

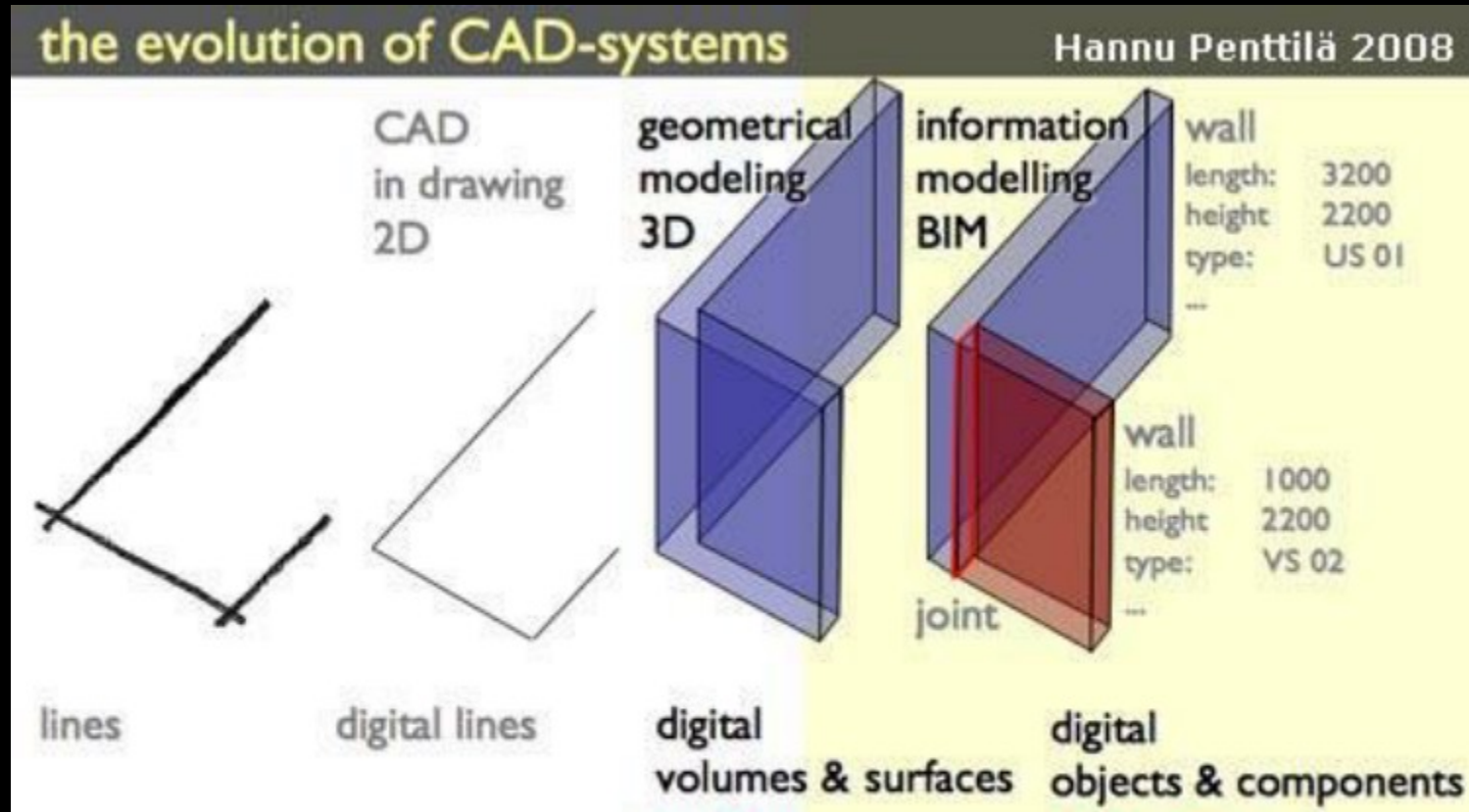
# Digital Design for CLIMATE RESILIENCE in Transport Projects

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# DIGITAL DESIGN



**BUILDING INFORMATION MODELLING**

# SEQUENCE

- **Sequence**

- What is BIM
- Case studies from ADB financed Pakistan Transport Sector projects
  - Immediately after flood (Madyan – Bahrain)
  - Post-flood (Shikarpur – Rajanpur)

# What is B-I-M?

**BUILDING**

**INFORMATION**

**MODELLING**

**BIM**

# BUILDING



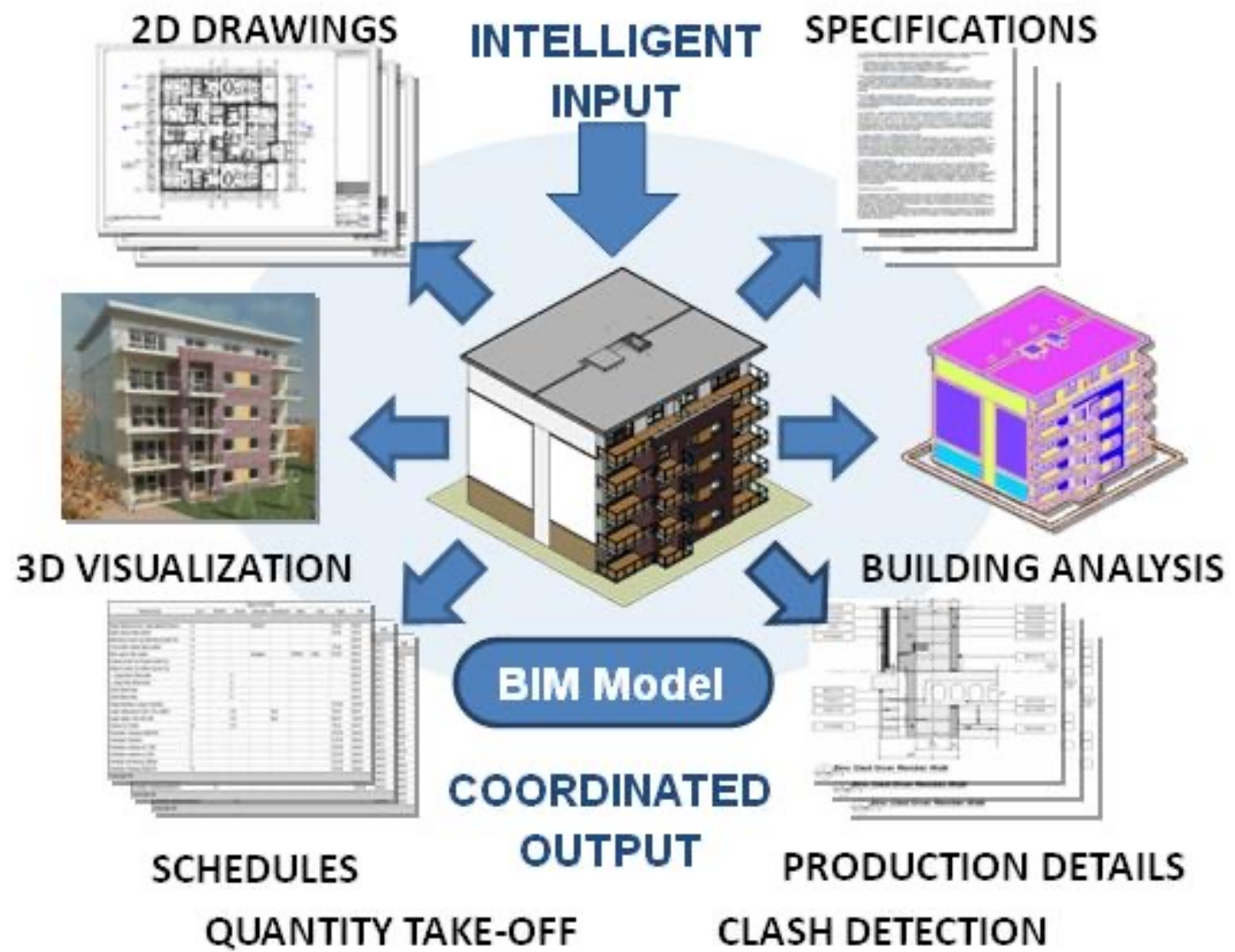
# BUILDING



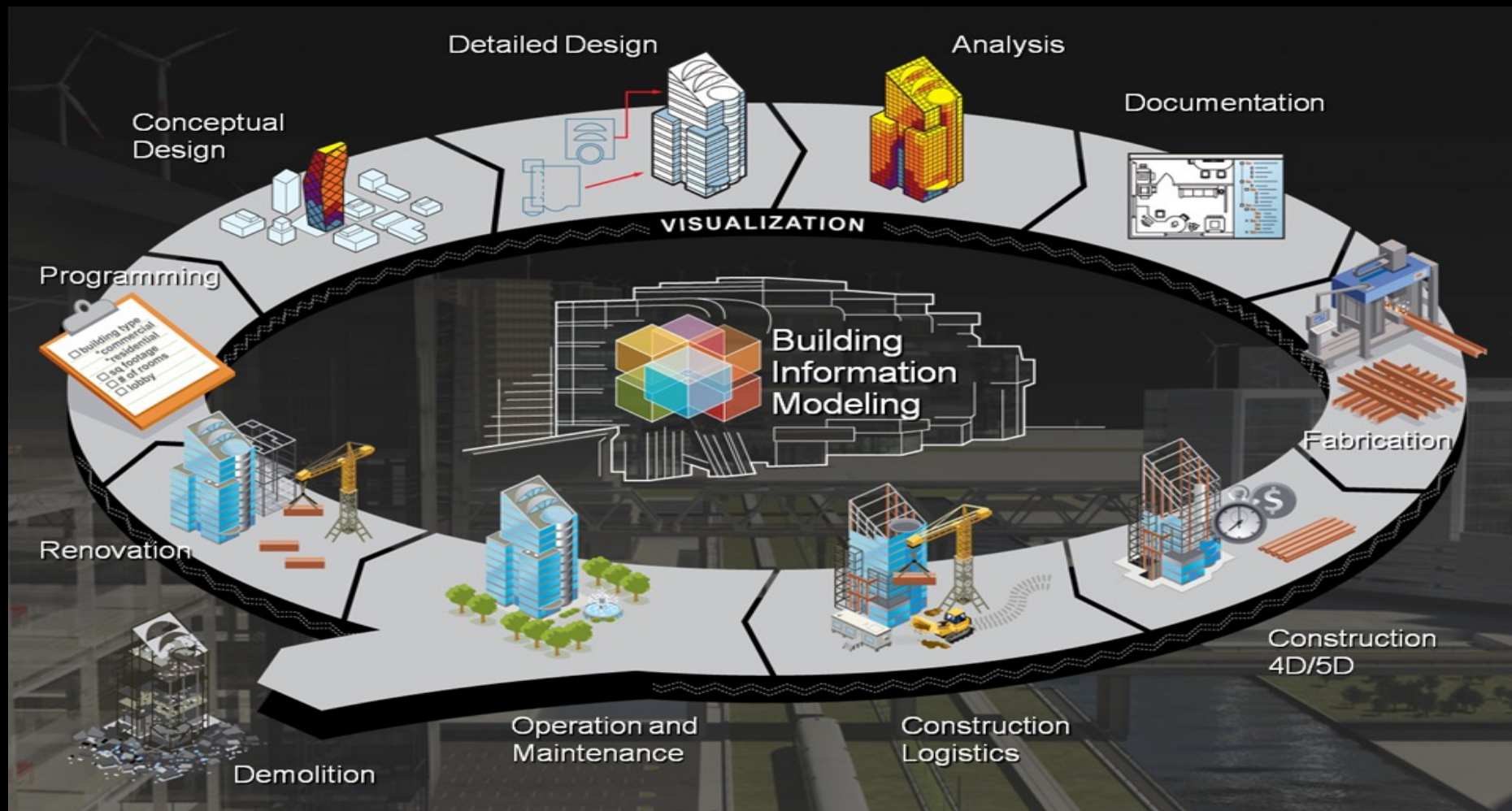
# INFORMATION



# MODELLING







An integrated digital process providing **coordinated**, reliable information about a project throughout all phases, from design through construction and into operation

# DIMENSIONS OF BIM

## 3D

- Existing Condition Models
- Safety and Logistic models
- Animations rendering walkthroughs
- BIM driven prefabrication
- Laser accurate BIM driven field Layout

## 4D

- **SCHEDULING**
- Project phasing simulations
- Lean scheduling
- Visual Validation for payment approval

## 5D

- **ESTIMATING**
- Real time conceptual modelling and cost planning
- Qty extraction to sp detail cost est
- Trade verification from Fabrication Models
- Value Engineering
- Prefabrication solutions

## 6D

- **SUSTAINABILITY**
- Conceptual Energy Analysis via D Profiler
- Detailed Energy analysis via Eco Tech
- Sustainable element tracking
- LEED Tracking

## 7D

- **FACILITY MANAGEMENT APPLICATIONS**
- Life cycle BIM strategies
- BIM As-Builts
- BIM maintenance plans and technical support



# MADYAN - KALAM

# AUGUST 2022 FLOODS



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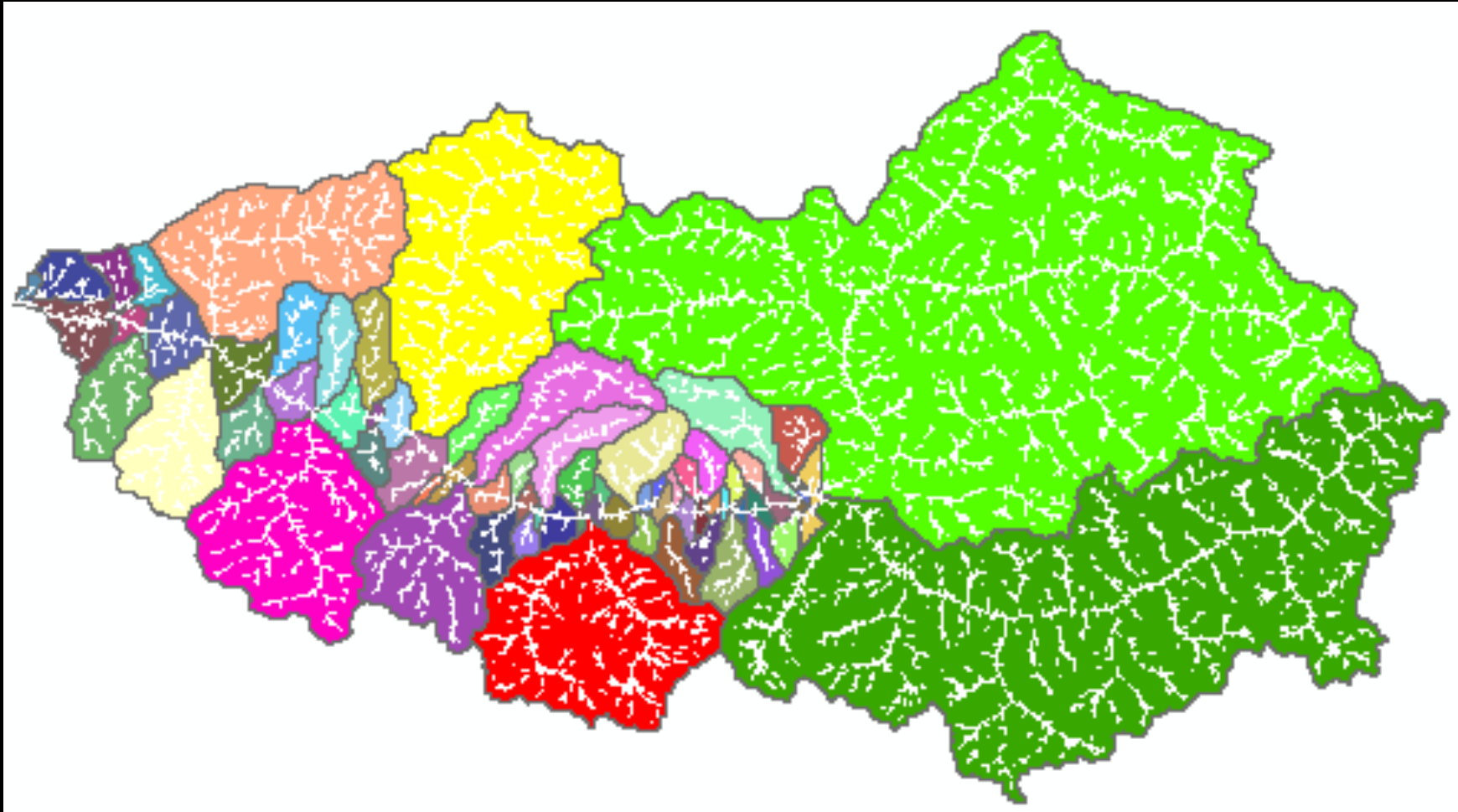




3,565 sq.km area studied

The road has major crossing at Bahrain and minor crossing all along the alignment  
Madyan has elevation of 1356-meter and Kalam has 1983-meter

**AREA OF STUDY**



**SRTM 30 METERS DEM (V3)**

**5 M DEM STRIP**

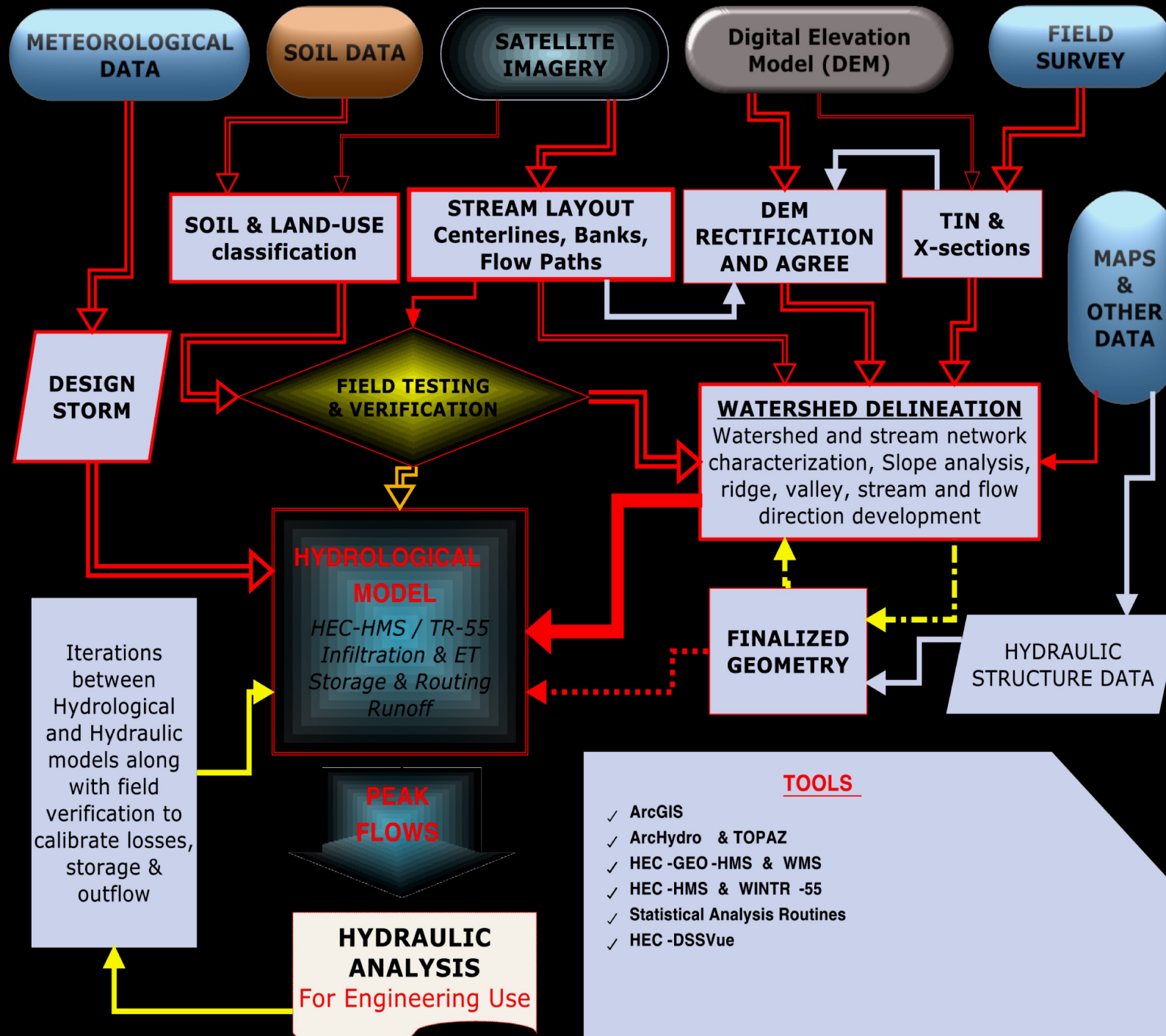
**SATELLITE IMAGERY**

**TOPOGRAPHIC SURVEY**

**UAV SURVEY**



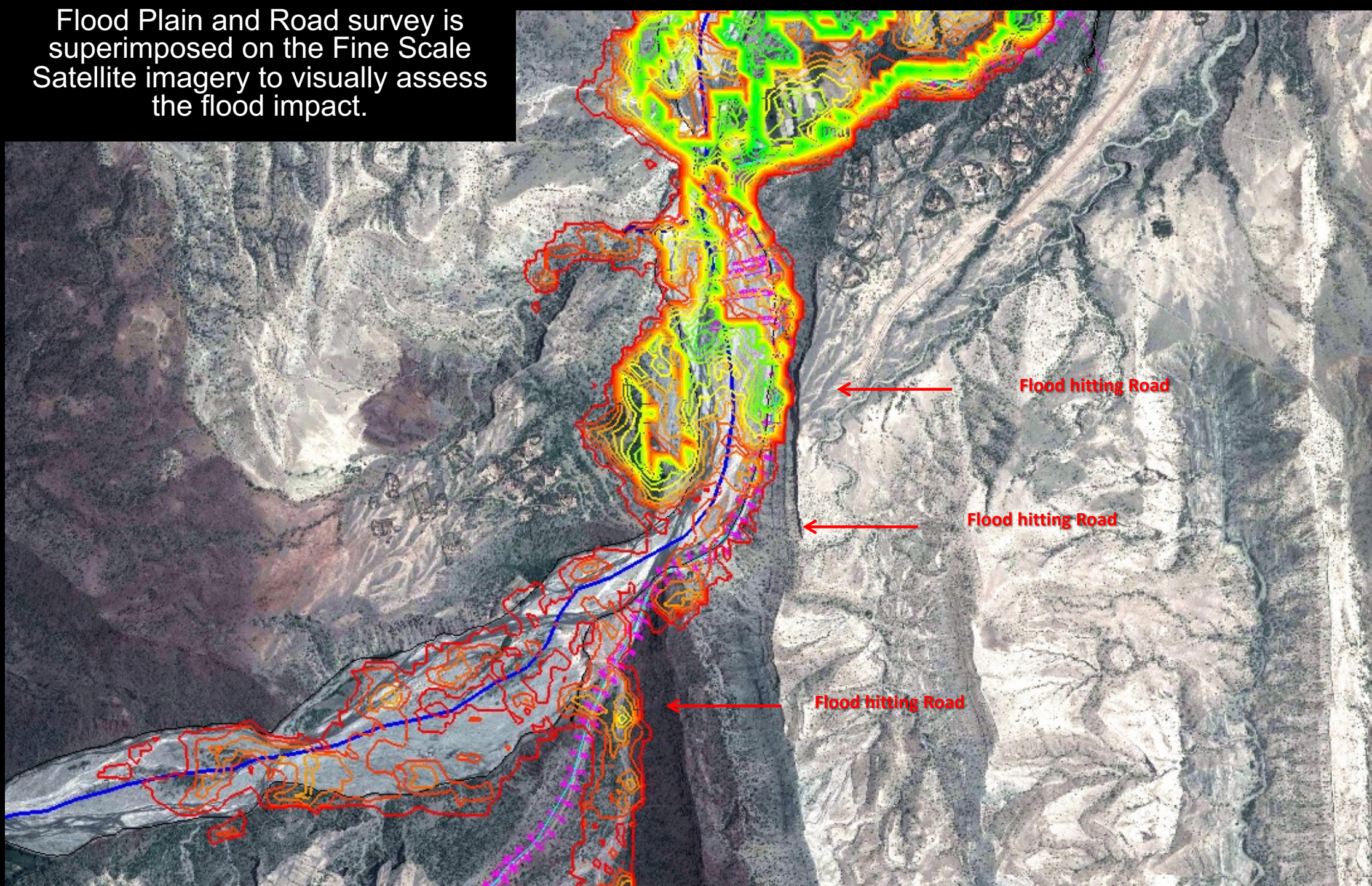
# METHODOLOGY



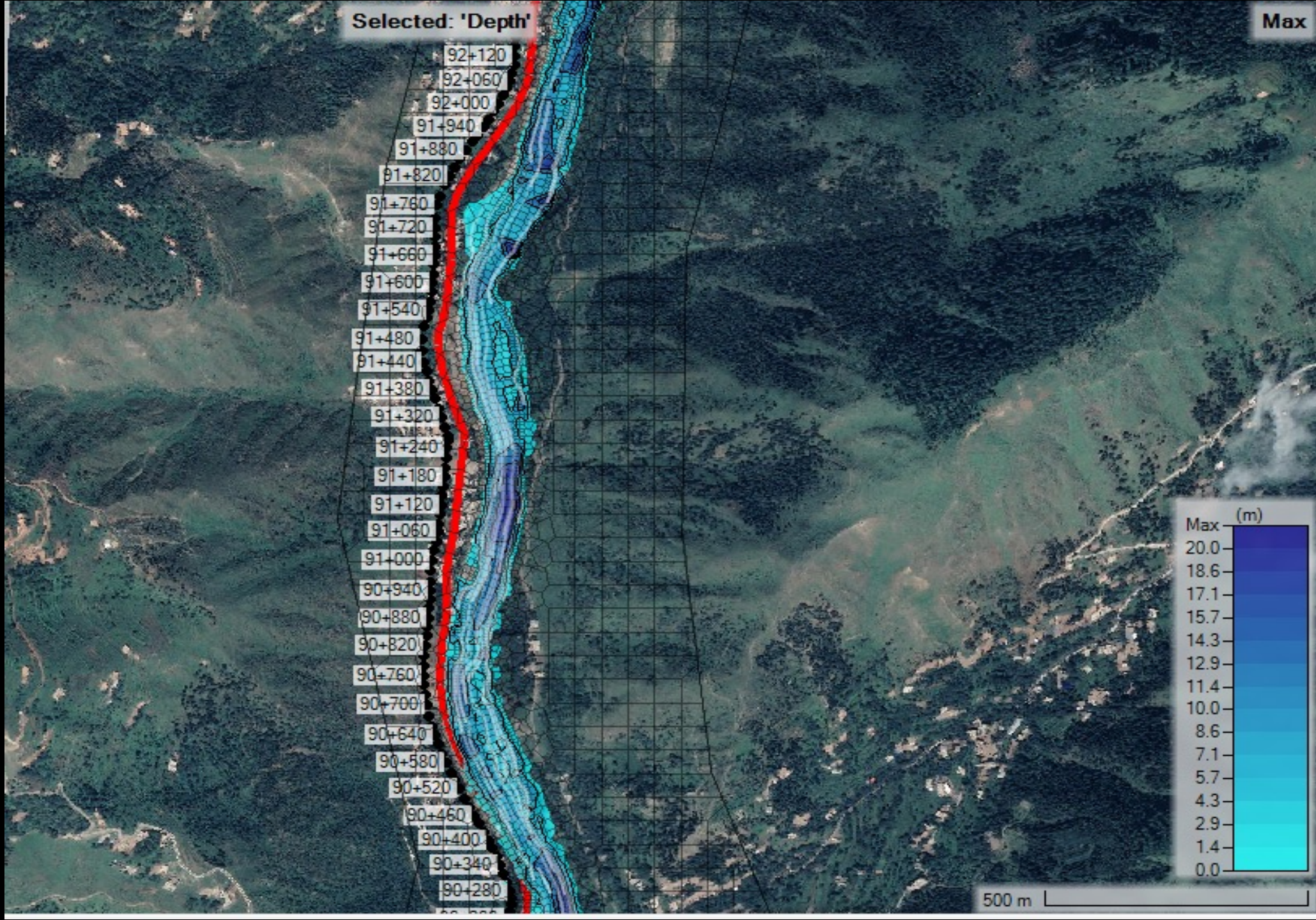
- TOOLS**
- ✓ ArcGIS
  - ✓ ArcHydro & TOPAZ
  - ✓ HEC-GEO-HMS & WMS
  - ✓ HEC-HMS & WINTR -55
  - ✓ Statistical Analysis Routines
  - ✓ HEC-DSSVue

Flood Plain and Road survey is superimposed on the Fine Scale Satellite imagery to visually assess the flood impact.

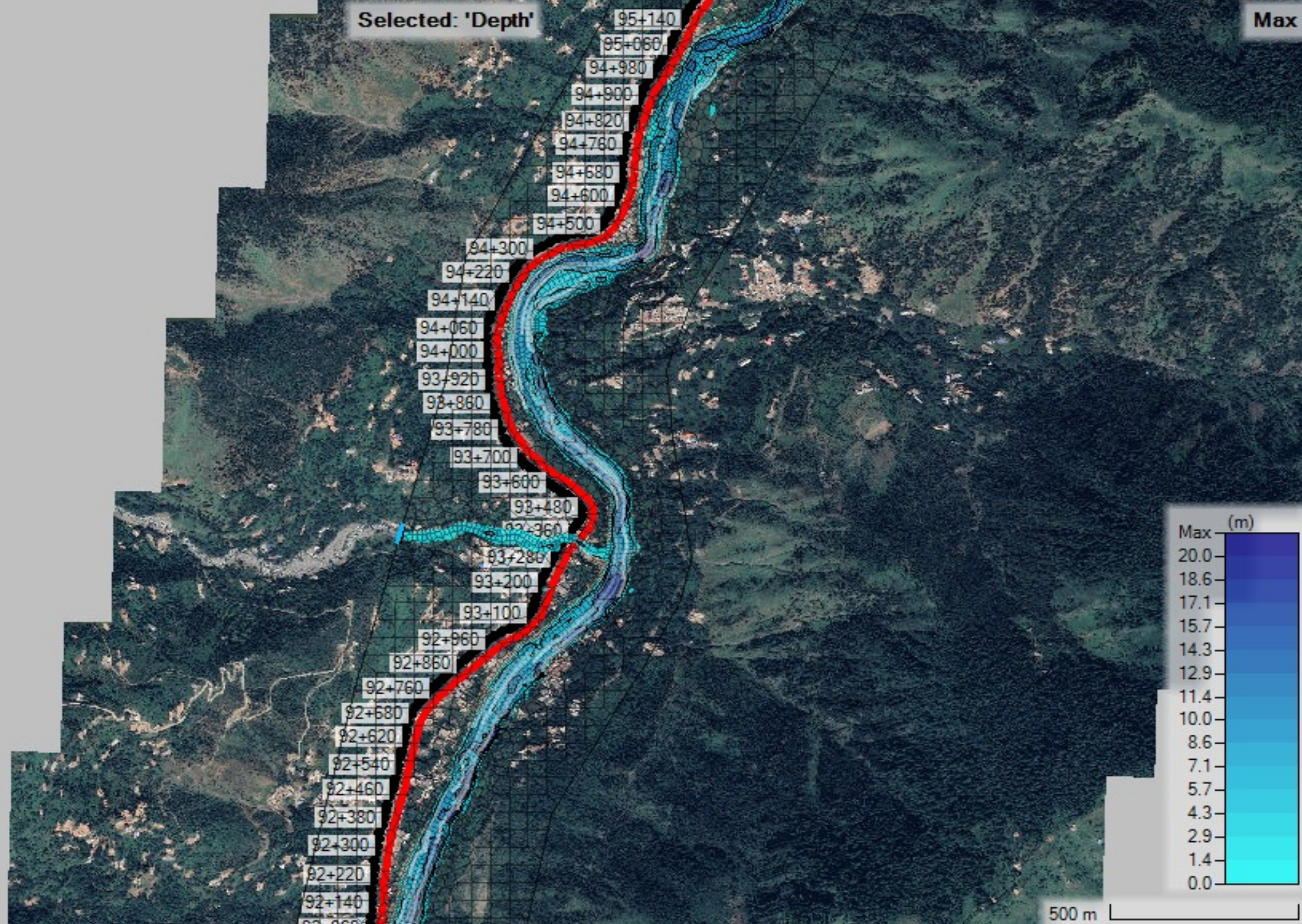
# RIVER SYSTEM ANALYSIS



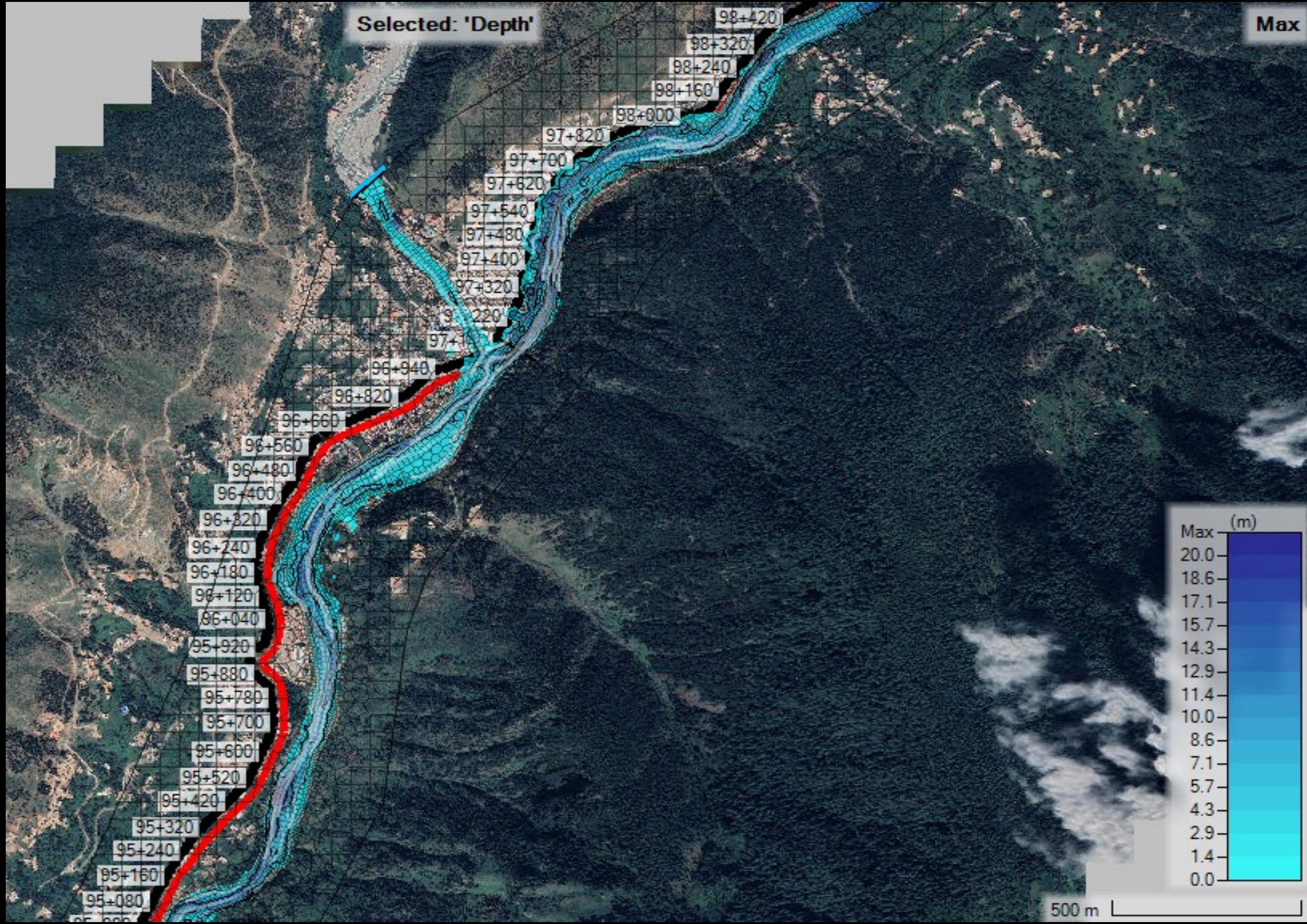
# FLOOD MODELING



# FLOOD MODELING



# FLOOD MODELING



# RESULTS

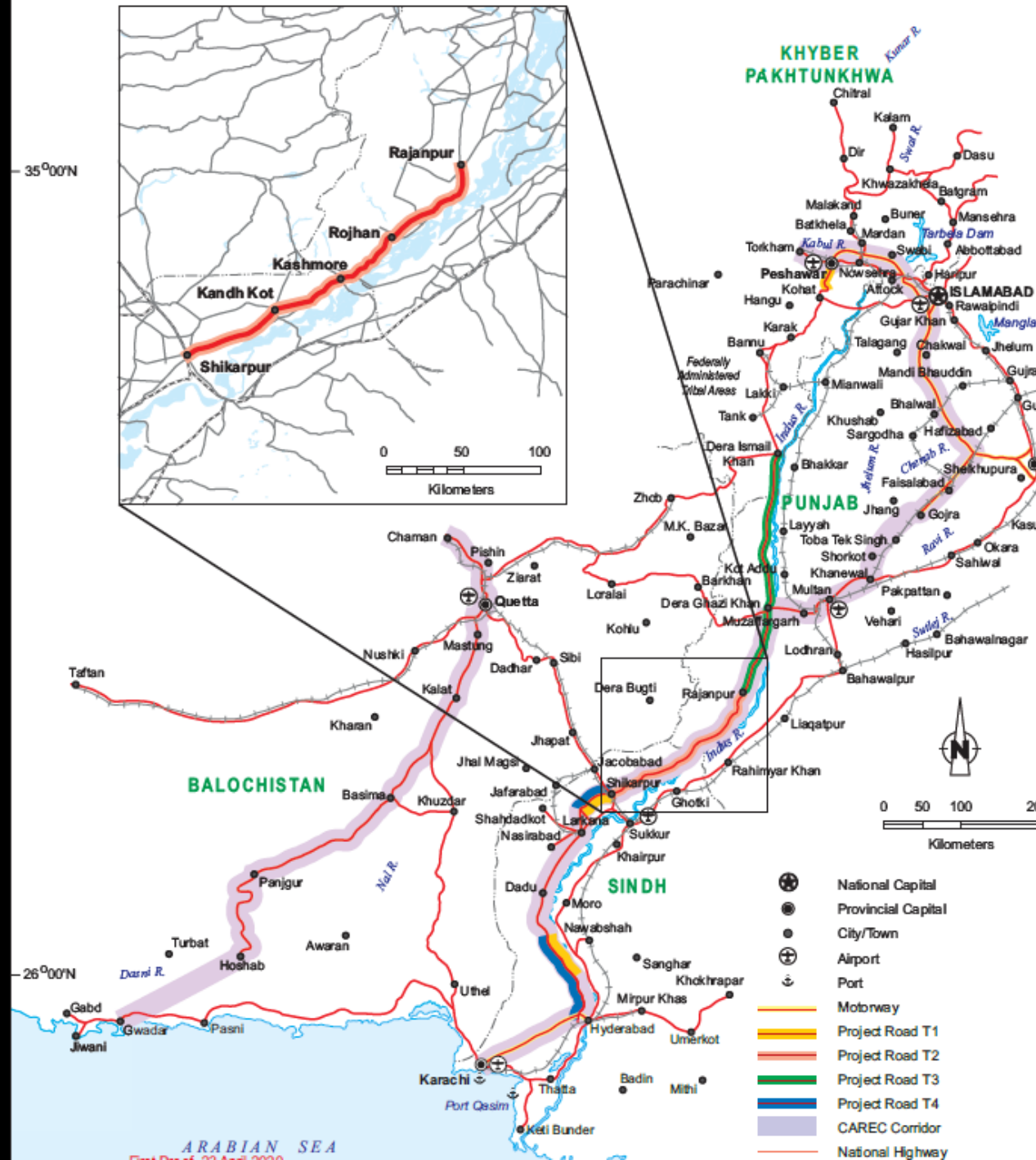
SECTION	REMARKS	SECTION	REMARKS
88+621 ~ 89+221	Major Flooding	110+521 ~ 110+571	Embankment Protection
89+221 ~ 90+221	Embankment Protection	110+621 ~ 111+621	Major Flooding
90+221 ~ 90+721	Major Flooding	112+071 ~ 112+371	Major Flooding
90+721 ~ 91+021	Embankment Protection	112+621 ~ 116+821	Major Flooding
96+921 ~ 99+371	Major Flooding	117+771 ~ 118+021	Major Flooding
99+521 ~ 99+921	Minor Flooding	118+321 ~ 119+821	Minor Flooding
103+721 ~ 104+521	Major Flooding	123+121 ~ 123+721	Land Slide + Minor Flooding
105+771 ~ 106+471	Minor Flooding	124+021 ~ 125+521	Land Slide + Major Flooding
108+871 ~ 109+071	Land Slide	127+671 ~ 127+871	Minor Flooding
109+221 ~ 109+421	Major Nullah Flooding	130+621 ~ 130+921	Major Flooding
109+521 ~ 110+171	Major Flooding	132+471 ~ 132+553	Minor Flooding
110+241 ~ 110+377	Embankment Protection		

- Boulders and debris came along the flood has changed the morphology of the river.
- Road profile be raised from 2m to 9m
- The bridges profile to be raised
- Buildings have encroached riverbanks and negatively impacting the river flow

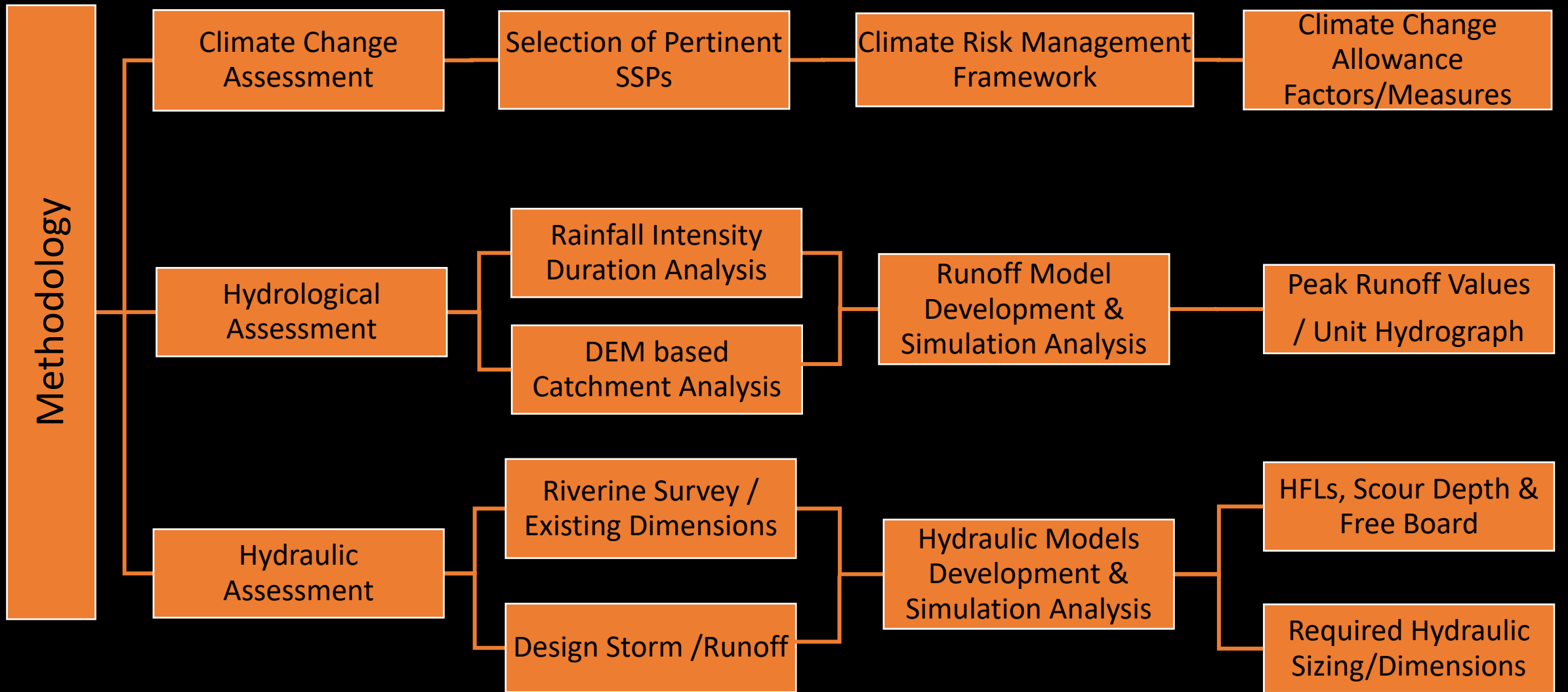


# SHIKARPUR – RAJANPUR

# MAP







# Climate Change Scenarios and Approaches

- Two scenarios i.e., Shared Socioeconomic Pathways (SSP)
  - SSP2-4.5
  - SSP5-8.5
- Climate risk assessment (Two Approaches)
  - Direct Approach
  - Indirect Approach

# Direct Approach

## One Day maximum Rainfall Averages for 2020 to 2039 (short term)

CMIP6 Scenarios	Rx1dy (mean)	Rx1dy (% Increase)
SSP2-4.5	25.16 mm	22.0 %
SSP5-8.5	26.47 mm	23.1 %

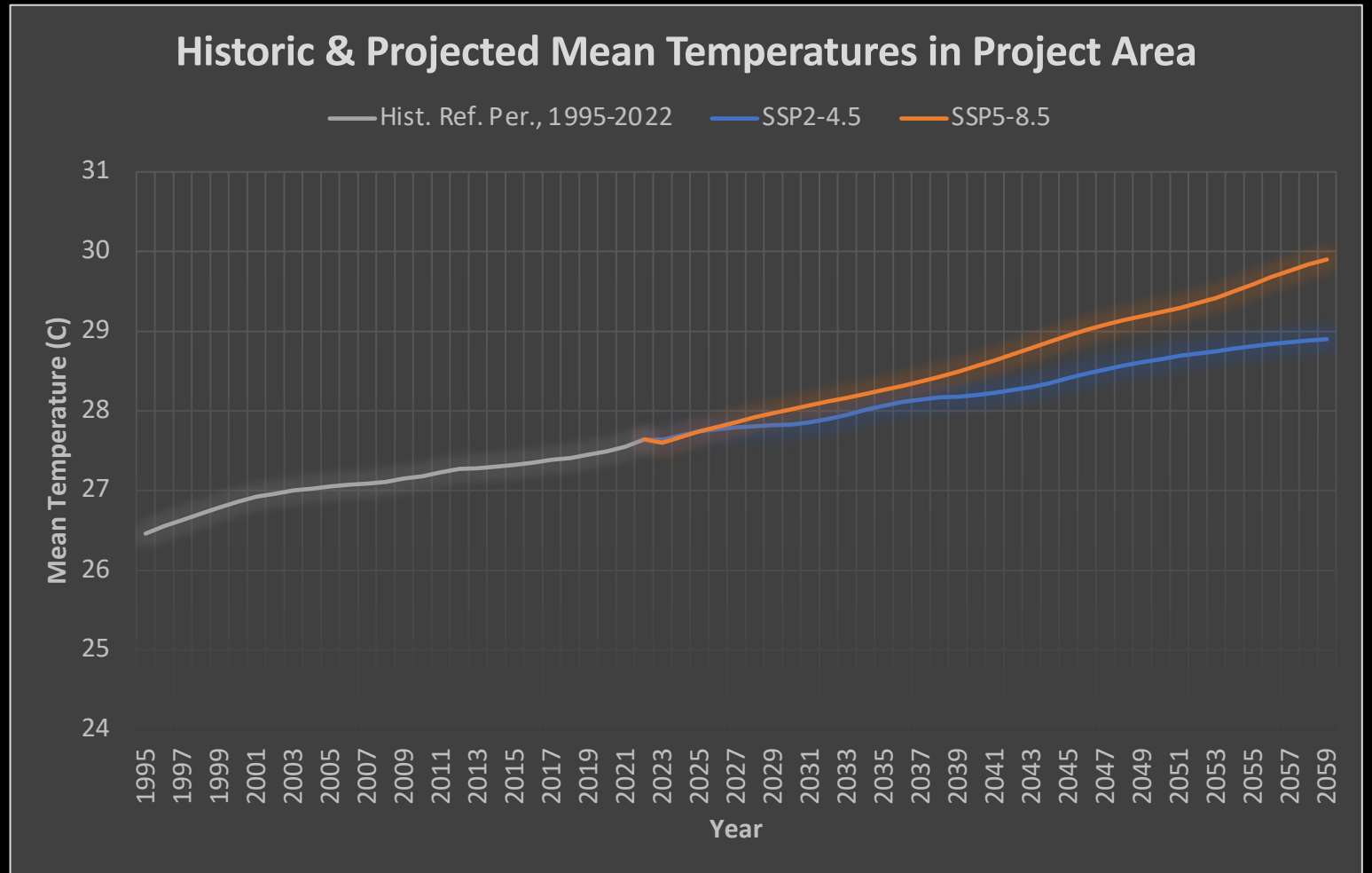
  

## One Day maximum Rainfall (mm) Averages for 2040 to 2059 (medium term)

CMIP6 Scenarios	Rx1dy (mean)	Rx1dy (% Increase)
SSP2-4.5	25.82 mm	22.6 %
SSP5-8.5	27.3 mm	23.9 %

# In-Direct Approach

Use of high confidence level parameter such as mean temperature increase to predict future changes based on its past relationship with 100 years return period rainfall



*The historic and projected mean temperature values of project area*

# In-Direct Approach

Duration	Historic Increase in Average Temperature (C)
2002 - 2007	0.13
2007 - 2012	0.18
2012 - 2017	0.12
2017 - 2022	0.25
<b>Total (2002 - 2022)</b>	<b>0.68</b>

Duration	100-year Storm Return Period Value (mm)	Percent Increase from Baseline (%)	Comments
1985 - 2002	95.66	0.00	Baseline Storm value
1985 - 2007	107.12	11.98	In 2005, major storm event of 99mm occurs and raises the 100-year return period value by 12 % approximately
1985 - 2012	108.75	13.68	No significant event happened in this region during this duration
1985 - 2017	107.6	12.48	No major event happened in this region during this duration
1985 - 2022	114.42	19.61	In 2022, major storm event of 110mm occurs and raises the 100-year return period value by 20 % approximately

# In-Direct Approach

Duration	Projected Increase in Average Temperature as per SSP2-4.5	Projected % Increase in 100-year storm as per SSP2-4.5	Projected Increase in Average Temperature as per SSP5-8.5	Projected % Increase in 100-year storm as per SSP5-8.5
Short Term (2022 - 2039)	<b>0.54</b>	<b><u>15.55</u></b>	<b>0.85</b>	<b><u>24.48</u></b>
Medium Term (2022-2059)	<b>1.26</b>	<b><u>36.28</u></b>	<b>2.26</b>	<b><u>65.08</u></b>

*Note For Reference; According to World Bank, Pakistan overall mean temperature increase for next 4 decades is 2 Celsius as per SSP5-8.5*

# Procurement of Rainfall Data

Station	Years of Record
Barkhan	37

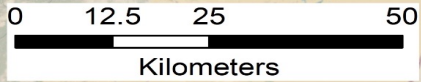


Station	Years of Record
Manpur	30

Station	Years of Record
Rahimyar Khan	30

Station	Years of Record
Sukkur Airport	30

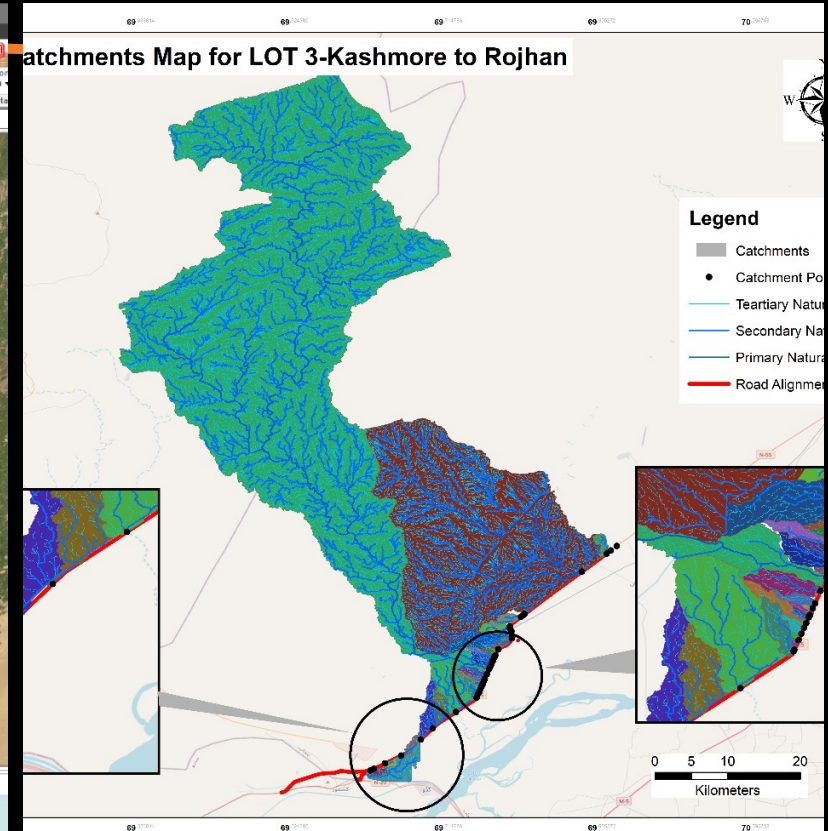
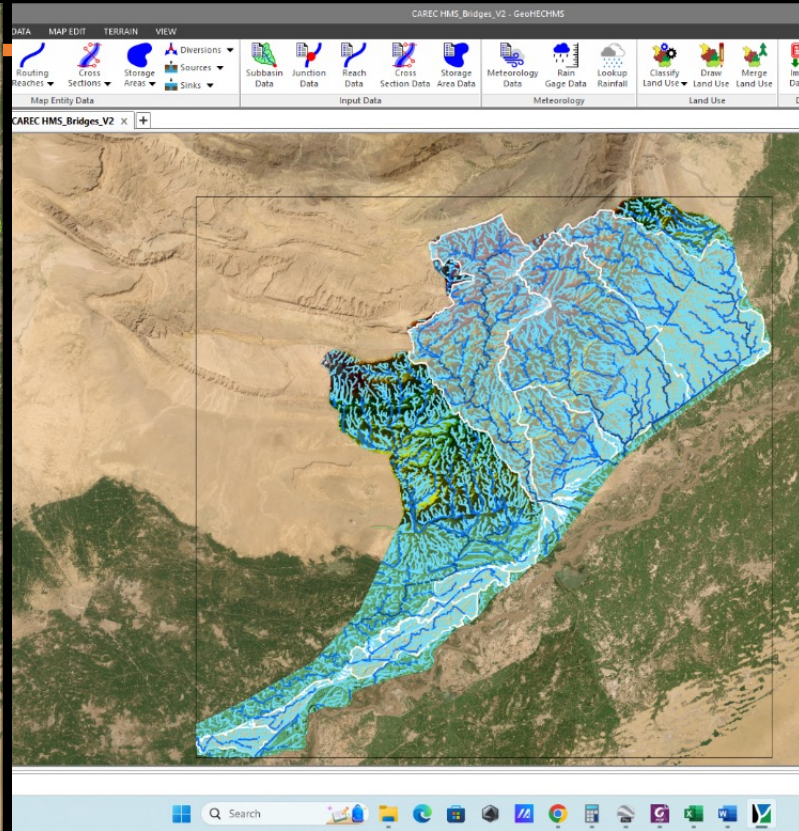
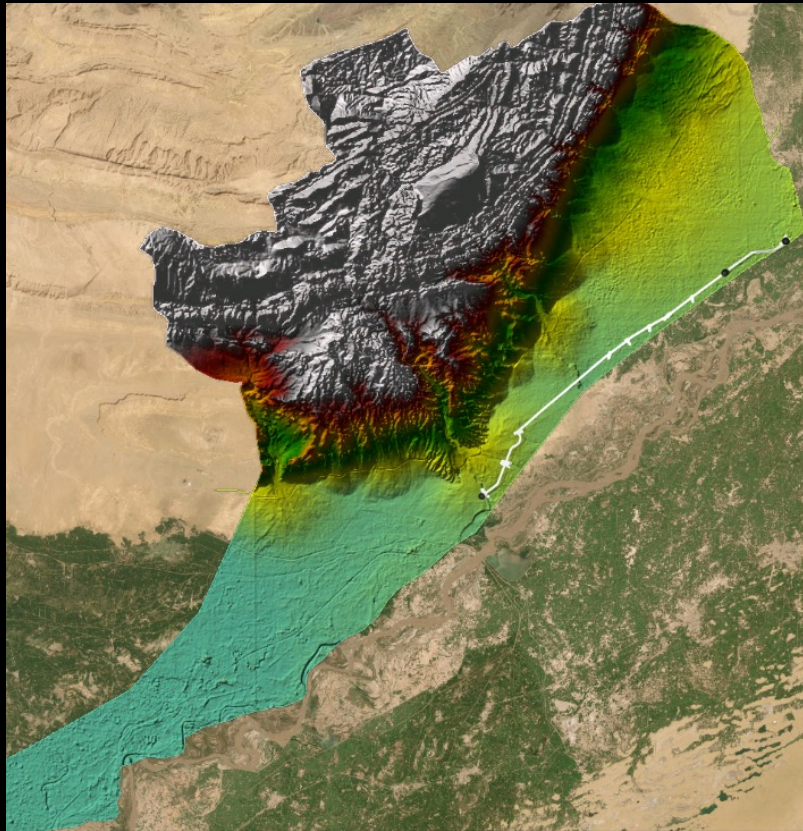
**Sukkur Airport Station**



### Legend

- Rain Gauge Stations
- Tranche 2 Road Alignment
- Catchments of Tranche 2 Alignment

# Processing DEM Data



***5 meter*** high resolution DEM for ***8,064 sq. km*** with high precision DEM for ROW and catchment areas



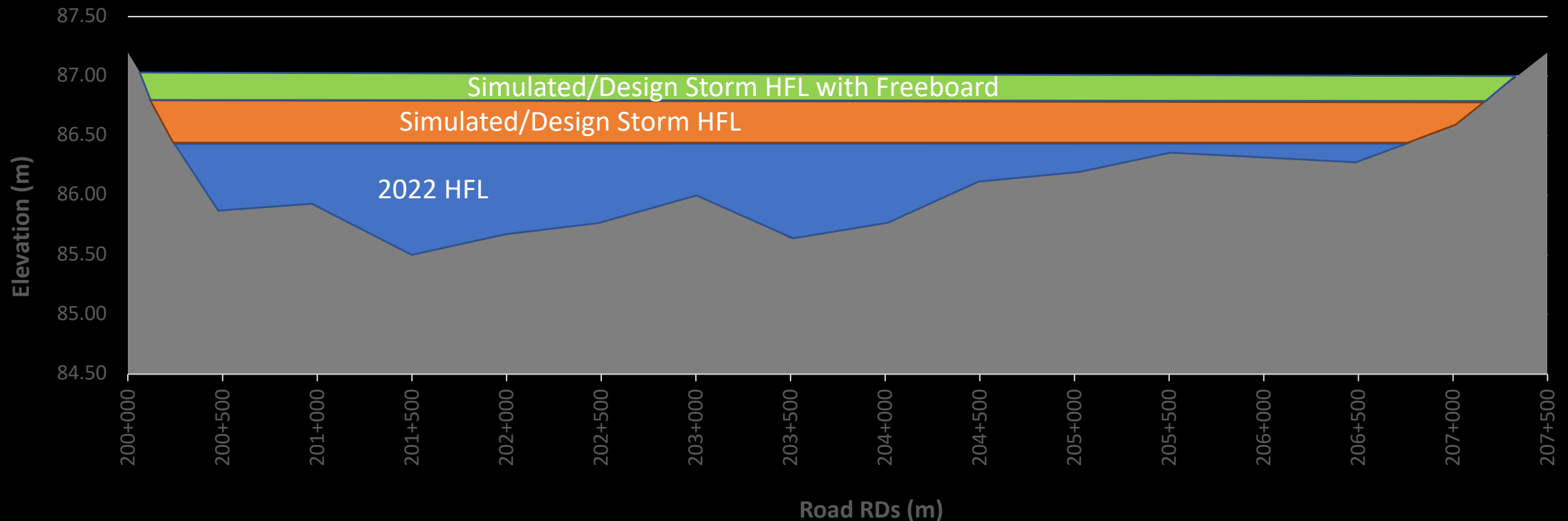
## Summary of Results

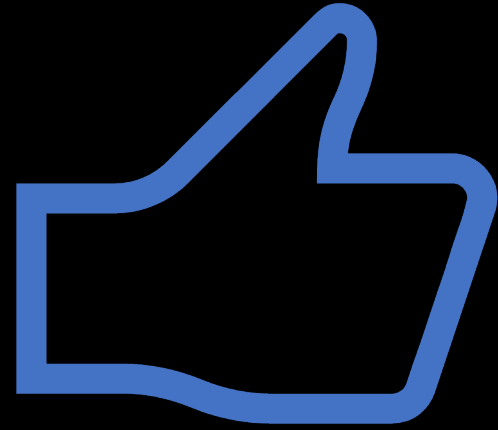
	Lot 1	Lot 2	Lot 3	Lot 4
Upsize of bridge	-	-	2 out of 6	-
Upsize of culverts	31 out of 64	14 out of 40	53 out of 124	37 out of 138
Additional Culverts	21	37	20	18
Profile raise	-	-	1.6m for 10.5km	-

# Summary of Results for Lot 3

- Profile Raise: Revision/raising of profile (1.6m maximum) for 10.5 km out of 48.9km (from RD 196+800 to RD 208+500)

Existing Road Profile with HFLS





Thankyou

