ADB

Climate Risk Management

The Pakistan Emergency Flood Assistance Project: Flood-damaged irrigation, drainage, and flood risk management Infrastructure

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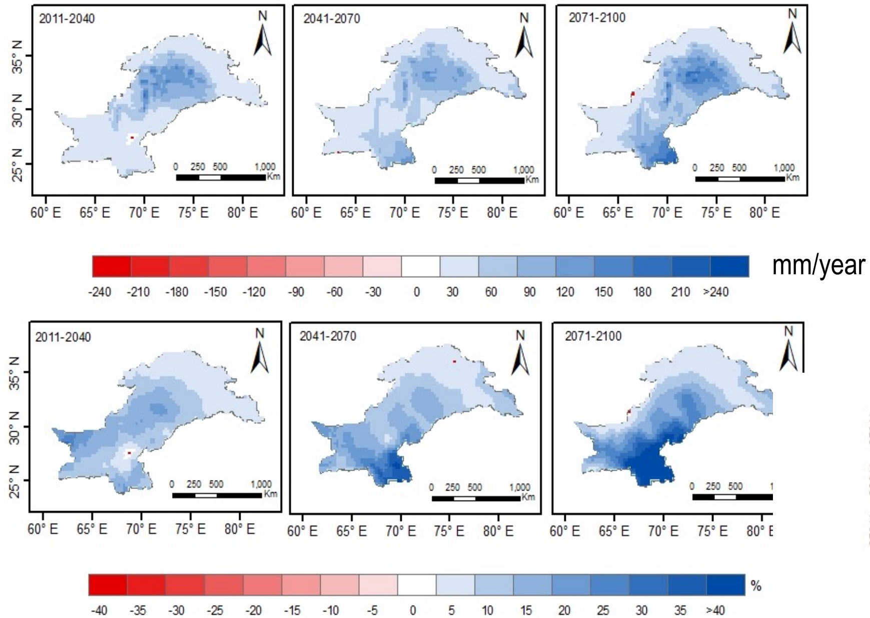
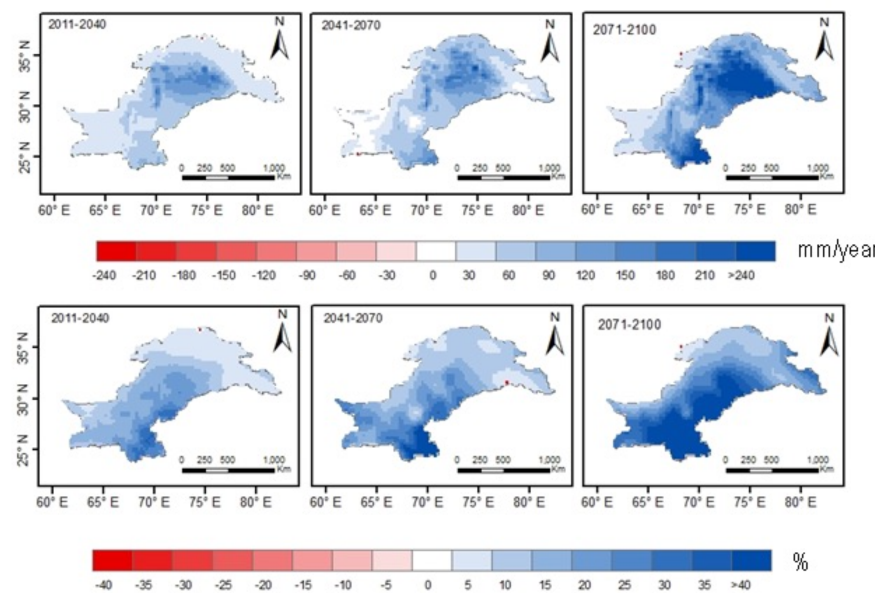
Pakistan Resident Mission

Outline

- Floods 2022, PDNA and the Project Cycle
- Guidance for Climate Risk Management
- Application
- Early Findings and Recommendations

Precipitation projections during 2011-2100





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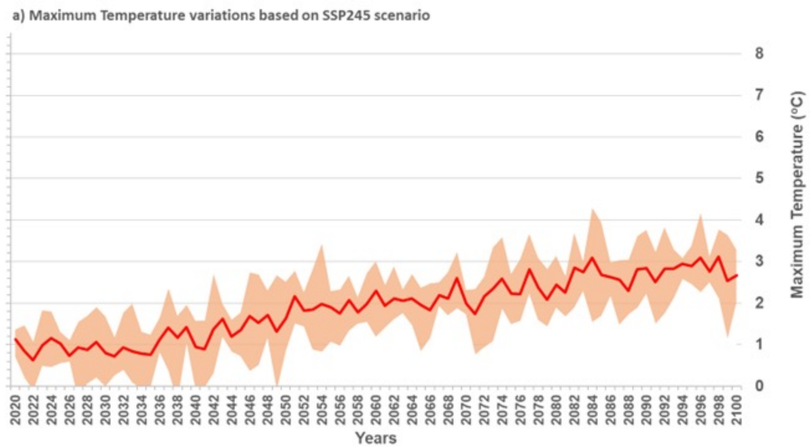
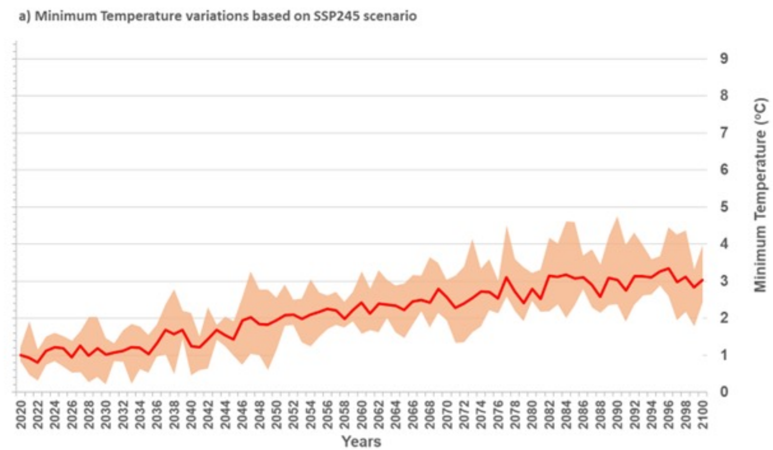
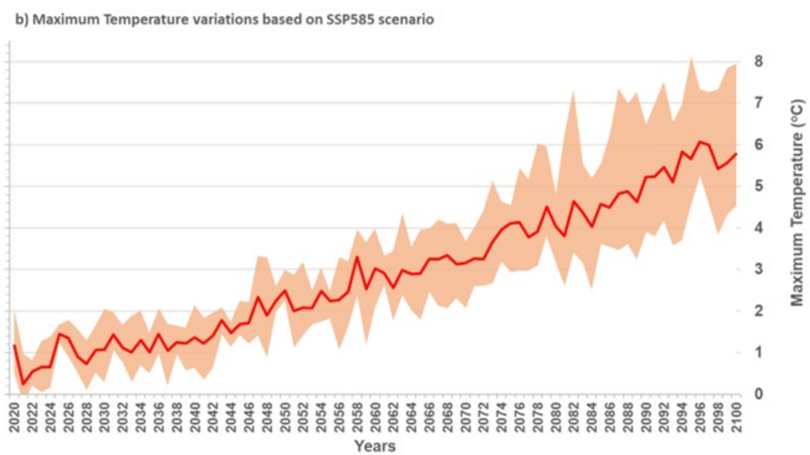
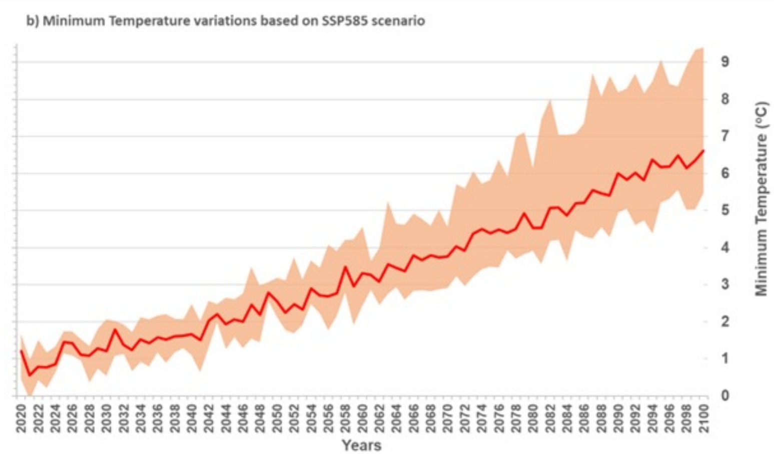
Temperature Projections during 2011-2100









Floods 2022 and the Project Cycle

Floods

June-Aug 2022

PDNA

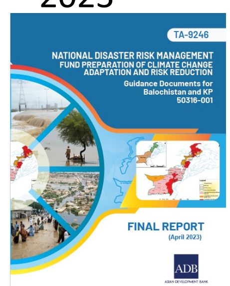
Sep-Oct 2022

Project Processing

Oct-Dec 2022 (Effective Feb 2023)

CRM Guidance Document

Jan-Mar 2023



DD Consultants Recruitment

Jan-Apr 2023

Sequential Design and Bidding

May-Dec 2023

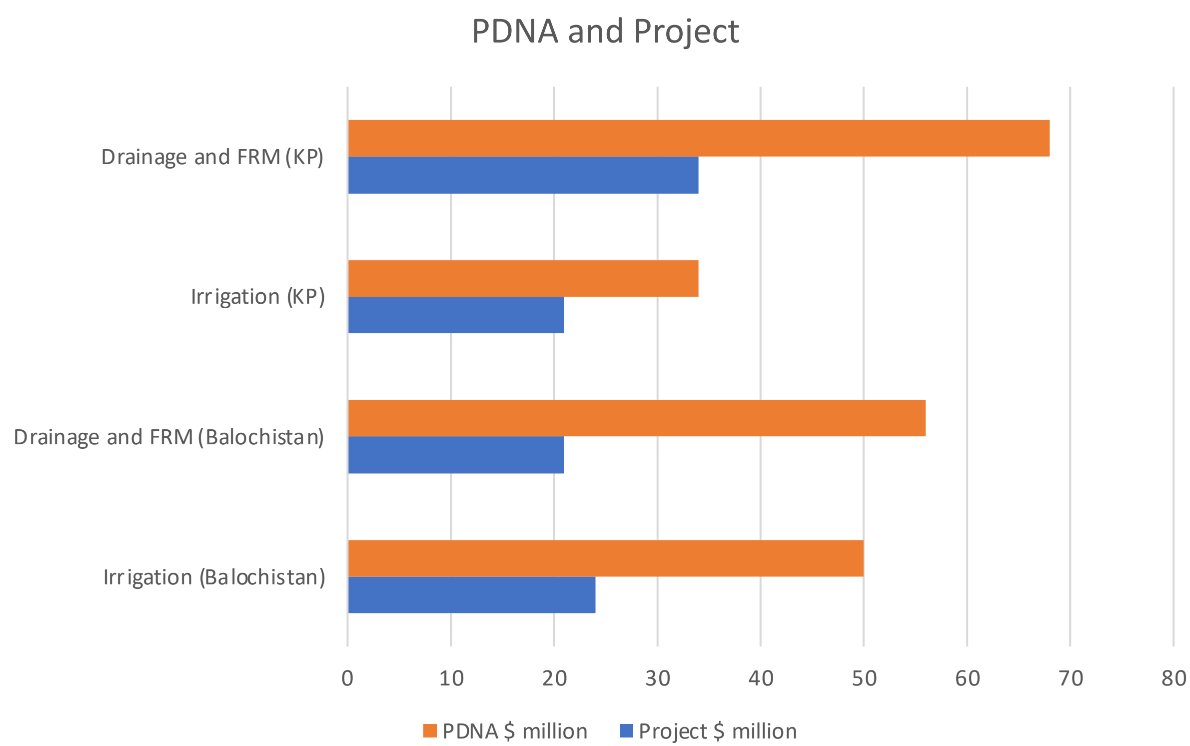
Design Cut-off 31 Dec 2023

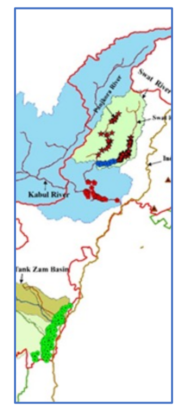
Completion

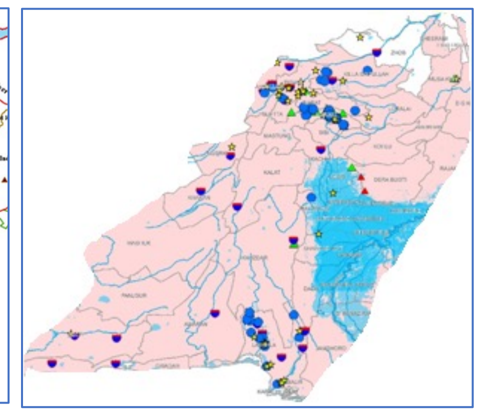
31 Dec 2025

PDNA and the Project

Irrigation, drainage, and flood risk management Infrastructure
Recovery and Reconstruction Needs: $782 million
Project Support: $110 million in two provinces (KP and Balochistan), about half of identified needs



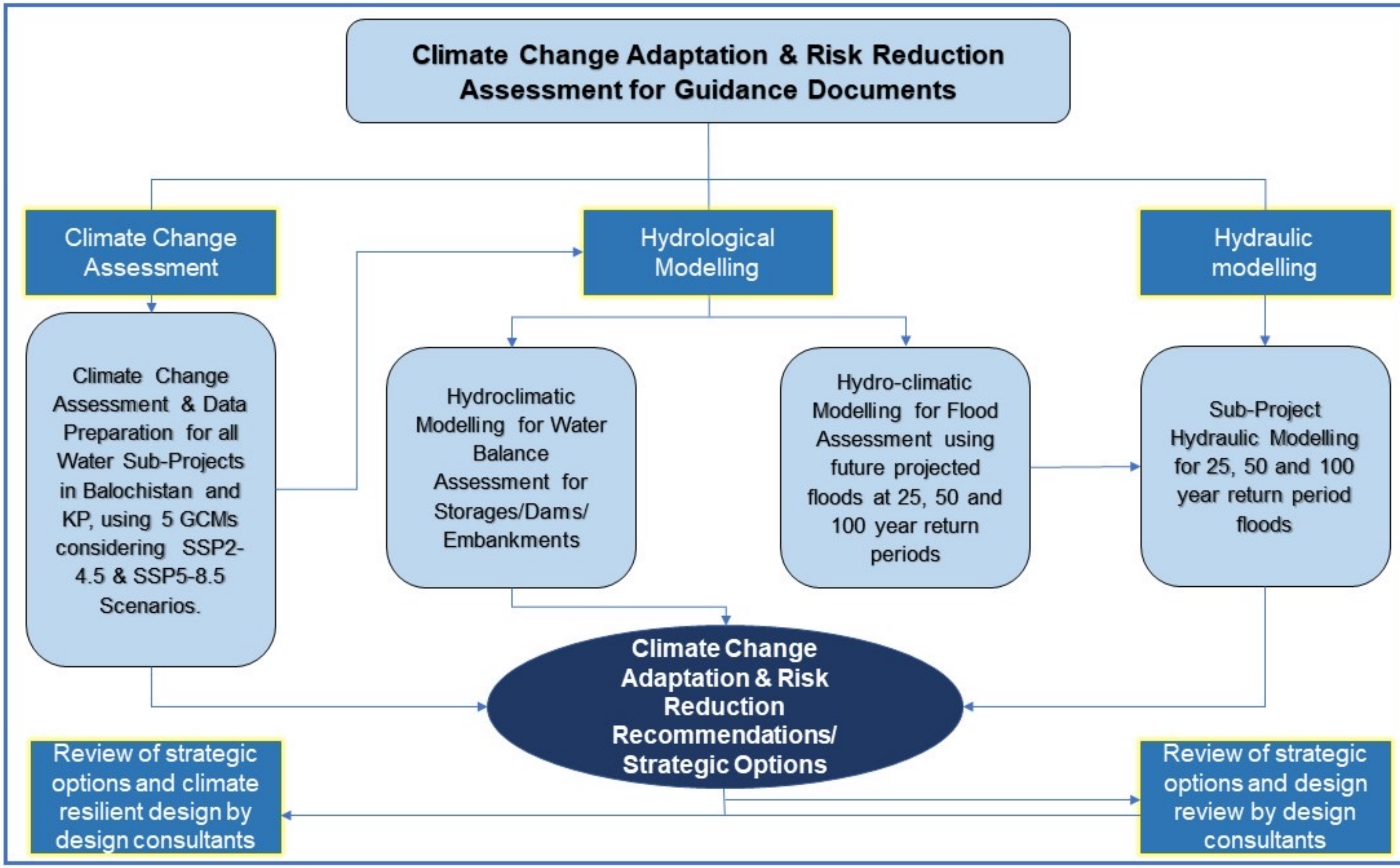




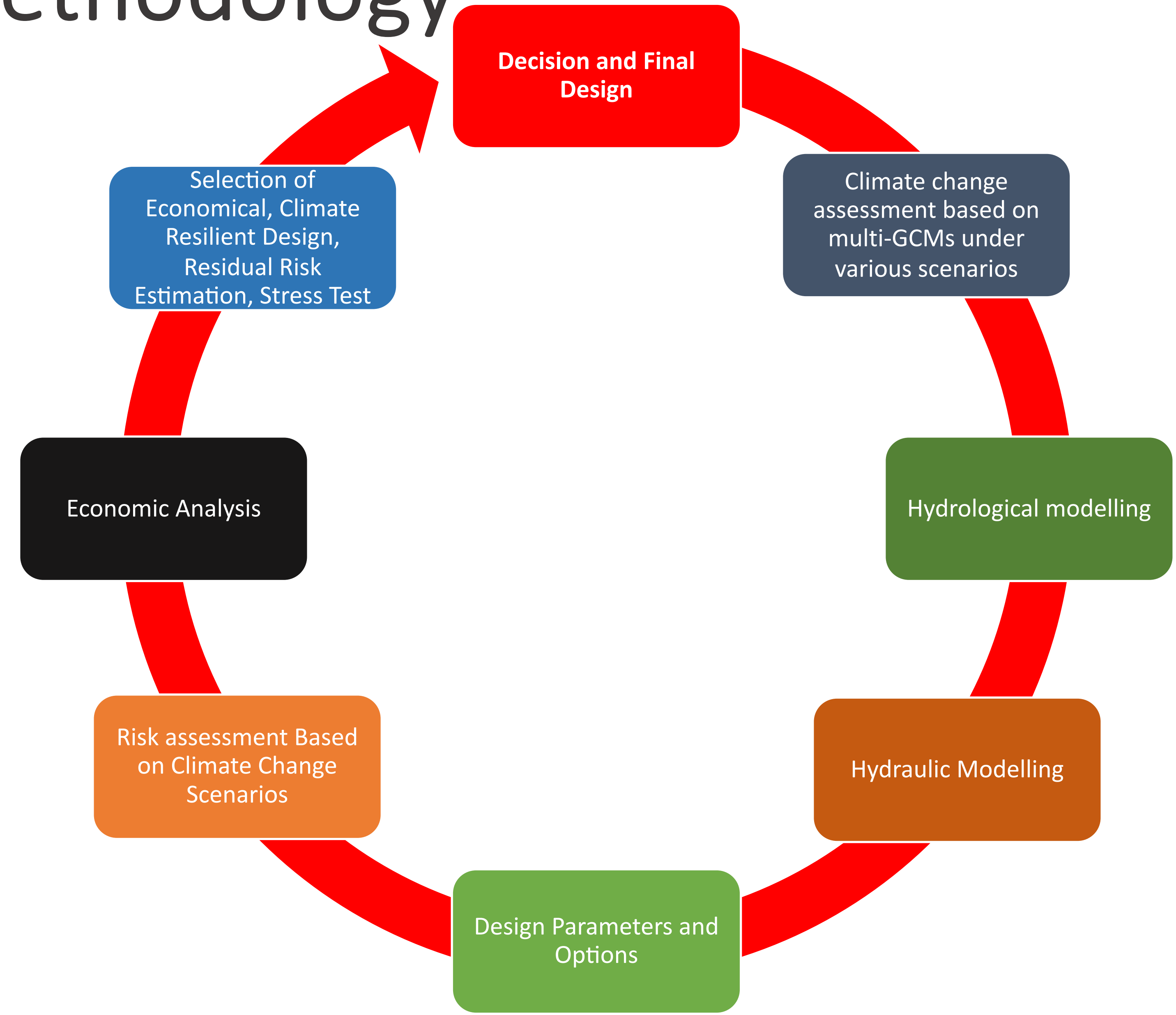

Latitude: 31.522325
Longitude: 70.75386
Elevation: 169.47±19 m
Accuracy: 9.3 m
Time: 10-12-2022 14:44
Note: Disty 18 RD 46800 near Indus highway at US 3
Powered by NoteCam


Latitude: 31.692131
Longitude: 70.669173
Elevation: 180.58±5 m
Accuracy: 10.4 m
Time: 10-12-2022 11:58
Note: CRBC main canal 382000 3
Powered by NoteCam

Early Guideline



Methodology



Methodology … *contd*

- Selection of Climate Change Models
- Selection of Hydrologic Models
- Selection of Time Series Data and Peak Factors
- Application of Hydraulic Modelling
- Climate Resilient Infrastructure Design

Climate Change Assessment

- Climate change models selection and bias-correction.
- For KP and Balochistan, several GCMs analyzed from the latest set of the CMIP-6
- Middle of the road SSP 2-4.5 and business as usual (extreme) SSP 5-8.5 scenario are suggested
- Quantile Delta Method for Precipitation and Simple Delta/Distribution Mapping method of bias-correction for temperature data

Selection of Climate Change Models

A complex task. There are many climate change models and scenarios

Three steps approach

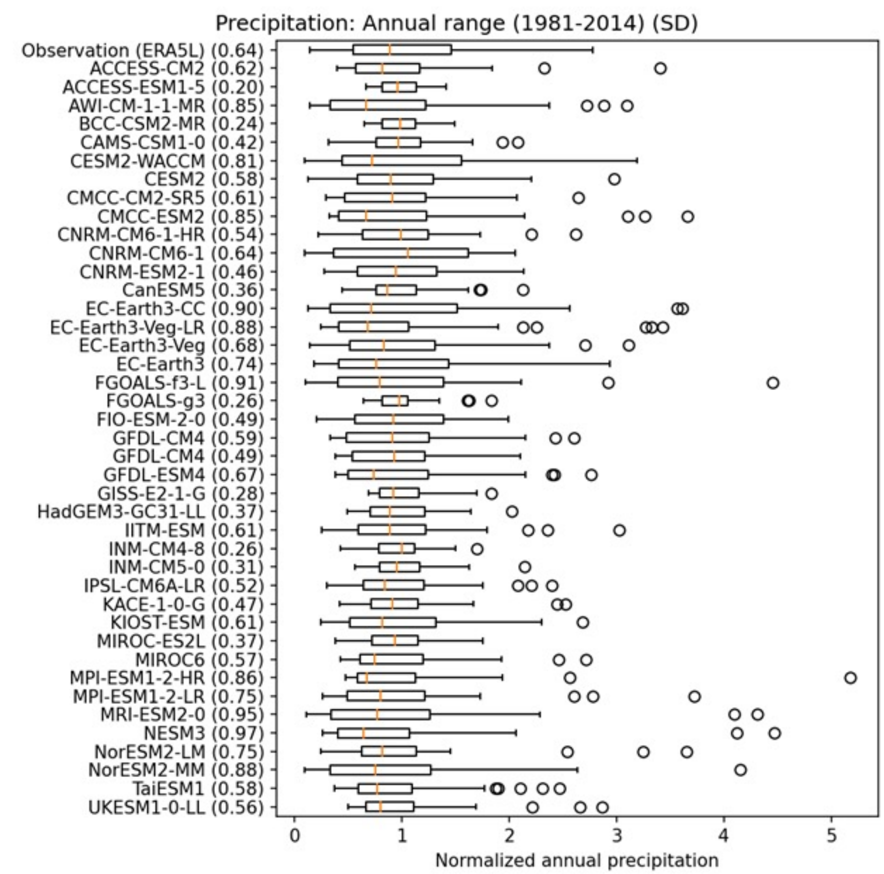
Step 1
Scrutinizing for internal variability

Step 2
Scrutinizing for best representation of the study area monthly climatology

Step 3
Selection of GCMs based on dry, wet, hot, cold and average projections

Plot GCMs data and climate stations/gridded climate data for the historic period.

The spread of box-whisker plot and outliers results in excluding few and retaining others



Three steps approach

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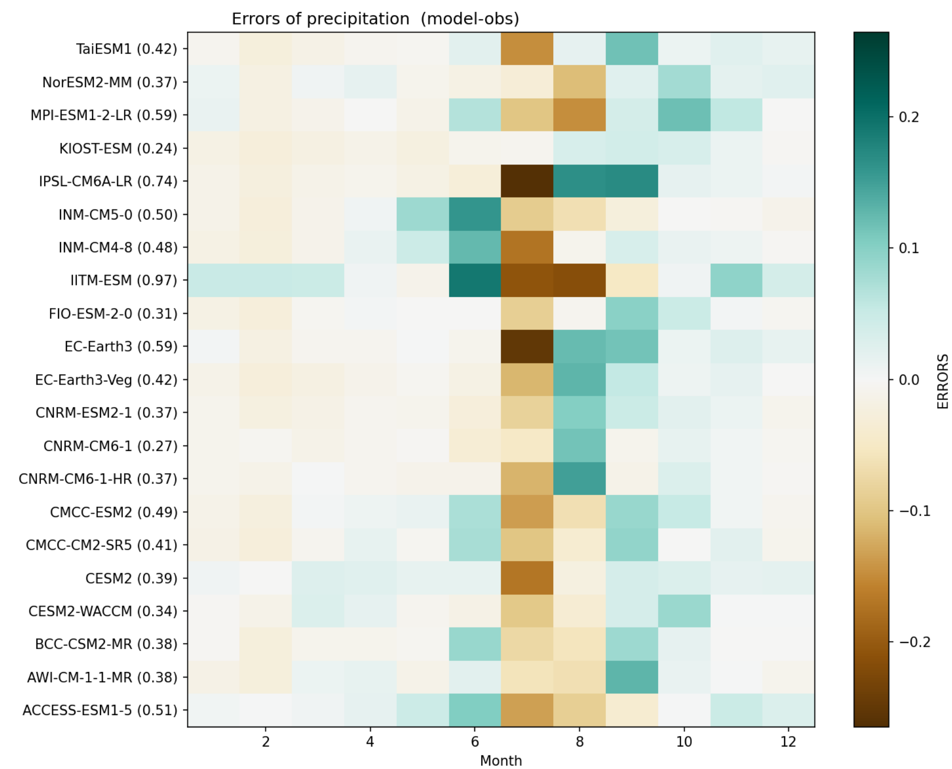
Selection of GCMs based on dry, wet, hot, cold and average projections

Compare GCMs historic monthly climatologies with the historic climate stations/gridded climate data.

This will enable excluding few of the worst available GCMs.

Selected more than 20 from 42



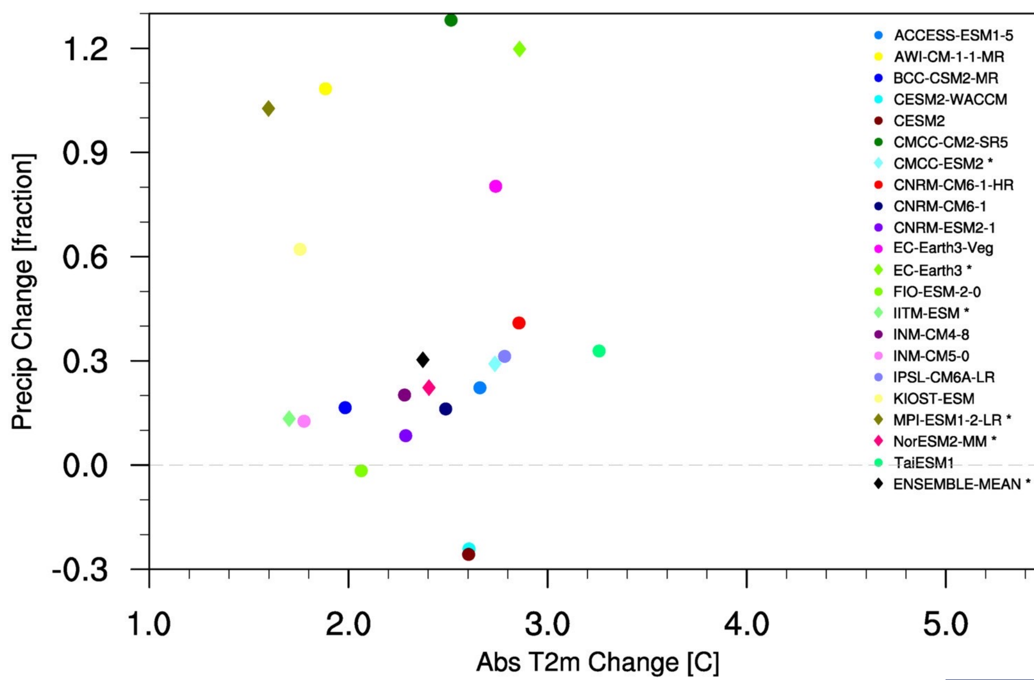
Three steps approach

Step 1
Scrutinizing for internal variability

Step 2
Scrutinizing for best representation of the study area monthly climatology

Step 3
Selection of GCMs based on dry, wet, hot, cold and average projections

The selection of 5 GCMs out of a pool of more than 20 GCMs used on dry, wet, hot, cold, and average projections of model data using 1986-2015 as base data and 2021-2100 as future projected data



Selection of Adequate Hydrological Model

Examples of suggested models:

- VIC Model
- WFLOW
- **SWAT Model**
- **HMS (with snow-melt module)**

Simple Hydrological Models (with no-snow-melt modules) are not suitable for hydrological modelling of Snow- and Glacier-melt contributing basins

Time Series Data and Peak Factors

- The time span of observed flow data available / selected is very critical.
- Hourly Peak factor important. Daily maximum flow value insufficient.
- Recommended using the longest time period data
- Recent decades to be included together with Peak Factors for instantaneous Flood
- **Time-Series, Event-based modelling with Peak factors have been used in the sub-projects**

Available Historic Data		
Peak Discharges (m³/s)		
Return Period		
25	50	100
1988-2022		
4238	5065	5886
1961-2022		
3451	4111	4767
2005-2022		
4133	4875	5612
2010-2021		
3161	3800	4434

Peak Factor	Available Historic Data		
	Peak Discharges (m³/s)		
	Return Period		
	25	50	100
1.37	1988-2022		
	5806	6939	8064
1.37	1961-2022		
	4728	5633	6531
1.16	2005-2022		
	4795	5655	6510
1.15	2010-2021		
	3635	4370	5099

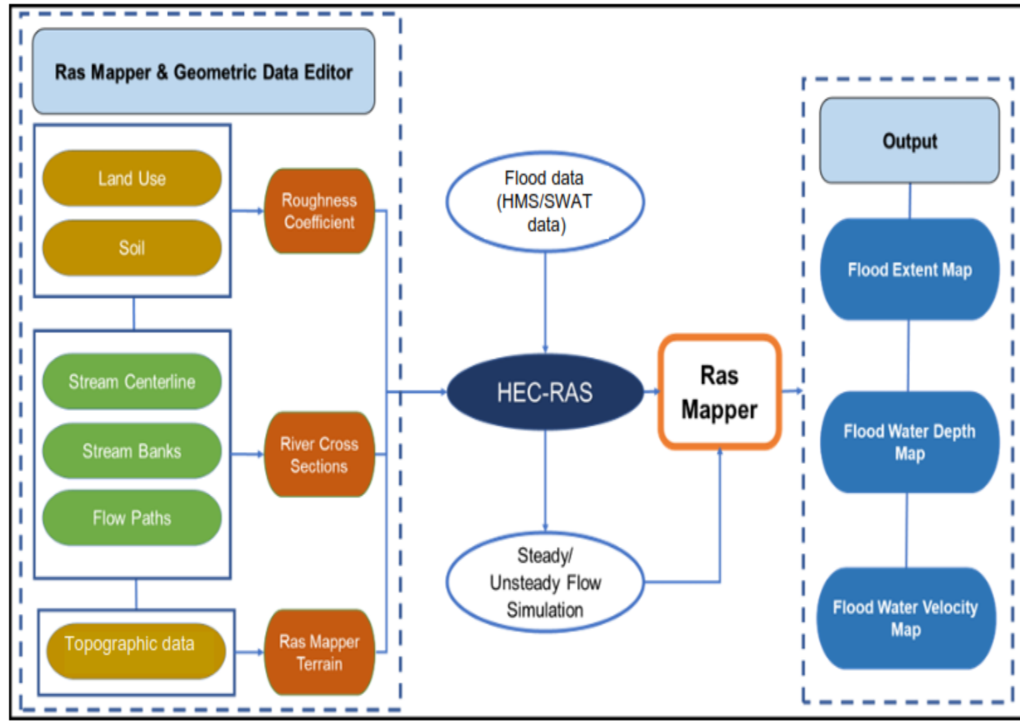
Hydraulic Modelling

- HEC-RAS 2-D modelling has been carried out for flood extents and depth assessment

- Site specific Topographic data (using Total Station, dGPS, Drones) has been used for structural design

- SRTM DEM (30m) has been used for flood extents assessment to quantify damages

- Various return period floods have been assessed for design and economic analysis

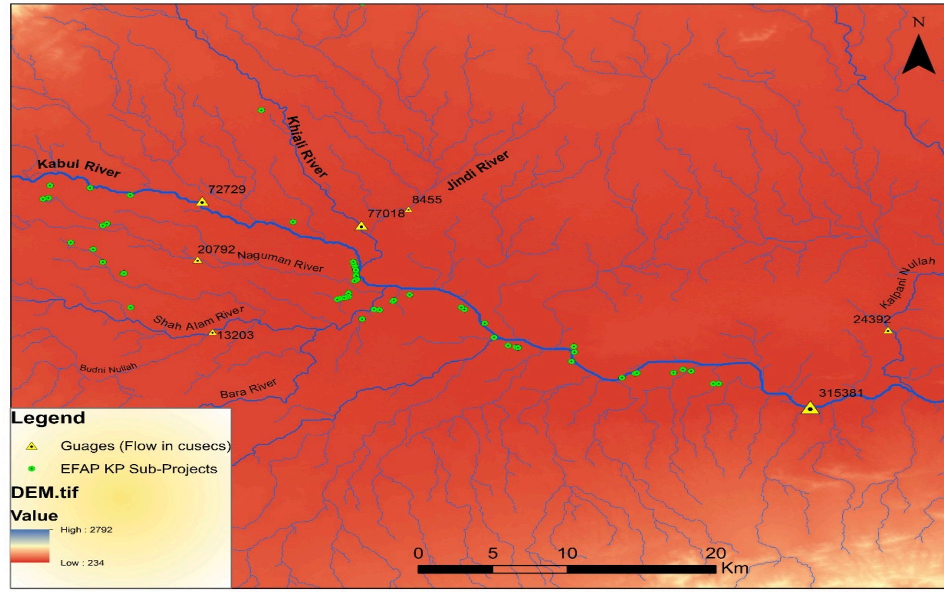


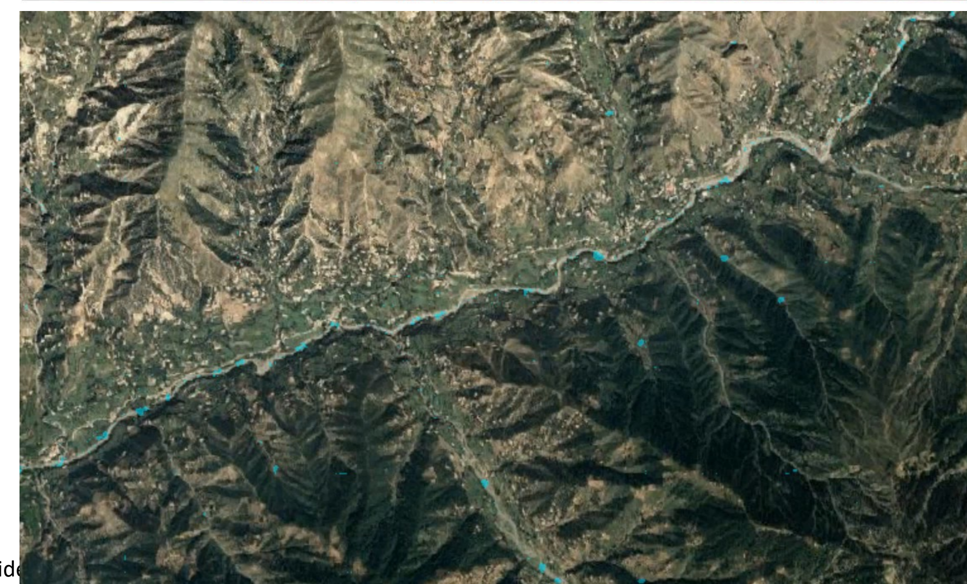
Additional Guidance on CRM

Additional studies of flood/waterway blockage due to junctions of small streams and large rivers

Recommendation on rain-on-grid modelling to assess the backwater and river/stream obstruction.

Irrigation: Increase in water/flow availability, increase in sediment transport, crop-water requirement





Sub-projects categories and screening

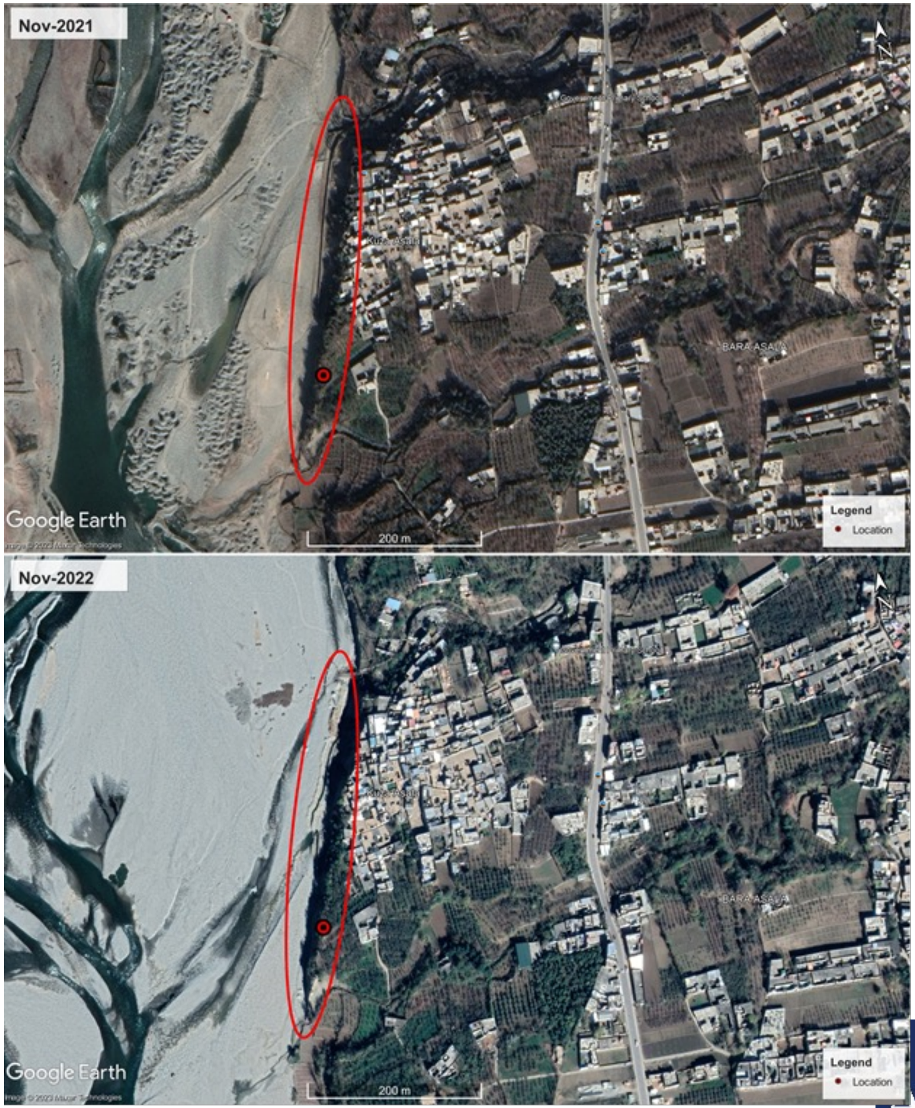
- **Category I:** maintaining the level of protection with an allowance for climate change (such as raising of structure). Less safeguards risk.

- **Category II:** climate resilient design and additional adaptation measures (such as raising or modification of structure with extension or upstream/downstream works and relocation). Safeguards sensitive with additional design considerations.

- **Category-III:** The location of the proposed structure is inadequate and need to be dropped (such as structures inside the flood plain, active streams/rivers) – do nothing/maladaptation.

Example of Cat-I

Raising of flood protection between 0.22m to 0.9m at various locations under SSP 2-4.5 scenario, and 0.3m to 2.5m under SSP 5-8.5 scenario

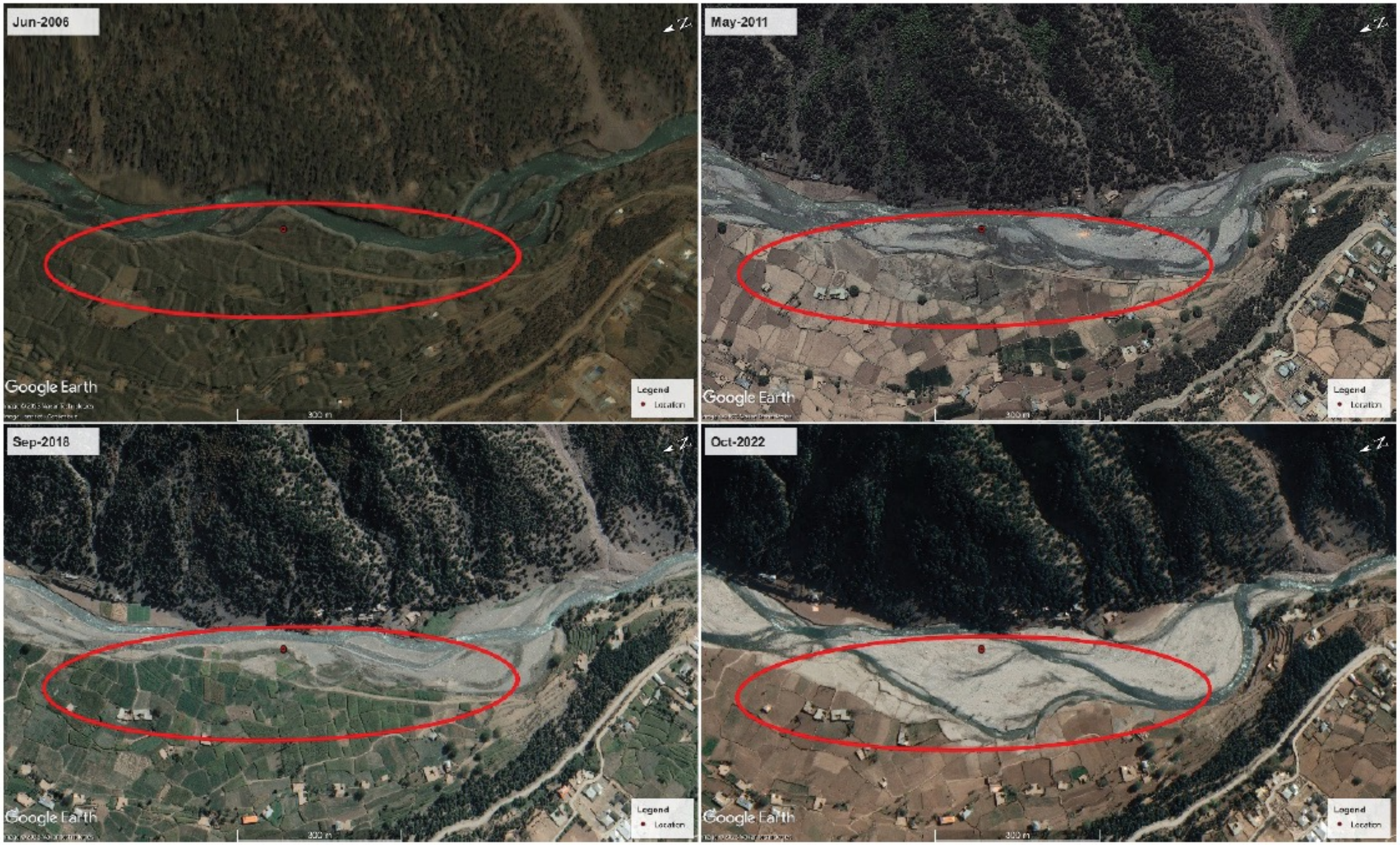


Example of Cat-II

Flood reclaimed the land - eroded agricultural lands in the flood plain.

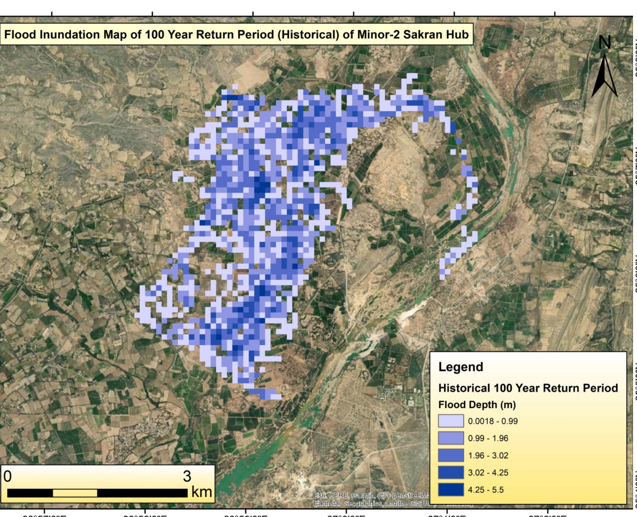
Example of Cat-III

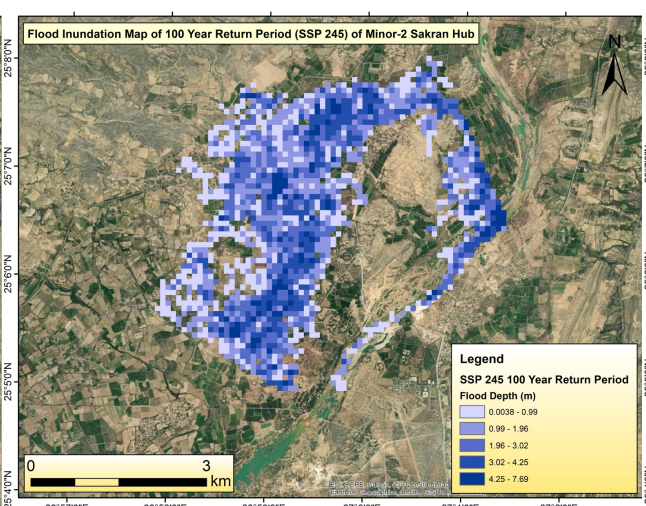
- Maladaptation. Abandonment. Do nothing.

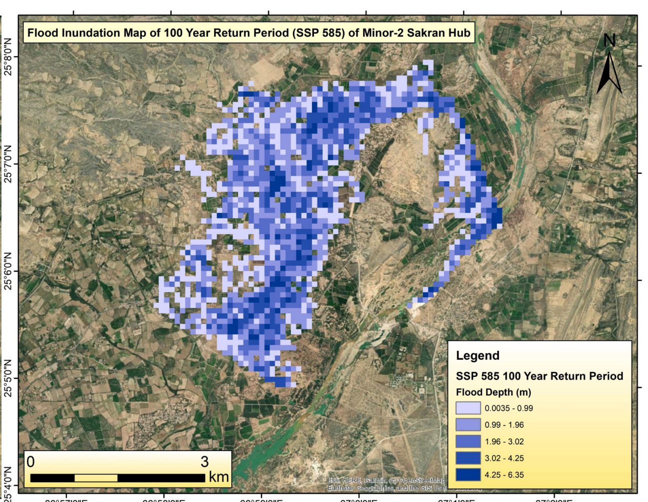


Decision and Design Example - FPW

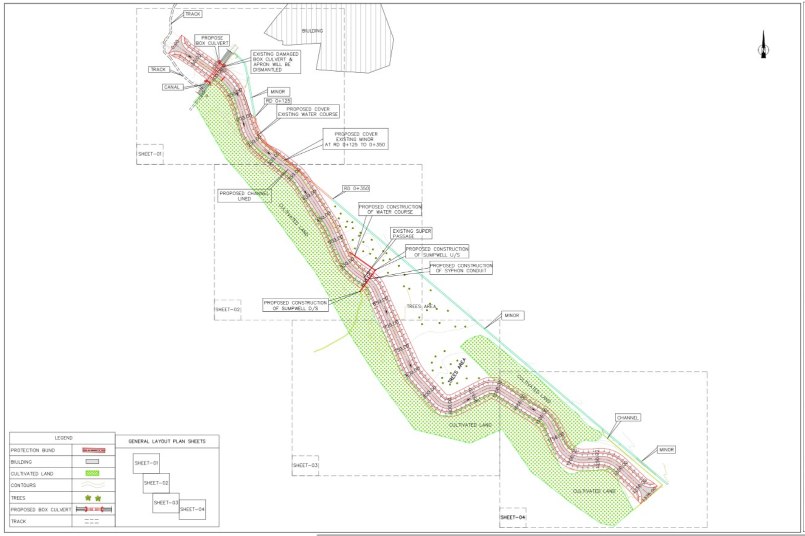
Conventional/ Historic Data	Climate Change Data under SSP 2-4.5	Climate Change Data under SSP 5-8.5
100-Year Return Period Flood	100-Year Return Period Flood	100-Year Return Period Flood
246 cumecs	425 cumecs	380 cumecs
Hydraulic Modelling	Hydraulic Modelling	Hydraulic Modelling
2.9m high protection wall at 70.22 million protecting 94 acres land and 99 houses	4m high protection wall at 87.18 million protecting 165 acres land and 133 houses. **High EIRR**	3.6m high protection wall at 81.17 million protecting 146 acres land and 124 houses

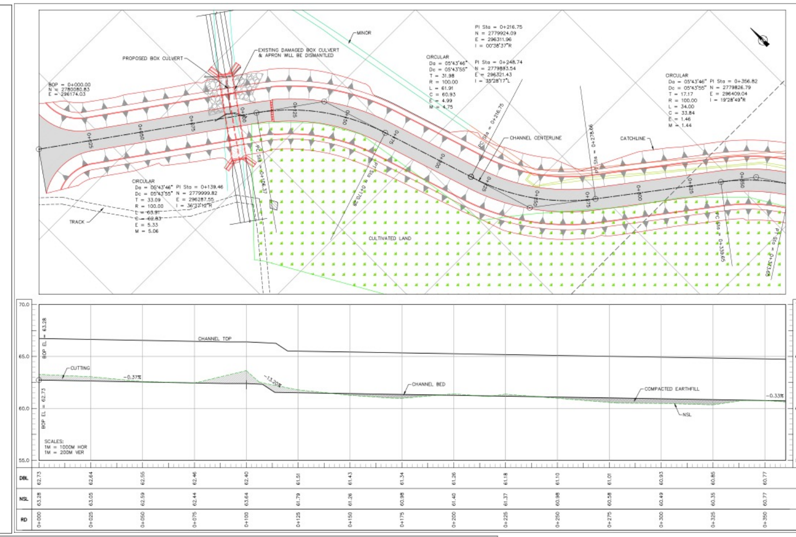


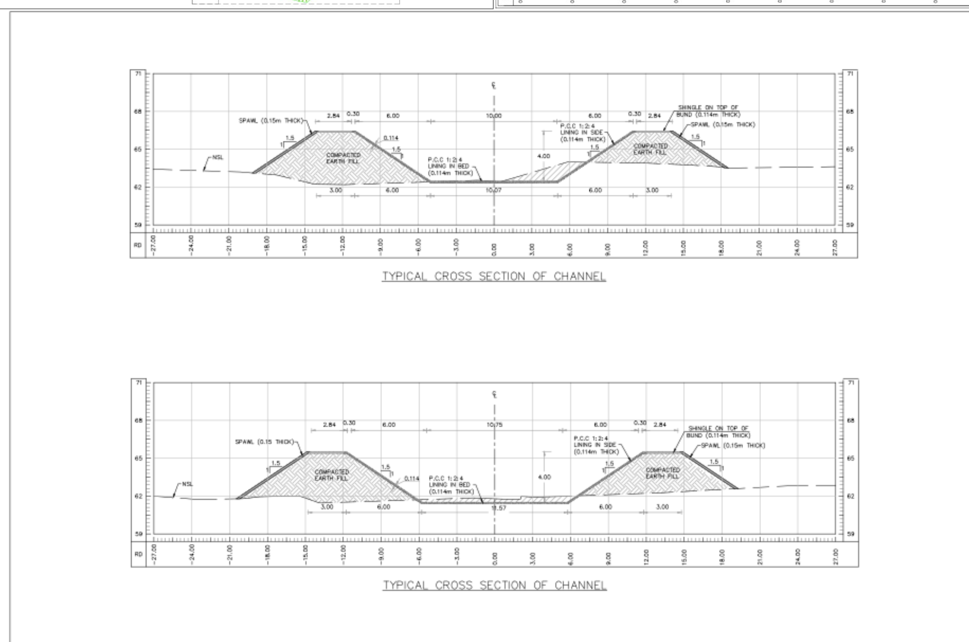




Drawings






TYPICAL CROSS SECTION OF CHANNEL
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Early findings and recommendations

- Emergency project - speed of delivery requires rapid CR assessment
- Upstream climate risk management advisory is beneficial to utilize time between project approval and EA consultants' recruitment
- Capacity of consulting industry is weak. Continuous supervision
- Data constraints, geographic spread and competing demand. Informed decision needed while dealing with data, modelling uncertainties, and ground surveys
- Long list of sub-projects is better. Provides flexibility in prioritization, shortlisting and design. Less risk of loan surplus, accommodates resilience premium.
- GIS/RS, modeling tools

Thank you.