

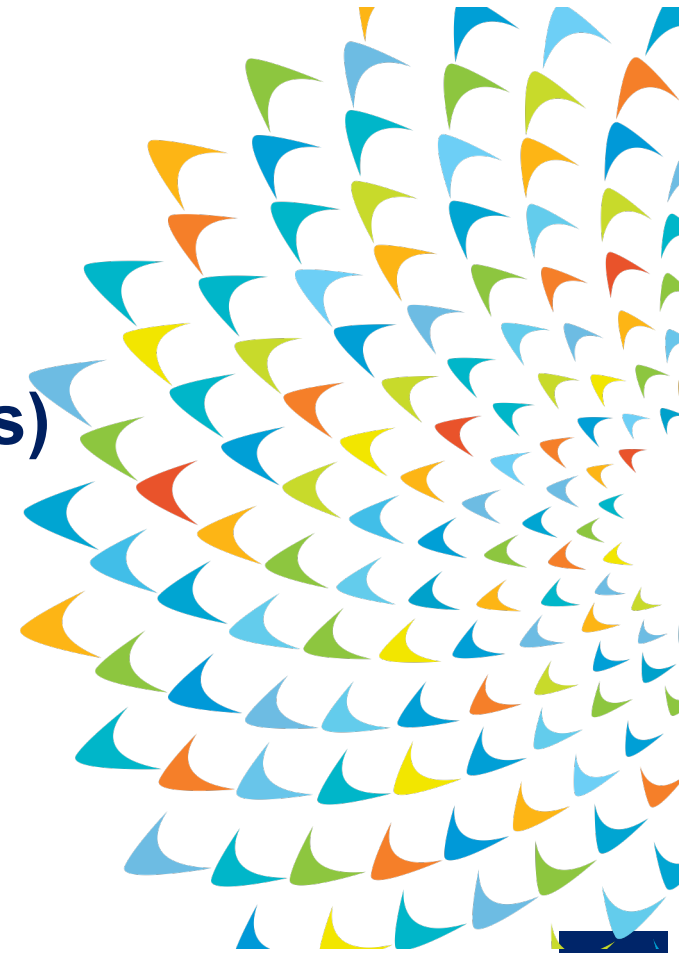
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# **Resilience to Floods (rather than resistance to floods)**

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# Flood Resilience

Resilience: “the capacity of the system to continue providing its function in the face of short-term shocks and long-term stresses”

Flood Resilience: “the capacity of physical, financial, social and environmental components to continue providing flood risk management in the face of floods, climate change, population growth, and limited financing”.



# Framework for Flood Resilience

TimeFrame		Physical	Financial	Social/Institutional	Ecological
Lifecycle stresses	Now	Risk-informed flood management plan Capital works (structural) Critical infrastructure	Reserves & loans EIRR & residual risk CAPEX & OPEX planning, budgeting and financing	Non-structural: Capacity building Governance Flood risk maps Landuse planning/consents Building codes Community consultation Pro-vulnerable investments	NbS/SuDS/LID, conservation, restoration, rehabilitation, biodiversity, ecosystem services, sponge cities, room for river
	+X years	Climate adaptation works Landuse adaptation works	As above + climate financing		
	End of Design Life	Remove, replace, rehabilitate, decommission works	Planning, budgeting and financing to remove, replace, rehabilitate, recommission		As above +sediment
Flood Event Shocks	Pre-Event	Maintenance works Data collection O&M	Planning, budgeting and financing for maintenance, data collection & community preparedness	Community awareness & preparedness Evacuation routes and safe zones Formal & informal networks	Maintenance (dredging, vegetation trimming)
	During Event: < Design	Data collection Monitor performance		Safety - Flood forecasting & early warning system. Community dissemination	Ecology renewal, erosion, floodplain renourishment of sediment
	During Event: > Design	Data collection Freeboard, sandbags, temporary flood structures		Safety - Flood forecasting & early warning system, community dissemination, evacuation routes, gender sensitive shelters, police/army/civil-defense	
	Post-Event	Data collection Build-back-better Rehabilitation &	Post-disaster financing, grants, contingent disaster financing, emergency assistance,	Safety - Emergency response Community cohesiveness Public health	Water quality & environmental health

TimeFrame		Physical	Financial	Social/Institutional	Ecological
Lifecycle stresses	Now	Risk-informed flood management plan Capital works (structural)	Reserves & loans EIRR & residual risk CAPEX & OPEX planning, budgeting and financing	Non-structural: Capacity building Governance Landuse planning/consents Building codes Community consultation Pro-vulnerable investments	NbS, conservation, restoration, rehabilitation, biodiversity, ecosystem services, sponge cities, room for river
	+X years	Climate adaptation works Landuse adaptation works	As above + climate financing		
	End of Design Life	Remove, replace, rehabilitate, decommission works	Planning, budgeting and financing to remove, replace, rehabilitate, recommission		As above +sediment
Flood Event Shocks	Pre-Event	Maintenance works Data collection O&M	Planning, budgeting and financing for maintenance, data, community preparedness	Awareness preparedness Evacuation routes and safe zones Formal & informal networks	Maintenance (dredging, vegetation trimming)
	During Event: < Design	Data collection Monitor performance		Safety - Flood forecasting & early warning system. Community dissemination	Ecology renewal, erosion, floodplain renourishment of sediment
	During Event: > Design	Data collection Freeboard, sandbags, temporary flood structures		Safety - Flood forecasting & early warning system, community dissemination, evacuation routes, gender sensitive shelters, police/army/civil-defense	
	Post-Event	Data collection Repair, Build-back-better	Post-disaster financing, insurance, relief funds, contingent financing	Emergency response Community cohesiveness Health	Water quality & health



# Flood Resilience

- Flood mitigation is all about balancing storage and conveyance
  - **Storage**:- within floodplains, reservoirs, retention basins
  - **Conveyance**:- within main channels, floodways, pipes
  - ➔ Room for the River: both storage and conveyance requires room
  - ➔ Resilient for future – plan & secure the land now.





# Flood Resilience

- Adaptive solutions
- Malleable (non-brittle) solutions
- Top-down vs bottom-up approaches



# Resilience Qualities

- **Reflective.** People and institutions systematically learn from experience, with an adaptive planning mindset that accepts unpredictable outcomes. They have mechanisms to continuously modify standards based on emerging evidence, rather than seeking permanent solutions based on an assessment of today's shocks and stresses.
- **Robust.** Robust city systems are designed and managed to withstand the impacts of extreme conditions and to avoid a catastrophic collapse of the city from the failure of a single element. A robust system anticipates system failures and makes provisions to maximize predictability and safety.
- **Redundant.** Redundancy is to deliberately plan capacity to accommodate for increasing demand or extreme pressures – if one component of the system fails, other pathways or substitutable components can meet essential functional needs. One example is having multiple pathways to access water, such as city supply, water tankers, wells and tanks etc. Overreliance on a system 'fail-safe' can expose an underlying lack of resilience.
- **Flexible.** Flexibility is a city with systems that can change, evolve and adopt alternative strategies (in either the short or longer term) in response to changing conditions. These systems tend to favor the decentralization of conventional infrastructure new technologies. For example, super storm Sandy in New York has brought into focus the value of decentralized energy systems in urban centers.
- **Resourceful.** People and institutions should invest in capacity to anticipate future urban conditions, set priorities, and mobilize and coordinate the resources (human, financial, and physical). Resourcefulness prepares a city to respond quickly to extreme events, modifying organizations or procedures as needed.
- **Inclusive.** An inclusive approach is one that includes the consultation and engagement of communities, particularly those who are vulnerable. A city cannot build resilience in isolation of others. Resilience needs collective ownership and joint vision from various groups within the city.
- **Integrated.** City systems, decision making, and investments should be mutually supportive of a common outcome. Resilient system integration has evidence of systems that exist across different scales of operation. Integration requires ongoing feedback system for collection of information and response.