Integrating Nature-Based Solutions into Urban Flood Management

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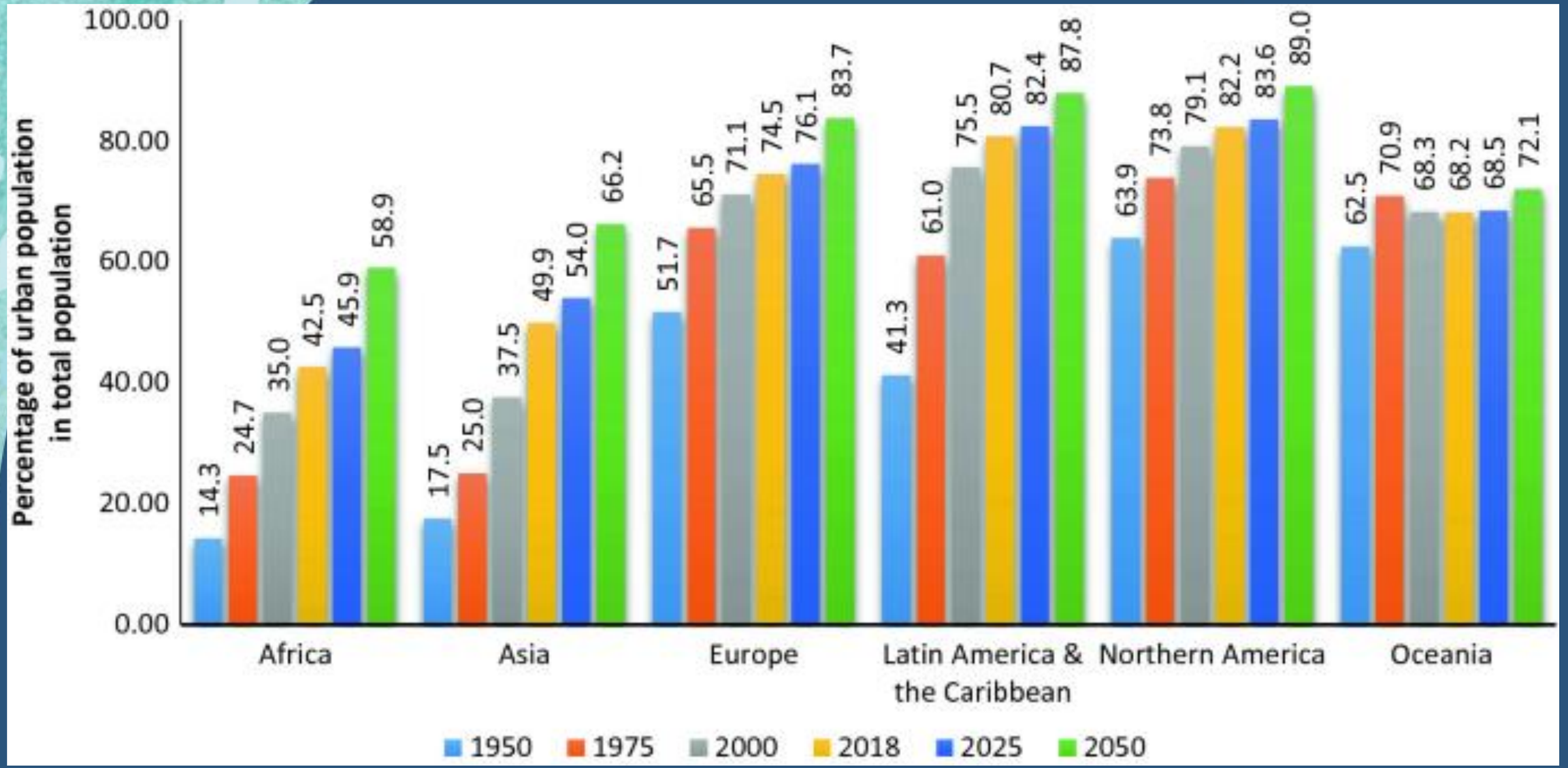
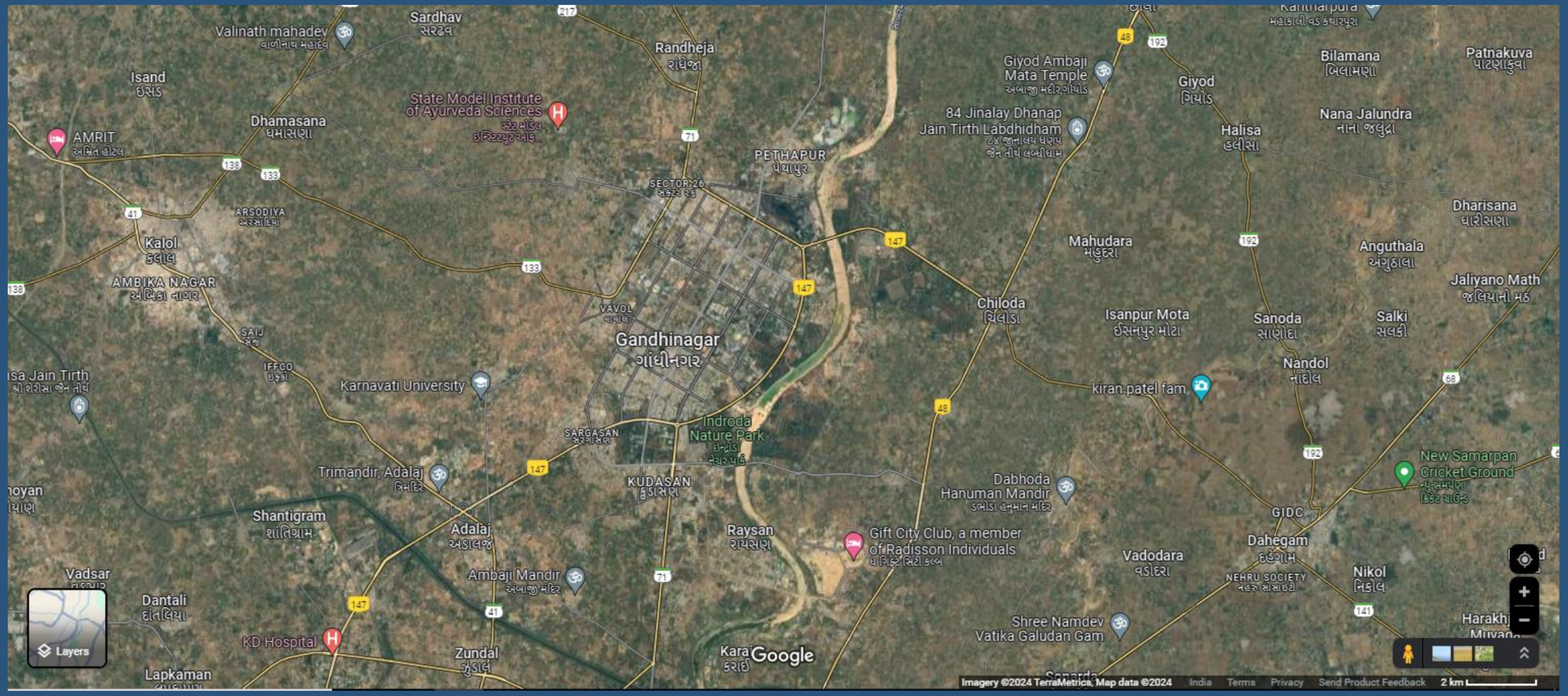
Global Trends of Urbanization



Planned Growth

Gandhinagar in 1970’s

Gandhinagar Today



Overview of Urban Flood Management Challenges

Rapid Urbanization

Urbanization is increasing pressure on natural watercourses, leading to increased increased flood risk. The growth of impervious surfaces, such as roads and and buildings, reduces infiltration and increases runoff, exacerbating flooding. flooding.

Climate Change

Climate change is altering precipitation precipitation patterns, with more frequent frequent and intense rainfall events. This This increases the frequency and severity of severity of floods, making urban flood management more challenging.

Aging Infrastructure

Many urban areas have aging flood infrastructure, which may be inadequate to inadequate to handle increased flood risks. risks. These systems often lack the capacity capacity to handle increased runoff volumes volumes and can be prone to failure.

Flood Management is All about its SPATIAL & TEMPORAL DISTRIBUTION

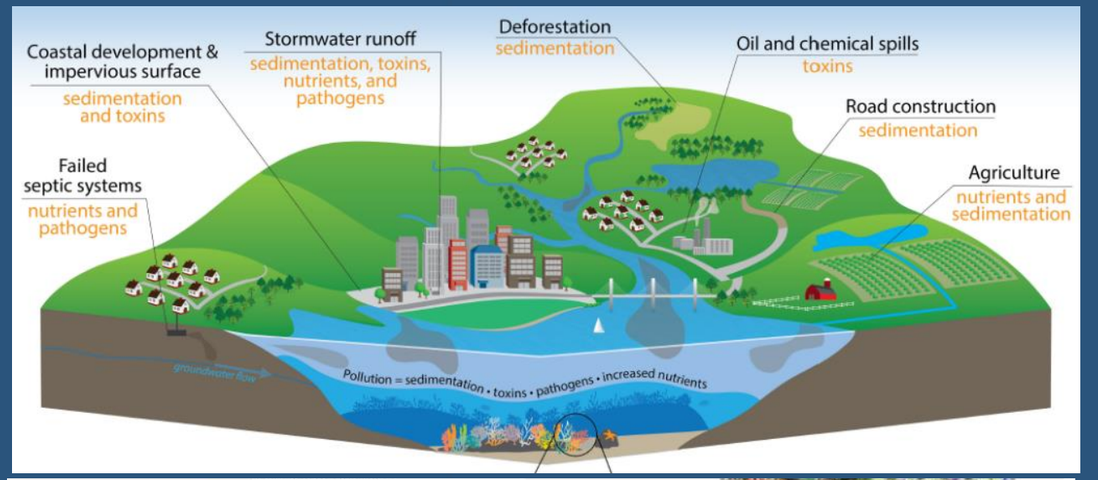
Integrating Nature based Solutions for Flood Risk Mitigation

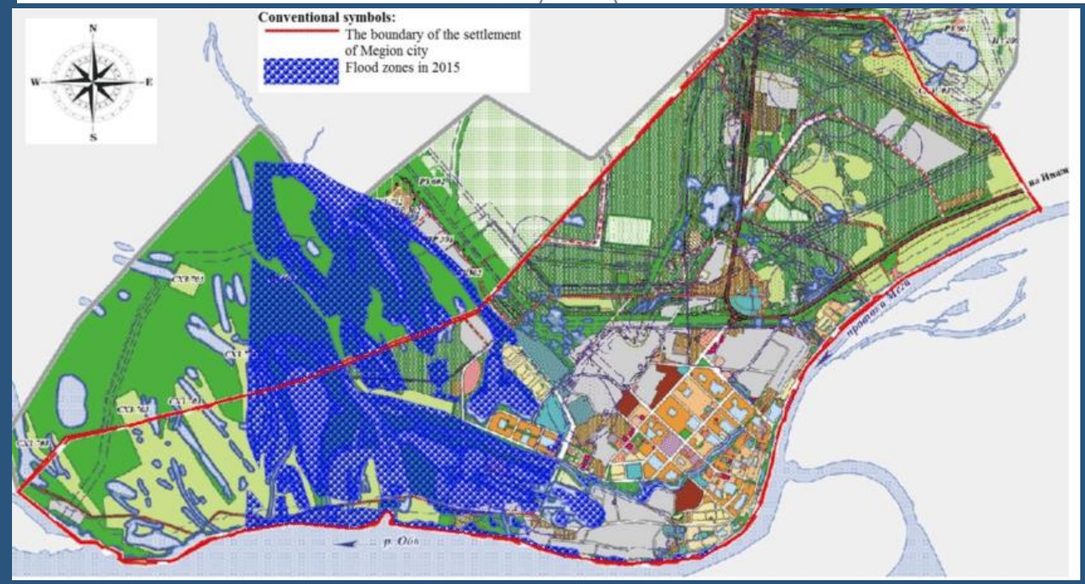
Pre-Development Measures

1. **Watershed management**: Protect and restore natural watersheds to reduce runoff.

2. **Floodplain management**: Avoid development in flood-prone areas.

3. **Zoning regulations**: Enforce zoning laws to guide development away from flood-prone areas.





Infrastructure Measures

1. **Storm-water drainage systems:** Design and maintain efficient storm-water drainage systems.

2. **Flood-control structures:** Build levees, dams, or floodwalls to protect critical infrastructure.

3. **Green infrastructure:** Incorporate green roofs, rain gardens, and permeable pavements to reduce runoff.

Community Engagement and Education

1. **Public awareness campaigns:** Educate citizens on flood risks and prevention measures.

2. **Community involvement:** Engage communities in flood mitigation and preparedness efforts.

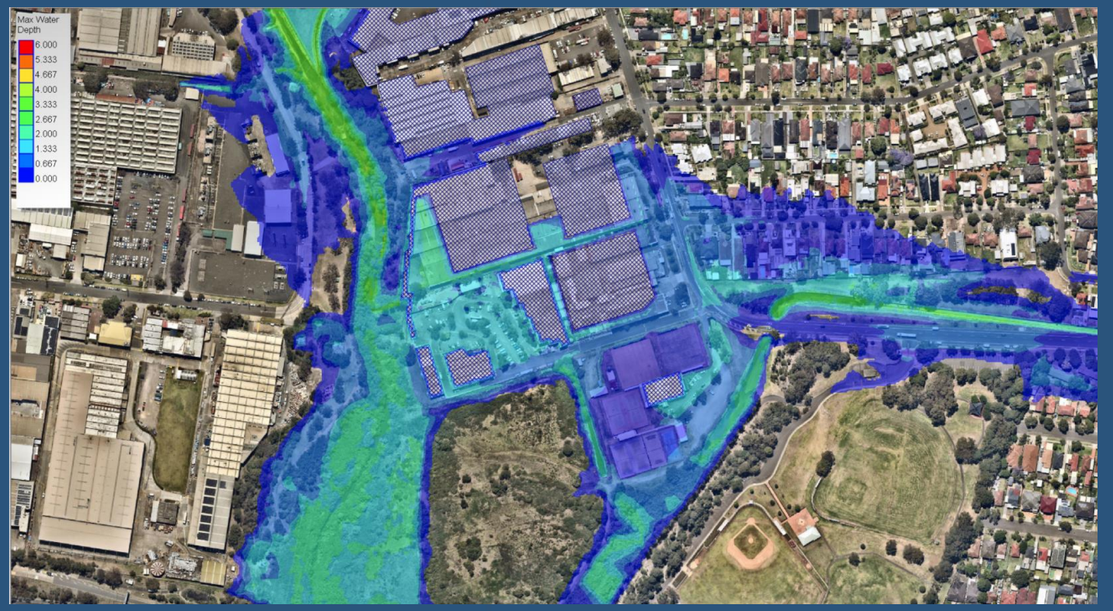
3. **Emergency preparedness plans:** Develop and disseminate emergency preparedness plans.

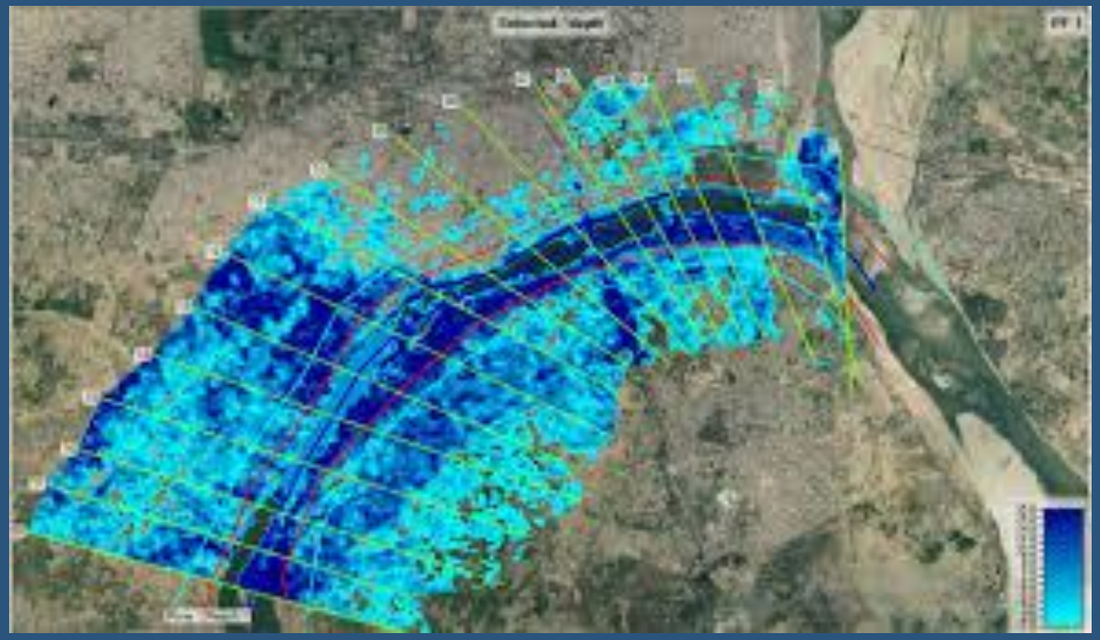
Maintenance and Monitoring

1. **Regular maintenance:** Regularly inspect and maintain storm-water drainage systems.

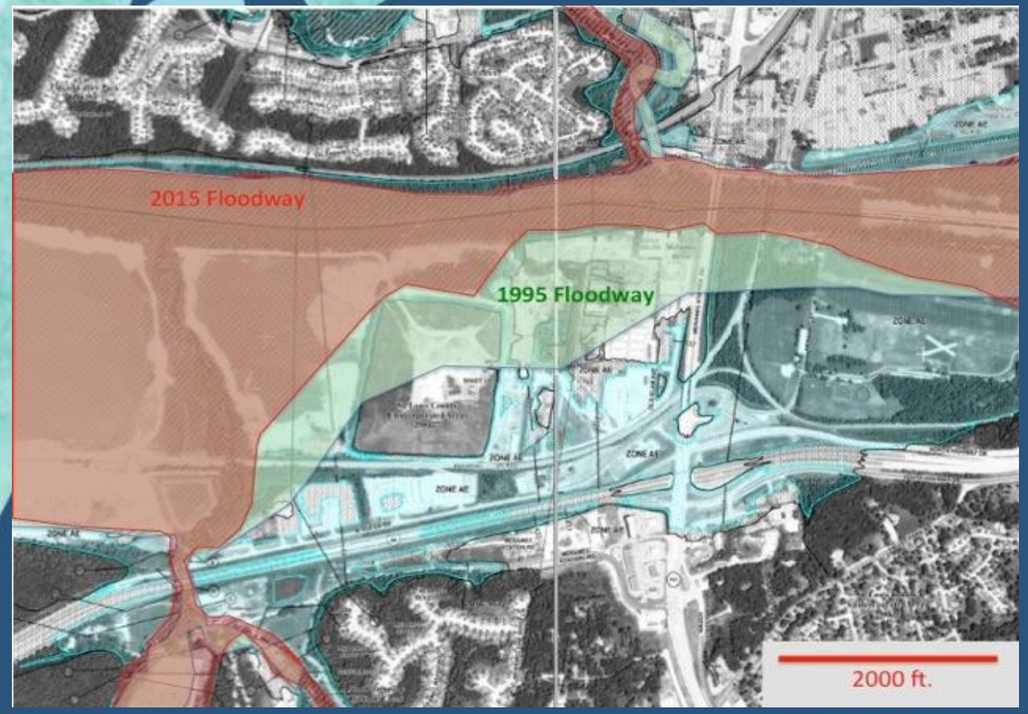
2. **Flood monitoring systems:** Install flood monitoring systems to provide early warnings.

3. **Data-driven decision-making:** Use data and analytics to inform flood mitigation decisions.





Flood Conveyance Strategies



1

Channel Improvement

Enhancing the capacity of existing channels by widening, deepening, or straightening straightening them can improve flood conveyance, but requires careful consideration consideration of ecological impacts.

2

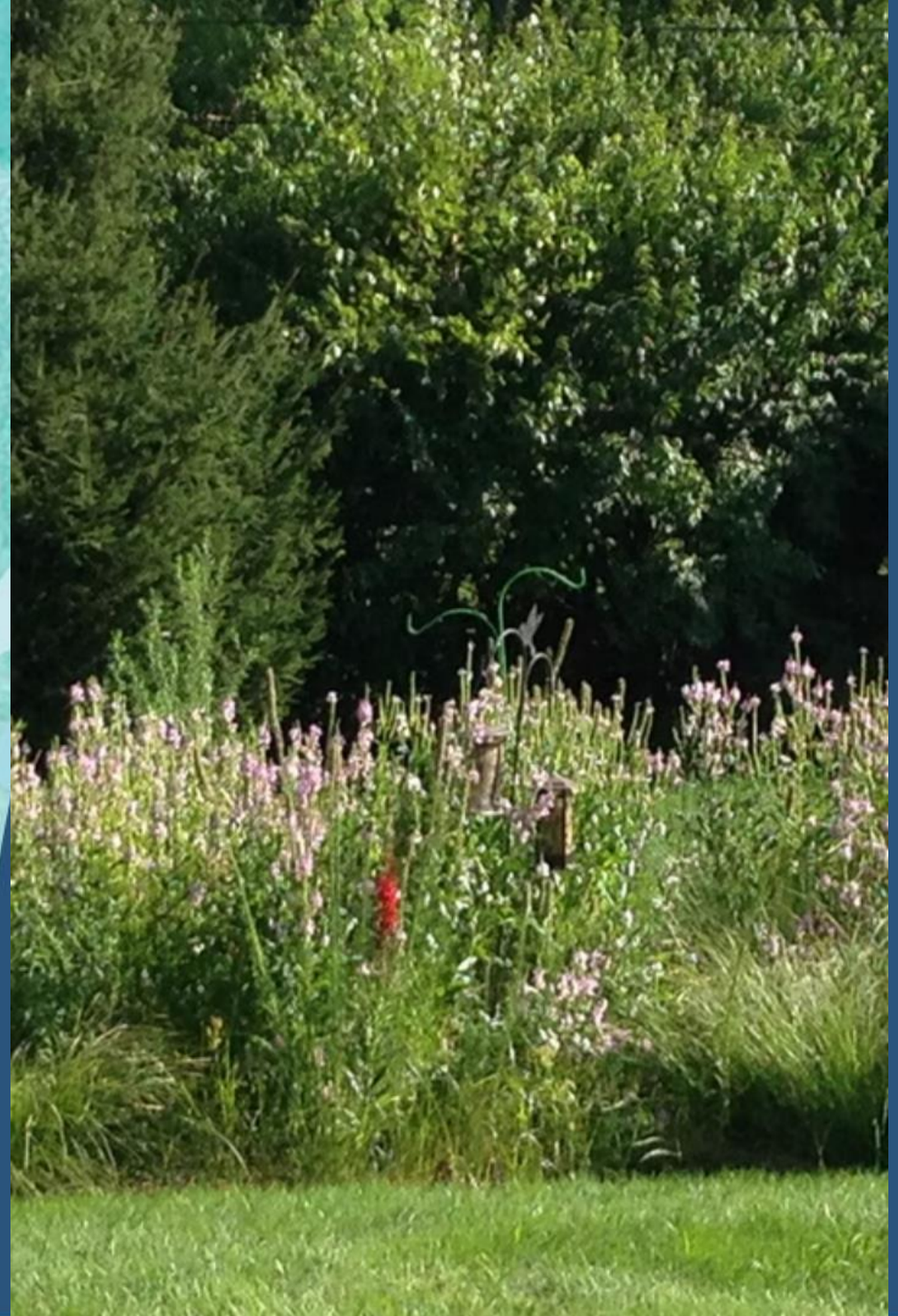
Floodplain Restoration

Restoring natural floodplains can increase flood conveyance by providing space for space for floodwaters to spread out and slow down, reducing peak flows and erosion. and erosion.

3

Bypass Channels

Constructing bypass channels can divert floodwaters around critical infrastructure, infrastructure, protecting vulnerable areas while allowing for natural flow patterns. patterns.



Water Retention and Detention Methods, Techniques and Examples

Swales

Vegetated channels designed to slow down down and filter runoff, promoting infiltration infiltration and reducing peak flows. They can They can be incorporated into roadsides, roadsides, parks, and other urban spaces. spaces.

Rain Gardens

Depressions planted with vegetation that capture and filter stormwater runoff, reducing pollution and promoting groundwater recharge.

Infiltration Basins

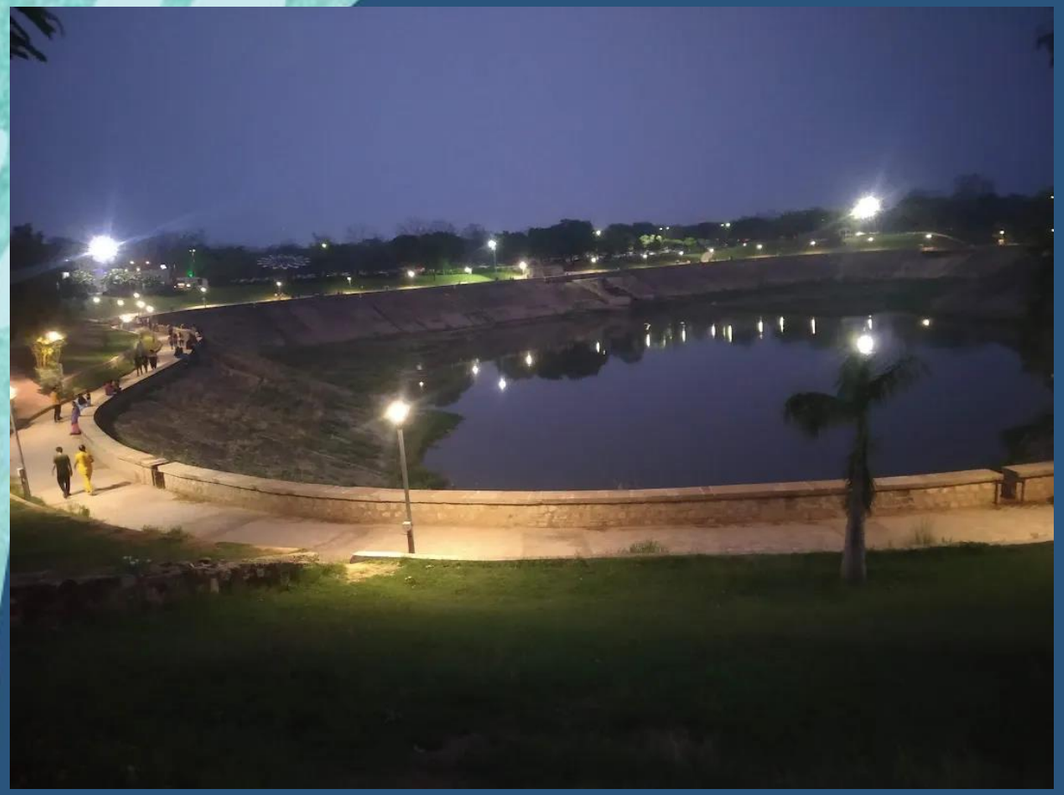
Depressions designed to hold stormwater stormwater runoff, allowing it to slowly infiltrate into the ground, reducing peak flows flows and promoting groundwater recharge. recharge.

Wet Ponds

Artificial ponds designed to capture and detain detain stormwater runoff, allowing for settling settling and filtration before being released released slowly. They can also provide habitat habitat for wildlife.

Water Retention Techniques

Water Retention Techniques



Water Retention Techniques : KHAMBHATI KUVA, Ahmedabad

Diameter 10 ft to 25 ft

75,000 to 1 Lakh Litres per Hour

1000 Year Old Infrastructure at Jaigarh Fort, Jaipur

Pucca canals and three underground tanks.

The largest tank is 158 feet long, 138 feet wide and 40 feet deep;
capacity of 60 lakhs gallon.

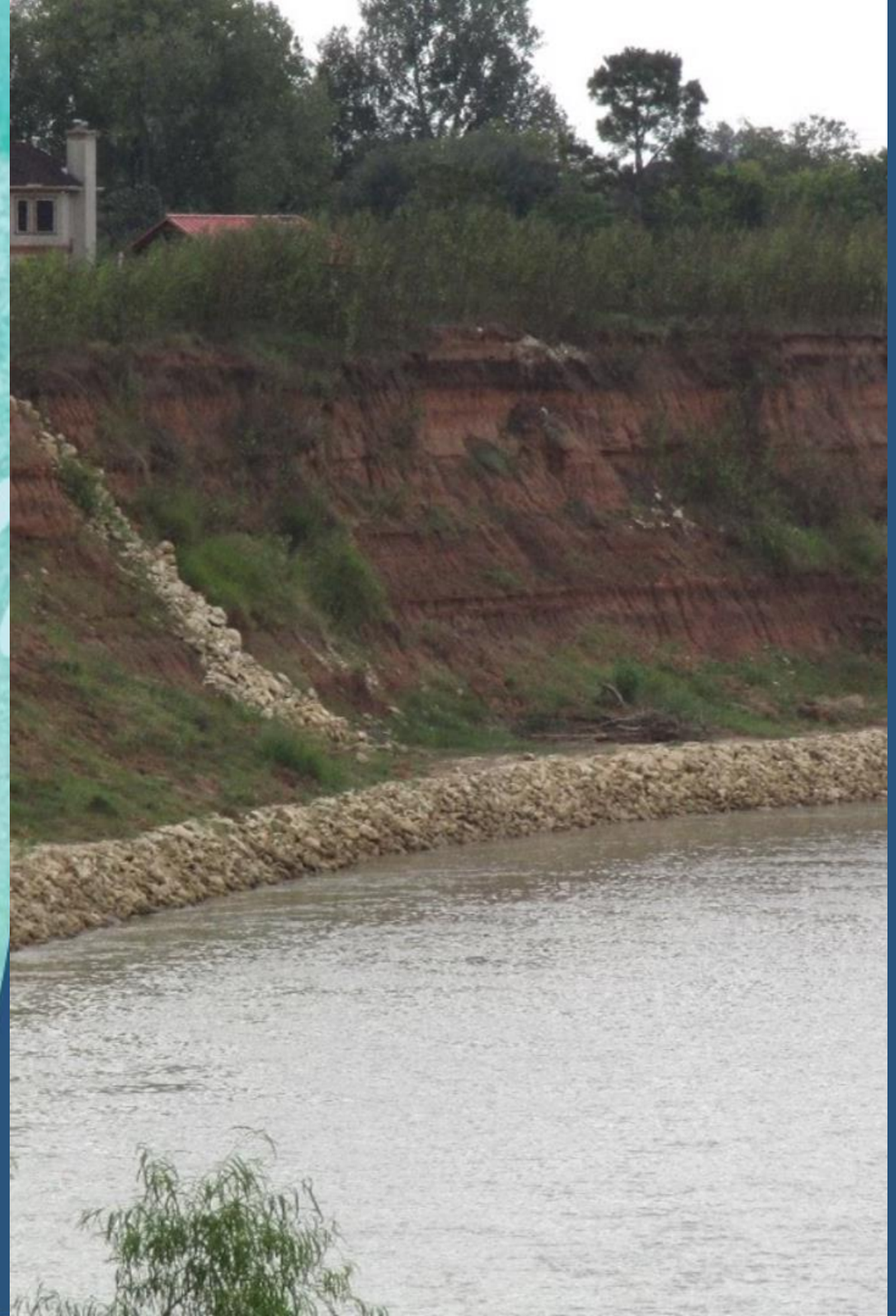
Bunds Pits - Africa

Infrastructure for RWT : Key to Flood & Drought Resilience

Sr.No	No. of Pumps to be installed	Capacity of Each pump (cusecs)	Total Pumping Capacity (cusecs)
1	8	35	280
2	8	40	320
Total	16		600

Community Participation in Gujarat State

1.87 L Checkdams, 1.25 L Boribandh & 3.23 L Farm Ponds



Controlling Bank Erosions: Approaches and Impact

1

Bioengineering

Using live vegetation, such as trees and shrubs, to stabilize riverbanks and and prevent erosion. This approach helps restore natural functions and and enhances biodiversity.

2

Riprap

Using rocks or other materials to armor riverbanks and prevent erosion. This erosion. This method is effective in high-flow areas but can have negative negative impacts on the surrounding environment.

3

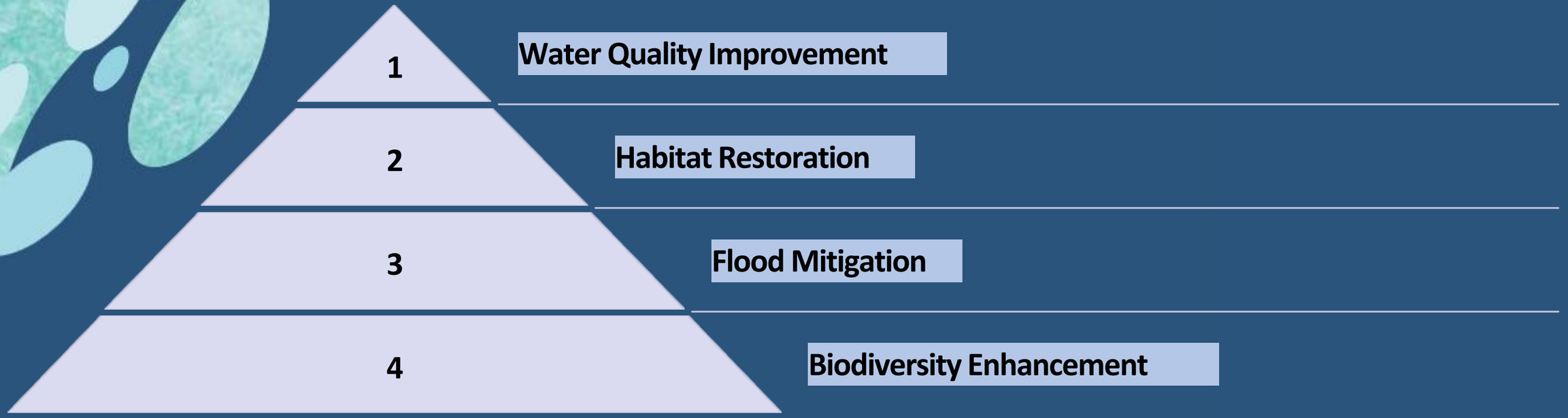
Gabions

Wire cages filled with rocks used to stabilize riverbanks. They are a cost-effective cost-effective solution but can be aesthetically less appealing.

Readymade
Concrete Blanket
2m wide, 10m long

Controlling Bank Erosions: Approaches and Impact

Wetland Restoration: Principles and Successful Projects



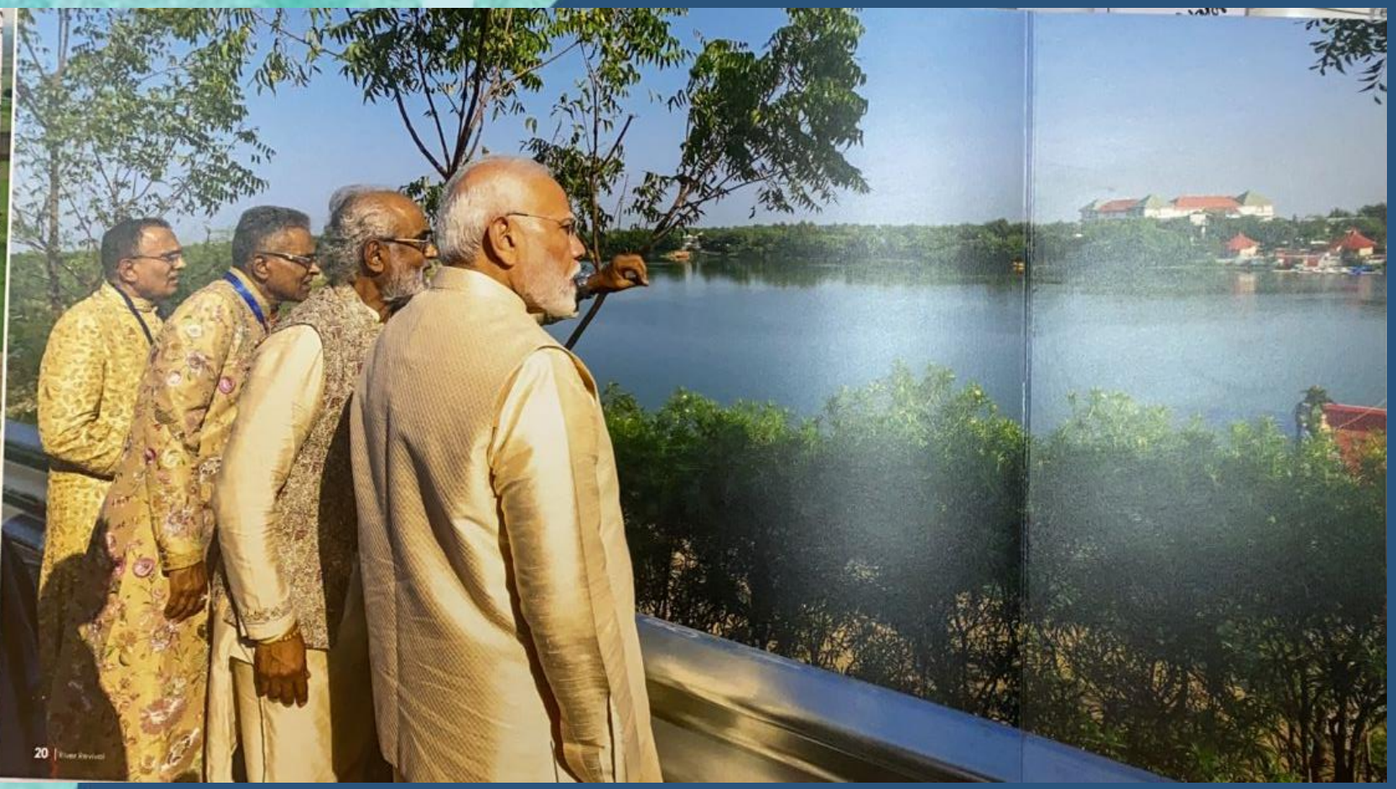
Wetland restoration involves re-establishing the natural functions of degraded or lost wetlands, including water filtration, flood attenuation, and wildlife habitat.

Meander Restoration and Reviving Old Channels: Rationale and Implementation

1. Increased Biodiversity
2. Improved Water Quality
3. Enhanced Floodplain Connectivity
4. Reduced Flood Risks

Restoring natural river meanders and reviving old channels can improve water quality, enhance biodiversity, and reduce flood risks by restoring natural flow patterns and increasing floodplain connectivity.

Stakeholder Engagement and Capacity Building



160 Lakes

30 Billion Litres

Effective implementation of nature-based solutions requires a collaborative approach involving stakeholders, including government agencies, government agencies, communities, and private organizations. Capacity building programs are crucial to empower stakeholders to effectively stakeholders to effectively manage and maintain these solutions.

Case Studies

Rotterdam, Netherlands - Water-Sensitive Urban Design

Case Studies

Chicago, USA - Green Infrastructure

Case Studies

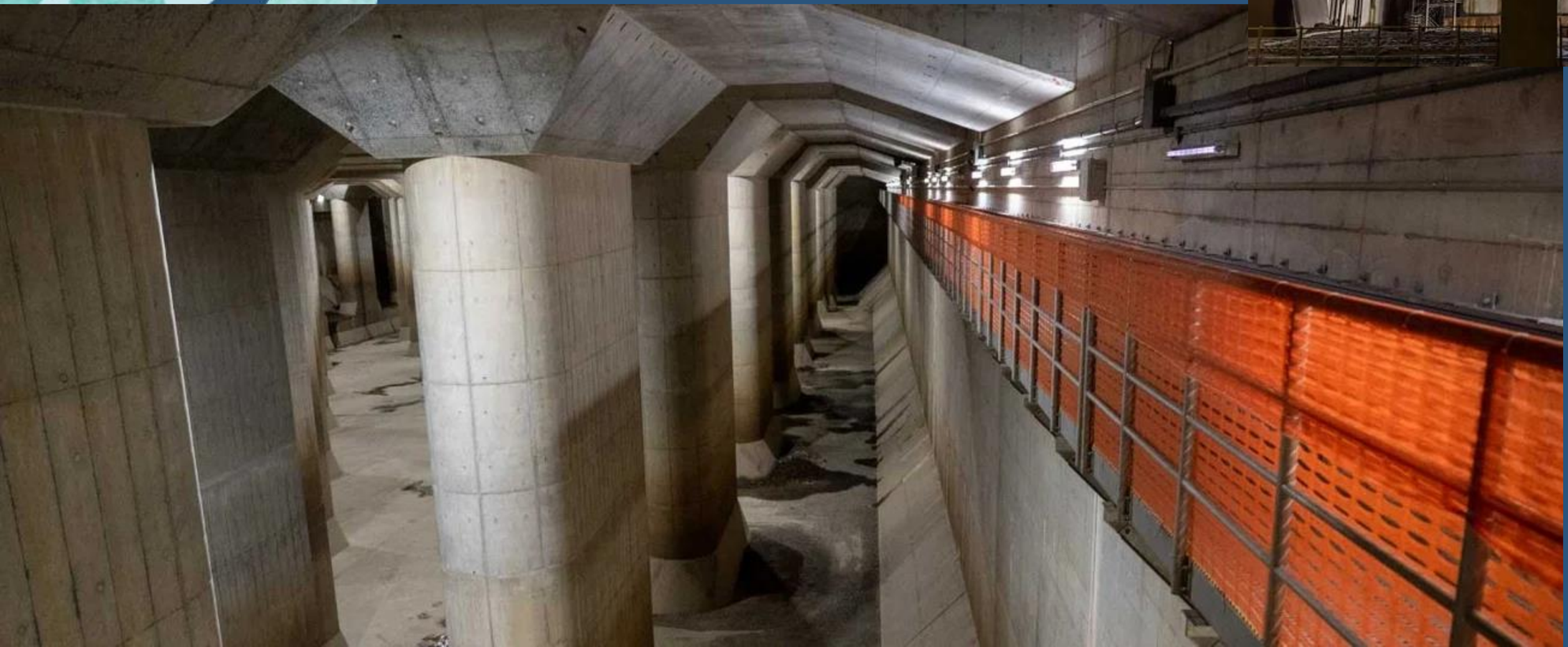
Copenhagen, Denmark -
Cloudburst Management

Case Studies

Singapore - Comprehensive Flood Management

Case Studies

Tokyo – Floodwater Diversion reduces Flood Damage Costs by 90%



Case Studies

Vancouver, Canada – RAINWAY

Case Studies

Surat, India - Flood-Resilient Urban Planning

Flood Evacuation Route

Characteristics of flood evacuation routes:

1. Clear passage: The route is free from obstacles and debris.
2. Elevation: The route is elevated above the expected flood level.
3. Signage: The route is clearly marked with signs and directions.
4. Lighting: The route is well-lit, especially at night.
5. Accessibility: The route is accessible for people with disabilities.

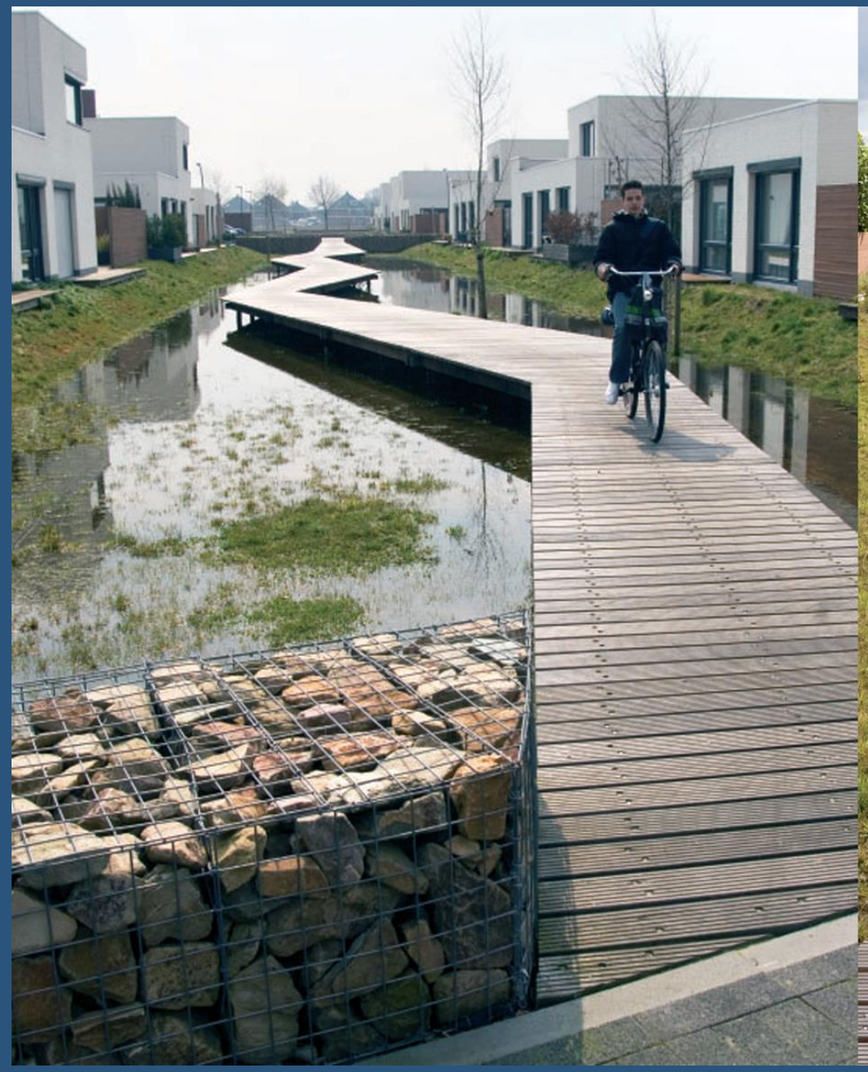
Flood evacuation routes can be:

1. Roads: Designated roads that are elevated or protected from flooding.

2. Pedestrian paths: Marked paths for pedestrians to follow.

3. Bridges: Elevated bridges that connect flood-prone areas to safer locations.

Flood Evacuation Route in Low lying Areas



Why Theory fails?

A classic example of what do we mean by Environmentally Integrated?

Why Theory fails?

A classic example of what do we mean by Socially Engaged and Shared Responsibility?

Thoughts for Thinking

- Our Goal is not only Prevention & Control of Floods but also gainful **Utilization of Flood Water** for the benefits of people and environment.

- **Nature based Solutions** have a key role to play, however, their integration with **Infrastructure Development & Management and Digital & AI Technologies** can yield far better results

- There is a strong & urgent need to revisit our **Heuristic Knowledge & Wisdom**

- **Community Engagement** is a must in our multi-pronged approach

Thoughts for Thinking

- ❑ Obviously one size can’t fit to all our needs – **Customized Solutions** need to be worked out for each city
- ❑ Investment in shaping our future cities has a great **Value for Money** as more than two third of the global population will be living in urban areas by 2050
- ❑ Storm-water Drainage Planning & Design need to be based on **RSP 8.5 or more**
- ❑ A lot has been done – but still a long way to go on the path of **Knowledge Sharing**

THANK YOU

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