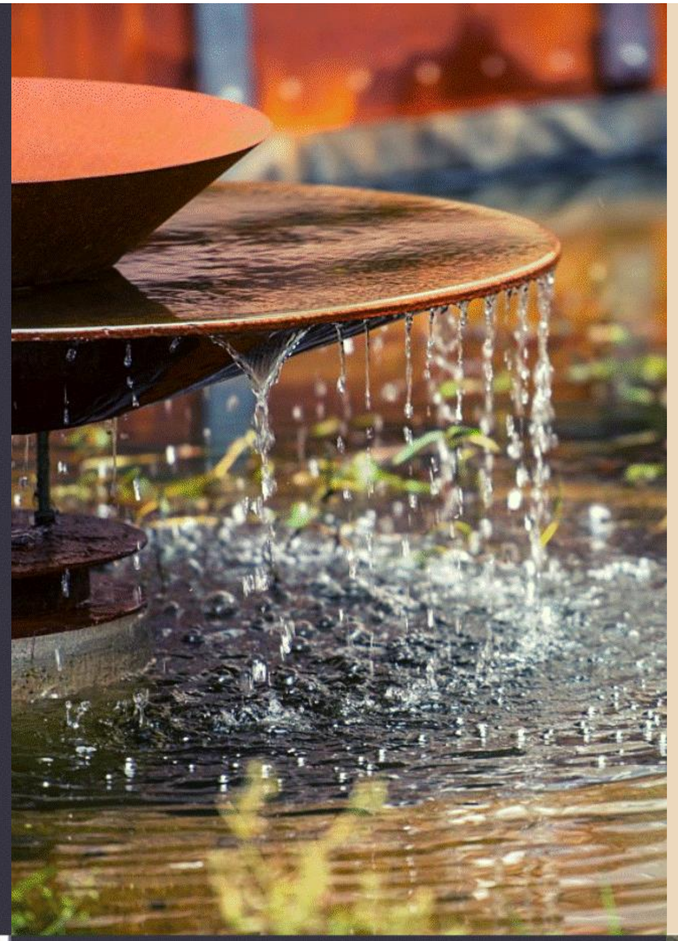
WE MAKE CITIES COOLER

Stormwater products for adaptation to climate change



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Space for water

Space for nature

Space for people