BEFORE THE NATIONAL GREEN TRIBUNAL, NEW DELHI
(PRINCIPAL BENCH)

OA No 1172 of 2024

IN THE MATTER OF:

Ashish Kumar Pathak Vs Union of India & Ors

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Respondent NO 4

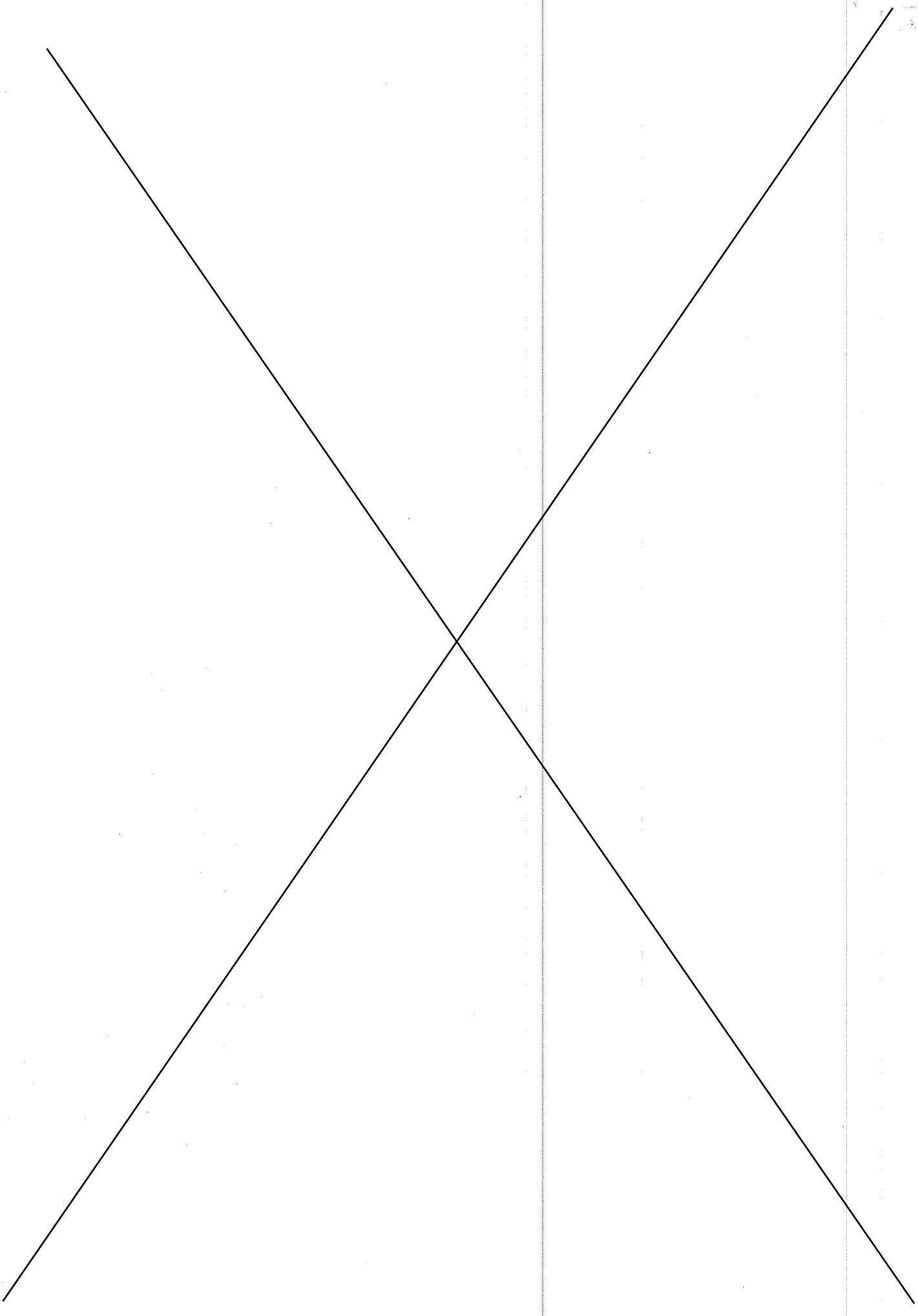
अनूप कुमार श्रीवास्तव/Anup Kumar Srivastava
कार्यकारी निदेशक (तकनीकी)/Executive Director (Technical)
राष्ट्रीय स्वच्छ गंगा मिशन/National Mission for Clean Ganga
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
Dept. of Water Resources, River Development and Ganga Rejuvenation
जल शक्ति मंत्रालय /Ministry of Jal Shakti
भारत सरकार, नई दिल्ली/Govt. of India, New Delhi
NMCG

Date: 11-11-2024

Place: New Delhi

Through Counsel

Gigi · C · George Adv.
Standing Council (UOI)
National Green Tribunal
Ch. No. 457 LB-I High Court
M-9810625315



BEFORE THE NATIONAL GREEN TRIBUNAL, NEW DELHI

(PRINCIPAL BENCH)

OA No 1172 of 2024

IN THE MATTER OF:

Ashish Kumar Pathak Vs Union of India & Ors

REPLY AFFIDAVIT ON BEHALF OF RESPONDENT NO 4, NATIONAL MISSION FOR CLEAN GANGA (NMCG), DEPARTMENT OF WATER RESOURCES, RIVER DEVELOMENT AND GANGA REJUVENATIN MINISTRY OF JAL SHAKTI, NEW DELHI

Most Respectfully, I, Anup Kumar Srivastava, aged 57 years, working as Executive Director (Technical) in the National Mission for Clean Ganga (NMCG), D/o WR, RD & GR, Ministry of Jal Shakti do hereby solemnly affirm, and declare as under:

1.That I, the deponent is working as Executive Director (Technical) in the NMCG and well conversant with the facts and circumstances of the present case on the basis of the information derived from the official records, and competent to submit this affidavit on behalf of the answering Respondent NMCG.

2. That it is submitted that NMCG is one of the authorities constituted under River Ganga (Rejuvenation, Protection and Management) Authorities Order, 2016 issued under the provisions of the Environment (Protection) Act, 1986.

3. That it is submitted that the Applicant in the above OA has inter-alia made the allegations with regard to a new building/construction being raised illegally at Rani Ghat (beside the Rani Kothi) in Varanasi adjacent to Prahlad Ghat on the bank of river Ganga. Further, it is mentionable that, as per the averments made by the applicant, the applicant had earlier filed PIL No. 31229/2005, before

The Seal of Oath Commissioner
SL No. 21/2024
SANDEEP AHLAWAT
App. By:- Delhi High Court
Period 1/05/2024 to 30/4/2026
Patiala House Courts, New Delhi

अनूप कुमार श्रीवास्तव/Anup Kumar Srivastava
कार्यकारी निदेशक (तकनीकी) / Executive Director (Technical)
राष्ट्रीय स्वच्छ गंगा मिशन / National Mission for Clean Ganga
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
Dept. of Water Resources, River Development and Ganga Rejuvenation
जल शक्ति मंत्रालय / Ministry of Jal Shakti
भारत सरकार, नई दिल्ली / Govt. of India, New Delhi

(2)

the Allahabad High Court, which in turn was transferred to this Hon'ble Tribunal in terms of the order dated 21.07.2023, passed in the PIL 4003 of 2006. The Applicant has mentioned that such construction as mentioned herein above is not permissible. The applicant has also mentioned that the applicant's complaint was transferred to the District Magistrate Varanasi. The Varanasi Development Authority had disposed of the complaint recording that the permission was granted vide dated 01.01.2024 by virtue of the rues framed by the department and that now the construction has been stopped. The applicant has also raised the plea that the flood plain zone of river Ganga has not been defined and that independent monitoring committee be appointed to assess the ground situation regarding the unauthorized constructions being raised within 200 meters from the highest flood level of the bank of river Ganga at Varanasi (U.P).

4. That it is submitted that the Ministry of Jal Shakti (MoJS) has constituted a Committee vide O.M dated 28.11.2022 and that the said Committee has proposed the division of flood plain into three zones for urban settlement and two zones for rural settlement. That as regards NMCG, it is submitted that from, time to time, NMCG has been advising all the states governments in Ganga basin for demarcation, delineation and notification of river flood plains and removal of encroachment from the riverbed/floodplain of the river Ganga and its tributaries in accordance to the provisions of the River Ganga (Rejuvenation, Protection and Management) Authorities Order. 2016.

5. That it is submitted that in para 12 of the Action taken Report submitted by the Irrigation Department of the Government of U.P dated 13.09.2024 before the Hon'ble Tribunal in the matter of OA 515/2024 which states that " it is respectfully submitted that the action taken report/status report combining flood frequency analysis satellite data and the hydraulic modelling will ensure accurate delineation and demarcation of the flood Plain Zones of Unnao to Ballia of river Ganga, in compliance with the Tribunals directives. It is submitted that the entire process for the earmarking of the flood

The Seal of Oath Commissioner, SL No. 21/2024, SANDEEP SHARMA, Patiala House Court, New Delhi

अनूप कुमार श्रीवास्तव/Anup Kumar Srivastava
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जल शक्ति मंत्रालय/Ministry of Jal Shakti
भारत सरकार, नई दिल्ली/Govt of India, New Delhi

(3)

plain zone would be completely by December, 2024" A copy of the status report filed by the State of U.P is attached as [**Annexure].**

6. That as per the provisions contained in the River Ganga (Rejuvenation, Protection and Management) Authorities Order, 2016, the following is provided therein:

i. *Para 3 (l)- "flood plain"* means such area of River Ganga or its tributaries which comes under water on either side of it due to floods corresponding to its greatest flow or with a flood of frequency once in hundred years;

ii. P*ara 6 (3)-* the provisions inter-alia provides that no person shall construct any structure, whether permanent or temporary for residential or commercial or industrial or any other purposes in the River Ganga, Bank of River Ganga or its tributaries or *active flood plain area* of River Ganga or its tributaries, provided that in exceptional circumstances like natural calamities or religious events at traditional locations, temporary structures can be raised after prior permission of the National Mission for Clean Ganga acting through the State Ganga Committee and the District Ganga Committee. And it is further provided further that in case any such construction has been completed, before the commencement of this Order, in the River Bank of River Ganga or its tributaries or active flood plain area of River Ganga or its tributaries, the National Mission for Clean Ganga shall review such constructions so as to examine as to whether such constructions are causing interruption in the continuous flow of water or pollution in River Ganga or its tributaries, and if that be so, it shall cause for removing them.

iii. Sub para (4) of para 6 provides that no person shall do any act or carry on any project or process or activity which, notwithstanding whether such act has been mentioned in this Order or not, has the effect of causing pollution in the River Ganga.

iv. Further as regards provisions of Para 42 of the River Ganga Authorities Order, 2016, it contemplates seeking prior approval in certain matters mentioned hereunder:

a) engineered diversion and storage of water in River Ganga

without affecting the flow of water downstream of the River Ganga;

b) construction of bridges and associated roads and embankments over the River Ganga or at its River Bank or its flood plain area;
c) construction of Ghats or extension of any existing Ghat;
d) construction of jetties;
e) construction of permanent hydraulic structures for storage or diversion or control of waters or channelization of River Ganga or its tributaries;
f) deforestation of hill slopes and notified forest and other eco-sensitive areas;
g) any other activity which contravenes the principles laid out in paragraph 4 which the National Mission for Clean Ganga may specify.

The project proponent(s) are mandated to seek prior approval from NMCG in terms of the above provisions.

7. **Partwise reply**

(i) That in response to the averments mentioned in para 1-4 , it is submitted that the same is a matter of record.

(ii) That in response to the averments mentioned in para 5, it is submitted that the same is not disputed.

(iii) That in response to the averments mentioned in para 6 -10, it is submitted that the same is a matter of record.

(iv) That in response to the averments mentioned in para 11, it is submitted that the same is not disputed that the authorities including the NMCG has been constituted under River Ganga (Rejuvenation, Protection and Management) Authorities Order, 2016 issued under the provisions of the Environment (Protection) Act, 1986.

(v) That in response to the averments mentioned in para 12, it is submitted that the same is a matter of record.

(vi) That in response to the averments mentioned in para 13-14, it is submitted that the same need no response from the answering respondent.

अनूप कुमार श्रीवास्तव/Anup Kumar Srivastava
कार्यकारी निदेशक (तकनीकी)/Executive Director (Technical)
राष्ट्रीय स्वच्छ गंगा मिशन/National Mission for Clean Ganga
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
Dept. of Water Resources, River Development and Ganga Rejuvenation
जल शक्ति मंत्रालय/Ministry of Jal Shakti
भारत सरकार, नई दिल्ली/Govt. of India, New Delhi

(15)

8. That it is humbly submitted for consideration of this Hon'ble Tribunal that if the project proponent, submits the application/proposal for seeking approval from the NMCG along with full details of the proposal and the clearances obtained from the other statutory authorities, the proposal shall be examined by the NMCG.

DEPONENT

अनूप कुमार श्रीवास्तव/Anup Kumar Srivastava
कार्यकारी निदेशक (तकनीकी)/Executive Director (Technical)
राष्ट्रीय स्वच्छ गंगा मिशन/National Mission for Clean Ganga
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
Dept. of Water Resources, River Development and Ganga Rejuvenation
जल शक्ति मंत्रालय/Ministry of Jal Shakti
भारत सरकार, नई दिल्ली/Govt. of India, New Delhi

VERIFICATION:

Verified at New Delhi on ---November, 2024 that the contents of the above affidavit are true and correct to my knowledge based on official record and no part of it is false and nothing material has been concealed therein.

11 NOV 2024

DEPONENT

I identify the Deponent who has signed/put T.I. in my presence

अनूप कुमार श्रीवास्तव/Anup Kumar Srivastava
कार्यकारी निदेशक (तकनीकी)/Executive Director (Technical)
राष्ट्रीय स्वच्छ गंगा मिशन/National Mission for Clean Ganga
जल संसाधन, नदी विकास और गंगा संरक्षण विभाग
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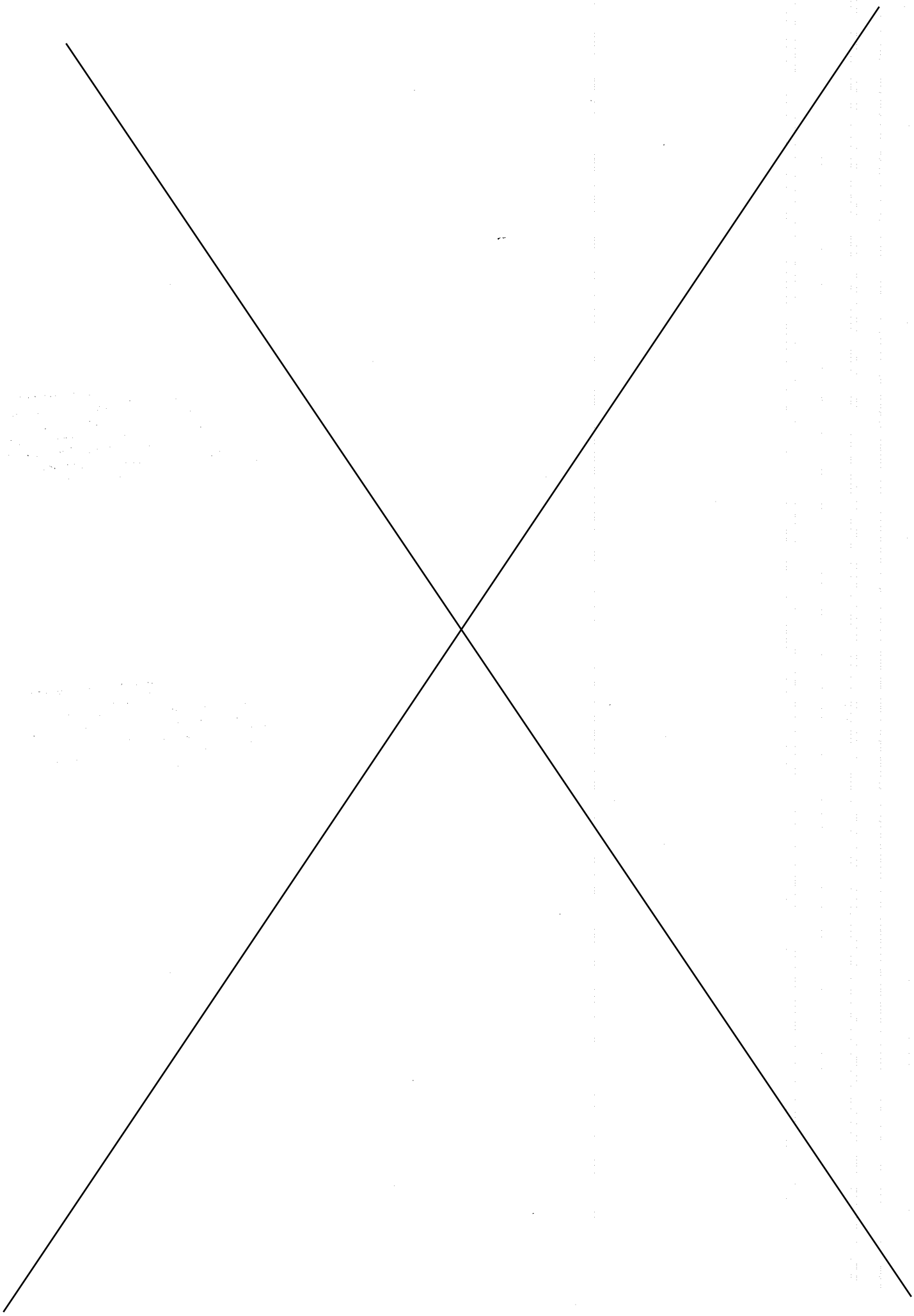
भारत सरकार, नई दिल्ली/Govt. of India, New Delhi

The Seal of Oath Commissioner
SL No. 21/2024
SANDEEP SHARMA
App. ... High Court
... 2024 to
30/4/2026
Patiala House Courts, New Delhi

Solemnly sworn before me read over & explained to the deponent Admitted to be correct

Oath Commissioner, New Delhi

11 NOV 2024



BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL

PRINCIPAL BENCH, NEW DELHI

O.A. No. 515 OF 2023

IN THE MATTER OF:-

GANGA POLLUTION .....APPLICANT

VERSUS

STATE OF U.P & ORS. ... RESPONDENTS

INDEX

6.	True Copy of the letter no. Mu.A/N.G.B.S./D.B. Hydro- Data/2024/160 dated 18.01.2024. (ANNEXURE R5)	15 - 16
7.	True copy of the NIH report July and the progress report till August. (ANNEXURE R6)	17 - 36
8.	True copy of the methodologies. (ANNEXURE R7)	37 - 38
9.	True copy of the 6 G&D Site wise observed annual maximum data graphs and the table of estimated floods of various return periods. (ANNEXURE R8)	39 - 41

FILED THROUGH: -

DATE: 13.09.2024
PLACE: NEW DELHI

BHANWAR PAL SINGH JADON
STANDING COUNSEL, STATE OF UP
NATICNAL GREEN TRIBUNAL, NEW DELHI
BHANWAR09JADON@GMAIL.COM

(8)

BEFORE THE HON'BLE NATIONAL GREEN TRIBUNAL

PRINCIPAL BENCH, NEW DELHI

O.A. No. 515 OF 2023

IN THE MATTER OF:-

GANGA POLLUTION ....APPLICANT

VERSUS

STATE OF U.P & ORS. ...RESPONDENTS

ACTION TAKEN REPORT/STATUS REPORT ON BEHALF OF PRINCIPAL SECRETARY, IRRIGATION DEPARTMENT, STATE OF UTTAR PRADESH IN COMPLIANCE WITH THE ORDER DATED 27.05.2024 and 11.07.2024

1. At the outset, with the utmost respect it is submitted that all the officers and authorities of the State of Uttar Pradesh have the highest respect and regard to the orders passed by the Hon'ble Tribunal and duty bound to fulfil the obligation which are assigned under the law and directions passed by this Hon'ble Tribunal in true letter and spirit.

2. That in the present Original Application 515/2023 Ganga Pollution vs. State of U.P. the core issue involved revolves around defining the flood plain zone of river Ganga and its tributaries in the State of U.P. and actions taken by the concerned authorities to protect the flood plain zone.

3. It is respectfully submitted that a report dated 24.02.2020, pertaining to the demarcation of Phase-I, has already been submitted before this Hon'ble Tribunal. Additionally, a report dated 24.05.2024, concerning compliance with the order dated 15.03.2024, has also been submitted before this Hon'ble Tribunal.

That the matter was listed on 27.05.2024 and 11.07.2024 and the Hon'ble Tribunal was pleased to pass the following order.

Order dated 27.05.2024:-

I. **Para 9** "We also take note of the fact that in respect of the stretch of Yamuna River at Gautam Budh Nagar and Greater Noida in OA No. 275/2023, exercise for demarcation of floodplain zone has been undertaken on the basis of the map obtained from Survey of India with 01m contour interval. Therefore, State authorities may consider as to why the same approach cannot be adopted for demarcating the floodplain zone of river Ganga in the stretch under consideration".

II. **Para 10** "Learned Counsel appearing for State of UP has submitted that NIH will be able to submit the interim report by October 2024 and completion of work defined in the Agreement dated 22.12.2023 will be completed by December 2024."

~~3~~ 10

Order dated 11.07.2024:-

III. Para 3 "Principal Secretary, Irrigation Department, State of UP has also submitted that authorities will approach Survey of India to obtain map of the relevant stretch with 01 m contour interval and explore the possibility of demarcation of flood plain on that basis."

IV. Para 4 "In respect of dividing the flood plain in three zones i.e. (i) prohibited zone: recurrence interval of 05 years; (ii) regulatory zone: 25 year return period flood; (iii) warning zone: 100 year return period flood as stated in the report dated 24.05.2024, a reliance has been placed upon the order of the Tribunal dated 13.07.2017 in OA No. 200/2014 and connected matters in the case of M. C. Mehta v. Union of India & Ors. Ganga Rejuvenation Order, 2016 was not brought to the notice of the Tribunal when the order dated 13.07.2017 was passed. If statutory order exists then the same is required to be complied with"

4. It is hereby submitted that vide letter 327/CE/ISO/2024- 25 dated 22.07.2024, the Chief Engineer/ UPSW Information System Organisation Irrigation & Water Resource Department IWRD Luknow, U.P has addressed a letter to the Director, Uttar Pradesh Geo-Spatial Directorate, Survey Of India, Manchitra Bhawan Lucknow. It is submitted that under the Guidance and support of Central Water Commission (CWC), Irrigation and Water Resource Department, U.P has initiated working on with NIH, to delineate and demarcate the Flood Plain Zone (FPZ) from Unnao to Ballia. The Chief Engineer, Information System Organisation,

Irrigation and Water Resource Department, Uttar Pradesh, Parikalp Bhawan, Telibagh, Lucknow, requested to provide the 01m Contour Interval for Uttar Pradesh so that the demarcation and delineation of the Flood Plain Zone can be done. True Copy of the letter no. 327/CE/ISO/2024-25 dated 22.07.2024 is annexed herein as **ANNEXURE R1.**

5. It is most humbly submitted that vide letter No. 4189/39- El dated 07.08.2024, the Director/Survey of India Map Bhawan/Manchitra Bhawan Uttar Pradesh Geospatial Directorate (Northern Zone) Uttar Pradesh G.D (Northern Zone) Luknow, has written a letter to the Chief Engineer, Irrigation and Water Resources Department Luknow. In the described letter the soft copy of 01m Contour interval of the Flood Plain Zone of river Ganga has been sent to the Assistant Engineer in Invoice No. RK/3773/UPGDC/LUCKNOW. True Copy of the letter no. 4189/39-El dated 07.08.2024 is annexed herein as **ANNEXURE R2.**

6. It is pertinent to note that, as per letter No. 366/M.A. (S.P.S)/2024-25 dated 08.08.2024, the Chief Engineer, Information System Organisation, Irrigation and Water Resource Department, Uttar Pradesh, Parikalp Bhawan, Telibagh, Lucknow, has corresponded with the Scientist, Head, Surface Water and Hydrology Division, National Institute of Hydrology (NIH), Rorkee, Uttarakhand. It is submitted that the 01-meter contour interval map received from the Survey of India is intended for the purposes of demarcation and determination of the Flood Plain Zone (FPZ): True Copy of the letter no. 366/M.A.

(S.P.S)/2024-25 dated 08.08 is annexed herein as **ANNEXURE R3.**

7. It is respectfully submitted that, by virtue of letter No. 07/Superintending Engineer/FMISC/2023-24 dated 16.01.2024, the Superintending Engineer, Flood Management Information System Centre, Irrigation and Water Resource Department, Uttar Pradesh, Lucknow, has formally communicated with the Chief Engineer, Lower Ganga Basin Organization (LGBO), Central Water Commission (CWC), Amarnath Road, Adaltganj, Patna 800001, for providing data and cross section data of maximum number of years of Gauge and Discharge stations established under LGBO on Ganga river and its tributaries located in Uttar Pradesh. It is further submitted that Gauge & Discharge and cross section data are very important for Flood Plain Zone determination and demarcation due to Uttar Pradesh being a flat land. A table of water level and Discharge of several Gauge stations of CWC has been obtained through WIMS portal, in which 55 years of maximum data has been obtained of Varanasi Gauge Station. True Copy of the letter no. 07/Adhikshan Abhiyanta/FMISC/2023-24 dated 16.01.2024 is annexed herein as **ANNEXURE R4.**

8. It is pertinent to note that in response to the vide letter No. Mu.A/N.G.B.S./D.B Hydro-Data/ 2024/ 160 dated 18.01.2024, the Chief Engineer, Water Resource, River Development, and Ganga Conservation Department, Lower Ganga Basin Organisation, Patna, has addressed a communication to the Superintending Engineer, Flood Management Information

System Centre, Irrigation and Water Resources Department, Uttar Pradesh, Lucknow. This correspondence includes an enclosed list detailing all. Gauge and Discharge stations established by the LGBO on the Ganga Basin River and its tributaries within Uttar Pradesh. True Copy of the letter no. Mu.A/N.G.B.S./D.B. Hydro-Data/2024/160 dated 18.01.2024 is annexed herein as **ANNEXURE R5.**

9. It is respectfully submitted for the esteemed consideration of this Hon'ble Tribunal that the report from the NIH July-2024 and the progress report till August has been annexed herein as **ANNEXURE R6.**

10. It is important to submit that the demarcation of the floodplain zone has been conducted with consideration of a 100-year spread, using the Hybrid Methodology. This approach utilizes a 100-year return period flood, which is estimated through flood frequency analysis of the annual maximum flood discharge data from available G&D (Gauge and Discharge) sites over the relevant periods. The estimation is conducted using hydraulic modeling-HEC-RAS, the flood frequency analysis is calculated using the L-Moment Ratio method and 37 years of data obtained through satellite imagery using Landsat data. The Hybrid Methodology was chosen because both satellite analysis and modeling have inherent limitations. Specifically, satellite data may not capture the full extent of flood events, and model results are subject to the quality of the Digital Elevation Model (DEM).True copy of the methodologies is annexed herein as **ANNEXURE R7.**

11. It is submitted that the study analysed the maximum yearly river discharge data from six sites using frequency distribution method i.e. Extreme Value (EV1), General Extreme Value (GEV), Logistic (LOS), Generalized Logistic (GLO), Normal (NOR), generalized pareto (GPA), generalized normal (GNO), Uniform (UNF), Exponential (EXP), Pearson Type-III (PT3), Kappa (KAP) and Wakeby (WAK), using flood frequency analysis with the L- moments approach. Twelve different statistical distributions were tested to find the best fit for predicting flood levels. The most suitable distributions were identified using specific criteria i.e., L-moment and Zisdt statistics, and the estimated flood levels for different and 100 year return periods at each site were summarized in a table. True copy of the 6 G&D Site wise observed annual maximum data graphs and the table of estimated floods of various return periods are annexed herein as **ANNEXURE R8.**

12. It is respectfully submitted that this action taken report/status report, combining flood frequency analysis, satellite data, and hydraulic modelling, will ensure accurate delineation and demarcation of the Flood Plain Zones for Unnao to Ballia of the River Ganga, in compliance with the Hon'ble Tribunal's directives. It is submitted that the entire process for the earmarking of the flood plain zone would be completed by the December 2024.

13. That the Irrigation Department of the State of Uttar Pradesh is fully committed to adhering to the directives of the Hon'ble Tribunal and ensuring compliance with the statutory orders outlined in the Ganga Rejuvenation Order, 2016.

(Anil Garg)

Principal Secretary

(16)

Annexure-2

From: -

Suprabhat Singh
Chief Engineer / Nodal Officer UPSW
Information System Organisation
Irrigation & Water Resources Department, IWRD
Lucknow, U.P.

To.

The Director,
Uttar Pradesh Geo-spatial Directorate,
Survey of India, Manchitra Bhawan,
5 -Vibhuti Khand, Gomti Nagar,
LUCKNOW PIN - 226 010

Letter No.: 327 /CE/ISO/2024-25 Date: 22/07/2024

Subject: - Regarding providing the map with 01 m contour interval of Uttar Pradesh

Dear Sir,

Honorable, National Green Tribunal (NGT) has ordered to delineate and demarcate the Flood Plain Zone (FPZ) with 100 Year's Return period of river Ganga and its tributaries

Under the guidance and support of the Central Water Commission (CWC), Irrigation & Water Resources Department, Uttar Pradesh (I&WRD, UP) has initiated working on it with the assistance of National Institute of Hydrology (NIH), Roorkee to delineate and demarcate the Flood Plain Zone (FPZ) from Unnao (near Kanpur) to Ballia

Honourable, National Green Tribunal in its order dated 11.07.2024 has directed Irrigation and Water Resources Department, Uttar Pradesh to obtain the map of relevant stretch with 01 m contour interval from Survey of India and explore the possibility of demarcation of flood plain zone on that basis.

In view of the above, undersigned request you to kindly provide the map with 01 m contour interval for Uttar Pradesh so that the demarcation and delineation of flood plain zone can be done

NGT order dated 11.07.2024 has been enclosed for your kind perusal
Your support and cooperation in this regard will be of utmost importance

Enclosure: As above

Yours faithfully,

22/7/24

(Suprabhat Singh)
Chief Engineer / Nodal Officer UPSW
ISO, IWRD, UP
Lucknow

Letter No: 327 /CE/ISO/2024-25 Dated:- 22/07/2024

Copy to: -

1. Special Secretary, Section-4, Uttar Pradesh Secretariat, Irrigation & Water Resources Department Lucknow
2. Engineer-in-Chief & Head of Dept., Irrigation & Water Resources Department, Lucknow.
3. Engineer-in-Chief (D. & P.), Irrigation & Water Resources Department, Lucknow.
4. Chief Engineer, Sharda Sahayak, Irrigation & Water Resources Department, Lucknow.
5. Chief Engineer, Sone, Irrigation & Water Resources Department, Lucknow.
6. Chief Engineer, Water Resources, Irrigation & Water Resources Department, Lucknow.
7. Superintending Engineer FMISC, Irrigation & Water Resources Department, Lucknow.

22/7/24

(Suprabhat Singh)
Chief Engineer / Nodal Officer UPSW
ISO, IWRD, UP
Lucknow

Received 23.07.24

ANNEXURE - R2

भारत सरकार
GOVT. OF INDIA

निदेशक का कार्यालय/Office of Director
भारतीय सर्वेक्षण विभाग/Survey of India
मानचित्र भवन/Manchitra Bhawan
उत्तर प्रदेश भू-स्थानिक निदेशालय (उत्तरीक्षेत्र)
Uttar Pradesh G.D (Northern Zone)
5, विभूतिखण्ड, गोमतीनगर, लखनऊ -226010(उ0प्र0)
5, Vibhuti Khand, Gomti Nagar, Lucknow-226010 (UP)

टेली-फैक्स/Tele-fax – 0522-2720634
दूरभाष/Telephone-0522-2720638
ई-मेल@E-mail: up.gdc.soi@gov.in (Tech)
upgdc-lko@up.nic.in (Admn)

पत्र सं0 त- 4189 /39-ED(कोर्ट केस)

दिनांक: 07/08/2024

सेवा में,

श्री सुप्रभात सिंह
मुख्य अभियन्ता,
सूचना प्रणाली संगठन
सिंचाई एवं जल संसाधन विभाग उ0 प्र0,
परिकल्प भवन, तेलीबाग,
लखनऊ।

विषयः- उत्तर प्रदेश राज्य का 1 मीटर कंटूर इन्टरवल (Contour Interval) मानचित्र उपलब्ध कराने के संबंध में।

संदर्भः- आपके कार्यालय का पत्र क्रमांक सं. 327/मु.अभि./सू.प्र.सं./2024-25 दिनांक 22/07/2024

महोदय,

उपरोक्त संदर्भित विषय में आपको अवगत कराना है कि आपके द्वारा की गयी वांछित गंगा नदी के फ्लड जोन (उन्नाव से बलिया) के 1 मीटर Contour Interval का साफ्ट कॉपी डाटा (Lidar Data) आपके कार्यालय से आये अधिकारी श्री हेमंत कुमार, सहायक अभियन्ता को दिनांक 07/08/2024 को इस कार्यालय के Invoice No. RK/3773/UPGDC/LUCKNOW दिनांक 07/08/2024 के द्वारा उपलब्ध करा दिया गया है।

उक्त डेटा इस आशय के साथ आपको सुपूर्द किया जा रहा है कि उपरोक्त डेटा का उपयोग केवल विषयक कार्य हेतु किया जायेगा तथा इसके अलावा डेटा को आपके द्वारा किसी व्यक्ति व संस्था के साथ साझा नहीं किया जायेगा तथा डेटा की पूर्ण सुरक्षा की जायेगी।

संलग्नः- 1. Invoice No. RK/3773/UPGDC/LUCKNOW दिनांक 07/08/2024
2. आपके कार्यालय का पत्र क्रमांक सं.327/मु.अभि./सू.प्र.सं./2024-25 दिनांक 22/07/2024

7-8-24

(रविन्द्र मीना)
अधीक्षण सर्वेक्षक
कृते निदेशक

प्रतिलिपिः-
1. भारत के महासर्वेक्षक, देहरादून को सूचनार्थ प्रेषित।
2. अपर महासर्वेक्षक, उत्तरी क्षेत्र, चण्डीगढ को सूचनार्थ प्रेषित।
3. लीगल सैल, भारत के महासर्वेक्षक कार्यालय, देहरादून को सूचनार्थ प्रेषित।

भारतीय सर्वेक्षण विभाग

INVOICE NO. R.K/3773/UPGDC, LUCKNOW
Dt.07-08-2024.

Survey of India

प्रेषक From	सेवा में, To,
निदेशक उत्तर प्रदेश भू-स्थानिक निदेशालय (उ०क्षेत्र) भारतीय सर्वेक्षण विभाग विभूति खण्ड गोमती नगर, लखनऊ–226010	अधिशासी अभियंता सिंचाई विभाग लखनऊ

संदर्भ: आपका पत्र सं0.. आपको निम्नलिखित रजिस्टर्ड / पार्सल / मालगाड़ी, सवारी गाड़ी द्वारा भेजी गई हैं कृपया हस्ताक्षर करके इस बीजक की एक प्रति वापस कीजिए

Reference your Letter No. 324 137/मु०अभि०/गं०प०नि०/2024-25 दि० 22-7-24

The under mentioned .... have been dispatched to you by hand/Registered/Parcel Post/Train. Please sign and return one copy of this invoice

हस्ताक्षर Signature.....Mohan..... 07/08/24 पद Designation................ (मोहन लाल/MOHAN LAL मुख्य मानचित्रकार/Chief D'man उ.प्र. भू-स्था. निदेशालय/U.P.G.D भारतीय सर्वेक्षण विभाग, लखनऊ Survey of India, Lucknow)

नाम साफ अक्षरों में Name in Block Letter..

क्रम सं0 Sl. No	विवरण Description	SPACE	FILES	FOLDERS	REMARK
1	NGO_TO_UPGD_NHP_NGT (UNNAO To BALIA)	646 GB	69241	83	
2	NDDC TO UPGD _NMCG-NGT_ (UNNAO To BALIA)	151 GB	11932	24	

संख्या No.
तारीख Date

उपर्युक्त प्राप्त किया Received the above
हस्ताक्षर Signature
पद Designation
नाम साफ अक्षर Name in block letter

(19)

ANNEXURE R-3

12

प्रेषक,

मुख्य अभियन्ता,
सूचना प्रणाली संगठन,
सिंचाई एवं जल संसाधन विभाग, उ0प्र0,
परिकल्प भवन, तेलीबाग, लखनऊ।

प्रेषित,

डा0 ए0के0 लोहानी,
वैज्ञानिक जी, प्रमुख, सतही जल एवं जल विज्ञान प्रभाग,
राष्ट्रीय जल विज्ञान संस्थान (NIH), रूड़की, उत्तराखण्ड।

पत्रांकः- 366/मु0अभि0(सू0प्र0सं0)/2024-25 लखनऊ, दिनांकः 08 अगस्त, 2024

विषयः-गंगा नदी के Segment B, Phase-II (उन्नाव से बलिया) का Flood Plain Zone (FPZ) के निर्धारण एवं सीमांकन (Delincation & Demarcation) हेतु Survey of India से प्राप्त 01 मी0 कंटूर इन्टरवल (Contour Interval) मानचित्र/डेटा हस्तगत कराने के संबंध में।

महोदय,

मा0 राष्ट्रीय हरित अधिकरण द्वारा दिनांक 11.07.2024 को दिये गये निर्देशों का अनुपालन करते हुए सर्वे ऑफ इंडिया, लखनऊ कार्यालय से गंगा नदी के Segment B, Phase-II (उन्नाव से बलिया) का Flood Plain Zone (FPZ) के निर्धारण एवं सीमांकन (Delincation & Demarcation) हेतु 01 मी0 कंटूर इन्टरवल (Contour Interval) मानचित्र की वांछना की गई थी, जिसके क्रम में सर्वे ऑफ इंडिया द्वारा दिनांक 07.08.2024 को 01 मी0 कंटूर इन्टरवल (Contour Interval) डेटा (LiDAR data) साफ्ट कॉपी में उपलब्ध करा दिया गया है।

उक्त डेटा का कुल Volume- 798 GB है, जिसको कार्य की महत्ता के दृष्टिगत रखते हुए आपसे अनुरोध है कि तत्काल किसी जिम्मेदार अधिकारी को नामित कर डेटा प्राप्त करने हेतु 1TB की hard disk के साथ भेजने का कष्ट करें, जिससे कि उक्त प्राप्त डेटा तत्काल आपको अग्रिम कार्यवाही हेतु अग्रसरित की जा सके।

उपरोक्त डेटा इस आशय के साथ आपको हस्तगत किया जा रहा है कि इसका उपयोग केवल विषयक कार्य हेतु किया जायेगा तथा इसके अलावा इस डेटा का प्रयोग किसी भी परिस्थिति में न तो किसी अन्य कार्य के लिए किया जायेगा और न ही किसी अन्य व्यक्ति व संस्था के साथ साझा किया जायेगा तथा डेटा की पूर्ण सुरक्षा की जायेगी।

08/8/24

(सुप्रभात सिंह)
मुख्य अभियन्ता (सू0प्र0सं0)

08.08.2024

पत्रांकः- /मु0अभि0(सू0प्र0सं0)/2024-25/तदिनांकः

प्रतिलिपि निम्नलिखित को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित है।

1. मुख्य अभियन्ता (शारदा सहायक), सिंचाई एवं जल संसाधन विभाग, उ0प्र0, लखनऊ।
2. मुख्य अभियन्ता (सोन), सिंचाई एवं जल संसाधन विभाग, उ0प्र0, वाराणसी।
3. मुख्य अभियन्ता (जल संसाधन), सिंचाई एवं जल संसाधन विभाग, उ0प्र0, लखनऊ।
4. अधीक्षण अभियन्ता, एफ0एम0आई0एससी, सिंचाई एवं जल संसाधन विभाग, उ0प्र0, लखनऊ।

(सुप्रभात सिंह)
मुख्य अभियन्ता (सू0प्र0सं0)

(20)

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ANNEXURE R-4

E-Mail

प्रेषक,

अधीक्षण अभियन्ता,
बाढ़ प्रबन्धन सूचना प्रणाली केन्द्र,
सिंचाई एवं जल संसाधन विभाग,
उ0प्र0, लखनऊ।

प्रेष्य,

मुख्य अभियन्ता,
लोवर गंगा बेसिन संगठन (LGBO),
केन्द्रीय जल आयोग, अमरनाथ रोड,
अदालतगंज, पटना–800001

पत्रांकः– 07 /अधी0अभि0/एफएमआईएससी/2023–24 दिनांकः 16 जनवरी, 2024

विषयः– उ0प्र0 में स्थित गंगा नदी एवं उसकी सहायक नदियों पर LGBO के अन्तर्गत स्थापित Gauge & Discharge stations का अधिक से अधिक वर्षों का डेटा एवं Cross-section data उपलब्ध कराने के सम्बन्ध में।

महोदय,

माननीय राष्ट्रीय हरित अधिकरण, नई दिल्ली के निर्देशों के अनुपालन में गंगा नदी के Segment-B, Phase-II (उन्नाव से बलिया) की Flood Plain Zone (FPZ) के निर्धारण एवं सीमांकन (Delineation & Demarcation) का कार्य सिंचाई एवं जल संसाधन विभाग, उ0प्र0 द्वारा किया जा रहा है।

Flood Plain Zone निर्धारण एवं सीमांकन हेतु Gauge & Discharge एवं Cross-section data उ0प्र0 का समतल भूभाग होने के कारण अत्यधिक महत्वपूर्ण है, जिसमें हमें WIMS Portal के माध्यम से निम्नलिखित गेज स्टेशनों के Water Level एवं Discharge data प्राप्त हुआ है –

S. no	District	Gauge Station Name	Water Level	Discharge	Data availability	Remarks
1	Fategarh	Fategarh	14-11-1971 to 31-05-2023	14-11-1971 to 31-05-2023	53 yrs	
2	Kanpur Nagar	Ankinghat	01-01-1974 to 20-03-2023	01-01-1974 to 20-03-2023	30 Yrs	
3	Kanpur Nagar	Kanpur	01-01-1974 to 28-02-2023	01-01-1974 to 28-02-2023	30 yrs	
4	Dalmau	Raibareli	N/A	N/A		
5	Phaphamau	Prayagraj	N/A	N/A		
6	Chhatnag	Prayagraj	03-07-1970 to 20-07-2023	03-07-1970 to 20-07-2023	53 Yrs	
7	Mirzapur	Mirzapur	01-06-1976 to 30-06-2023	01-06-1976 to 30-06-2023	48 yrs	
8	Varanasi	Varanasi	01-01-1968 to 30-06-2023	01-01-1968 to 30-06-2023	55 Yrs	
9	Ghazipur	Ghazipur	01-06-2014 to 16-08-2023	N/A	10 yrs	Discharge Not available
10	Ballia	Turtipar	01-01-1974 to 14-08-2023	01-01-1974 to 14-08-2023	50 yrs.	
11	Fatehpur	Bhitaura	01-01-1974 to 31-07-2023	01-01-1974 to 31-07-2023	49 yrs.	
12	-	Chunar	15-10-2018 to 16-05-2023	15-10-2018 to 16-05-2023	06 yrs	
13	-	Narayanpur	15-10-2018 to 31-07-2023	15-10-2018 to 31-07-2023	06 yrs.	

S. no	District	Gauge Station Name	Water Level	Discharge	Data availability	Remarks
14	-	Saidpur	15-10-2018 to 31-07-2023	15-10-2018 to 31-07-2023	06 yrs	
15	-	Buxar	01-01-1974 to 15-08-2023	01-01-1974 to 15-08-2023	49 yrs.	

अतः आपसे अनुरोध है कि आपके संगठन में उपरोक्त स्टेशनों के अतिरिक्त उ0प्र0 में स्थित गंगा नदी एवं उसकी सहायक नदियों का Gauge & Discharge data एवं Cross-section data उपलब्ध कराने कष्ट करें, जिससे के कार्य को अविलम्ब पूर्ण किया जा सके।

(देवेश शुक्ला)
अधीक्षण अभियन्ता

पत्रांकः— /अधी0अभि0/एफएमआईएससी/2023—24/दिनांकः

प्रतिलिपि—निम्नलिखित को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित—

1. मुख्य अभियन्ता, सूचना प्रणाली संगठन, सिंचाई एवं जल संसाधन विभाग, उ0प्र0, लखनऊ।
2. मुख्य अभियन्ता (शारदा सहायक), सिंचाई एवं जल संसाधन विभाग, उ0प्र0, लखनऊ।
3. अधिशासी अभियन्ता, बाढ़ प्रबन्धन सूचना प्रणाली केन्द्र, सिंचाई एवं जल संसाधन विभाग, उ0प्र0, लखनऊ।

(देवेश शुक्ला)
अधीक्षण अभियन्ता

ANNEXURE R-5

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जल शक्ति मंत्रालय, भारत सरकार
जल संसाधन, नदी विकास एवं गंगा संरक्षण विभाग
मुख्य अभियंता कार्यालय
निचली गंगा बेसिन संगठन
केंद्रीय जल आयोग, पटना

Ministry of Jal Shakti, Government of India
Deptt. of Water Resources, RD & GR
Office of the Chief Engineer
Lower Ganga Basin Organisation
Central Water Commission, Patna

सं. मु.अ/नि.गं.बे.सं/डी.बी. हाइड्रो-डाटा/2024/160 दिनांक-18.01.2024

सेवा मे,

अधीक्षण अभियंता,
बढ़ प्रबंधन सूचना प्रणाली केंद्र,
सिंचाई एवं जल संसाधन विभाग,
उ० प्र०, लखनऊ ।

विषय: उ० प्र० मे स्थित गंगा नदी एवं उसकी सहायक नदियों पर LGBO के अंतर्गत स्थापित गेज & Discharge stations का अधिक से अधिक वर्षों का डाटा एवं cross-section data उपलब्ध करने के संबधं में ।

संदर्भ: आपका पत्रांक 07 / अधी०अभि०/एफ़एमआईसी/2023-24 दिनांक: 16.01.2024।

महोदय,

संदर्भित पत्र के द्वारा आपने यह सूचित किया है कि सिंचाई एवं जल संसाधन विभाग द्वारा गंगा नदी के Segment-B! Phase-II (उन्नाव से बलिया) की Flood Plain Zone (FPZ) के निर्धारण एवं सीमांकन (Delineation & Demarcation) का कार्य हेतु, CWC के गेज stations के Water Level एवं Discharge, WIMS पोर्टल से प्राप्त हो गए हैं । साथ ही उत्तर प्रदेश मे स्थित गंगा नदी एवं उसकी सहायक नदियों का Gauge & Discharge एवं cross-section data उपलब्ध कराने का अनुरोध किया गया है ।

इस संबंध मे यह बताना है कि उत्तर प्रदेश मे स्थित गंगा नदी एवं उसकी सहायक नदियों पर LGBO के अंतर्गत स्थापित सभी Gauge & Discharge stations की सूची संलग्न कर प्रेषित की जा रही है । इन सभी sites से संबन्धित आंकड़े WIMS Portal पर उपलब्ध जिसे आवश्यक कारवाई हेतु download किया जा सकता है ।

यह मुख्य अभियंता की अनुमति से जारी किया जाता है ।

भवदीय

मुकेश कु० सिंह 18/1/24

(मुकेश कुमार सिंह)
अधीक्षण अभियंता (समo)

अदालतगंज, पटना,
दूरभाष : 0612-2541087/2541065
फैक्स : 0612-2541865/2541087
e-mail: celgbo-cwc@nic.in

Adalatganj, Patna – 800001
Telephone: 0612-2541087/2541065
FAX: 0612-2541865/2541087
e-mail: celgbo-cwc@nic.in

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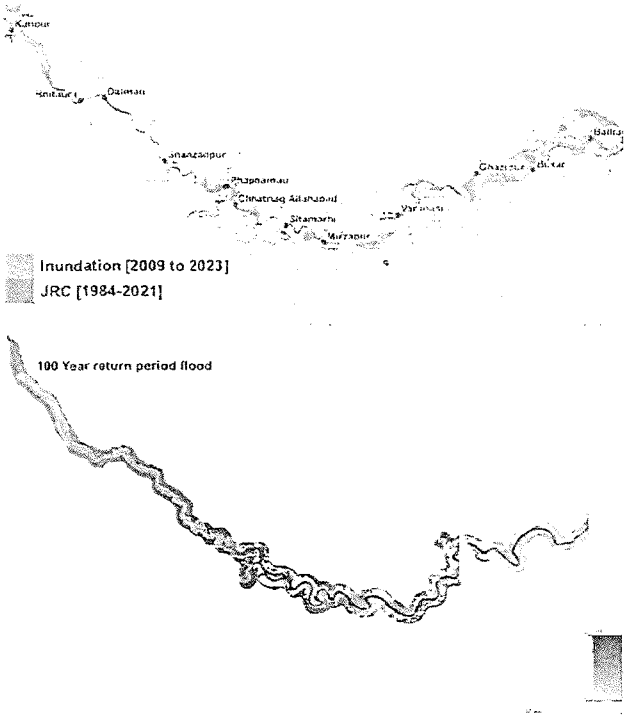
Sites under LGBO in Uttar Pradesh

S. No	Site Name	RIVER NETWORK	Sub - Basin	DISTRICT	STATE
1	Chhitaunighat	Ganga/Gandak	Gandak	Kushi Nagar	Uttar Pradesh
2	Ahrora	Ganga/Jirgo	Jargo	Mirzapur	Uttar Pradesh
3	Akbarpur	Ganga/Chhoti Sarju	Chhoti Sarju	Ambedkar Nagar	Uttar Pradesh
4	Ashatpur	Ganga/Chhoti Sarju/Maghai	Chhoti Sarju	Ghazipur	Uttar Pradesh
5	Azamgarh	Ganga/Chhoti Sarju	Chhoti Sarju	Azamgarh	Uttar Pradesh
6	Mau	Ganga/Chhoti Saryu	Chhoti Sarju	Mau	Uttar Pradesh
7	Chakghat	Ganga/Tons	Tons	Allahabad	Uttar Pradesh
8	Chopan	Ganga/Sone	Sone	Sonbhadra	Uttar Pradesh
9	Chunar	Ganga	Ganga	Mirzapur	Uttar Pradesh
10	Devkali	Ganga/Gaangi	Gaangi	Ghazipur	Uttar Pradesh
11	Duddhi	Ganga/Sone/Kanhar	Sone	Sonbhadra	Uttar Pradesh
12	Jalalpur	Ganga/Gomti/Sai	Gomti	Jaunpur	Uttar Pradesh
13	Kasmabad	Ganga/Chhoti Saryu	Chhoti Sarju	Ghazipur	Uttar Pradesh
14	Kohdarghat (Tones Aquaduct)	Ganga/Tons	Tons	Allahabad	Uttar Pradesh
15	Lalganj	Ganga/Tous/Belan	Tons	Mirzapur	Uttar Pradesh
16	Maighat	Ganga/Gomti	Gomti	Jaunpur	Uttar Pradesh
17	Mejaroad	Ganga/Tons	Tons	Allahabad	Uttar Pradesh
18	Narahan	Ganga/Durgawati/Karamnasa	Durgawati	Chandauli	Uttar Pradesh
19	Narayanpur	Ganga	Ganga	Mirzapur	Uttar Pradesh
20	Negai	Ganga/Sone	Sone	Sonebhadra	Uttar Pradesh
21	Niwari	Ganga/Sone	Sone	Sonebhadra	Uttar Pradesh
22	Pratapgarh	Ganga/Gomti/Sai	Gomti	Pratapgarh	Uttar Pradesh
23	Saidpur	Ganga	Ganga	Saidpur	Uttar Pradesh
24	Shahzadpur	Ganga	Ganga	Kaushambi	Uttar Pradesh
25	Sitamarhi	Ganga	Ganga	Sant Ravidas Nagar	Uttar Pradesh
26	Sultanpur	Ganga/Gomti	Gomti	Sultanpur	Uttar Pradesh
27	Tendui	Ganga/Varun	Varun	Varanasi	Uttar Pradesh
28	Khadda	Ganga/Gandak	Gandak	Kushi Nagar	Uttar Pradesh
29	Rihand Dam	Ganga/Sone/Rihand	Sone	Sonbhadra	Uttar Pradesh
30	Allahabad	Ganga	Ganga	Allahabad	Uttar Pradesh
31	Ballia	Ganga	Ganga	Ballia	Uttar Pradesh
32	Gazipur	Ganga	Ganga	Gazipur	Uttar Pradesh
33	Jaunpur	Ganga/Gomti	Gomti	Jaunpur	Uttar Pradesh
34	Mirzapur	Ganga	Ganga	Mirzapur	Uttar Pradesh
35	Phaphamau	Ganga	Ganga	Allahabad	Uttar Pradesh
36	Varanasi	Ganga	Ganga	Varanasi	Uttar Pradesh

ANNEXURE - R6

Progress Report

FLOOD PLAIN ZONE DELINEATION FROM UNNAO TO BALIA



National Institute of Hydrology

Jal Vigyan Bhawan, Roorkee (Uttarakhand) – 247667

July, 2024

25

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26

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1 INTRODUCTION

Floods constitute one of the major national calamities faced by India almost every year resulting in substantial loss of life, large scale damage to property, disruption of community lifelines besides entailing untold misery to the millions. Concerted efforts have been made over the years to reduce the damage due to floods and mitigate the sufferings of the people. Various structural flood control measures were taken up in the past including construction of reservoirs, embankments, drainage channels, etc. It is, however, now realised that absolute and permanent protection to all flood prone areas and for all magnitudes of floods by structural measures alone is not only impossible but also not economically viable. The emphasis has therefore been rightly shifted to non-structural measures like Flood Plain Zoning and Regulation, Flood Forecasting, etc., to effectively supplement the structural measures for providing sustainable protection to flood affected areas. The broad concept in flood plain zoning is to regulate the land use in order to mitigate the damage potential. The role of flood plains and need for flood plain zoning was recognized by the Central Water Commission (CWC) as early as 1975. CWC had prepared a Model Floodplain Zoning Bill for adaptation by states but it did not receive due attention of states.

In pursuance to the directions contained in the judgment passed by Hon'ble NGT a Report on identification and demarcation of the flood plains of river Ganga in segment B of Phase- I (Haridwar to Unnao) was prepared by CWC in 2019. Subsequently, the Irrigation and Water Resources Department, Govt. of UP has approached NIH Roorkee to carry out the study "Flood plain zone delineation from Unnao to Balia" as per direction given by Hon'ble NGT. This study was originally envisaged with similar methodologies as used by CWC in the earlier study for the Ganga River in the stretch of Haridwar to Unnao. However, as per direction given by Hon'ble NGT it was decided to first demarcate the flood plain corresponding to once in hundred years return period (REGD. NO. D. L.-33004/99; 2016).

2 OBJECTIVES AND SCOPE OF WORK

The following tasks are to be carried out by NIH, Roorkee for this study.

a) Estimation of floods of various return periods viz. 2 year, 3 year, 10 year. 25 year, 50 year and 100 year at different gauging sites based on flood frequency

analysis

b) Flood Plain Demarcation based on Satellite Data/Images.
c) Flood Plain Demarcation based on hydraulic modelling.
d) Demarcation of flood plain by combining results of Satellite Data/Images and hydraulic modelling.

3 STUDY AREA AND DATA

The study reach of Ganga river from Unnao to Balia is shown in Figure 1. The length of river stretch is about 700 km and 30 km buffer zone is also demarcated for analysis.

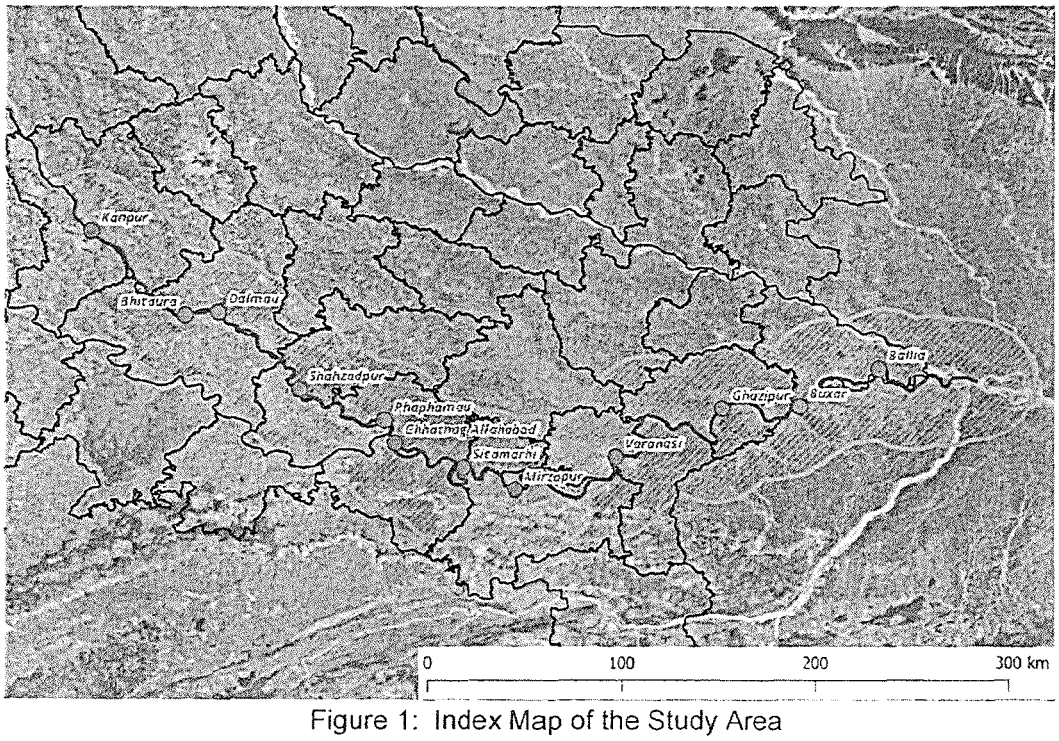

Figure 1: Index Map of the Study Area

3.1 Data

The locations of G&D sites (CWC) and contributing catchment area is shown in Figure 2. The long term annual maximum data and water level are available at six G&D sites. Details are given in Table 1.

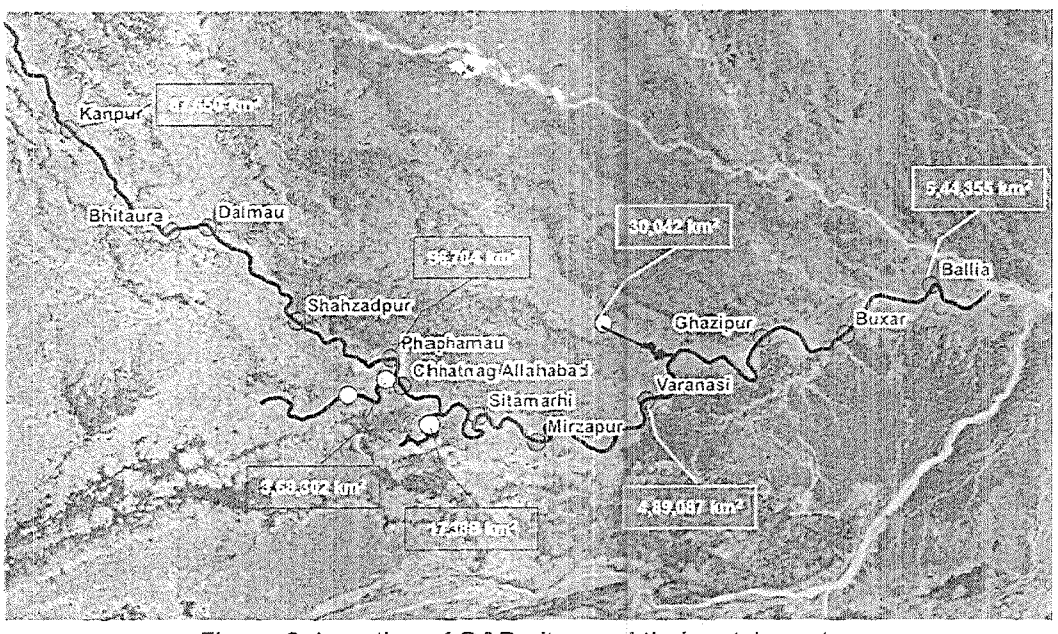

Figure 2: Location of G&D sites and their catchment area

Table 1: Summary of data availability at various G&D sites.

SN	HO Site	Data available
1	Kanpur	01/01/1974 to 28/02/2023
2	Bhitaura	01/01/1974 to 31/07/2023
3	Chhatang Allahabad	03/07/1970 to 20/07/2023
4	Mirzapur	01/06/1976 to 04/07/2023
5	Varanasi	01/01/1968 to 30/06/2023
6	Buxar	01/01/1974 to 15/08/2023

River cross-sections at these CWC's HO locations are provided to NIH. Further, river cross-sections at 25 locations surveyed by AECOM are also made available. In additions cross-section survey at 19 locations are carried out for this study. The LiDAR DEM (Digital Elevation Model) prepared by the survey of India under the National Hydrology Project (NHP) for improved flooc hazard mapping and other planning purposes was also made available. As per survey of India the DEM is of 0.5 m vertical accuracy and having 1m X 1m grid size. Extent of DEM and location of

surveyed Cross-sections are shown in Figure 3. Moreover, as per recent direction of Hon'ble NGT attempts are being made to obtain 1 m contour data of the area from SOI. These DEM doesn't capture topography under water as shown in Figure 4 and ANNEXURE-I. Hence these surveyed river cross-sections are also important for hydraulic modelling for proper representation of conveyance (discharge capacity of river).

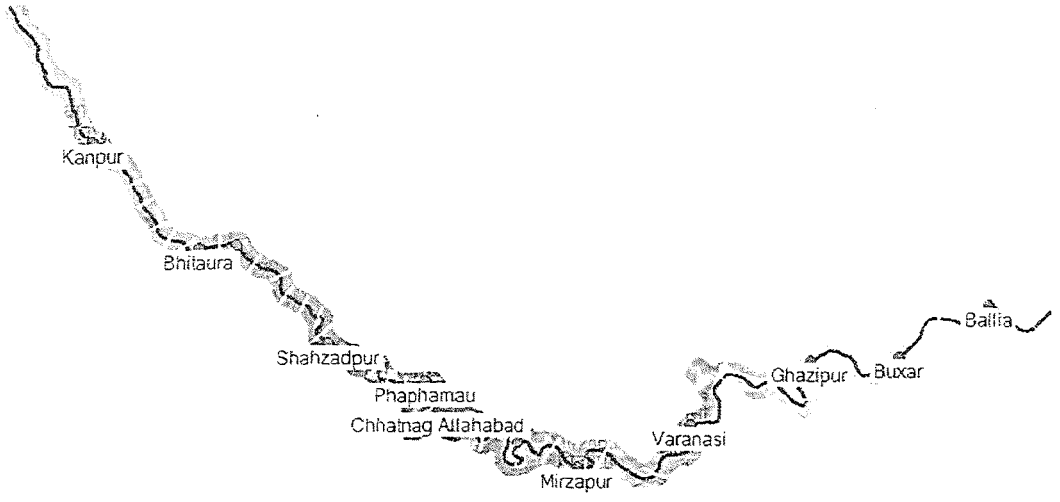

Figure 3: Extent of DEM and location of surveyed Cross-section

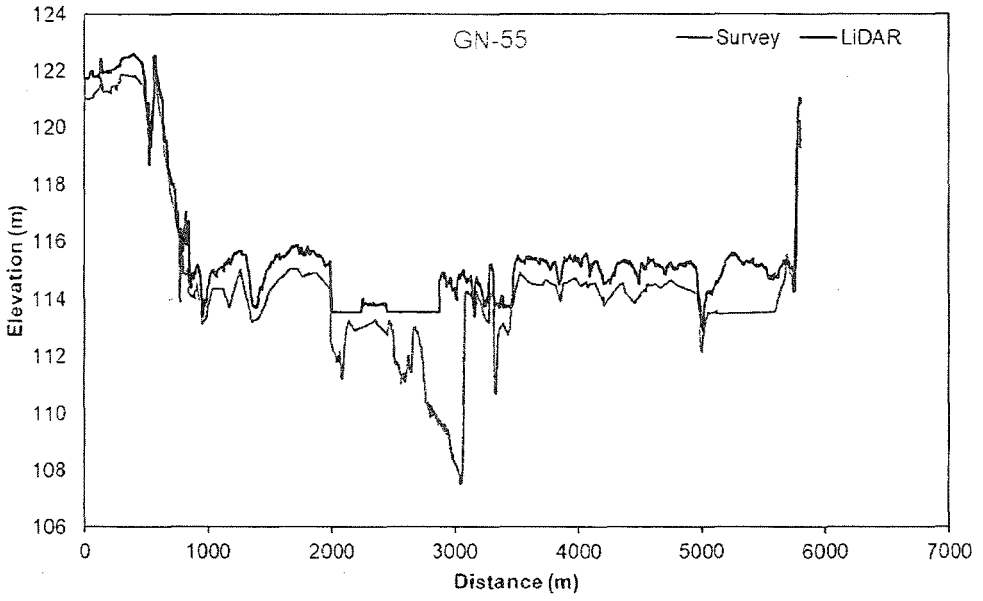

Figure 4: Comparison of river Surveyed River cross-section with DEM (SOI)

4 METHODOLOGY

The study will be carried out with the same methodology as used by Central Water Commission (CWC) in the study for river Ganga from Haridwar to Unnao (Phase-I). Three Types of Approaches will be used for flood plain zoning viz.

a. Satellite
b. Hydraulic Model - HEC RAS
c. Hybrid

First, the flood frequency analysis will be carried out for various gauging sites in the study reach using various frequency distributions to estimate floods of various return periods up to 100-year return period.

4.1 Satellite base approach

The Joint Research Centre-European Commission has analyzed Landsat multispectral satellite images of the past 37 years (1984-2021) for deriving the frequency with which water returns from year to year i.e. recurrence interval. The same will be used in the study through the Google Earth engine platform. The flood inundation Extent of recent years as per availability (RSAC-UP/ NRSC) will be analyzed with reference to return period floods.

4.2 Hydraulic Model approach

HEC-RAS, a hydraulic model developed by the USACE, is extensively applied in calculating the hydraulic characteristics of rivers. HEC-RAS model needs details of river cross sections (for 1-D modelling) and DEM (for2-D modelling and flood inundation mapping) apart from boundary conditions (discharge, water level etc.).The latest update on the program, HEC-RAS 6.5 includes capabilities to model the hydraulics both one and two dimensionally is used for this study. The HEC-RAS model is setup using:

- Upstream branch to provide constant flood magnitude equal to the given return period at upstream boundary (Unnao).
- Downstream boundary as normal depth at downstream of Balia.
- Flood plain bathymetry (DEM), River cross-section for routing the flows between Unnao and Balia.
- Different locations (G&D sites) flow is added to match the estimated flood of

corresponding return period at the intermediate gauging sites (Bhitaura, Chhatnag_Allahabad, Mirzapur, Varanasi, Buxar).

The HEC-RAS model will provide inundation extent for various return periods (corresponding to discharge)

4.3 Hybrid approach

The results of satellite analysis and modelling have their own limitation. Satellite may not cover the full flood event and model results are subjected to DEM quality. Therefore, hybrid approach will combine both the results by taking union of the areas obtained from both the results.

5 RESULTS AND DISCUSSIONS

5.1 Flood Frequency Analysis

The annual maximum discharge series of available six G&D sites are shown in Figure 5. The G&D site wise observed annual maximum discharge data are shown in Figure 6. Flood frequency analysis of annual maximum discharge series of available has been carried out using the L-moments approach as described elsewhere (Hosking and Wallis, 1997; Kumar and Chatterjee, 2005). Twelve frequency distributions viz. extreme value (EV1), general extreme value (GEV), logistic (LOS), generalized logistic (GLO), normal (NOR), generalized pareto (GPA), generalized normal (GNO), uniform (UNF), exponential (EXP), pearson Type-III (PT3), kappa (KAP) and wakeby (WAK) have been used to identify robust distribution based on the L-moment ratio diagrams and the Z^{dist}– statistic criteria. The Estimated floods of various return periods at six G&D sites are shown in Table 2.

33

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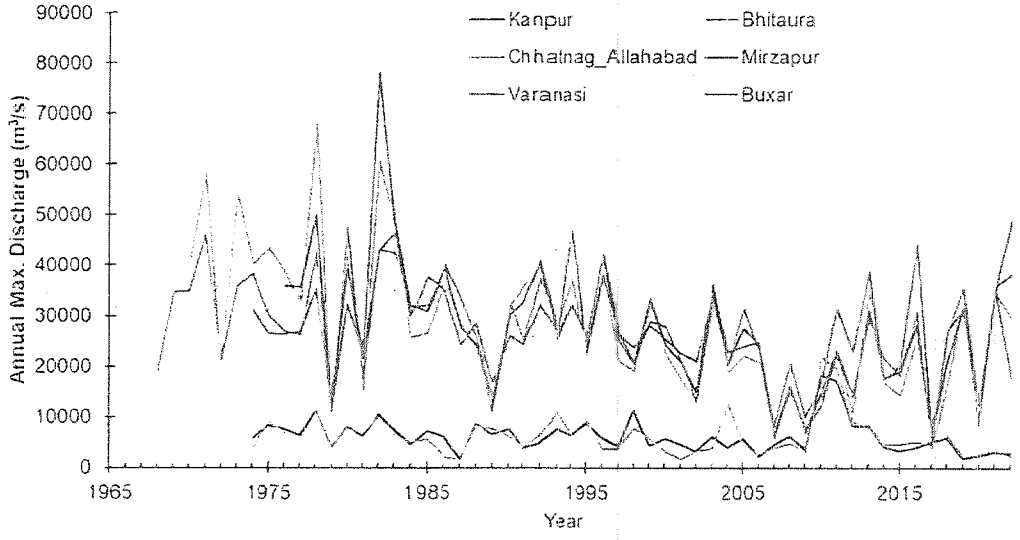
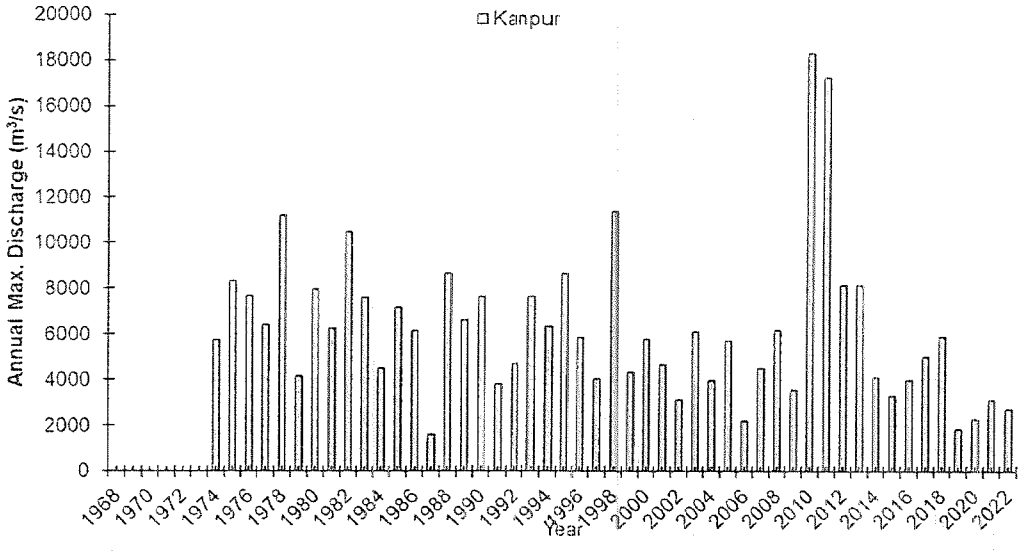
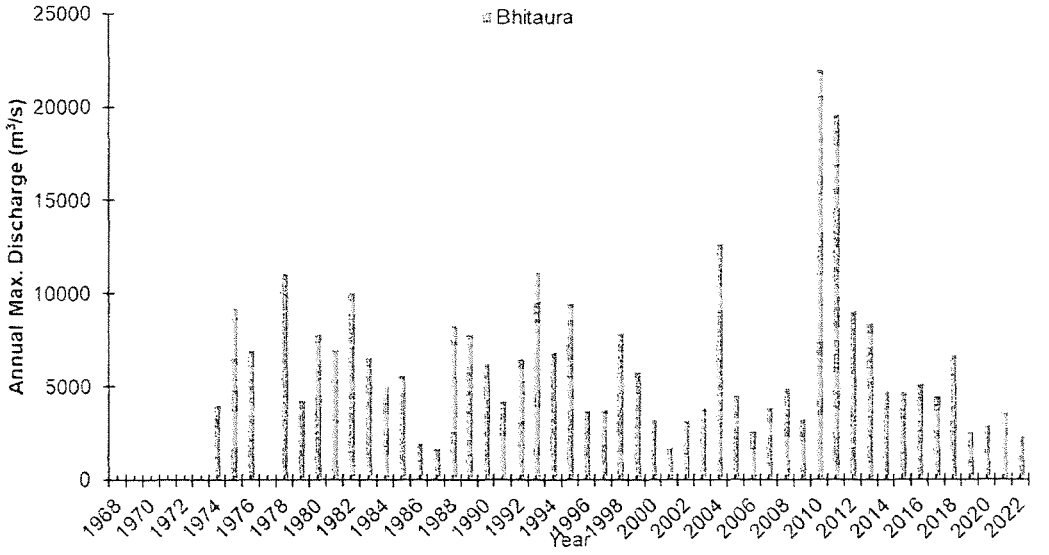
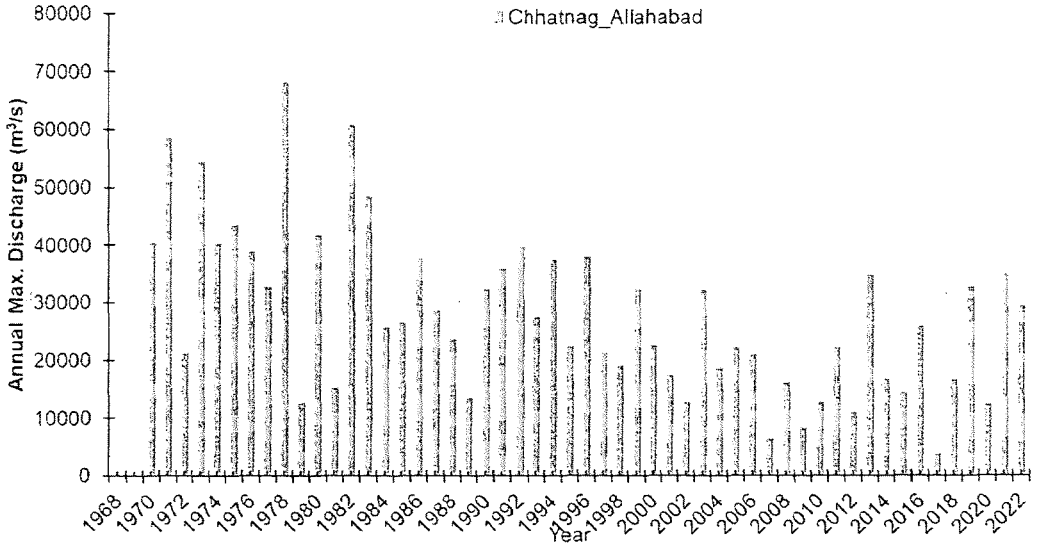
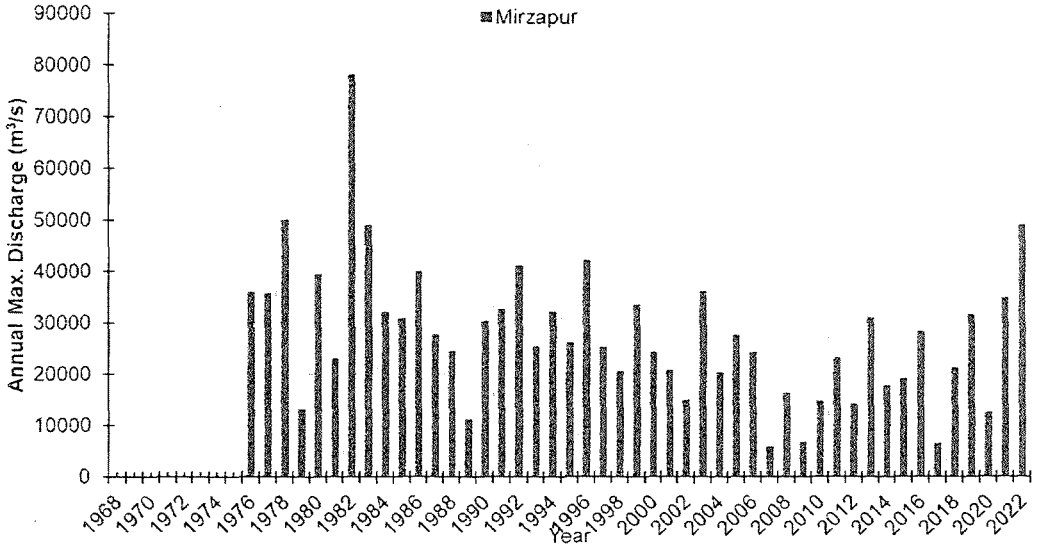


Figure 5: Annual maximum discharge series




Bhitaura
Annual Max. Discharge (m³/s)
25000
20000
15000
10000
5000
0
1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022
Year


Chhatnag_Allahabad
Annual Max. Discharge (m³/s)
80000
70000
60000
50000
40000
30000
20000
10000
0
1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022
Year


Mirzapur
Annual Max. Discharge (m³/s)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022
Year

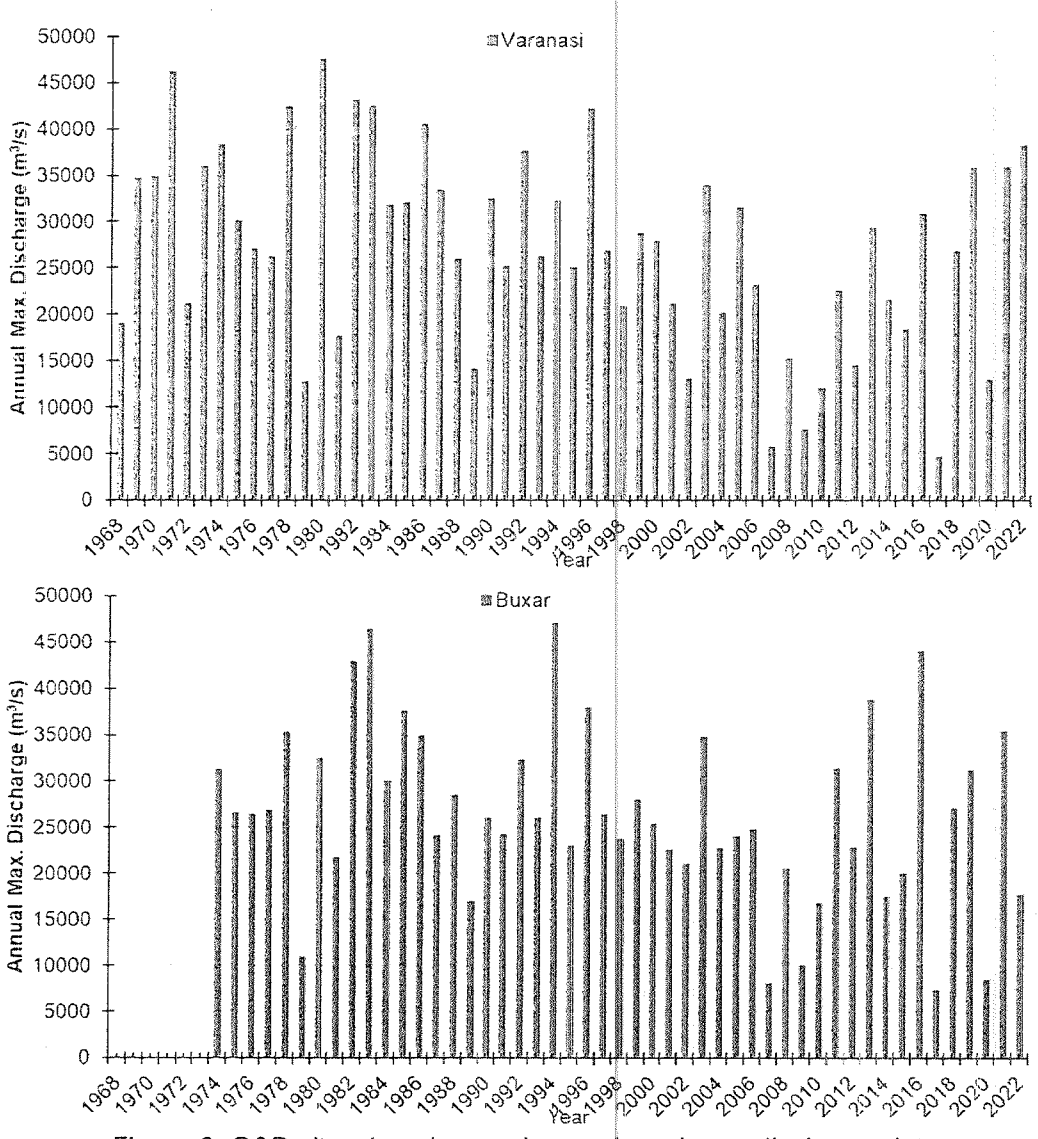


Figure 6: G&D site wise observed annual maximum discharge data.

Table 2: Estimated floods of various return periods

Return Period (Year)	Discharge (cumec)					
	Kanpur	Bhitaura	Chhatnag_Allahabad	Mirzapur	Varanasi	Buxar
2	5595.2	5216.7	25926.1	26291.2	27659.0	26364.9
5	**8174.7**	**8434.2**	**39098.5**	**36907.2**	**36697.2**	**33931.8**
10	10112.4	11002.0	47163.7	43956.8	40944.0	38445.5
20	12243.3	13850.9	54475.5	51061.8	44047.5	42693.6
25	**12991.0**	**14838.0**	**56708.1**	**53411.7**	**44864.2**	**44021.1**
50	15539.3	18192.9	63405.9	60986.7	47042.0	48163.0
100	**18492.7**	**22010.2**	**69824.7**	**69086.9**	**48702.7**	**52278.4**

5.2 Flood Plain Demarcation based on Satellite Data/Images

The Joint Research Centre- European Commission have analyzed Landsat multispectral Satellite images of past 37 years (1984-2021) for deriving frequency with which water returns from year to year i.e. recurrence interval. The maximum flood extent map is shown in Figure 7.

The flood date wise and annual flood extent layer extracted from remotesensing data for the priod 2009 to 2023 supplied by NRSC are also made available. The overlay of JRC inundation extent and NRSC data set is shown in Figure 8. However, these Satellite /remote sensing based flood inundation extent needs further classification and ground truthing for extraction of Riverine Flood (flooding due to over bank flood of the Ganga river). This will be jointly carried out by NIH and Irrigation and Water Resources Department, Govt. of UP.

Figure 7: Maximum flood inundation extent map (JRC, 1984-2021)

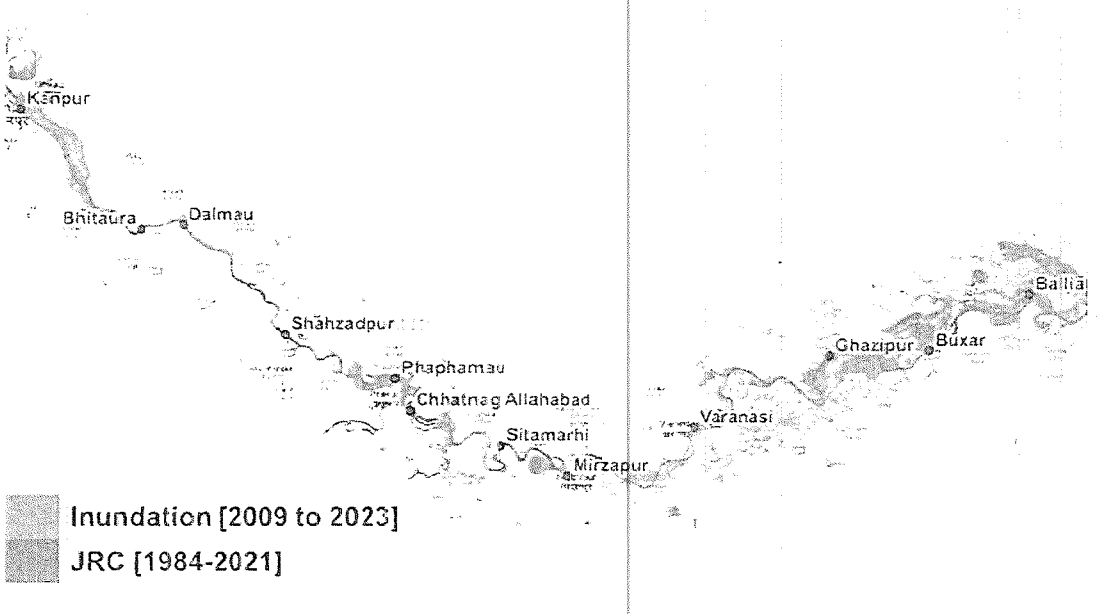


Figure 8: Overlay of maximum flood inundation extent of JRC and NRSC

5.3 Flood Plain Demarcation based on hydraulic modelling

In the previous study by CWC (2019), SRTM DEM (90 m) was used with correction of river profile below the water surface based on available cross-sections. Similarly in this study also the LiDAR DEM (SOI) is used. About 44 surveyed river cross-sections are being used for HEC-RAS model setup. The 1-D HEC-RAS model with extended river cross-section has been prepared. The model is being calibrated for past flood of 2010, 2013, 2016, 2019, 2022 etc.

Comparisons of longitudinal simulated water surface profile for 100-year return period flood and 2010 flood event are shown in Figure 9. The inundation extent for 100-year return period flood is shown in Figure 10. The discharge at Kanpur and Bhitaura in they year 2010 is maximum and near to 100 year return period.

The HEC-RAS model is still requires some recalibration based on recently obtained flood inundation extents from satellite data. Further, if the 1 m contour data from SOI is available, model will be updated with it.

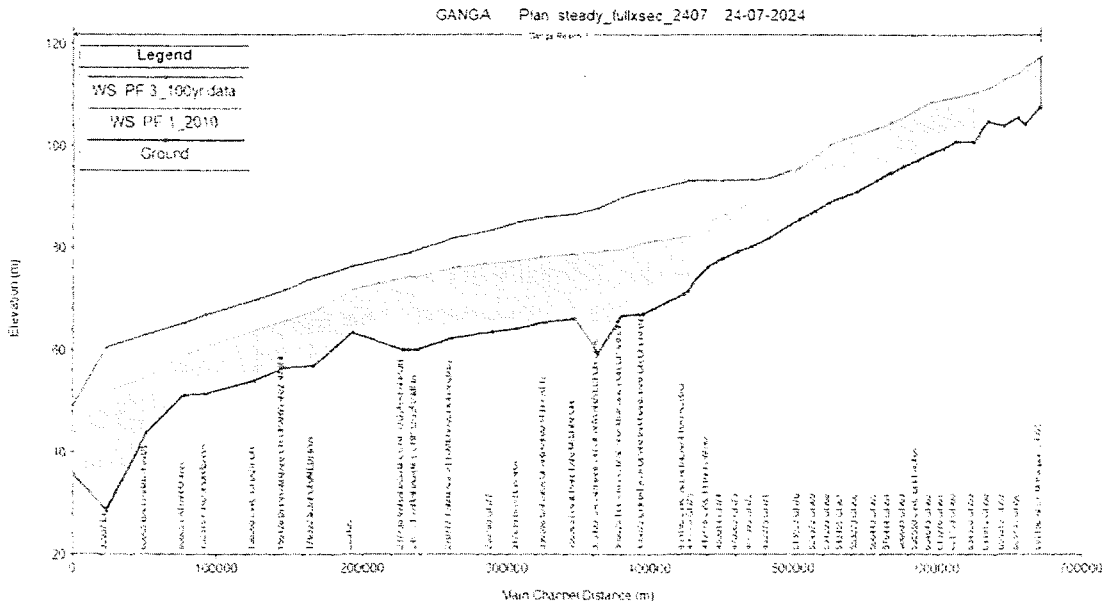


Figure 9: Longitudinal simulated water surface profile for 100 year return period flood and 2010 flood

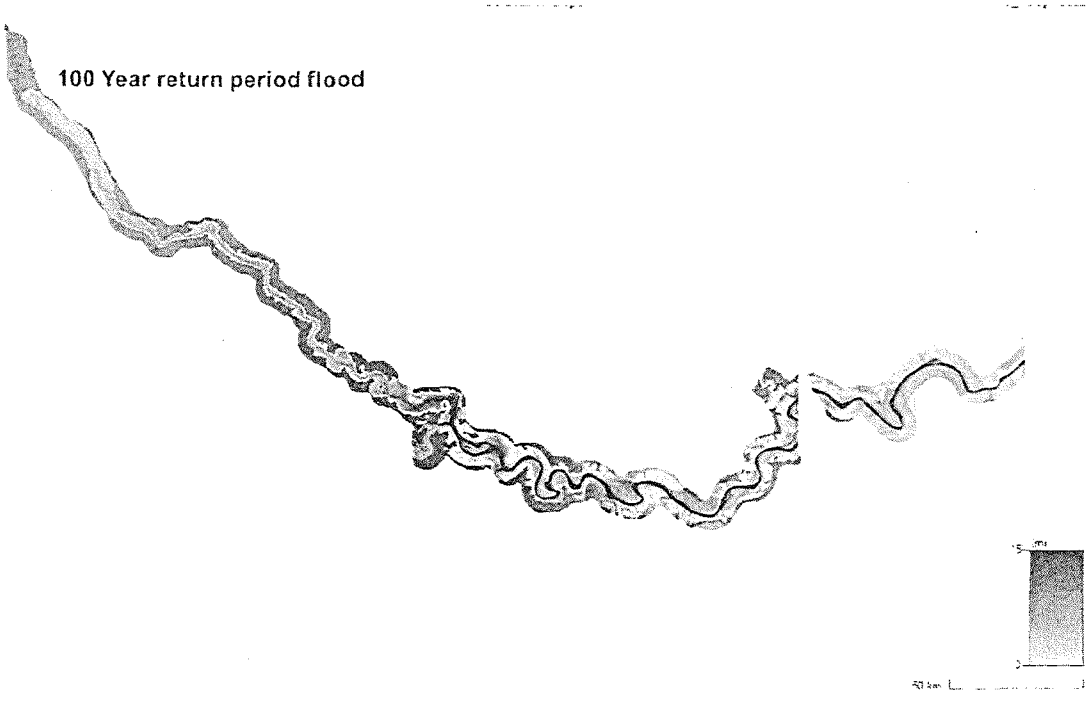


Figure 10: Flood Inundation extent for 100-year return period flood

6 Future Work Plan

The major time line of activities of this study are given below. As mentioned at section 5.2 the satellite /remote sensing-based flood inundation extent needs further classification and ground truthing for extraction of riverine Flood (flooding due to over bank flood of the Ganga river) and this will be jointly carried out by NIH and Irrigation and Water Resources Department, Govt. of UP. Moreover, attempts are being made to obtain 1 m contour data of the area from SOI on direction of Hon'ble NGT. The hydraulic modelling approach based inundation map will be redeveloped using these data as per availability. After this, in hybrid approach both the results will be combined by taking union of the flood inundation areas obtained these approach to make fina flood plain boundary for 100 year return period flood. The flood plain boundary will be provided as georeferenced GIS layer (shape file) so that it can be super imposed over any other layer as per requirement. The coordinates (Lat, Long) at regular interval will also be provided, so that it can be marked on the ground when required.

SN	Task/ Component	Month					
		Aug		Sep		Oct	
1	Inception Report	Completed					
2	Data collection and Processing	Under progress (1m contour data from SOI is under progress)					
3	Flood frequency analysis	Completed					
4	Flood plain zoning based on the JRC Satellite images of past 37 years (1984-2021)	Completed					
5	Flood Plain Demarcation based on Satellite Data/Images						
6	HEC RAS model setup (Calibration/valication)						
7	Finalization of hydraulic model results						
8	Submission of interim findings discussion, ground truthing/ result verification						
9	Demarcation of flood plain based on *hybrid approach*						
10	Submission of draft Report						
11	Submission of final Report					*	

*Final report will be submitted after incorporating the comments received from the sponsoring agency.

(40)

Bibliography

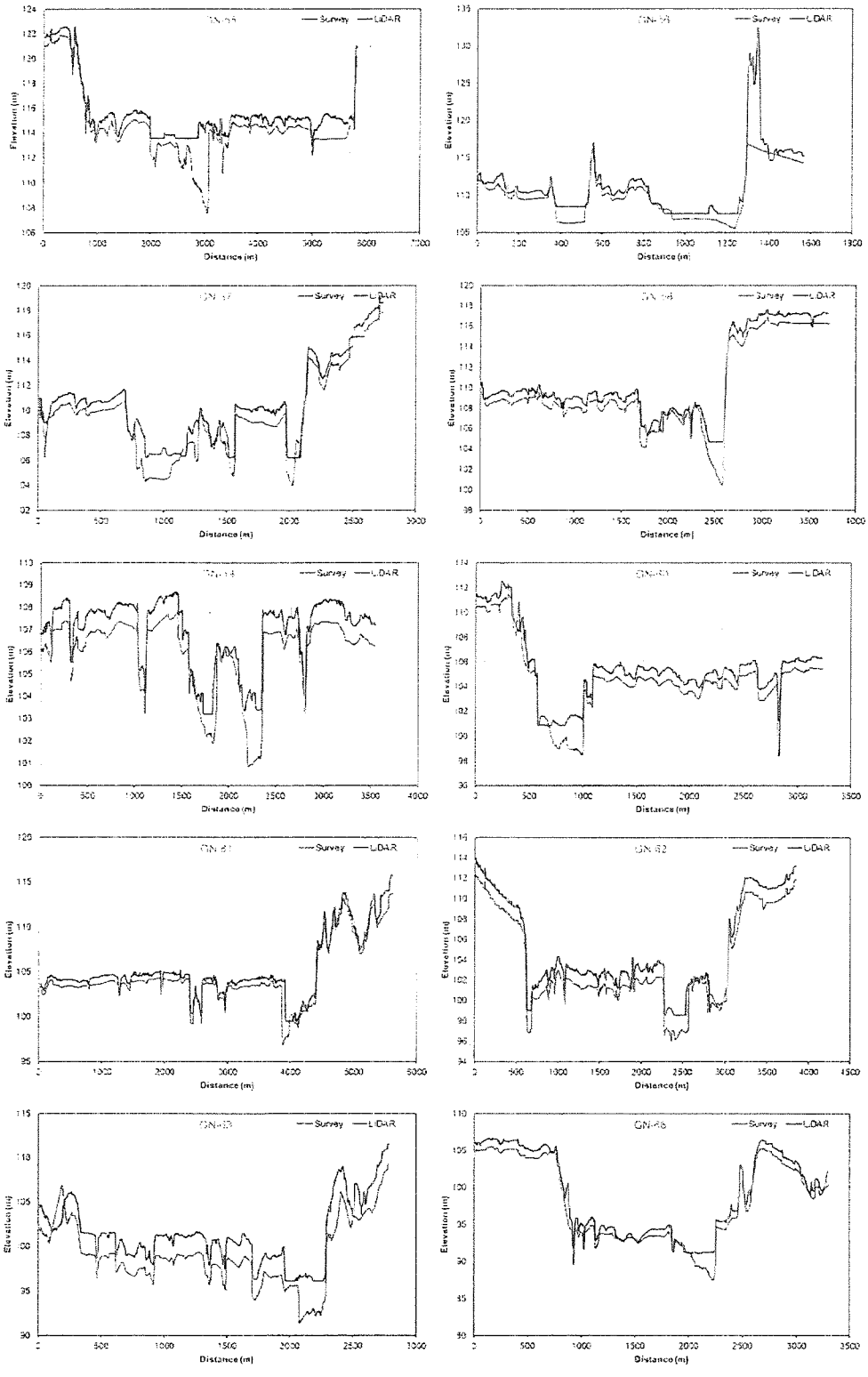
Hosking, J.R.M., and Wallis, J.R. (1997). *Regional frequency analysis: an approach based on L-moments*. Cambridge University Press, Cambridge.

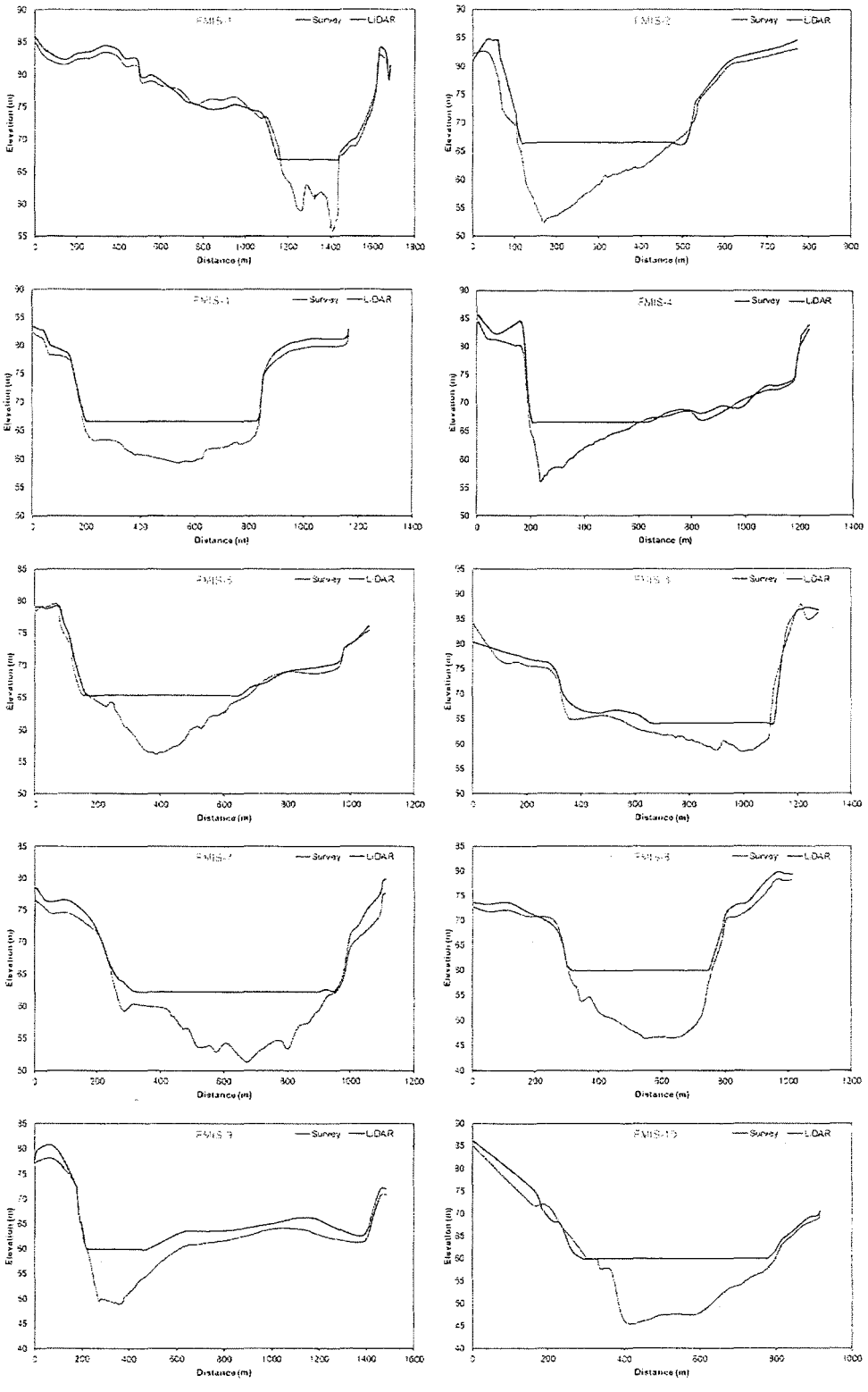
Kumar, R., and Chatterjee, C. (2005). Regional flood frequency analysis using L-moments for North Brahmaputra Region of India. *Journal of Hydrologic Engineering, American Society of Civil Engineers, 10(1)*, 1–7.

NEW DELHI, FRIDAY, OCTOBER 7, 2016/ASVINA 15, 1938: https://nmcg.nic.in/writereaddata/fileupload/47_AuthorityNotification.pdf

ANNEXURE-I

Comparison of River cross-section river Surveyed vs LiDAR DEM (SOI)




Survey
LiDAR
Elevation (m)
Distance (m)

Progress report on Flood Plain Zone, delineation and demarcation of river Ganga (Segment B, Phase II) from Unnao to Ballia till August, 2024

1. As per the direction of Hon'ble NGT, the DEM data of 1m contour interval from SOI has been provided to NIH on August 08, 2024, the total volume of data received by NIH is 835 GB which are in 1X1 km tile. To use this data for HEC-RAS modelling, merging of all these tiles are required. As the complete data set are in large number of tiles, merging is taking huge time. Therefore, processing of 1m contour interval data is under progress.
2. The flood frequency analysis of available Six Gauge sites discharge data has been completed and 100-year return period flood has been computed.
3. Flood plain zoning based on the JRC Satellite images of past 37 years (1984-2021) has been completed (because only 37 years satellite data is available).
4. Under the satellite-based approach method, flood plain demarcation based on satellite data/images received from NRSC, Hyderabad (from 2017 to 2023) and inundation data received from RSAC-UP, Lucknow (from 2009 to 2016) have been completed.
5. Under Hydraulic Model, HEC RAS method, for delineation of FPZ, the river cross sections data provided to NIH have been utilized for 1-D modelling. After processing of SOI 1m DEM the same will be incorporated in the HEC RAS model for FPZ.

Head, Surface Water Hydrology Division
National Institute of Hydrology
Roorkee

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5 RESULTS AND DISCUSSIONS

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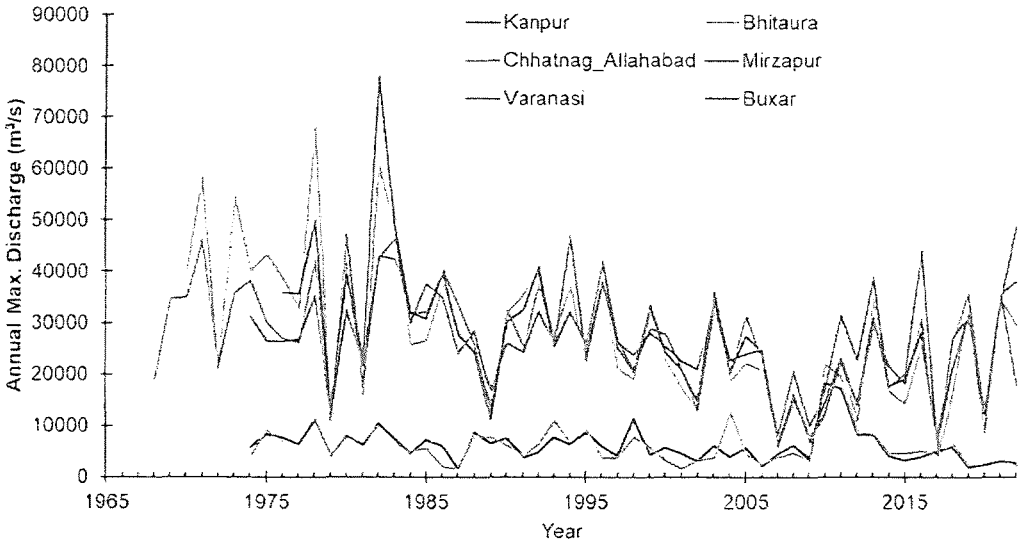
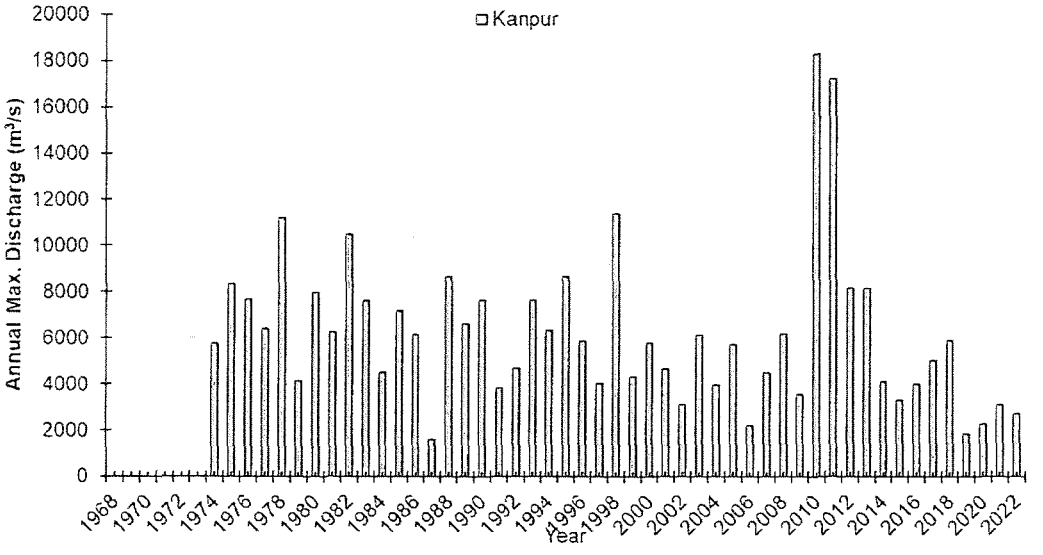


Figure 5: Annual maximum discharge series



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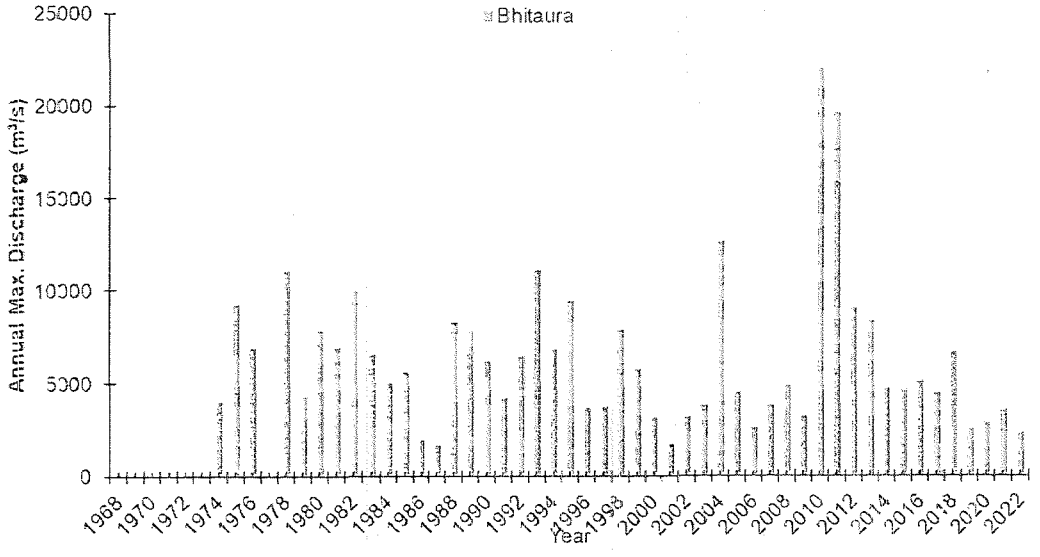
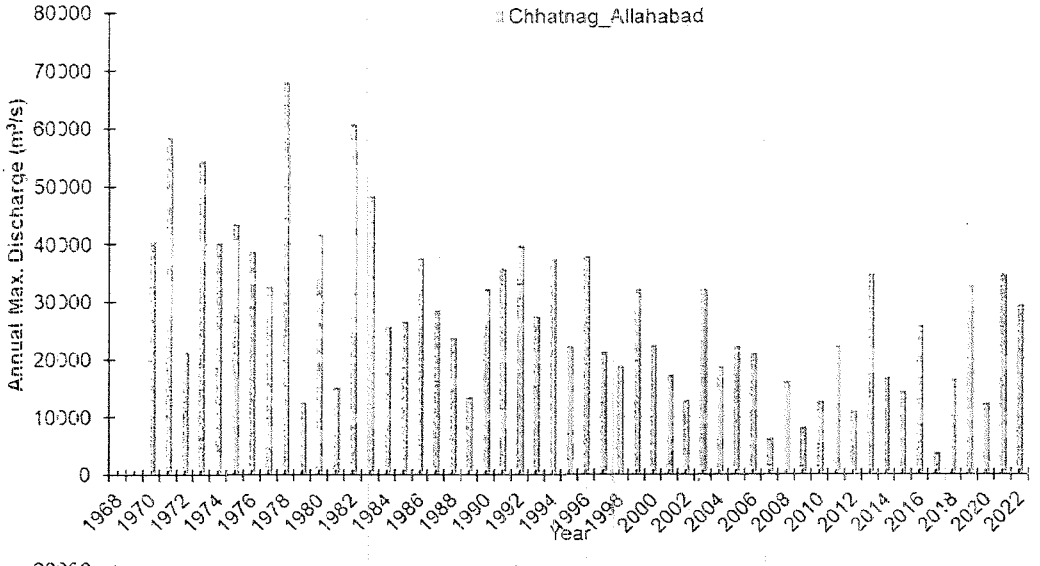
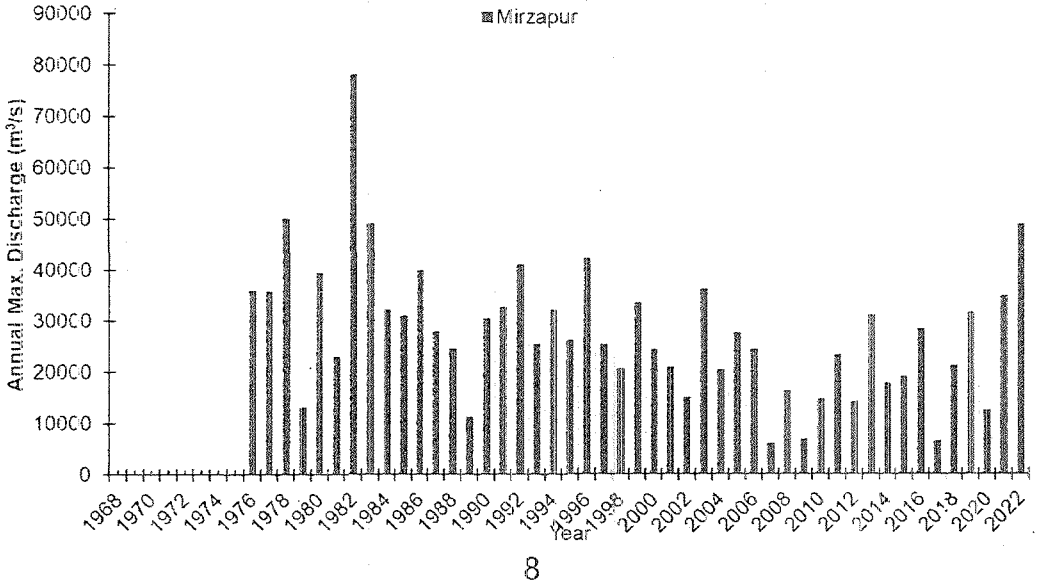

Bhitaura
Annual Max. Discharge (m³/s)
25000
20000
15000
10000
5000
0
1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022
Year


Chhatnag_Allahabad
Annual Max. Discharge (m³/s)
80000
70000
60000
50000
40000
30000
20000
10000
0
1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022
Year


Mirzapur
Annual Max. Discharge (m³/s)
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022
Year

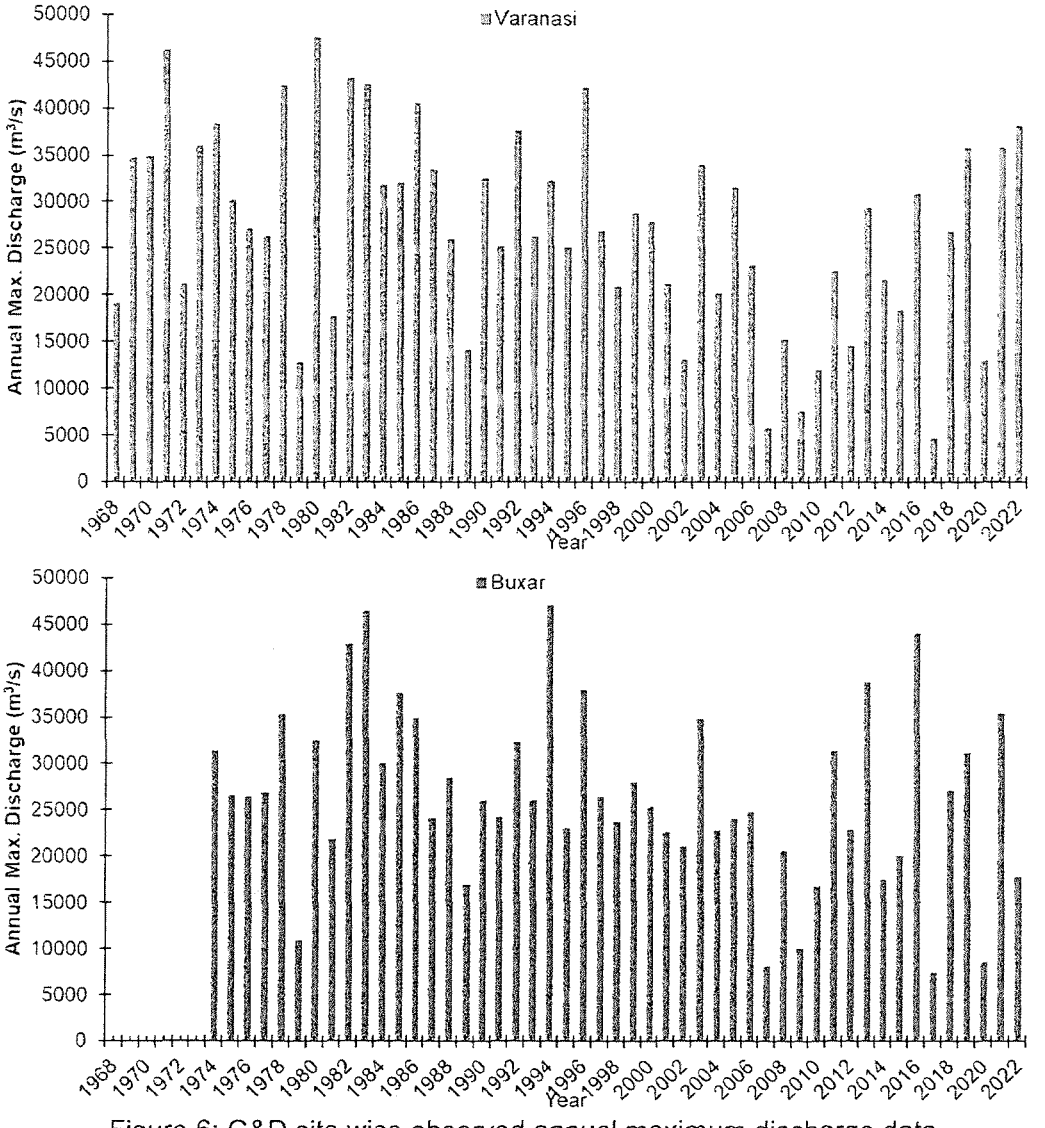


Figure 6: G&D site wise observed annual maximum discharge data.

Table 2: Estimated floods of various return periods

Return Period (Year)	Discharge (cumec)					
	Kanpur	Bhitaura	Chhatnag_Allahabad	Mirzapur	Varanasi	Buxar
2	5595.2	5216.7	25926.1	26291.2	27659.0	26364.9
5	**8174.7**	**8434.2**	**39098.5**	**36907.2**	**36697.2**	**33931.8**
10	10112.4	11002.0	47163.7	43956.8	40944.0	38445.5
20	12243.3	13850.9	54475.5	51061.8	44047.5	42693.6
25	**12991.0**	**14838.0**	**56708.1**	**53411.7**	**44864.2**	**44021.1**
50	15539.3	18192.9	63405.9	60986.7	47042.0	48163.0
100	**18492.7**	**22010.2**	**69824.7**	**69086.9**	**48702.7**	**52278.4**