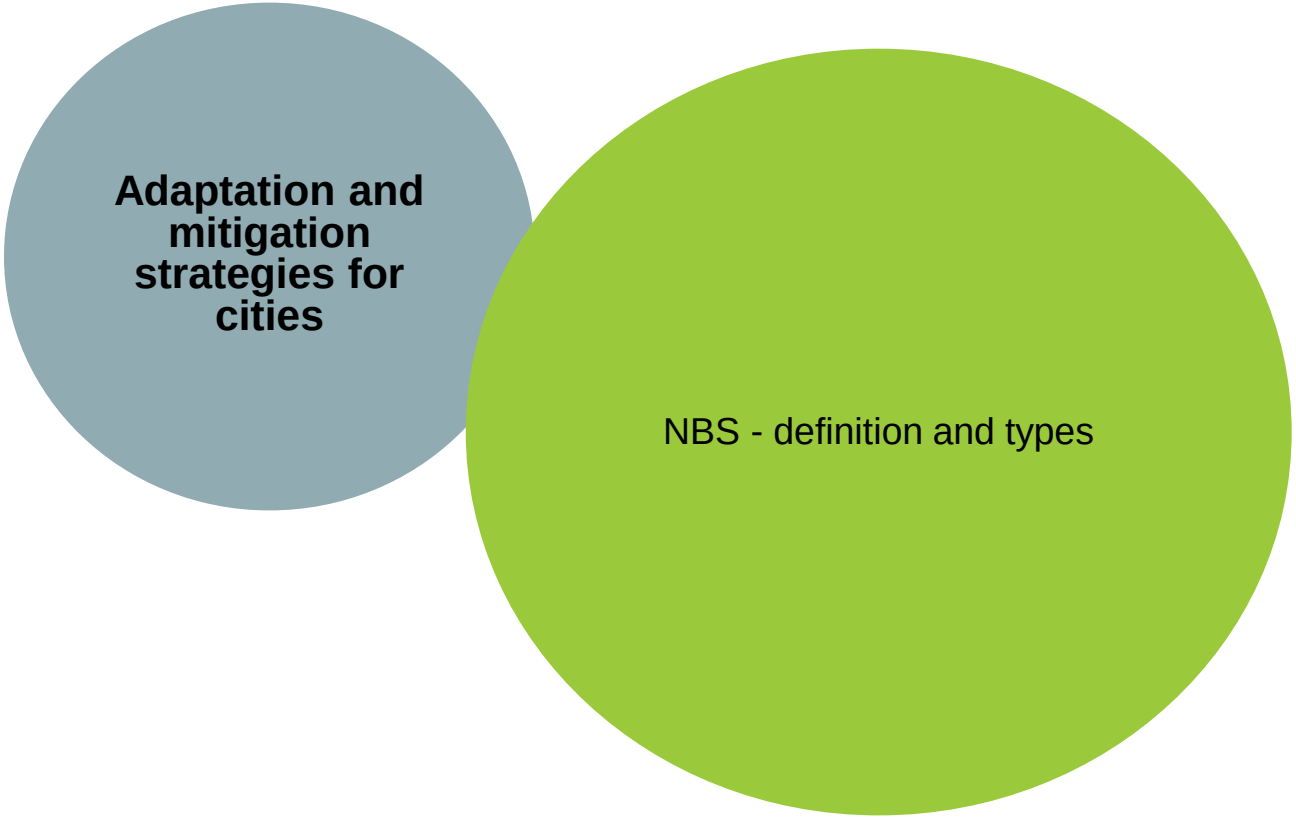
Adaptation and mitigation strategies for cities

CONE – 1st Workshop - Training of trainers

ONLINE | 3 of March 2025

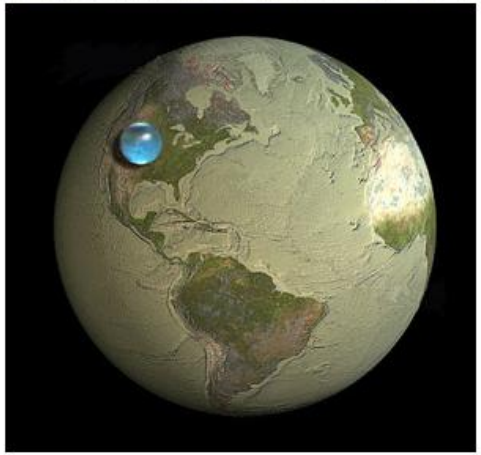
Presenter: Magdalena Gajewska


Adaptation and mitigation strategies for cities
NBS - definition and types

Water resources

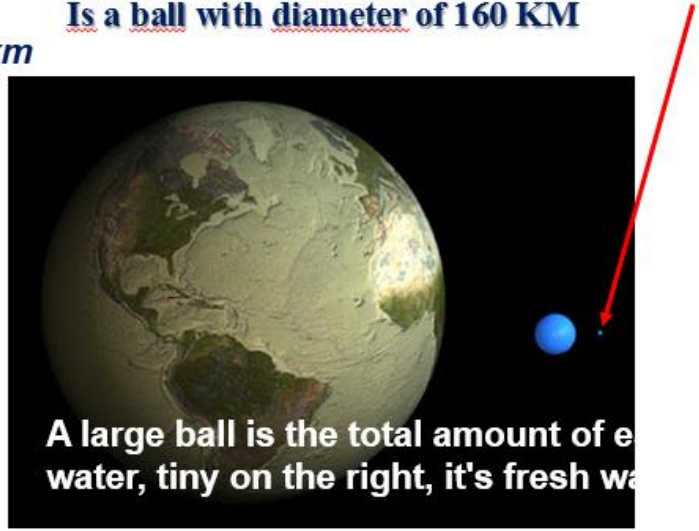
TOTAL WATER RESOURCES

A ball that can hold all the water on Earth it has a diameter of 1385 km



SWEET WATER RESOURCES

Is a ball with diameter of 160 KM



rys. Jack Cook, Woods Hole Oceanographic Institute

DEFINITIOS

- **Nature-based Solutions address societal challenges through actions to protect, sustainably manage, and restore natural and modified ecosystems, benefiting people and nature simultaneously.**

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DEFINITIOS

The EU Commission defines nature-based solutions as

“Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes, and seascapes, **through locally adapted, resource-efficient and systemic interventions.”**

European Commission. (2015). Towards an EU Research and Innovation policy agenda for Nature-Based Solutions & Re-Naturing Cities. https://doi.org/10.2777/765301

Key Features of NBS:

1. **Inspired and powered by nature**
2. **Addresses social challenges**
3. **Provides multiple services and benefits**
   - **Biodiversity gain**
   - **High effectiveness**
   - **Economic efficiency**

Sowińska-Świerkosz, B., & García, J. (2022). What are Nature-based solutions (NBS)? Setting core ideas for concept clarification. Nature-Based Solutions, 2, 100009. https://doi.org/10.1016/J.NBSJ.2022.100009

NBS vs. BGI

Feature	Nature-Based Solutions (NBS)	Blue-Green Infrastructure (BGI)
Ecosystem as a foundation	Yes	Not necessarily
Biodiversity impact	Positive	Can be neutral or negative
Effectiveness & Efficiency	High	Varies
Social & Environmental Benefits	Comprehensive	Limited
Integration in CWE	Essential	Used as components

Sowińska-Świerkosz, B., & García, J. (2022). What are Nature-based solutions (NBS)? Setting core ideas for concept clarification. Nature-Based Solutions, 2, 100009. https://doi.org/10.1016/J.NBSJ.2022.100009

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Key insight

1. **NBS always integrates ecosystem principles, ensuring biodiversity gain.**
2. **BGI elements may exist within NBS but do not inherently follow ecosystem-based principles.**
3. **In Circular Water Economy (CWE), BGI is an essential part of NBS.**

Sowińska-Świerkosz, B., & García, J. (2022). What are Nature-based solutions (NBS)? Setting core ideas for concept clarification. Nature-Based Solutions, 2, 100009. https://doi.org/10.1016/J.NBSJ.2022.100009

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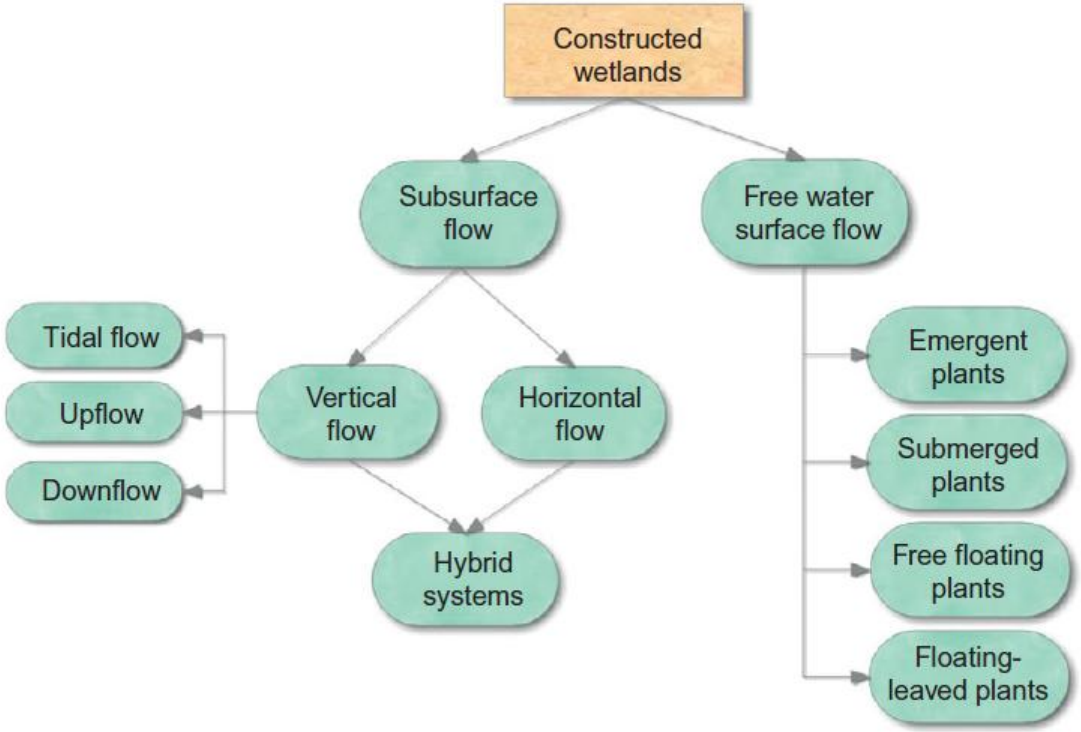
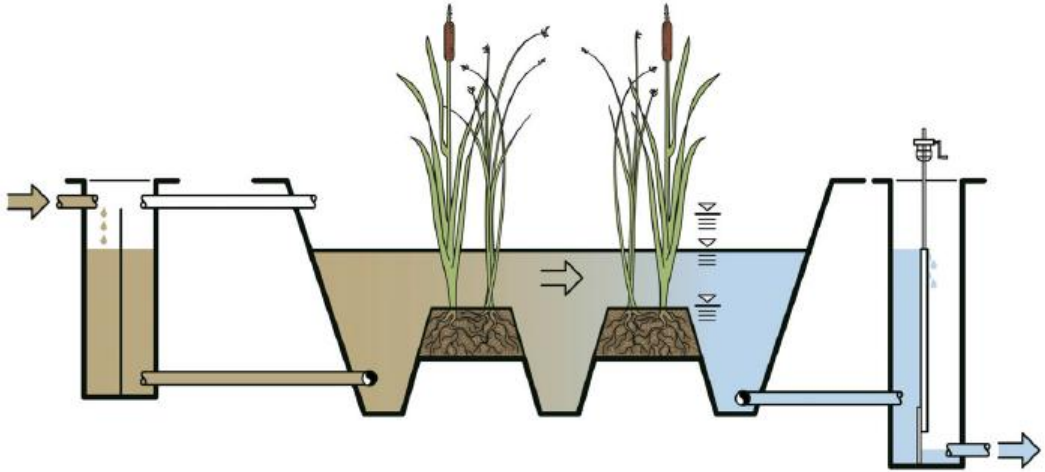
CLASIFICATION of CONSTRUCTED (TREATMENT) WETLSND



Classification of constructed wetlands for wastewater treatment.

FWS



FWS wetland

- Resemble natural wetlands in appearance.
- Require large surface area, are generally lightly loaded.
- Various plant genus can be used: a) emergent: *Typha, Phragmites, Scirpus*, (b) submerged: *Potamogeon, Elodea*, etc, (c) floating: *Eichornia* (water hyacinth), *Lemna* (duckweed).
- Are mainly used for tertiary treatment.

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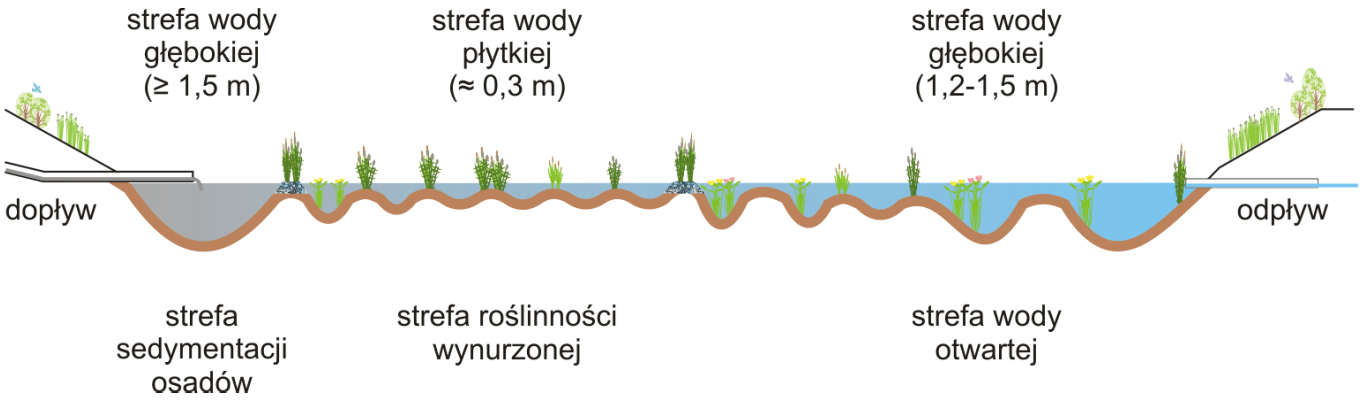
WYDZIAŁ INŻYNIERII LĄDOWEJ I ŚRODOWISKA

STAW CZY OBIEKT HYDROFITOWY ?



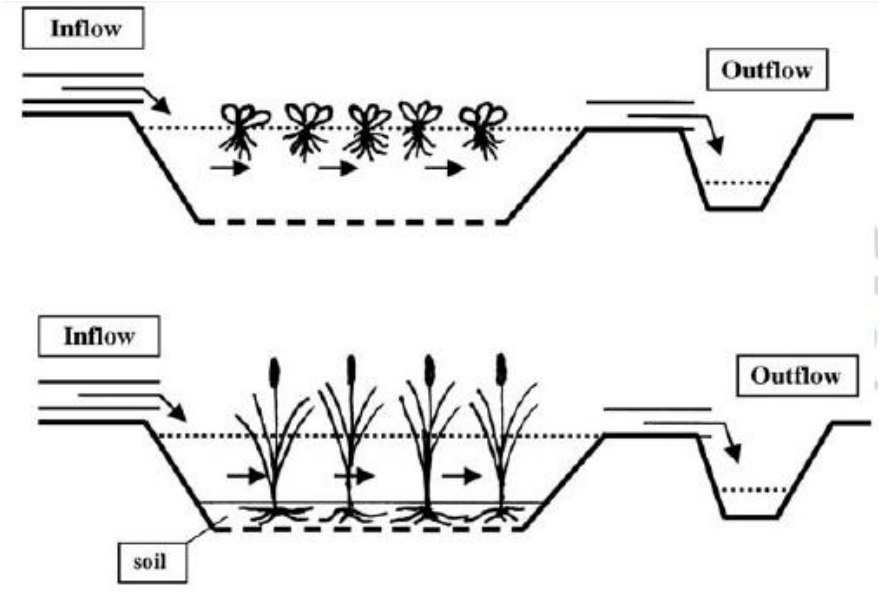
Przekrój podłużny przez staw hydrofitowy,

na podstawie Bavor (2001), EPA (2000), Kadlec i Wallace (2009)

FWS

FFP

SP



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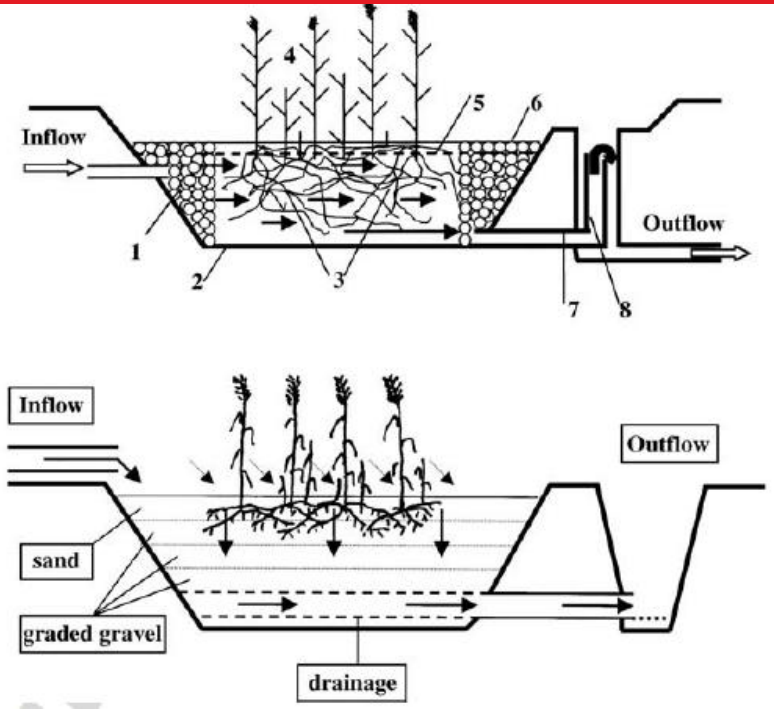
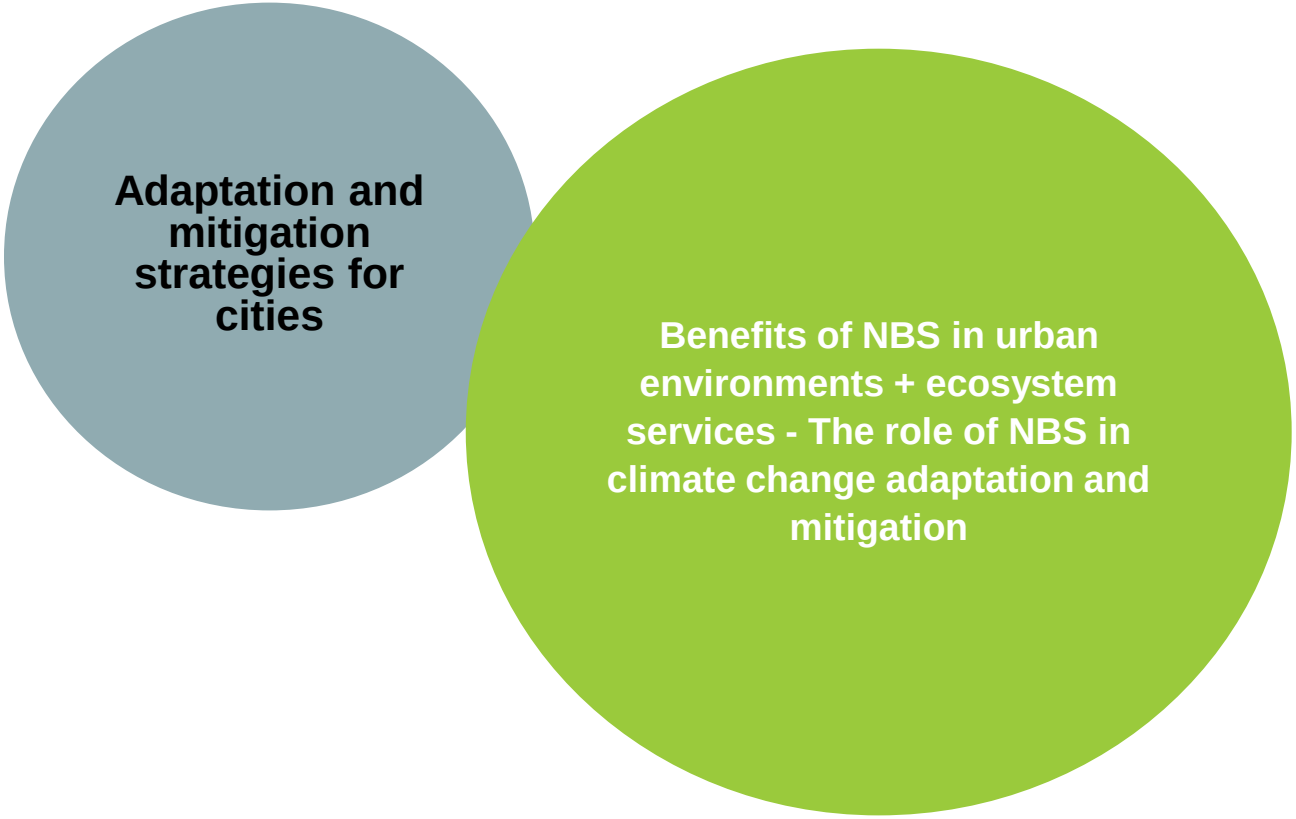
Constructed wetlands for wastewater treatment

Subsurface CW systems

- SSVF – vertical: dominating processes are organic matter mineralisation and ammonia nitrification
- SSHF – horizontal: appropriate conditions for denitrification, removal of suspended solids and organic matter
- Hybrid: combine the benefits of both types of beds proving to achieve higher efficiency of pollutants removal, especially nitrogen compounds

SS HF vs SS VF


Inflow
1
2
3
4
5
6
7
8
Outflow
Inflow
sand
graded gravel
drainage
Outflow


Adaptation and mitigation strategies for cities
Benefits of NBS in urban environments + ecosystem services - The role of NBS in climate change adaptation and mitigation

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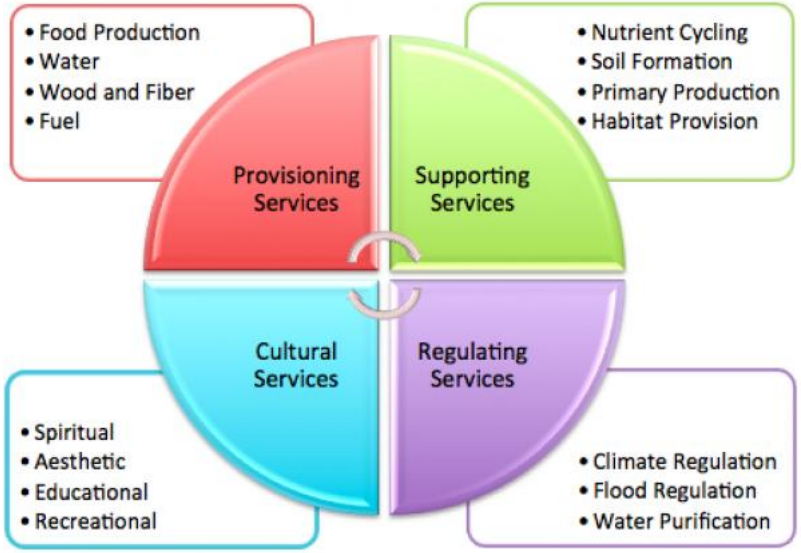
Ecosystem services

GREY *VS* GREEN INFRASTRUCTURE ?

VS



Source: Millenium Ecosystem Assessment, 2005.

Ecosystem service for Rain Garden

- Ecosystem services are the benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth *(Millennium Ecosystem Assessment*

Ecosystem service	Provisioning	Regulating	Cultural	Supporting
item	☆ food	☆ climate	☆ educational	☆ nutrient cycling
	☆ raw materials	☆ air quality	☆ spiritual	☆ soil formation
	☆ fresh water	☆ water runoff	☆ aesthetic	☆ habitat provision
	☆ fuel	☆ treatment and processing	☆ recreational	☆ water cycling
	☆ medicine	☆ pollination	☆ health	☆ primary production
summary value	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆

17

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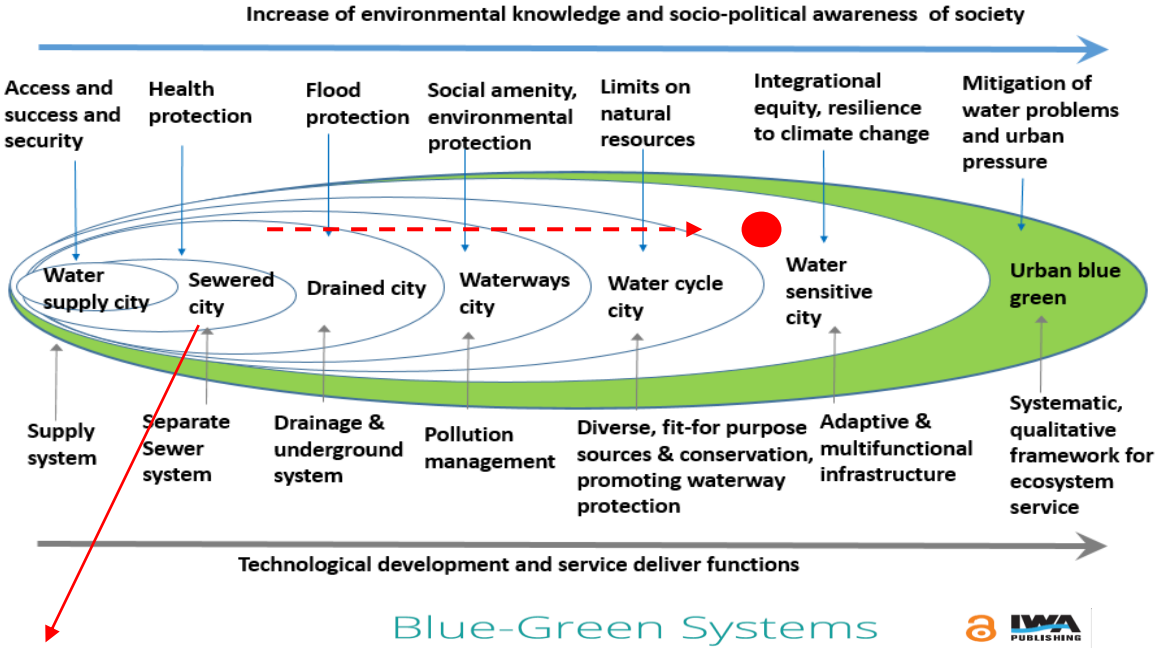
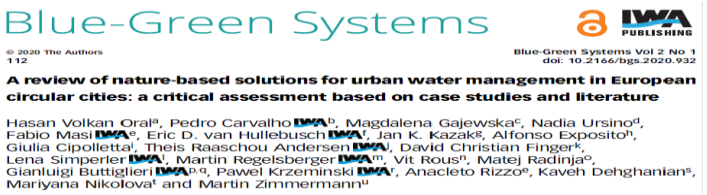
Development of storm water managment



In Gdańsk since 1870 and separate sewer and storm water systems


Blue-Green Systems

IWA PUBLISHING

112

Blue-Green Systems Vol 2 No 1
doi: 10.2166/bgs.2020.932

A review of nature-based solutions for urban water management in European circular cities: a critical assessment based on case studies and literature

Hasan Volkan Oral[a], Pedro Carvalho[b], Magdalena Gajewska[c], Nadia Ursino[d], Fabio Masi[e], Eric D. van Hullebusch[f], Jan K. Kazak[g], Alfonso Exposito[h], Giulia Cipolletta[i], Theis Raaschou Andersen[j], David Christian Finger[k], Lena Simperler[l], Martin Regelsberger[m], Vit Rous[n], Matej Radinja[o], Gianluigi Buttiglieri[p,q], Pawel Krzeminski[r], Anacleto Rizzo[e], Kaveh Dehghanian[s], Mariyana Nikolova[t] and Martin Zimmermann[u]

Storm water is a valuable resource

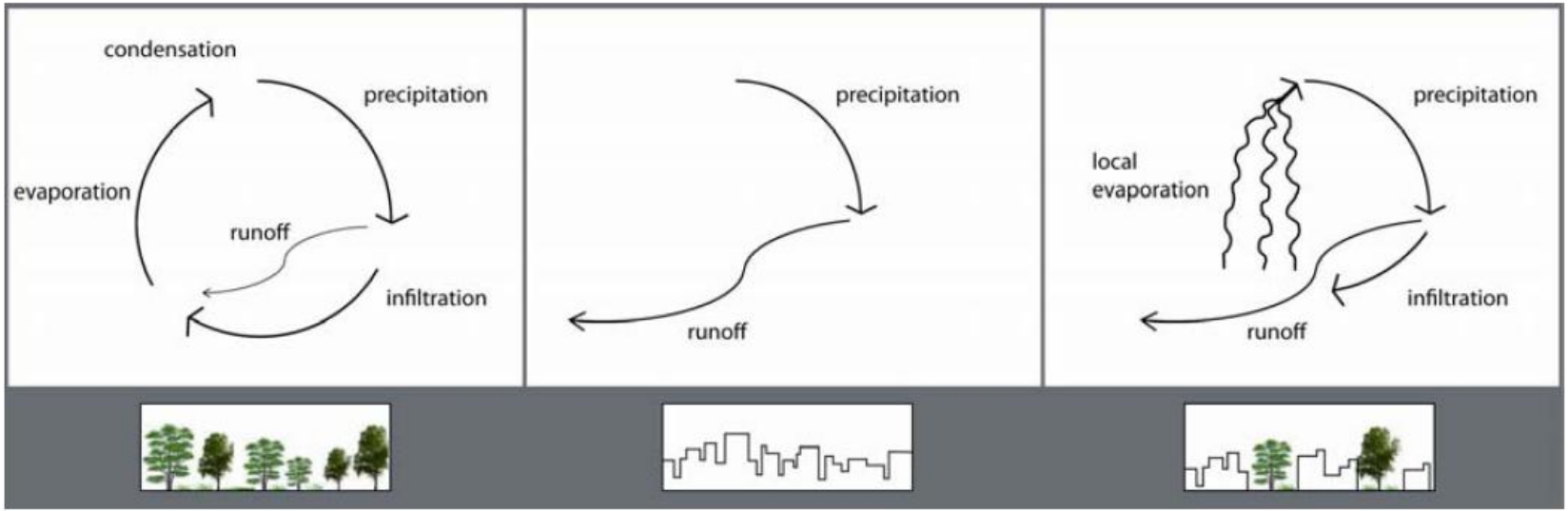


Fig. 1. Water cycle in natural systems (left); in an urban area without sustainable stormwater management (middle); and in an urban area with sustainable stormwater management (right) (© HCU Hamburg).

Urban Water Integrate Cycle

Hoban, A., and Wong, T.H.F., (2006) "WSUD resilience to Climate Change" *1st international Hydropolis Conference, Perth WA*, October 2006.

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Strategy

The IWA Principles for Water Wise Cities

17 Principles for Water-Wise Cities

4 Levels of Action

1 Regenerative Water Services

- Replenish Waterbodies and their Ecosystems
- Reduce the Amount of Water and Energy Used
- Reuse, Recover, Recycle
- Use a Systemic Approach Integrated with Other Services
- Increase the Modularity of Systems and Ensure Multiple Options

2 Water Sensitive Urban Design

- Enable Regenerative Water Services
- Design Urban Spaces to Reduce Flood Risks
- Enhance Liveability with Visible Water
- Modify and Adapt Urban Materials to Minimise Environmental Impact

3 Basin Connected Cities

- Plan to Secure Water Resources and Mitigate Drought
- Protect the Quality of Water Resources
- Prepare for Extreme Events

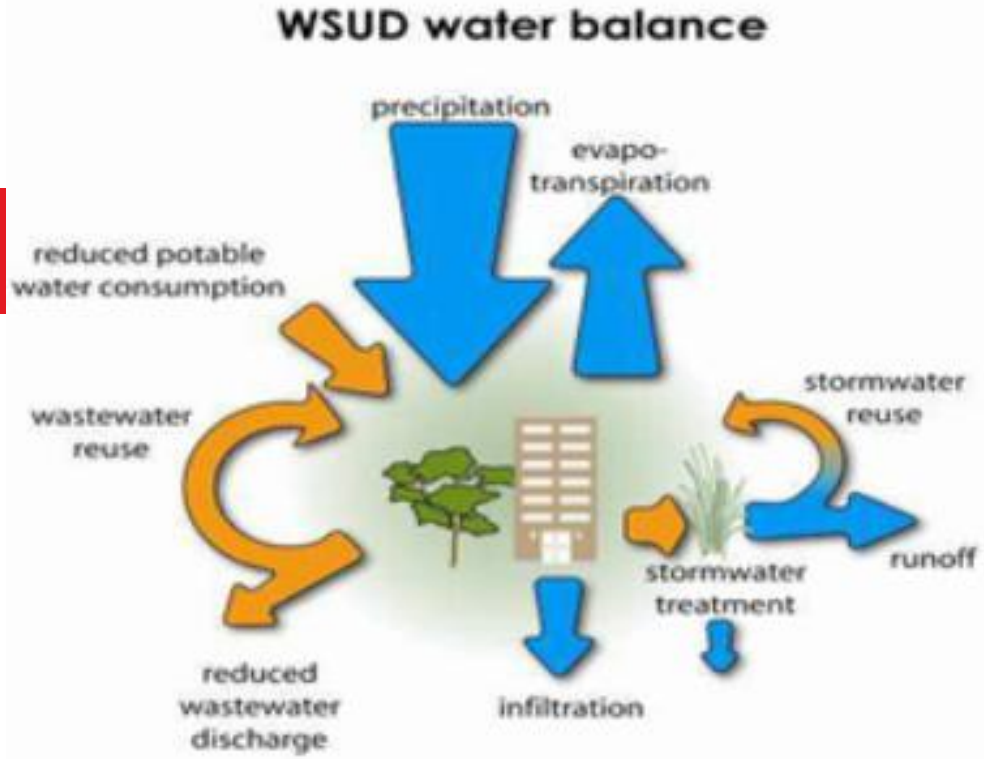
4 Water-Wise Communities

- Empowered Citizens
- Professionals Aware of Water Co-benefits
- Transdisciplinary Planning Teams
- Policy Makers Enabling Water-Wise Action
- Leaders that Engage and Engender Trust

5 Building Blocks

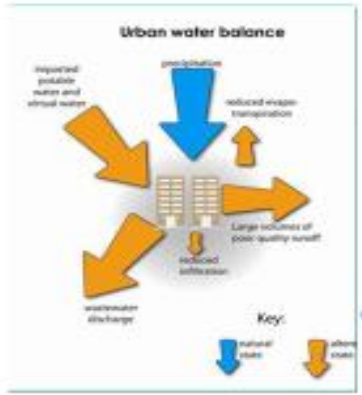
Vision | Governance | Knowledge & Capacity | Planning Tools | Implementation Tools

Figure 1: The "Principles for Water-Wise Cities" Framework: four Levels of Action and five Building Blocks for urban stakeholders to deliver "Sustainable Urban Water" in their cities


WSUD water balance
precipitation
evapo-transpiration
reduced potable water consumption
wastewater reuse
stormwater reuse
runoff
stormwater treatment
reduced wastewater discharge
infiltration
Hoban & Wong, 2006

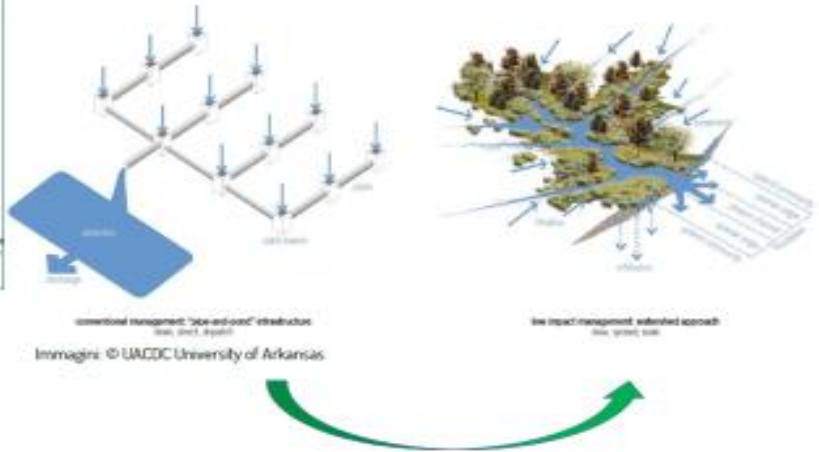
Challenge

Hoban, A., and Wong, T.H.F., (2006) "WSUD resilience to Climate Change" *1st International Hydropolis Conference, Perth WA*, October 2006.



hard engineering
...just transfers pollution
to another site

soft engineering
...metabolizes pollutants
on site—parks, not pipes!

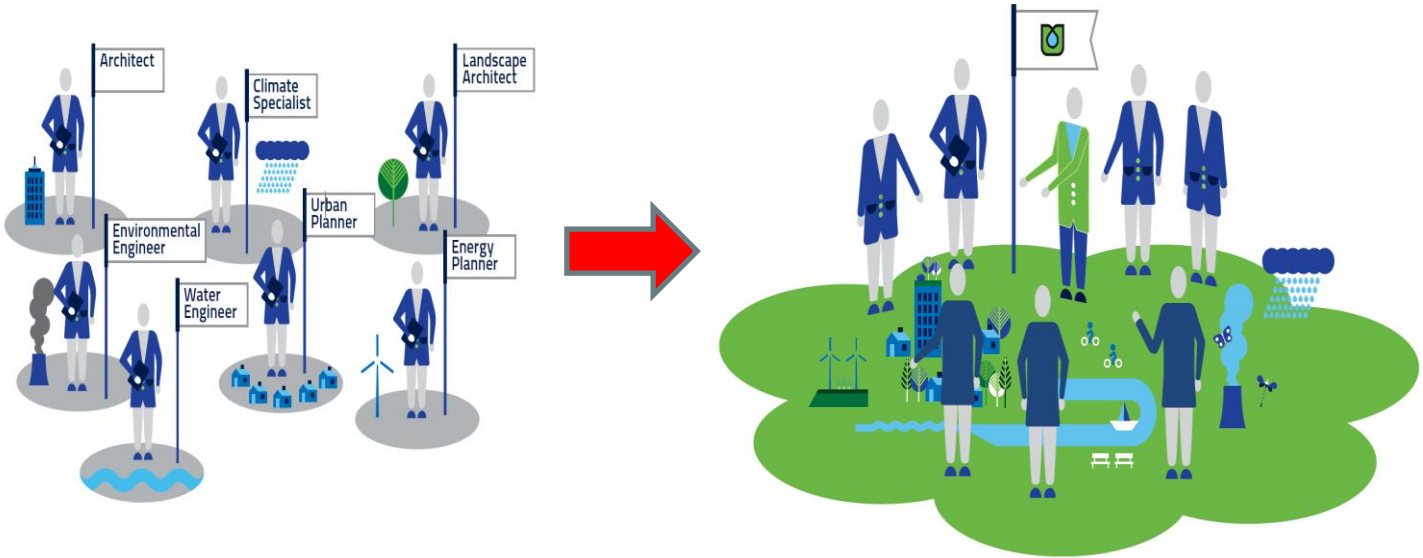


Immagini © UACDC University of Arkansas

Integrated Storm Water Management (ISWM)

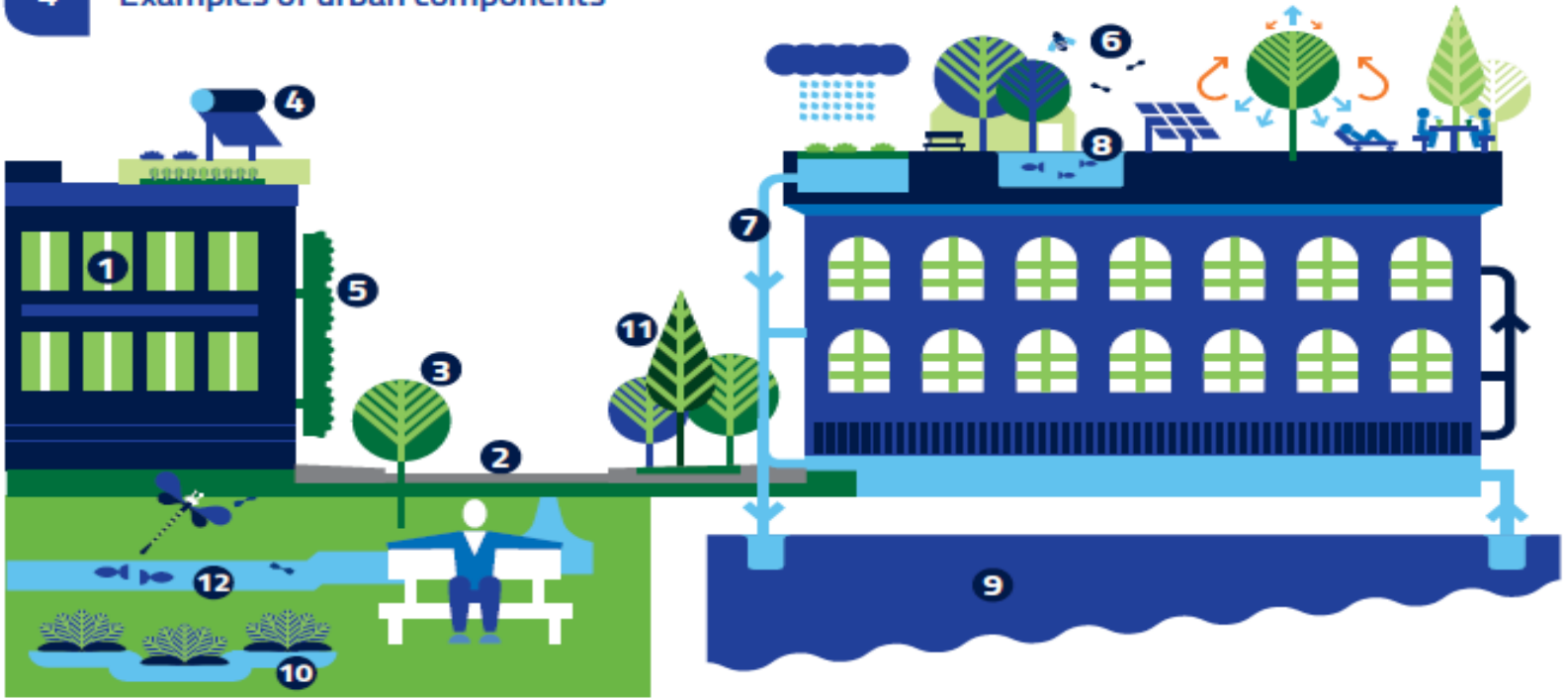
Needs

WISE interdisciplinary approach



Blue Green Solutions. A Systems Approach to Sustainable, Resilient and Cost- Efficient Urban Development

4 Examples of urban components



1 Building 2 Street 3 Trees 4 Solar water heating 5 "Multi-functional" green wall
6 "Multi-functional" roof garden 7 Storm water harvesting and recycling 8 Food production
9 Ground water aquifer 10 Constructed wetland 11 Pocket park 12 Urban streams and ponds

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Different name for the same idea- WSUD, SUDS, SPONG City

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CONCLUSIONS

Summing up:

Integrated Urban Water Management (IUWM)- wastwater, rainwater, indastrial ww, others …….reuse,

- ✓ **Treatment of waste not longer single purpose BUT multifunctional with manufacturing of product : water, N, P, K, soil conditioner (compost, humic substances), heavy metals**
- ✓ **Closing and reconnecting loop**
- ✓ **Resilient, robust and flexible as well as attractive**
- ✓ **Treatment in place with as many as possible ecosystem service**
- ✓ **A lot of has been done so far but still there is a lot of possibilities and challenges**

Nature Based Solutions like treatment wetland meet these criteria

Thank you

Interreg
CENTRAL EUROPE

Co-funded by
the European Union

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