Assessment of Changes in Hydrologic Regime of the Teesta River by Teesta –V Hydroelectric Power Project in Sikkim India

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INTRODUCTION

- Dams as monuments to progress and prosperity and hydropower as a contributor to the ever , rising global energy demand has multiplied the number of hydropower constructions.

- According to the International Commission on Large Dams (ICOLD), more than 40,000 large dams are being built across the rivers of the world holding back 15%of total annual global river runoff (Baghel et.al 2010).

- The ailing manifestation of the river obstruction by hydropower construction can be categorized in the following four broad themes, Ecology, Social impact, Changes in Hydrological Regime (MC.P 2008).

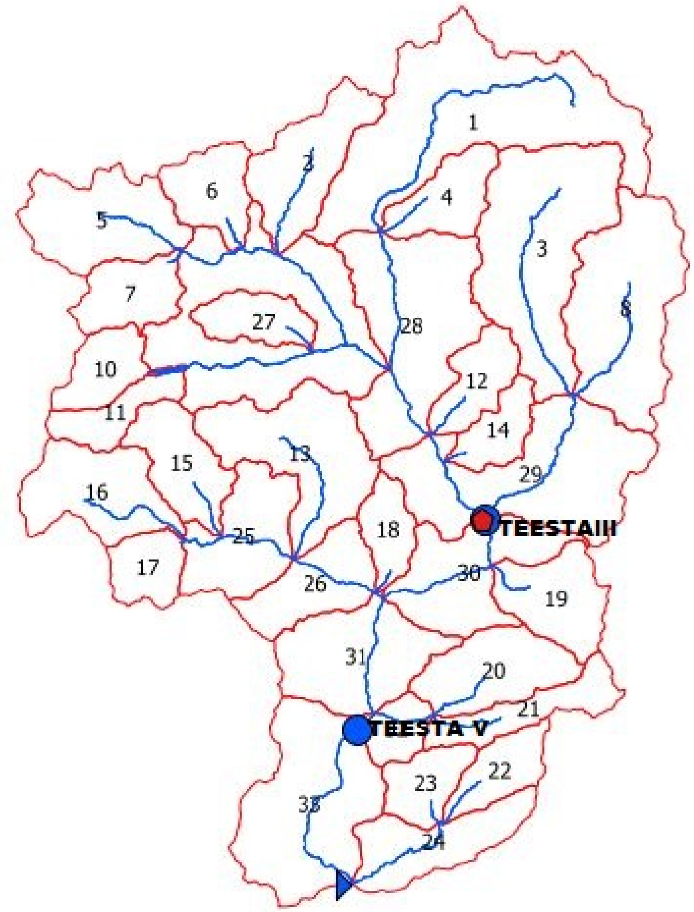
- Dam constructions in India have seen serious condemnations and protests owing to its large scale environmental and social harm.

STATEMENT OF THE PROBLEM

- Hydroelectric generating projects in Sikkim have faced serious condemnations from the native society for their environmental and cultural repercussions.

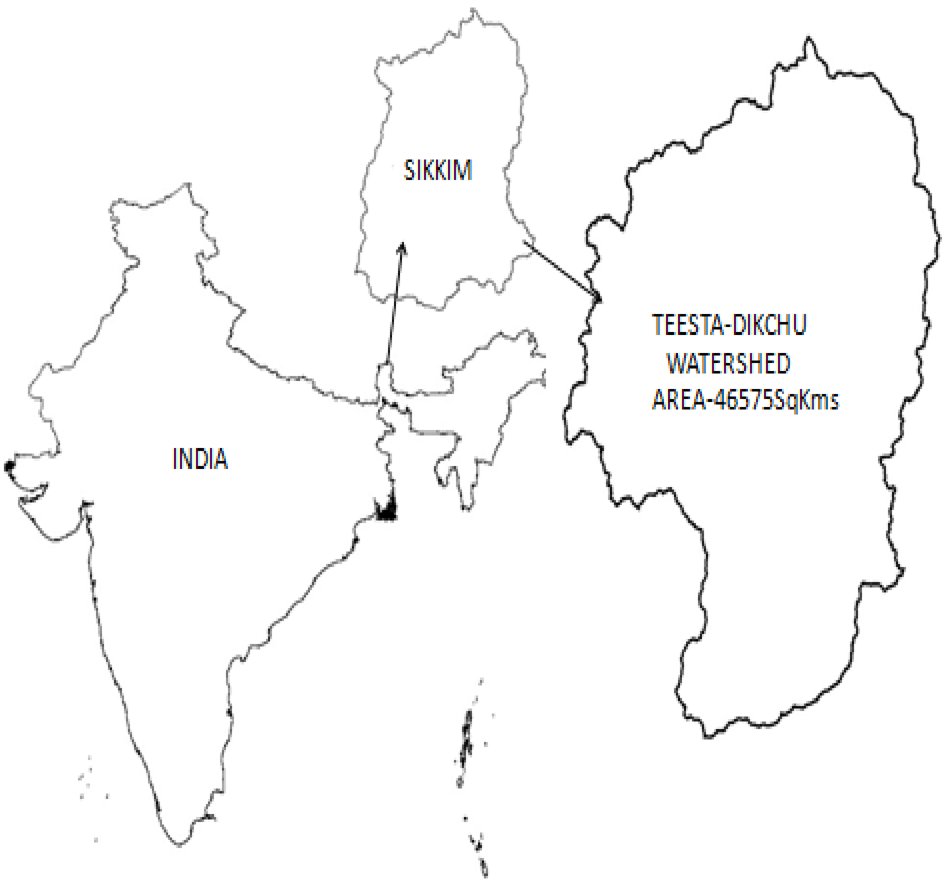
- Change in catchment flow regime due to hydroelectric power projects construction, loss of productivity of land, increased rate of erosion and the impact on the social and cultural practices have been reported(ACT 2010)

- To analyse the changes in hydrological regime and catchment flows due to construction of Teesta V hydroelectric power project.



STUDY AREA

- A sub catchment of the river Teesta river basin in the Indian state of Sikkim.
- Teesta-Dikchu watershed The Teesta V hydroelectric power project.
- 510MW
- Operational since 2008
- Total area of 4657 Sqkm.
- located 88°13"E, 28°12N" to 88°51"E to 27°20"N.
- Elevation 310-7,734



METHODOLOGICAL FRAMEWORK

Sources of Data

1.Soil database-
Soil Map of Sikkim
Source: Geological Survey of India

2. **Land use database**
Land use Land cover data.
Source: USGS – Landsat 8.

3.DEM
Aster DEM 30m
(NIH Roorkee)

3.**Weather database**
Rainfall and Temperature
Source : India Meteorology Department Pune., **(Chungthang, Khanitar, Sankalam, Gangtok)**

4.Discharge
NHPC Teesta III, Teesta IV
(Dikchu & Sankolong)

5. Reservoir Data
NHPC Teesta V

Data Analysis

1.**Soil and Water Assessment Tool (SWAT) (Data Generation)**

2-Indicators of Hydraulic Alteration (IHA)

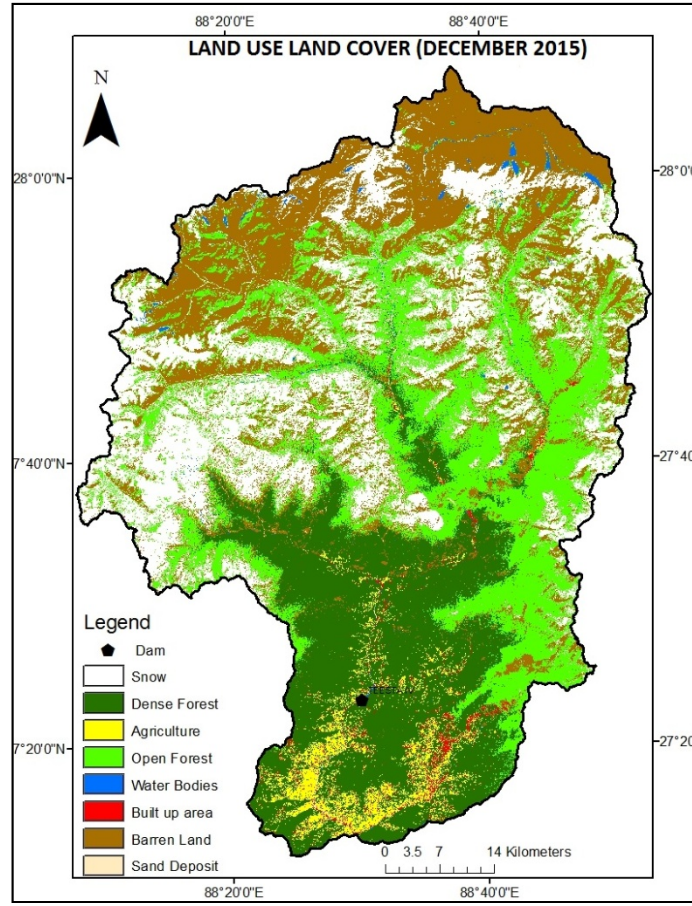
Hydrological studies in the 2,400 kilometres long eastern Himalayan stretches with a vast water reserve having a total ice cover of 3,735km (IR 2008)

DATA BASE

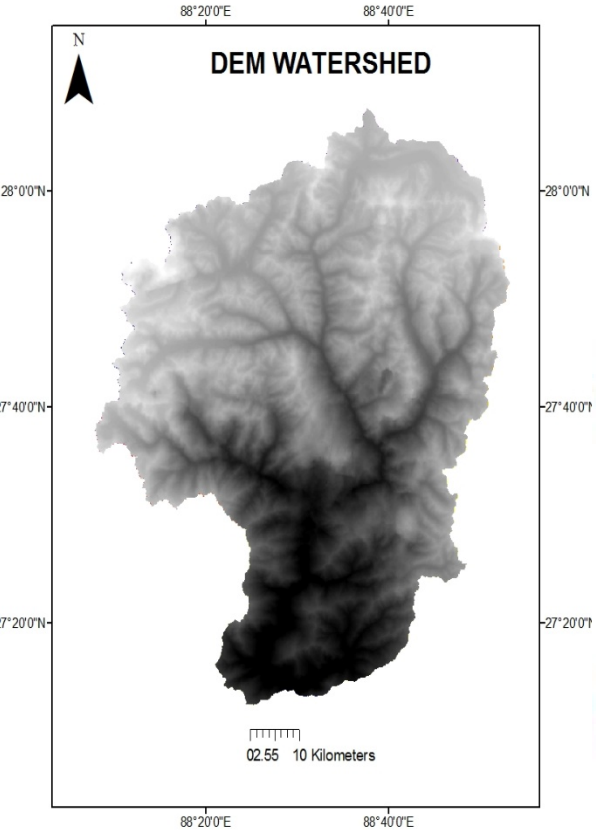
WEATHER Station Name	Parameter	Period from	Period to
Gangtok	Daily Maximum & Minimum Temperature and Rainfall	01.01.1985	30.11.2015
Tadong		01.01.1985	30.11.2015
Chungthang		01.01.1985	30.11.2015
Mangan		01.01.1985	30.11.2015
Magitar		01.01.1985	30.11.2015

DISCHARGE Station Name	Parameters	Period from	Period to
Sangkhola	Daily discharge	2006	2015

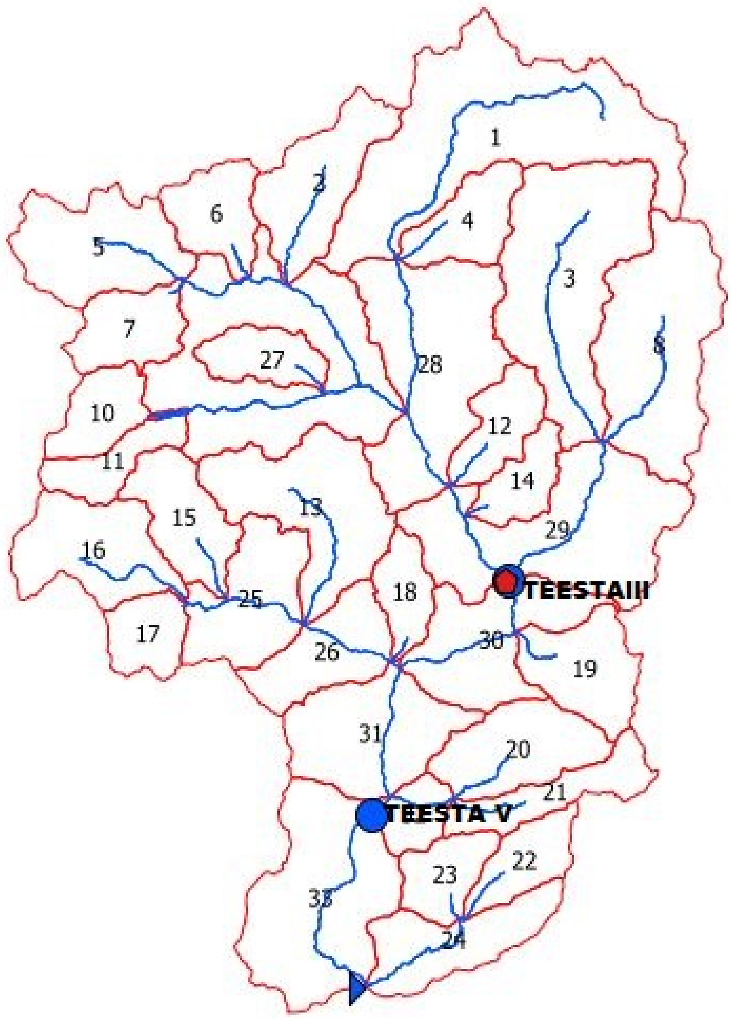
Sl. No.	Elevation (m)	Reservoir Area (ha)	Reservoir Capacity (Mm^3)	Sl. No.	Elevation (m)	Reservoir Area (ha)	Reservoir Capacity (Mm^3)
1	581	65.17	10.88	12	559	22.06	1.67
2	579	61.62	9.61	13	557	19.22	1.26
3	577	58.38	8.41	14	555	16.63	0.92
4	575	54.87	7.29	15	553	12.63	0.63
5	573	50.68	6.23	16	551	9.44	0.41
6	571	44.46	5.29	17	549	7.24	0.24
7	569	34.18	4.50	18	547	4.36	0.12
8	567	31.85	3.84	19	545	3.16	0.05
9	565	29.51	3.23	20	543	1.01	0.01
10	563	27.63	2.66	21	541	0.03	0.00
11	561	24.96	2.14	22	539	0.00	0.00

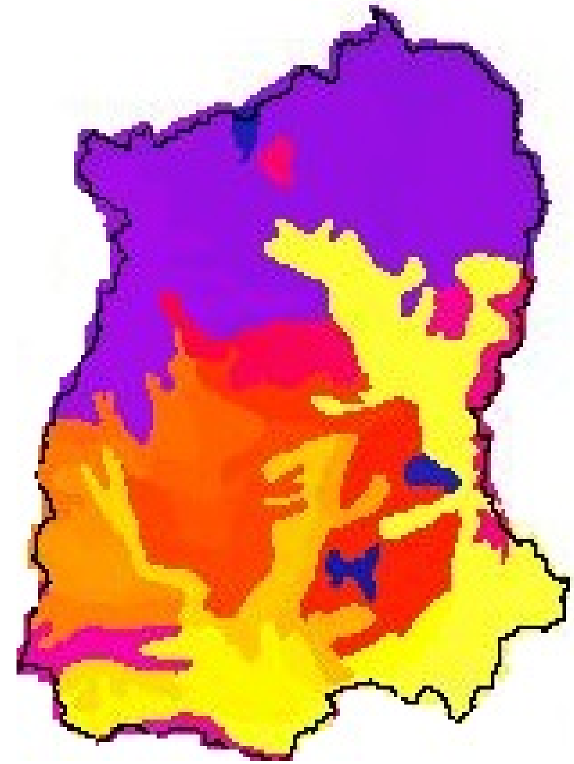


Teesta Dikchu Watershed



ASTER DEM 30m
Source:NIH Roorkee





SOIL MAP SIKKIM
Source:NIH,Roorkee,India

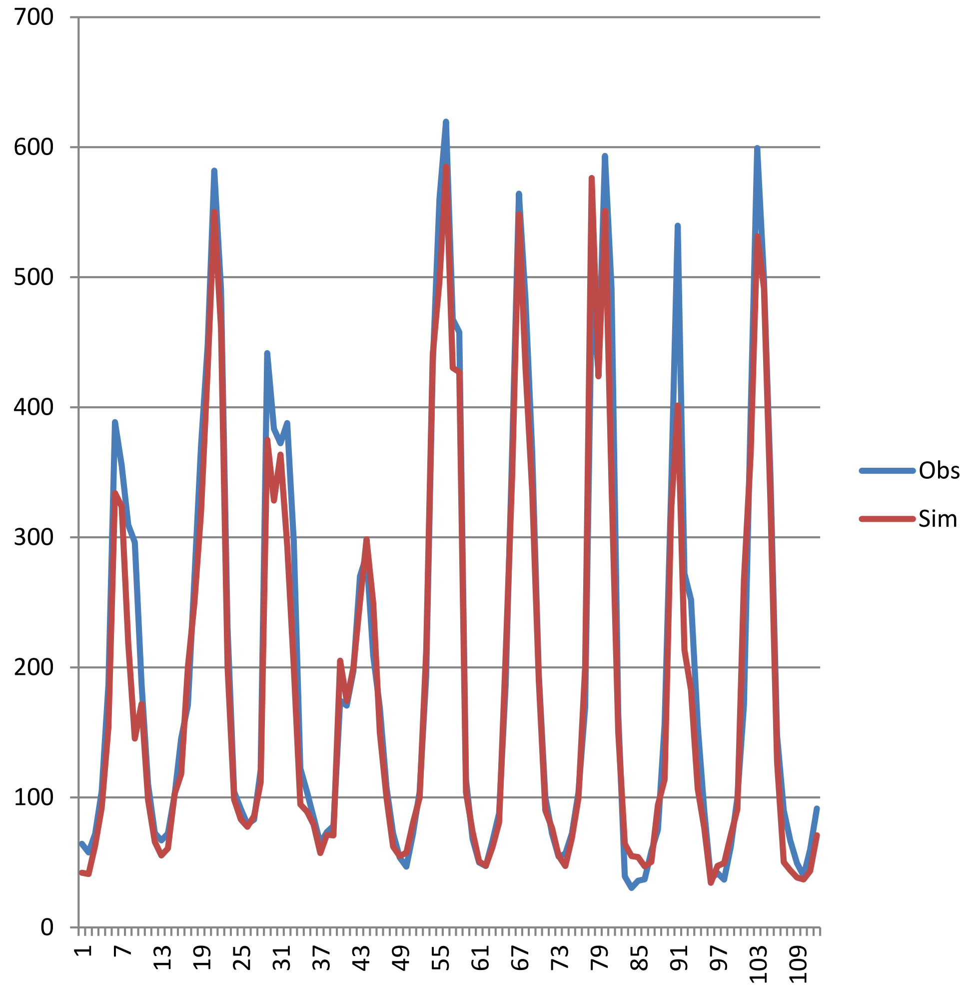
RESULTS AND DISCUSSION

-SWAT Model Run Period:2000-2015

-Calibration Period:2006-2015

-Generation of daily time series flow data for a 15year period.

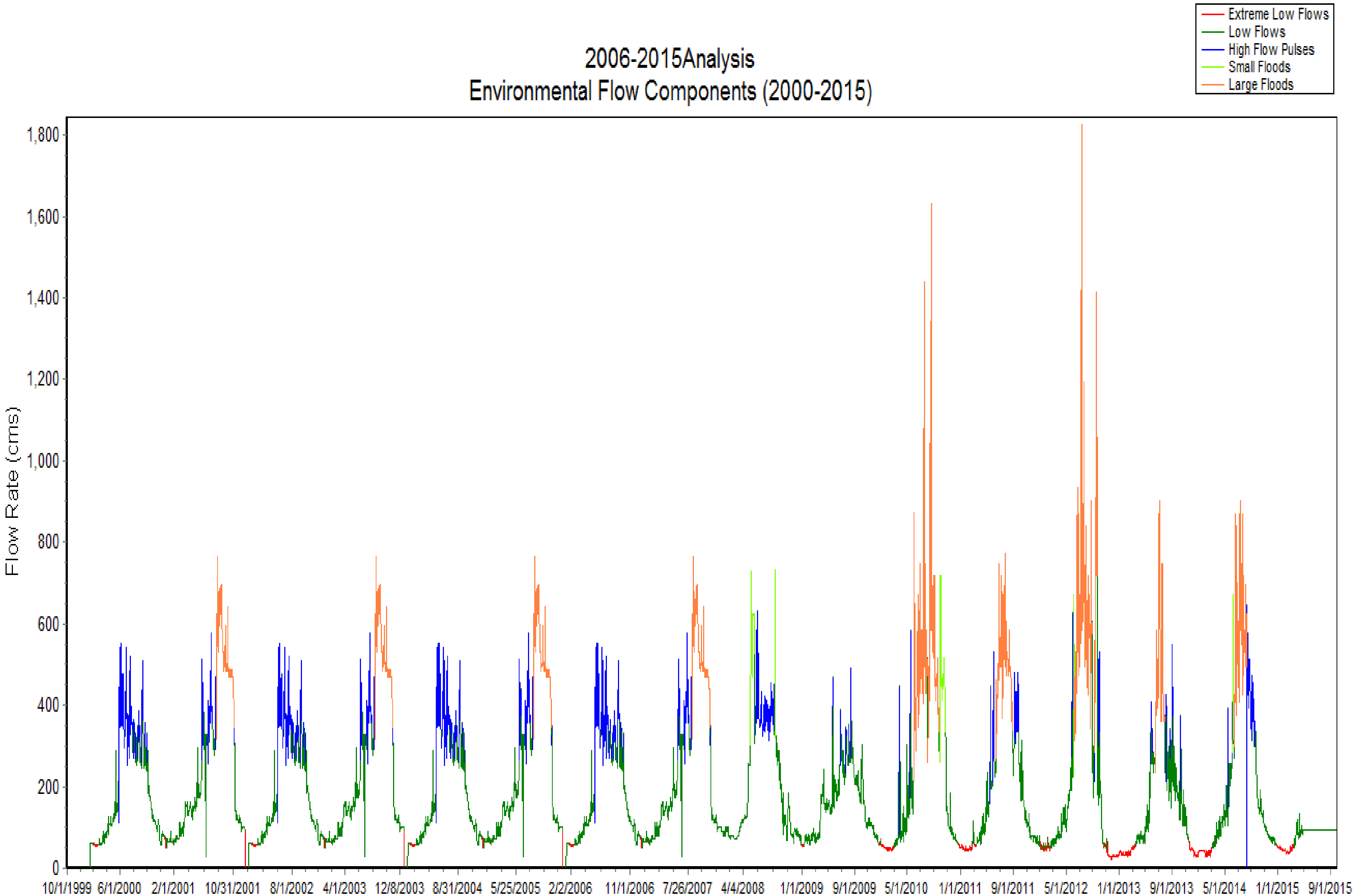
- The generated data used in the IHA



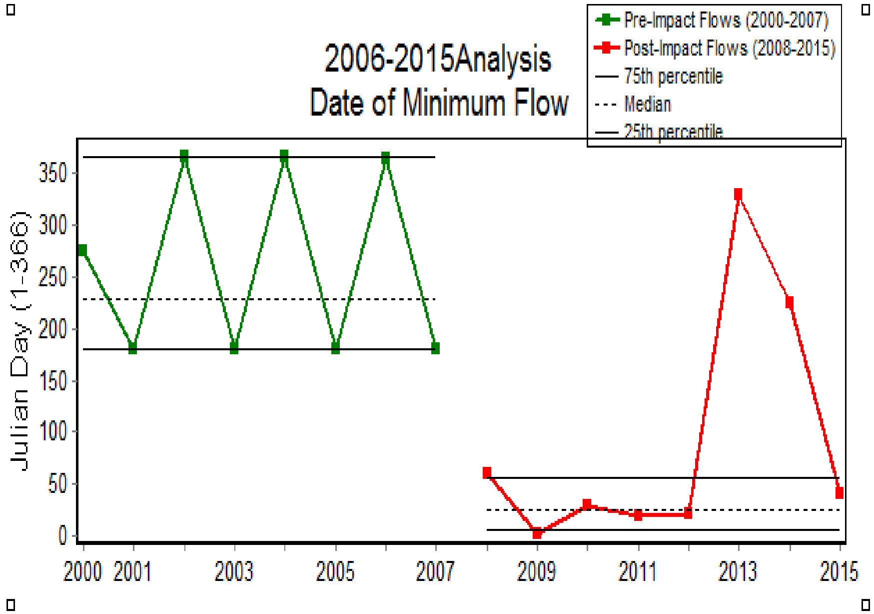
IHA analysis reads the flow output in five groups:

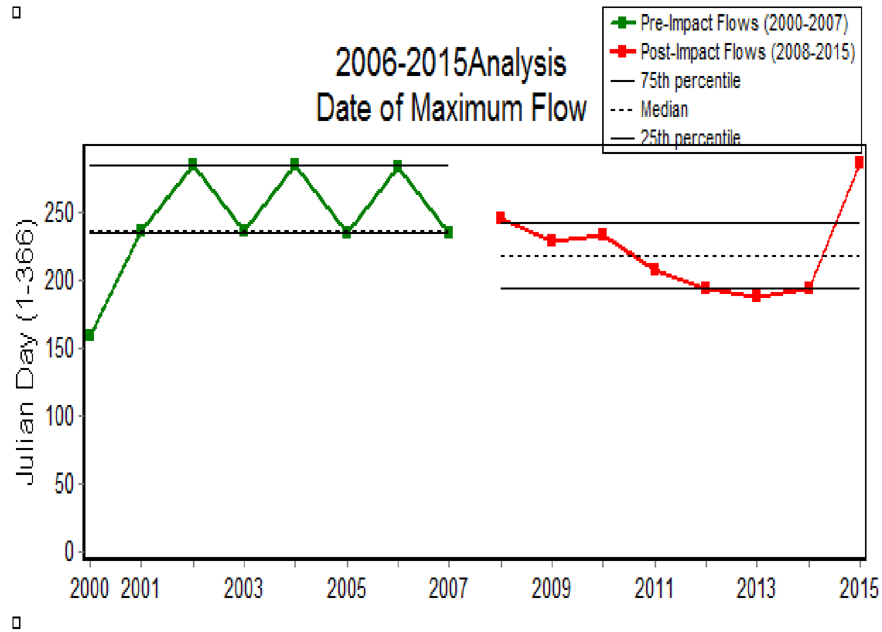
1) Magnitude of monthly flow conditions
2) Magnitude and duration of extreme flow events (e.g. high and low flows)
3) The timing of extreme flow events.
4) Frequency and duration of high low flow pulses; and
5) The rate and frequency of changes in flows, before and after the construction of the Teesta V reservoir in the Teesta river channel.

IHA RESULTS



2006-2015Analysis
Environmental Flow Components (2000-2015)
Extreme Low Flows
Low Flows
High Flow Pulses
Small Floods
Large Floods
Flow Rate (cms)
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
10/1/1999
6/1/2000
2/1/2001
10/31/2001
8/1/2002
4/1/2003
12/8/2003
8/31/2004
5/25/2005
2/2/2006
11/1/2006
7/26/2007
4/4/2008
1/1/2009
9/1/2009
5/1/2010
1/1/2011
9/1/2011
5/1/2012
1/1/2013
9/1/2013
5/1/2014
1/1/2015
9/1/2015


2006-2015Analysis
Date of Minimum Flow
Pre-Impact Flows (2000-2007)
Post-Impact Flows (2008-2015)
75th percentile
Median
25th percentile
Julian Day (1-366)
0
50
100
150
200
250
300
350
2000
2001
2003
2005
2007
2009
2011
2013
2015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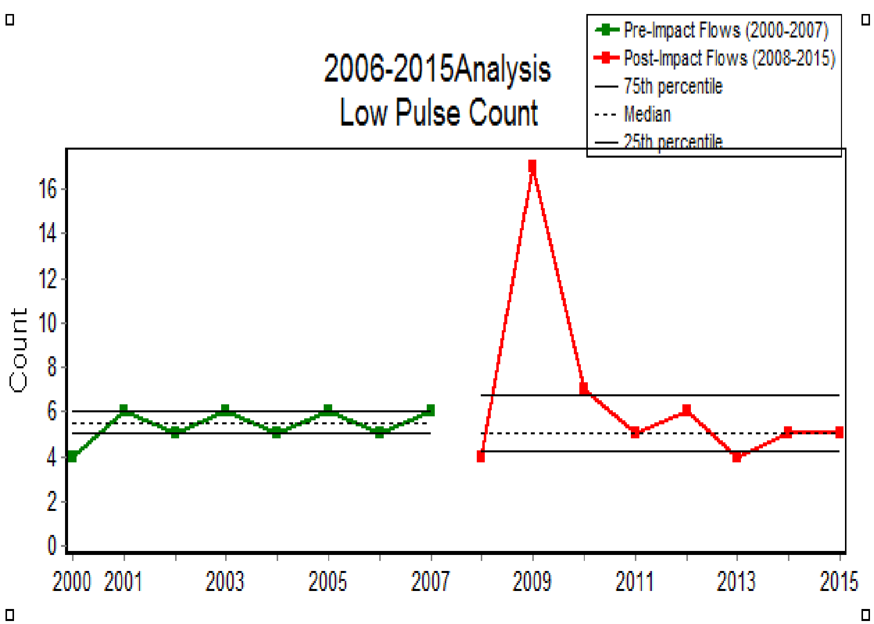
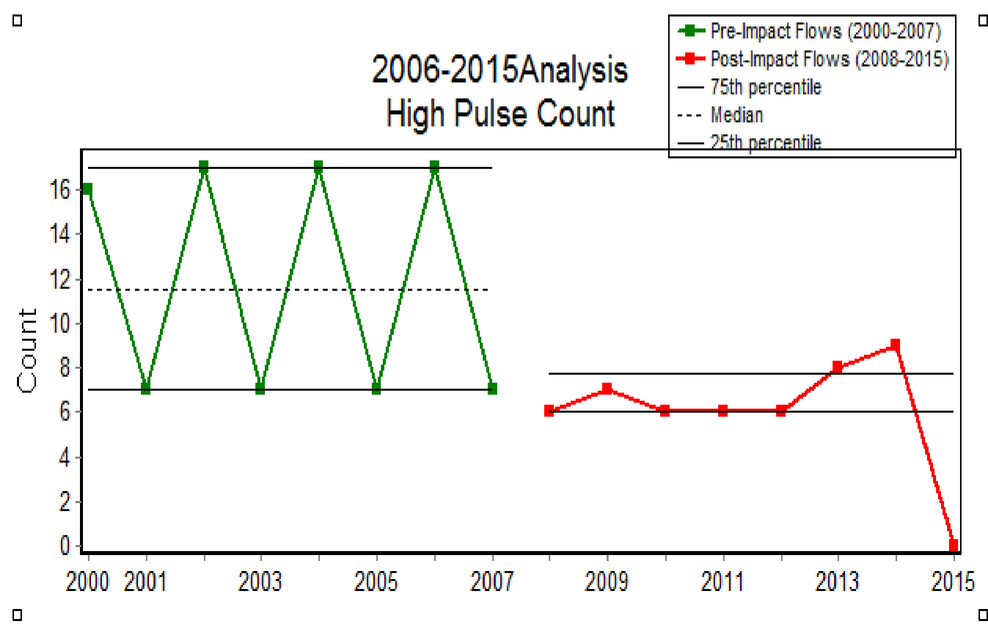

2006-2015Analysis
Low Pulse Count
Pre-Impact Flows (2000-2007)
Post-Impact Flows (2008-2015)
75th percentile
Median
25th percentile
Count
0
2
4
6
8
10
12
14
16
2000
2001
2003
2005
2007
2009
2011
2013
2015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High Pulse Count
Pre-Impact Flows (2000-2007)
Post-Impact Flows (2008-2015)
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14
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2000
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2003
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2007
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2011
2013
2015

CONCLUSION

- The 1-day maximum, 3-day maximum, 7-day maximum, 30-day maximum and 90-day maximum show a rising trend of the daily weekly, monthly and quarterly minimum flow cycle post period.
- The timing of extreme flow events are such that the dates of each annual 1-day minimum move forward from the 182nd day in the pre-impact period to the 24th day in the post-impact period.
- The dates of each annual 1-day maximum move forward from the 237th day in the pre-impact period to the 211th day in the post-impact period.
- Frequency and duration of low flow pulses count is higher in the post period than those in the pre-impact period and high pulse counts in the post-impact period is lower than those in the pre-impact period.

THANK YOU