South Asia

Islamic Republic of Pakistan: Emergency Flood Assistance Project

Climate change risk screening and assessment

Dr Steven Wade

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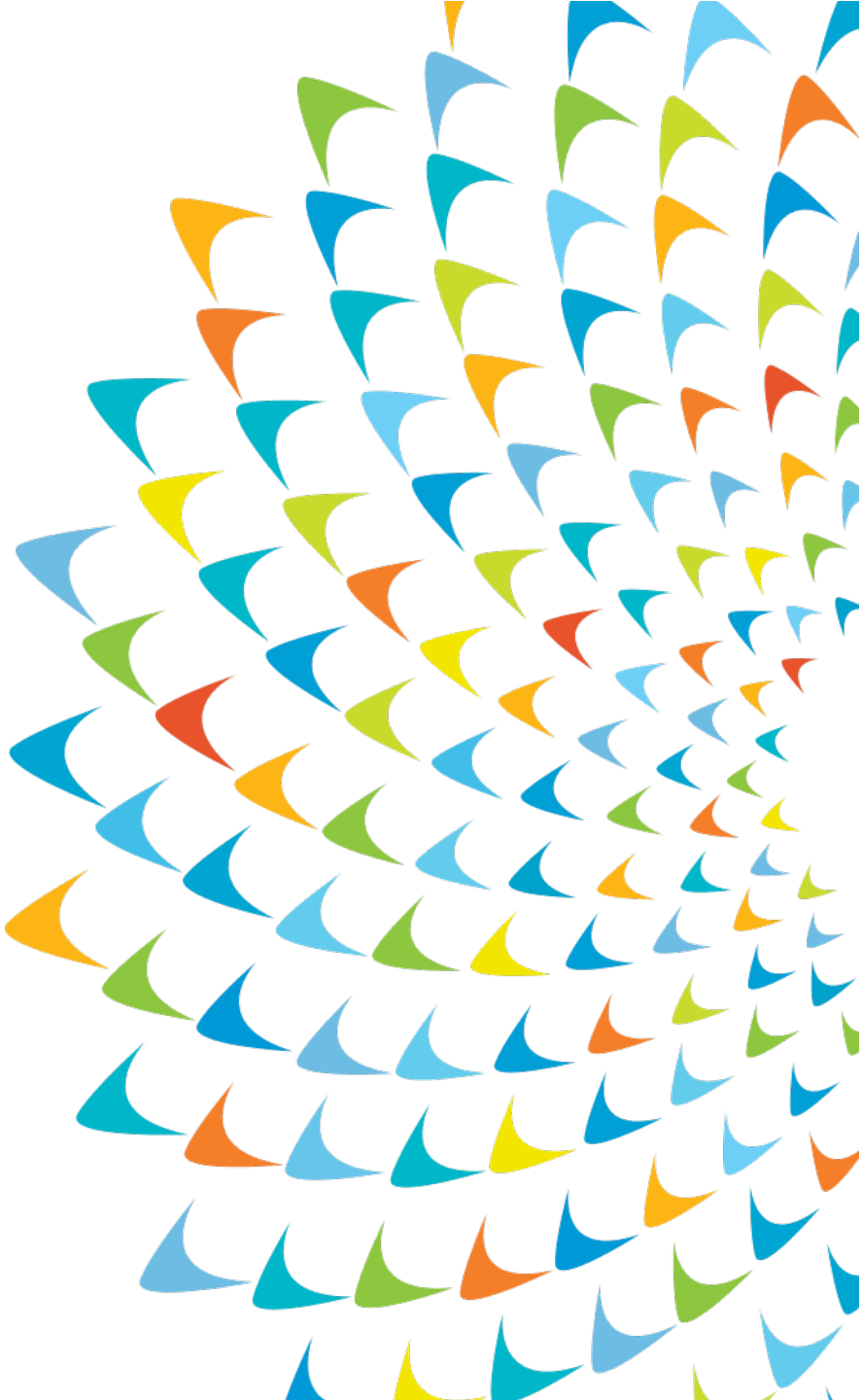


Proposed approach

Vision

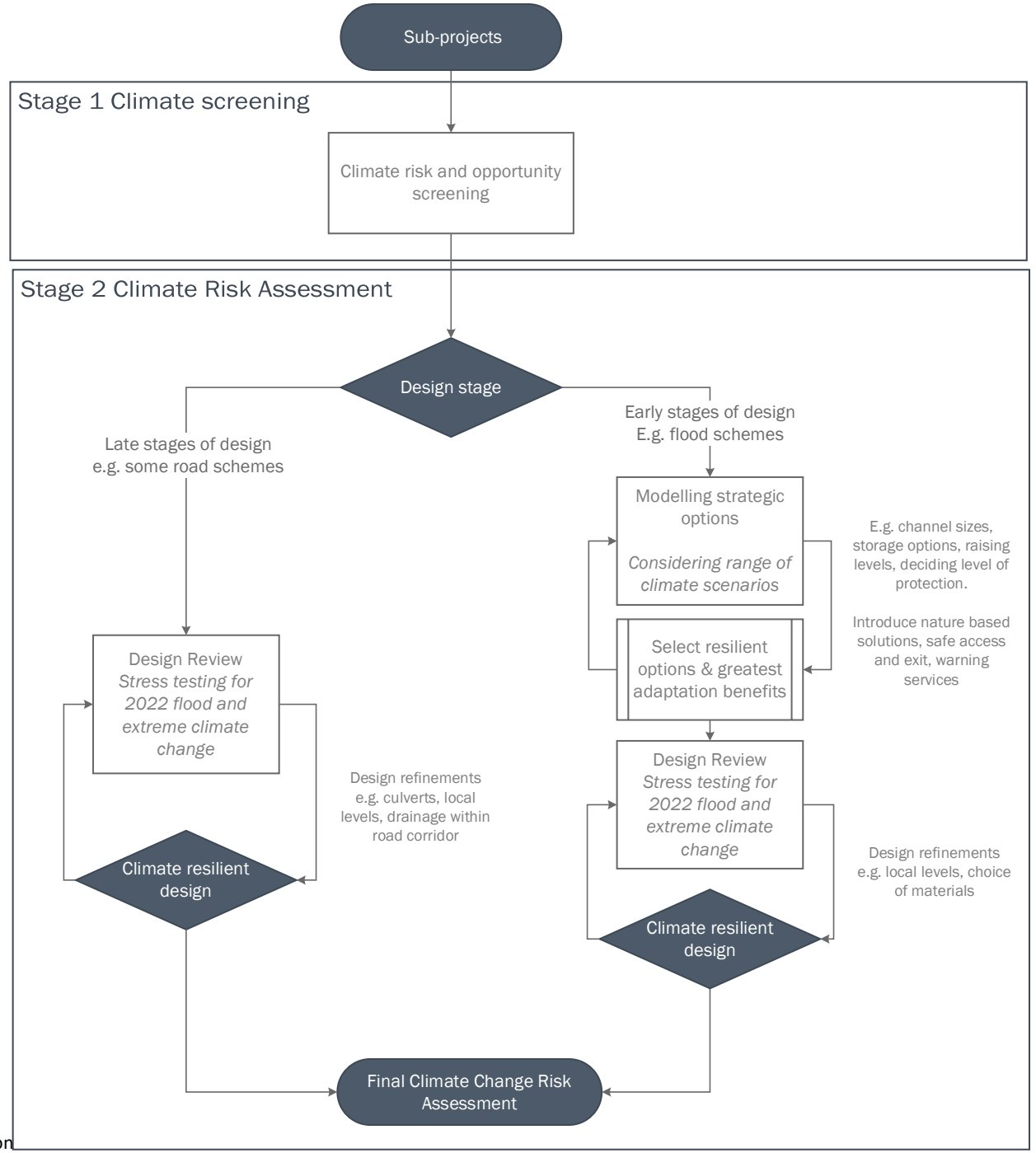
- Ensuring climate resilience and identifying opportunities for improvements.

Stage 1 Climate risk and opportunity screening

- Provides essential information about sub-projects including hazard exposure and vulnerability

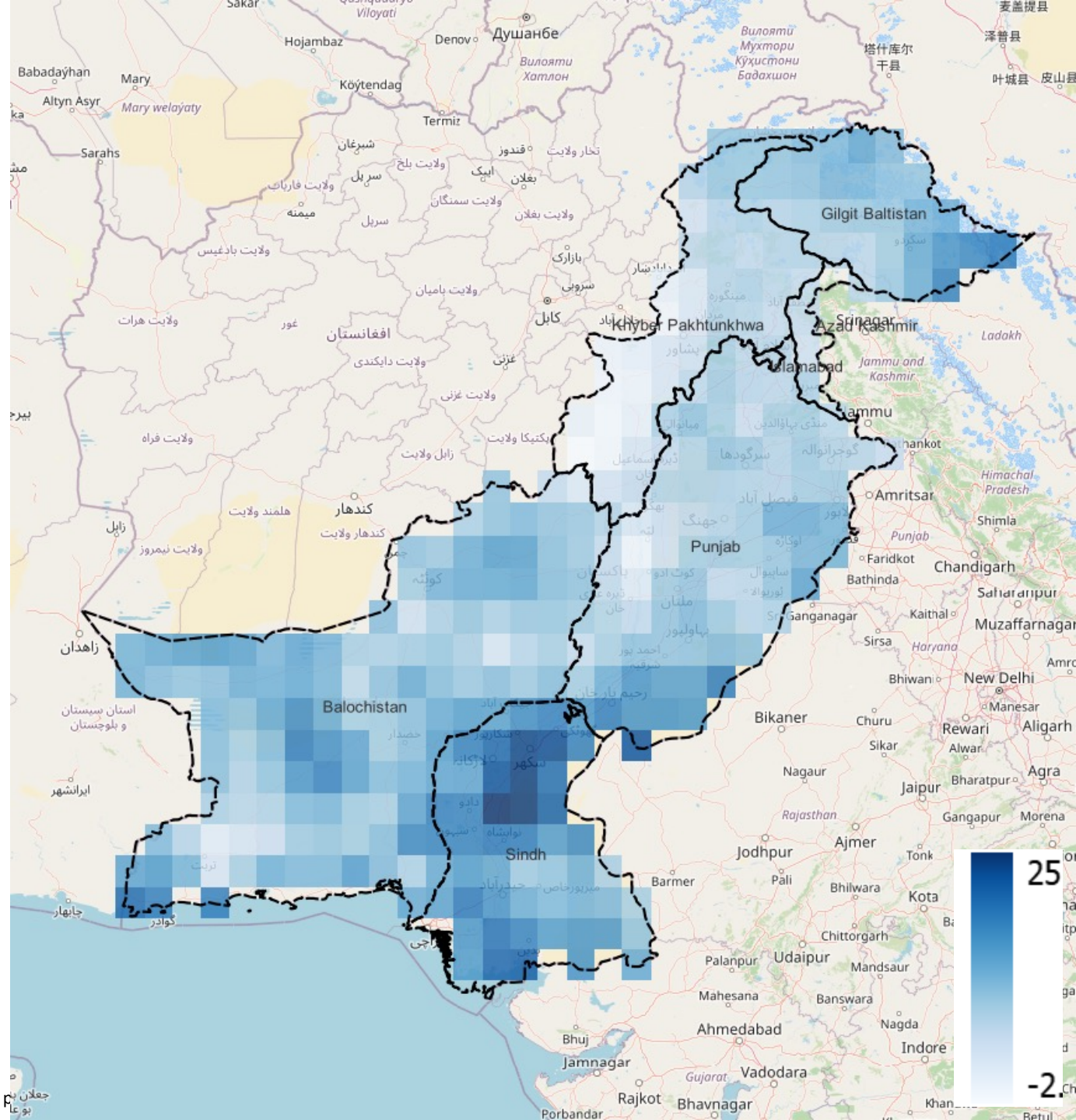
Stage 2 Climate Risk Assessment.

- Analysis of **strategic options**
- **Iterative process** not an *a priori* design criteria for 'climate proofing'
- **Stress testing** or near final design on all projects



Average changes in heavy rainfall and maximum temperatures 2050s

- CORDEX S ASIA ~ 20%
- CMIP6 downscaled RX-5 day
  - 18% SSP2 45
  - 32% SSP5 85
- CMIP6 downscaled Tmax
  - 1.8^{o}CSSP2 45
  - 2.5^{o}C SSP5 85
- Likely increase in snowmelt and fluvial flood risk
- Considerable uncertainty in precipitation



General guidance

Standard engineering considerations

- Consider **strategic options** including "do nothing" and option for maintaining and enhancing levels of climate resilience.
- **Sizing and capacity** of drainage systems and crossings
- **Bridge** spans, piers, deck levels
- **Slopes** of cuttings and embankments
- **Design for exceedance** considering flow paths, breach scenarios etc…
- *Generally captured in **design standards** and **guidelines***

Integration with flood risk management

- **'Maintaining'** or '**enhancing'** flood resilience may include channel sizing, flood storage, bypass channels, bank protection, larger culverts/bridge structures and changing road levels.
- Consider s**afe access, exit, refuge** where roads can have a key role during floods
- Consider other **strategic** and **property level flood resilience** measures along the road corridor.
- *Achieved by taking a **systems approach** and **collaboration** between projects.*

Climate adaptation

- Avoid **maladaptation** and **"lock-in"** that continue to place communities at risk.
- Providing **integrated resilient road systems** that continue to operate through extreme floods, providing **multiple benefits**.
- **Nature based solutions** particularly opportunities for flood storage to prevent flooding
- **Weather and climate services** providing information on risks and early warning systems.
- *Achieved by taking a **long term view** and considering links with **climate change***

International examples: Transport projects in flood sensitive areas

- Typical actions to manage flooding include:
  - Options appraisal considers multiple climate and environmental criteria
  - No worsening of flood risk upstream or downstream of road developments
  - Inclusion of additional storage
  - Inclusion of climate change allowances
  - Widening bridges
  - Inclusion of river and drainage monitoring
  - Operational metrics linked to weather and climate include *"the % of carriageway that does not have an observed significant susceptibility to flooding"*
  - 30 year management plans

Atkins M25 A12 interchange J 28 – improved the water environment

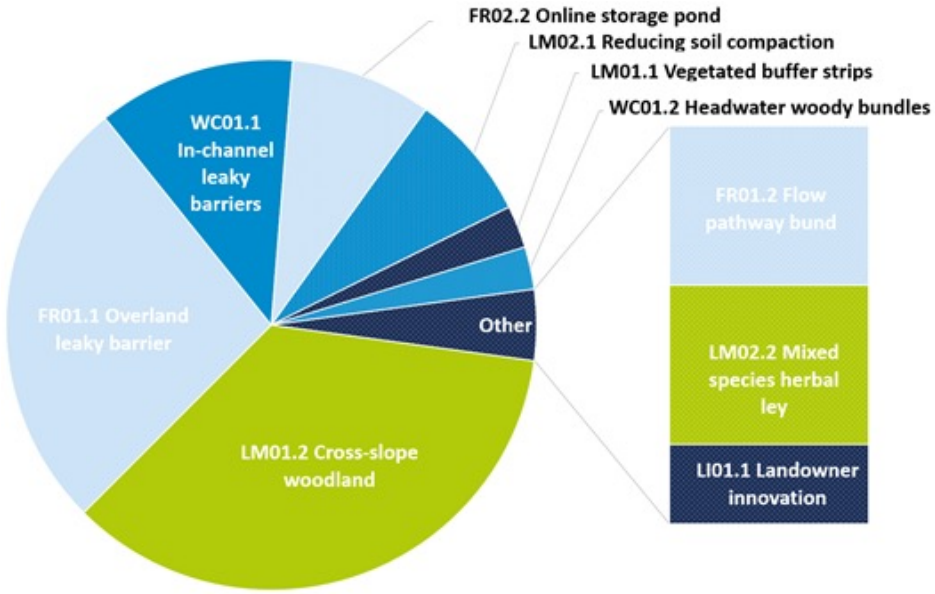
HS2 Cherwell Valley Viaduct – allowing free flow of flood water

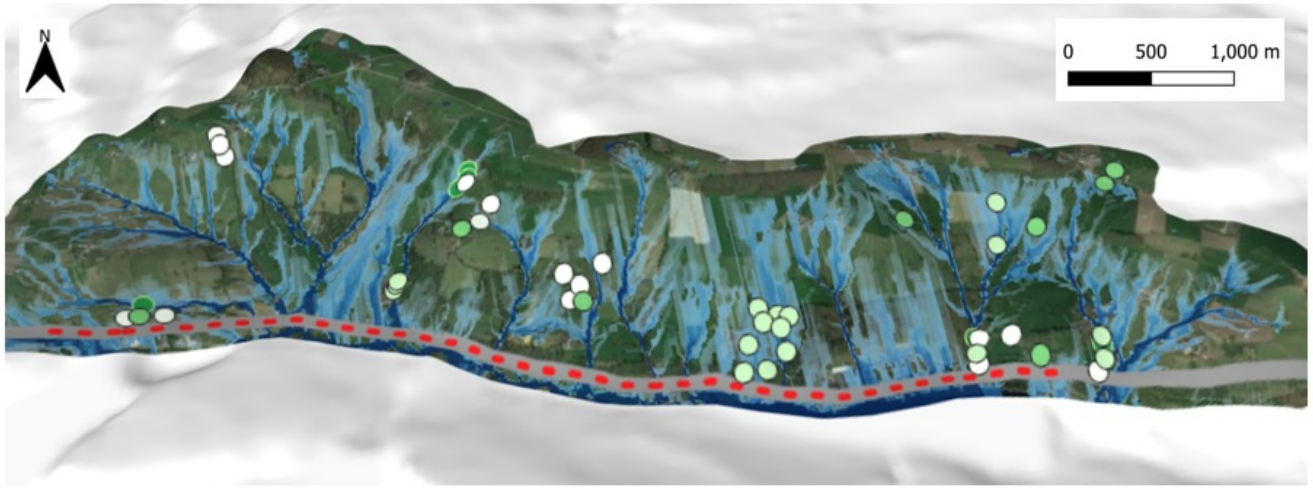
International example: River erosion ~ A40 Afon Twyi

- **Strategic and whole catchment assessment of flood and erosion risks** including an iterative approach
- Case of historic alignment “locking in” future risk.
- Consideration of options for increasing road resilience, threatened by highly active river
- Including potential for realignment versus bank strengthening and erosion protection
- Flood risk and erosion assessments including climate change

International Example: UK National Highways Natural Flood Management Pilot: Using **nature-based solutions** and an innovative approach to reduce surface water flooding on motorways and trunk roads.

- Increasing catchment water storage to reduce flooding on a major road
- Payment to land managers to reduce flood risk as well as funding to highways operator
- *Potential to link road improvements, land management and flood risk management?*





NFM measures funded by Pilot
- Land management (soil de-compaction)
- Land use (cross slope woodland & hedges)
- Flow pathway (storage)
- In-channel (leaky barriers & bundles)

Flow paths and connectivity
- 0.25 (low connectivity)
- 0.50
- 0.75
- 1.00 (high connectivity)

General
- Section of road liable to flooding
- A616 Road

Practical implementation

- The **DRAFT CLIMATE CHANGE RISK MANAGEMENT FRAMEWORK** (PAM Appendix 2) provides high level guidance.
- National Climate Change Specialists need to work closely with road engineers and hydrologists and be part of the engineering feasibility teams
- Climate screening can be completed rapidly for the whole project (map project infrastructure with climate, hazards and other data) (National Climate Change Consultants and potential to integrate across the whole project)
- Broad scale hydrological modelling and hydraulic modelling can be completed for all river crossings to aid culvert sizing
- More detailed assessments are needed where communities are at high risk of flooding and where there are opportunities to enhance protection
- Stress testing is essential to understand the consequences of high impacts scenarios including 2022 flood and future climate scenarios (National Climate Change Consultants and Hydrologists)
- Need to establish **Implementing Agency design guidance** and agreed approaches on **collaboration** including **data sharing across teams** (choice of scenarios etc…).

Thankyou

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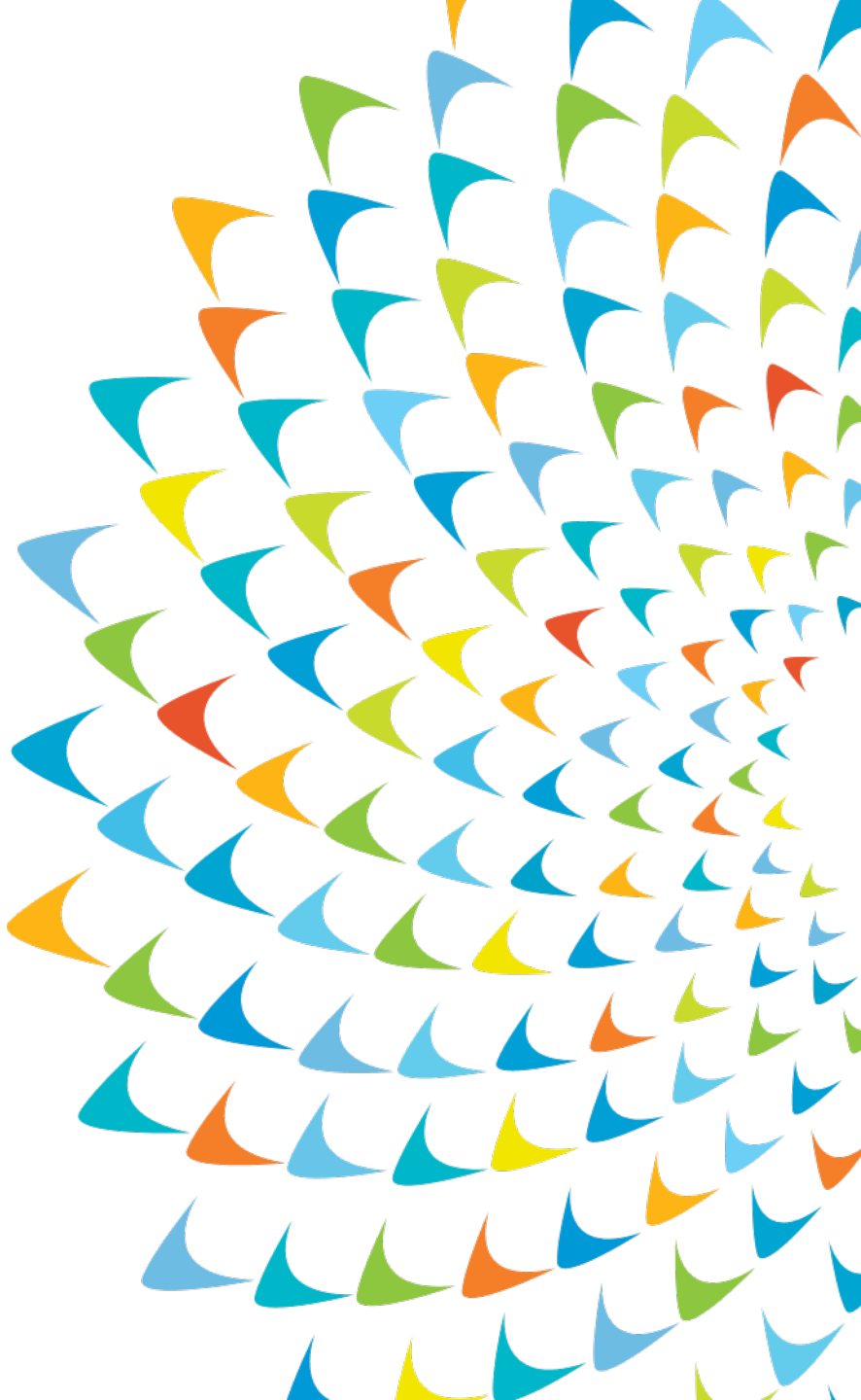
Further background slides attached



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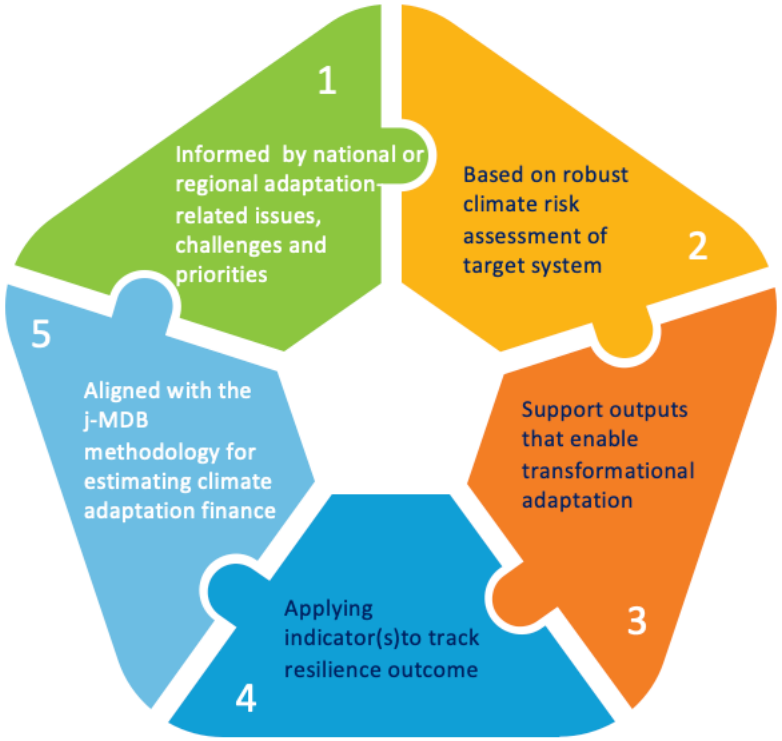
Types of climate change projects

Can the project be considered as a Type 2 climate adaptation project?

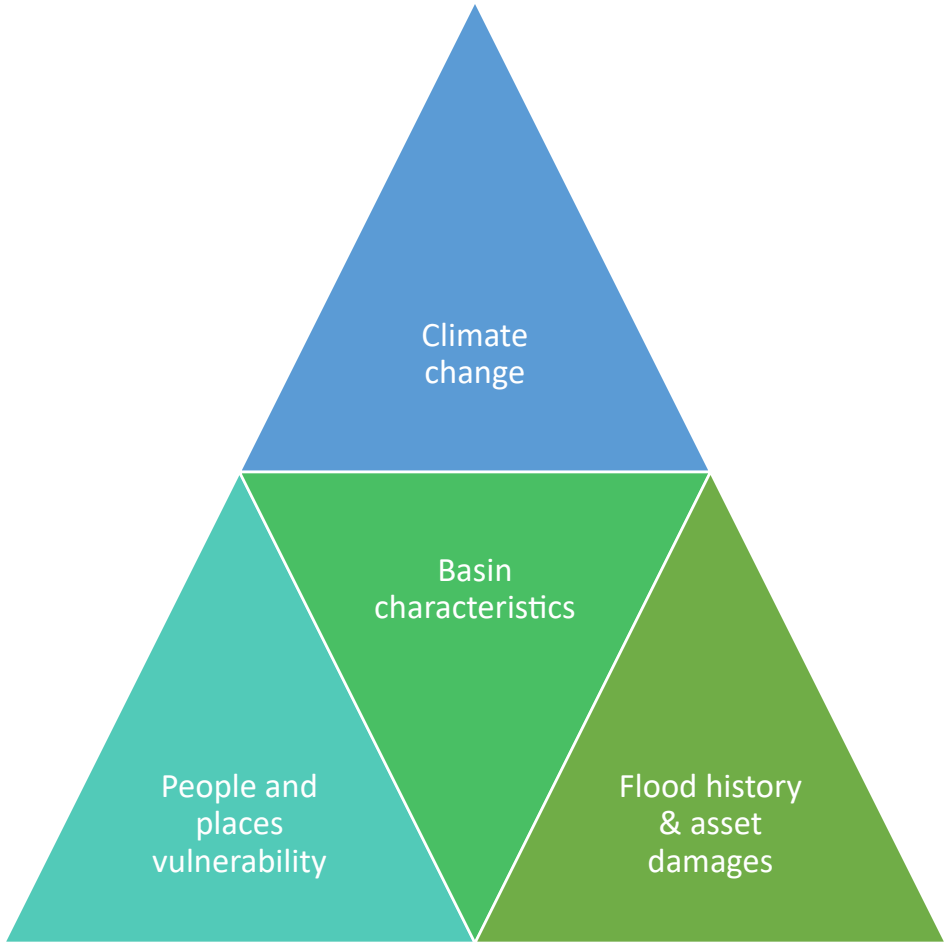
Five principles of Type 2 projects



Source: ADB *draft*

- All projects must be Paris-aligned
- ADB Type 1 projects include *"climate proofing"* to protect investments from future climate risks.
- **Type 2A projects include further climate adaptation activities and include at least one *climate resilient output* to support development outcomes.**
- **Type 2B projects are needed because of climate change and are focused on delivering a number of *climate resilience outputs* and *overall climate resilience outcome*.**

Climate risk and opportunity screening



- Basin characteristics to understand flood hazard
  - Catchment classes based on AREA, stream length and TC
- Flood history to understand frequency
  - High, Medium, Low based on flood history (2003-2022)
  - Damage and loss of assets in 2022 floods
- Vulnerability to target activities to increase coping capacity
  - High, Medium, Low based on district socio-economic/poverty rate indicators
- Climate change metrics to indicate rates and direction of increasing risk
  - RX_{1day}, RX_{5day}, T_{max}, T_{min}, P_{annual}, mid-term changes (2050s)