



NBS
EduWORLD



Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

Flood Defence Through NBS

Lecture (online)

Learning Unit 43

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Introduction

Flood Mitigation Through Nature-Based Solutions

- Understanding the challenges of urban flooding and its consequences.
- How nature-based solutions (NBS) can effectively mitigate flood risks.
- Overview of the **REDUNA project** and its role in flood management.



“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.



NBS Definition – EU

Reference: [European Commission](#)

“Solutions that are **inspired** and **supported** by nature, which are cost-effective, simultaneously provide **environmental, social and economic benefits** and help build **resilience.**”

- NBS involve working with natural systems to reduce environmental risks like flooding, erosion, and water pollution.
- Solutions include creating green infrastructure such as wetlands, rain gardens, and urban forests to manage water sustainably.



NBS Definition – EU

Reference: [European Commission](#)

Class Exercise

1. Reflect on major flood events, what are common issues?
2. Are you aware of systemic failings
3. What could be done differently in future?

Take Five

REDUNA Project

Introducing the REDUNA Project

- **REDUNA** is a European project focused on enhancing urban resilience to climate change impacts, with an emphasis on flood mitigation.
- The project focuses on urban flood management through the integration of NBS in cities across Europe.
- REDUNA aims to demonstrate how NBS can reduce the risk of flooding while simultaneously promoting biodiversity and improving urban spaces.

Understanding Flood Risks in Urban Areas

Urban Flooding: Causes and Impacts

- Urban areas face increased flood risks due to population growth, impermeable surfaces, and climate change.
- **Consequences of Urban Flooding:**
 - Infrastructure damage and loss of property.
 - Increased vulnerability for people, especially in low-lying and densely populated areas.
 - Water quality issues, such as contamination of drinking water supplies

How NBS can help

Key Benefits of NBS for Flood Mitigation

- **Reduce Runoff:** Green infrastructure like green roofs, permeable pavements, and rain gardens capture rainwater and reduce surface runoff.
- **Flood Prevention:** Wetlands and floodplain restoration absorb excess water, reducing the chances of urban flooding.
- **Co-Benefits:** Improved biodiversity, increased green space, and enhanced urban well-being.



Wetlands in Flood Mitigation

Wetlands as Natural Water Regulators

- Wetlands act as natural sponges, storing water during heavy rainfall and releasing it slowly.
- In the **REDUNA project**, the restoration of wetlands helps reduce flood risks and improve water quality.
- Wetland plants also filter pollutants, contributing to cleaner rivers and lakes.



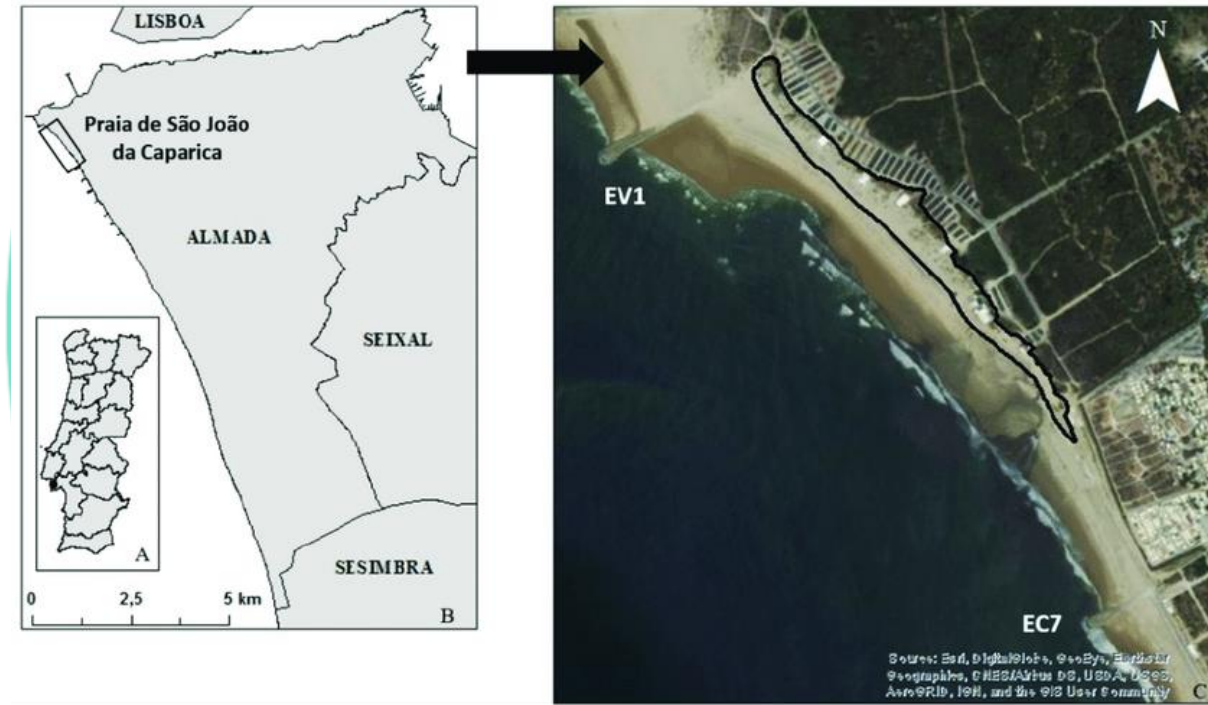
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Almada

Urban Forests in Mitigating Flood Risks

- Urban forests play a key role in reducing the urban heat island effect and managing flood risks.
- Trees and vegetation absorb rainwater, reduce runoff, and help manage extreme weather events such as heavy rainfall.
- In **REDUNA**, urban forests are being restored and created to mitigate both flooding and heatwaves.



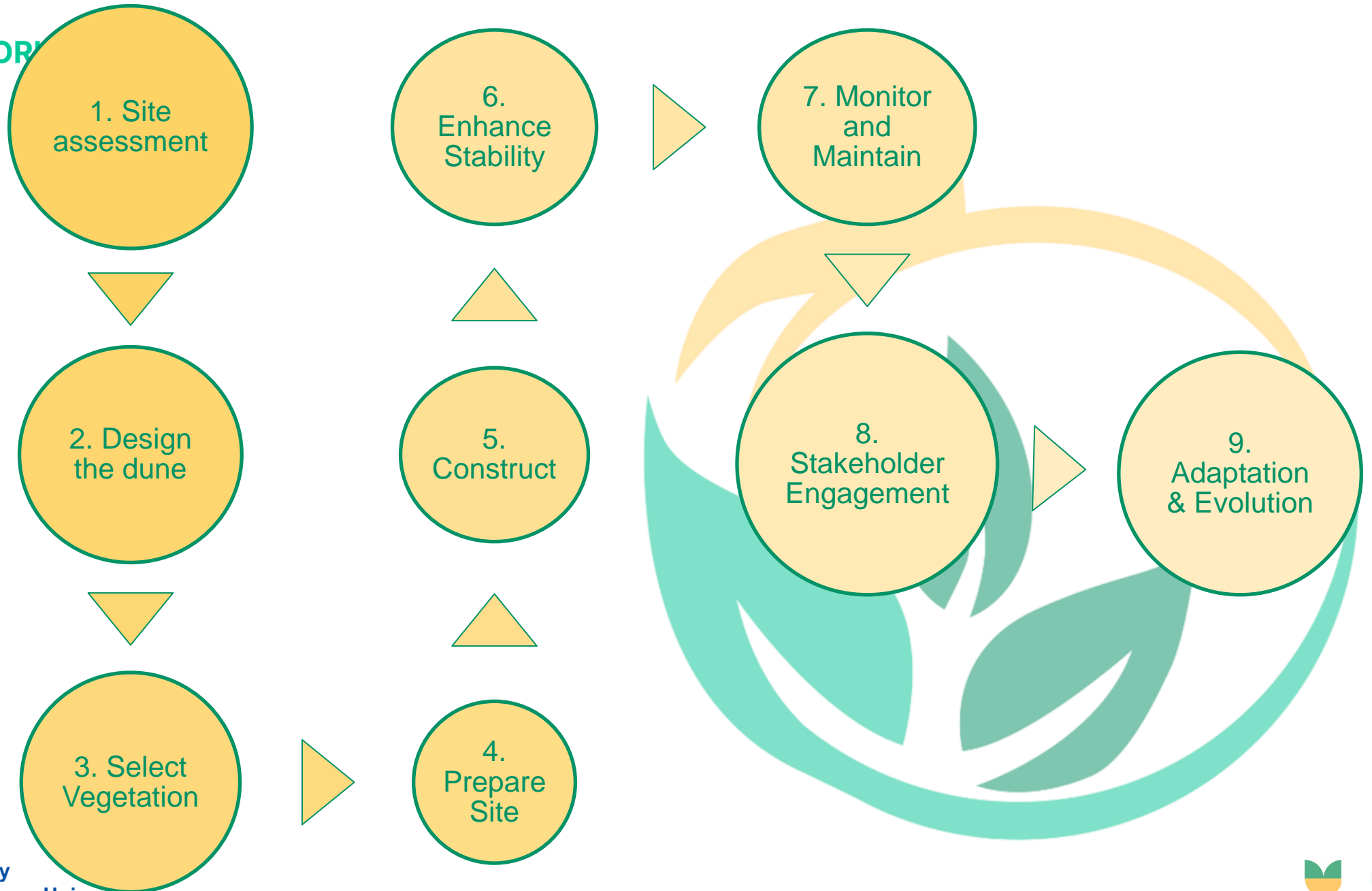
Almada

Flood Mitigation in Almada, Portugal

- **Almada** uses NBS such as green streets and floodplain restoration to manage flood risks.
- The integration of trees and permeable surfaces has helped reduce surface runoff and manage stormwater.
- The restoration of natural habitats increases water retention, improving local resilience to flooding.



Steps Towards Dune Design



1. Site Assessment

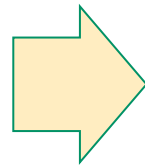
Understanding the Environment and Requirements

Coastal Assessment: Evaluate the specific needs of the coastal area, including the level of flood risk, erosion patterns, and existing vegetation.

Topography: Conduct a topographical survey to determine the natural slope and contours of the coastline. Identify areas vulnerable to flooding and erosion.

Soil Composition: Test soil quality and composition to ensure it supports the establishment of dune vegetation.

Ecological Impact: Assess the potential impacts on local ecosystems, ensuring the project supports local wildlife and does not disrupt existing habitats.



2: Design the Dune Structure

Planning the Dune's Shape and Function

Dune Shape: Design dunes with natural slopes, typically between 30° and 45°, to create effective barriers against storm surges and waves.

Height and Width: Determine the necessary height and width of the dunes based on the flood risk, wave height, and expected storm surges for the area. Generally, dunes should be at least 2-3 meters high for adequate protection.

Multiple Layers: Consider creating multiple layers of dunes or berms to act as additional barriers, with smaller dunes closest to the water and larger dunes further inland.



3: Select Appropriate Vegetation

Choosing Plants for Dune Stabilization

Native Plant Species: Select salt-tolerant and drought-resistant native plant species, such as marram grass (*Ammophila arenaria*) or beach grasses, which have strong root systems to stabilize the dunes.

Vegetation Coverage: Ensure full vegetation coverage of the dune to prevent erosion. Roots of plants help anchor sand in place, allowing the dunes to grow in height and strength over time.

Ecological Benefits: Choose plants that support local wildlife and contribute to biodiversity. Dune vegetation can also provide habitats for birds, insects, and other coastal species.

4: Prepare Site

Site Preparation and Groundwork

Erosion Control: Use temporary measures such as sand fences or coir rolls (made from coconut fiber) to help stabilise loose sand before planting vegetation.

Sand Sourcing: Obtain clean, well-sorted sand, ideally from local sources, to match the natural characteristics of the area.

Site Preparation: If necessary, remove invasive species, debris, or other vegetation that could hinder the establishment of native dune plants.



5: Construct

Building the Dunes Using Natural Materials

Dune Creation: Pile the sand into the designed dune shape, ensuring the slopes and contours align with the site assessment.

Vegetation Planting: After constructing the dunes, immediately plant the selected vegetation along the dune. Make sure plants are spaced appropriately for their growth habits.

Layering: Add multiple layers of sand if necessary, to build the dune to the required height, and plant more vegetation in layers for stability.



6: Enhance Stability

Reinforcing and Stabilizing the Dunes

Coastal Mats or Sand Fencing: Install sand fencing, coastal mats, or jute netting on the surface of the dunes to help trap sand and protect newly planted vegetation from wind erosion.

Mulching: Apply a light mulch of straw or organic material around the plants to retain moisture and reduce wind erosion until vegetation establishes itself.

7: Monitor & Maintain

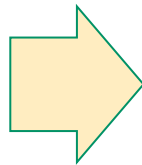
Ensuring Long-Term Stability and Functionality

Ongoing Monitoring: Regularly monitor the dune's condition to check for erosion, plant health, or any issues related to storm damage.

Vegetation Maintenance: Ensure that vegetation is thriving. Replant areas where grasses or other plants have failed or been washed away.

Dune Maintenance: Replenish sand, rebuild eroded areas, and reinforce the dunes after major storms or flooding events.

Erosion Monitoring: Use sediment monitoring and erosion markers to track the progress of the dune in providing effective coastal protection..



8: Stakeholder Engagement

Raising Awareness with Local Communities

Public Involvement: Engage local communities in dune development and management to encourage a sense of ownership and stewardship of the coastal environment.

Educational Programs: Provide educational materials about the importance of sand dunes for flood protection, wildlife habitat, and the local ecosystem.

Tourism and Recreation: Promote the dunes as a recreational area for walking, bird-watching, and environmental education, while ensuring protection of sensitive areas..



9: Adaptation & Evolution

Long-Term Adaptation to Climate Change

Adapt to Changing Conditions: As climate change accelerates, monitor the impact of rising sea levels and extreme weather events on the dunes.

Update Design: Periodically review and adjust the dune design as needed to improve flood protection and ensure the system adapts to evolving climate conditions.

Continuous Research: Stay updated with the latest research on coastal resilience and consider incorporating new techniques and technologies to enhance dune effectiveness.

NBS for Coastal Flooding

Addressing Coastal Flooding with NBS

- Coastal areas are particularly vulnerable to flooding due to rising sea levels.
- NBS, such as the restoration of coastal wetlands, mangrove forests, and dunes, can help buffer against storms and high tides.
- The **REDUNA project** explores NBS applications for managing coastal flooding, providing better protection for cities along Europe's coastlines.



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Class Exercise

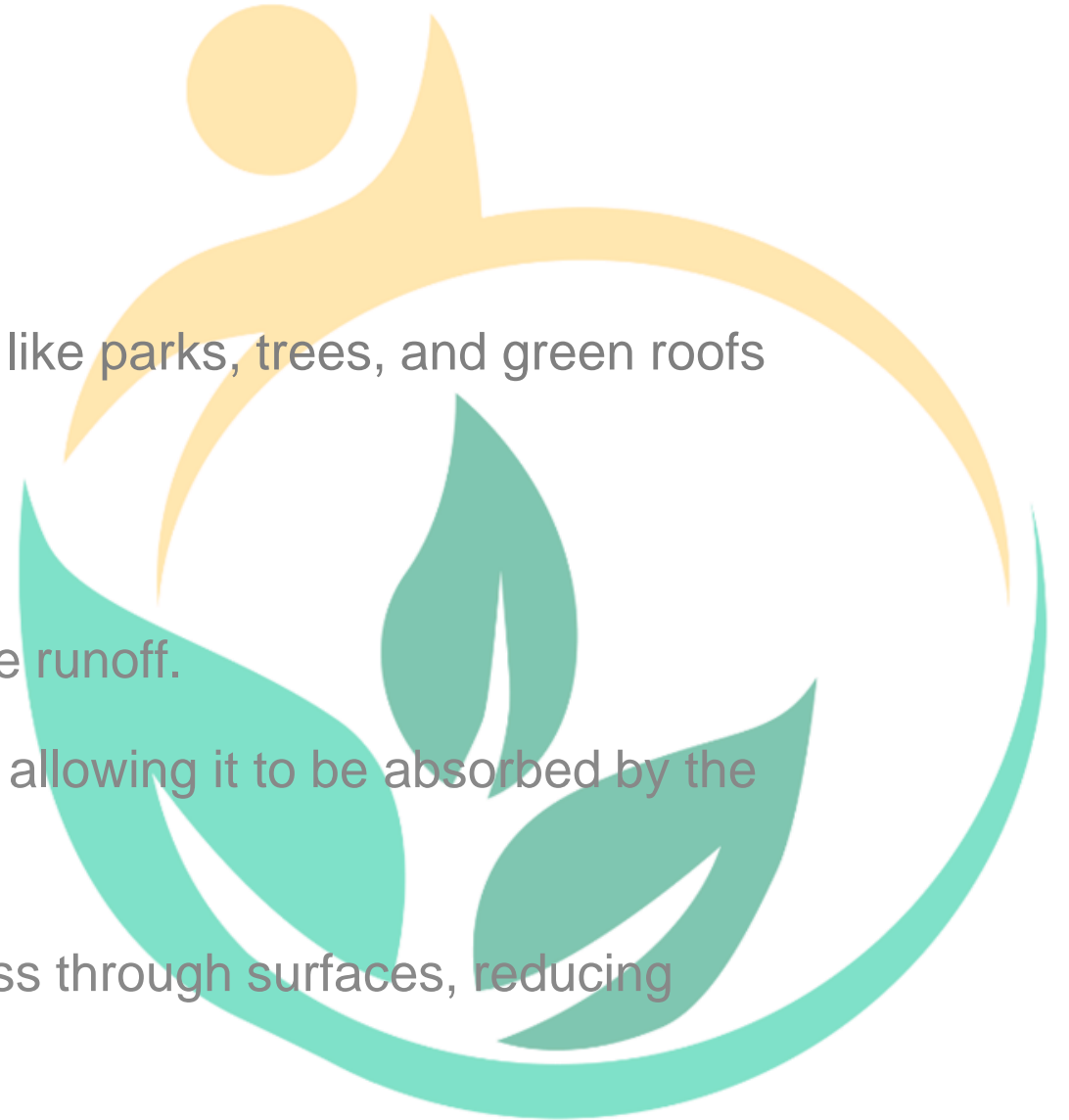
Reflect on alternative NBS which may help local issues in your community – who would be needed to implement this?

Take Five

Wetlands in Flood Mitigation

Green Infrastructure for Flood Resilience

- Green infrastructure refers to urban elements like parks, trees, and green roofs that help manage stormwater.
- **Key Elements:**
 - **Green Roofs:** Absorb rainwater and reduce runoff.
 - **Rain Gardens:** Collect and filter rainwater, allowing it to be absorbed by the soil.
 - **Permeable Pavements:** Allow water to pass through surfaces, reducing surface runoff.



Milan

Urban Forests for Flood Management in Milan

- Milan integrates urban forests and green roofs into its urban planning to combat flooding.
- These solutions increase green space while reducing pressure on stormwater systems, particularly during heavy rainstorms.
- This NBS approach has improved flood resilience across the city.



1 Implementing NBS

Challenges in Implementing Nature-Based Solutions

- **Upfront Costs:** While NBS can save costs in the long run, the initial investment can be a barrier.
- **Space Constraints:** Urban areas may lack available land for implementing large-scale NBS projects.
- **Political and Social Will:** Urban planners, policymakers, and communities must be aligned in recognizing the value of NBS.



2 Implementing NBS

Strategies for Overcoming Implementation Challenges

- **Policy Support:** Governments must create policies that incentivize NBS and integrate them into urban planning.
- **Community Engagement:** Local communities should be involved in the planning and maintenance of NBS to ensure success.
- **Funding and Investment:** Public-private partnerships and EU funding mechanisms can support NBS implementation.

3 Implementing NBS

Monitoring and Assessing NBS Effectiveness

- For NBS to be effective, continuous monitoring is essential.
- Key indicators for success include:
 - Reduction in flood events.
 - Increased water retention and improved water quality.
 - Positive impacts on biodiversity and ecosystem services.



Implementing NBS: Additional Benefits

Additional Co-Benefits of Nature-Based Solutions

- **Biodiversity Enhancement:** NBS restore natural habitats and increase biodiversity in urban areas.
- **Improved Air Quality:** Green spaces help absorb pollutants and improve air quality.
- **Human Well-Being:** Access to nature improves mental health, provides recreational spaces, and creates more liveable cities.



The Future of Urban Planning

Looking Ahead: NBS for Sustainable Urban Development

- Urban flood mitigation through NBS is an essential part of creating resilient cities.
- Future cities must incorporate NBS into their infrastructure planning to meet climate change challenges head-on.
- Urban greening, water management, and ecosystem restoration must be integrated into all aspects of urban development.

Conclusion

Summing Up: The Need for Nature-Based Solutions

- Nature-based solutions offer a promising and sustainable approach to mitigating flood risks.
- The **REDUNA project** demonstrates the potential of NBS in transforming cities into climate-resilient, sustainable environments.
- Collaboration between governments, urban planners, communities, and stakeholders is key to successfully implementing NBS for flood mitigation





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