ANNUAL FLOOD REPORT 2016

INDEX

PREFACE

The State of West Bengal is the lower most riparian State in the Ganga Basin and most of the rivers in the State originate from outside the state boundary and are of inter-state/international category. The State is quite often ravaged by destructive flood, even without any appreciable rainfall within the geographical limits of the State. Along with flood, various allied problems like bank erosion, drainage congestion, and cyclonic disaster accentuate the flood situation. The State, being 42.30% of its geographical area flood prone, happens to be one of the prime flood prone States in the country.

The flood, water related disaster in the state of West Bengal has been an annual feature. Some parts of the state are victims of onslaughts offload each year resulting severe loss to standing crops, cattle and human properties. The state has all possible facets of fload, drainage, bank erosion, cyclonic storm ravages and associated problems. It has been noticed that the furies due to flood have increased during the last two decades.

Embankments in various districts of the State in general and Sundarban areas in particular are used as communication link, particularly during periods of calamity for safe passage of people and carrying relief materials. Disruption of such communication links leads livelihood activities almost to a grinding halt. Moreover, embankments, constructed either decades or century ago, are functioning as lifeline to the people of Sundarban since those prevent entry of high tidal water into the countryside where average ground level is substantially lower than the normal amplitude of high tide. Due to breach as well as washout of embankments major portion of the area becomes disconnected from basic facilities of life.

Many factors such as intensity and duration of rainfall, sedimentation in river bed, natural or manmade obstruction etc. play a role in the occurrence of flood. Study of these factors and evaluation of flood hazards every year for a given basin/sub-basin are indispensable for evolution of various flood management measures. Accordingly Irrigation & Waterways Directorate, at the end of each flood season, prepare annual flood report comprising rainfall patterns, rainfall in the districts, reservoir condition and major flood events of the year.

1. INTRODUCTION

The state West Bengal crowned by the mighty snow-white Himalayas in the North and frothy sea on the South is a combination of land varying from high regions in the north and partly high in the south west to the plains in the rest areas. The state is beset with extensive network of rivers, their tributaries, rivulets, jhoras, canals, tanks beels and low lying pockets of water bodies. With the Tropic of Cancer running across it, the state is situated between 21° 31' & 27° 13'14" North Latitudes and 85° 45'20" & 89° 53' East Longitudes. The salient feature of the State is given below.

Salient Feature

Geographical area	:	88,752 sk. km
Population (2011 census)	:	9.13 crore
Districts	:	22 nos.
Total blocks	:	341 nos.
Most vulnerable blocks	:	111 nos. (Flood & Tidal inundation)
River basins with code	:	2A. Ganga, 2B. Brahamaputra 6. Subarnarekha
Catchment area	:	1,80,628 sq. km
Average rainfall	:	1,760 mm (Northern area: 2750 mm, Alluvial and Deltaic plain: 1650 mm, Western plateau: 1450 mm)
Flood prone area	:	37,542 sq. km
Area already protected	:	35,380 sq. km
Length of Embankment	:	10,400 km
Lenth of Drainage Channel	:	7,129 km
Surface water potential	:	132.90 BCM
Ground water potential	:	14.60 BCM

2. RIVER SYSTEMS AND FLOOD PROBLEMS

West Bengal, a part of Bengal Delta, has a long recorded history of flood. At present 42.3% of total area of the State is susceptible to flood. Reason is the landmass of the State was formed by the Ganga-Padma system of rivers through the delta building process of which flood being the main carrier of sediments, the bulk of fluvial deposit, in huge volumes. The highest affected area as recorded in 1978 is about 30,607 sq. km and in 2000 is about 23,971 sq. km.

Most of the rivers in the State are either Inter-State or International in character. The flood problems of the state are of different nature at different regions. In North Bengal, the rivers **Teesta, Torsa, Jaldhaka, Raidak** and **Sankosh** after originating in the neighbouring countries of Bhutan and Tibet and the state of Sikim, flow downwards through the districts of Darjeeling, Jalpaiguri, Alipurduar and Coochbehar to meet the Bramhaputra at different locations in Bangladesh, another neighbouring country. The combined catchment of all this system of rivers up to the international border is 37, 545 sq. km.

The rivers of the districts of Uttar Dinajpur and Dakshin Dinajpur viz. **Tangon, Atreyee** and **Punarbhaba** after originating at Bangladesh pass through these districts and either directly or indirectly contribute upper catchment discharges into the river **Ganga-Padma** at downstream of Farakka in Bangladesh. The combined catchment area of this river system up to the international border is 8, 873 sq. km.

The southern part of district Malda through which the river Ganga flows receives its flood water from about 11 States and is battered by the run-off flow generated from these vast areas. Ultimately the river flows down the Farakka Barrage to Bangladesh. The western side of the Malda district receives floodwater mostly from neighbouring country of Nepal and state of Bihar through a network of rivers called **Mahananda** and **Fulhar**. Fulhar, after flowing straight south, joins with Ganga upstream of Farakka barrage while Mahananda turns towards south-east and after bifurcating Malda, outfalls into river Ganga-Padma at downstream of Farakka Barrage in Bangladesh. The combined catchment of

Mahananda-Fulhar system is 19, 342 sq. km.

Major contributing factors to flood in North Bengal regions are the run-off because of heavy local rainfall, discharge of upper basin areas and also outfall condition in the neighbouring countries. The Mahananda and most of the rivers of Uttar and Dakshin Dinajpur districts get stagnated when the Ganga upstream and downstream of Farakka Barrage rules high thereby not allowing drainage of flood discharge during that period.

In South Bengal, there are certain distinctive features of drainage condition which give rise to flood situation. The flood in this zone becomes voluminous because of the shape of the catchment area, its steep slope starting from a high level plateau area and sloping sharply down to a flat terrain near the outfall of limited capacity. This feature is again adversely affected by tidal condition as is generally noticed in the month of September, the likely month of occurrence of flood.

Basin-wise there are quite a number of river systems on the west bank of the river Bhagirathi-Hooghly like **Pagla-Bansloi**, **Dwarka-Brahmani**, **Mayurakshi-Babla** and **Ajoy**. These rivers together drain out flood water from an area of 18,177 sq. km, spread over the state of Jharkhand (the old Bihar Plateau) and the districts of Birbhum, part of Murshidabad (west of Bhagirathi) and Burdwan to outfall into river Bhagirathi. Carrying capacity of the river Bhagirathi is only 25% of the combined peak flood discharges generated from these basins because of simultaneous heavy rainfall, as it occurred during the flood of September 2000. In this vast tract of land there is one major reservoir i.e. Massanjore dam over river Mayurakshi which interferes the flood discharge of only 11% of aforesaid combined catchments.

On the left bank of the Bhagirathi river system the **Bhairab-Jalangi-Sealmari** group of rivers originate from Ganga-Padma at Akherigunj in Murshidabad district and meet the Bhagirathi at Swarupgunj in Nadia District. This system of rivers between them drains a total area of 2, 537 sq. km of Murshidabad and Nadia districts. Generally this area suffers from flood because of three reasons - (i) high intensity rainfall in the basin area itself (ii) inflow of flood water from Ganga-

Padma at its high spate and (iii) drainage congestion at its outfall because of high stage of river Bhagirathi during high tide.

In the **Damodar-Barakar** river system, the rivers originate at Choto Nagpur plateau of Jharkhand and flows down the planes of West Bengal to outfall into the Rupnarayan-Hooghly system through two channel namely Mundeswari and Amta Channel. The catchment area up to Durgapur Barrage is 18,026 sq. km as against total catchment of 24,341 sq. km. In this catchment area there are only 4 (four) reservoirs having a storage capacity of 1.21 BCM. The original concept of flood storage was to have an area reserved for storing a volume of 3.58 BCM. Thus with this limited flood storage capacity the storage dams at present can modify only the peak flood discharge. Any discharge above 70,000 cusecs downstream of Durgapur barrage may cause flood depending on the outfall condition of the Mundeswari at Harinkhola.

The **Shilabati-Darakeswar** and **Kangsabati-Kaliaghai** river systems which have combined catchment areas of 16, 938 sq. km spread out in the districts of Purulia, Bankura, Paschim and Purba Medinipur outfall into river Rupnarayan and Haldi respectively which finally meet river Hooghly. The Kangsabati-Kumari dam at Mukutmanipur, Bankura intercepts flood discharge of only 22% of the aforesaid combined catchment area. In this basin spillway discharge from Kangsabati dam above 50,000 cusecs may cause flood at lower reaches downstream of Mohanpur Anicut near Midnapore Town depending on tidal condition of the outfall and rainfall in the uncontrolled catchment downstream of Kangsabati dam.

The **Mathabhanga-Churni-Ichamati** system of rivers originate at the Mathabhanga off-taking from Ganga-Padma downstream of Farakka Barrage in Bangladesh and on reaching West Bengal at Majdia in Nadia district, bifurcates in two branches (i) the Churni flowing on South-Westerly direction meeting the Bhagirathi at Ranaghat and (ii) the other branch viz. the Ichamati flowing on South-Easterly direction to meet Bay of Bengal through the creek of Raimangal. The main flood situation in this area arises because of inflow from Ganga-Padma (when it rules high), rainfall in the own catchment area and also tide lockage. In flood 2000 a very unusual situation arose where the Bhagirathi transferred a large

volume of its floodwater to this basin area by breaching its embankments at several places.

Historical record of flood in West Bengal is given below:

Flood affected Area	Years during which the Flood occurred	Total No. of Years
< 500	1985,89,92,94,97,2001,2005, 2006, 2013 & 2014	10
500 - 2000	1962,63,64,65,66,72,75,96,2003,2004,2007,2009, 2011 & 2015	14
2000 - 5000	1960, 61, 67, 69, 70, 74, 76, 80, 81 & 82	10
5000 - 10000	1973,77,93,95,98 & 2008	6
10000 - 15000	1968, 79, 83, 90 & 99	5
15000 - 20000	1971, 86, 87 & 88	4
> 20000	1978, 84, 91 & 2000	4

Index map of rivers of South Bengal and North Bengal and the inventories have been presented below.

BASIN: BRAHAMAPUTRA		SUB-BASIN: LOWER BRAHAMAPUTRA			
Sl. No.	RIVER	Tributaries		Location	
		Primary	Secondary	STATE	District
1	2	3	4	5	6
1	Sankosh			Assam	Kokrajhar
				WB	Coochbehar
		Chhoto Sankosh		Assam	Kokrajhar
				WB	Alipurduar
		Raidak-II		WB	Alipurduar, Coochbehar
2	Torsa			WB	Alipurduar, Coochbehar
		Raidak-I	Dhakshi	WB	Alipurduar, Coochbehar
		Gadadhar	Jayanti	WB	Alipurduar
		Kaljani	Bala	WB	Alipurduar
			Nonai	WB	Alipurduar
			Dima	WB	Alipurduar
			Pana	WB	Alipurduar
			Garam	WB	Alipurduar
			Bania	WB	Alipurduar
			Ghargharia	WB	Alipurduar, Coochbehar
		Holong		WB	Alipurduar, Coochbehar
		Dharala		WB	Coochbehar
3	Jaldhaka			WB	Jalpaiguri, Coochbehar
		Mujnai	Titi	WB	Alipurduar
			Pagli	WB	Alipurduar
			Ekti	WB	Alipurduar
			Shukti	WB	Alipurduar
		Jurapani	Dudua	WB	Jalpaiguri, Alipurduar
			Gilandi	WB	Jalpaiguri
		Diana	Longit	WB	Jalpaiguri
		Khuji Diana	Chetia	WB	Jalpaiguri
		Jiti		WB	Jalpaiguri
		Murti		WB	Jalpaiguri
		Sutanga		WB	Coochbehar
		Jarda	Bagdan	WB	Jalpaiguri, Coochbehar
		Dolong		WB	Coochbehar
4	Teesta			SIKKIM	North Sikkim, South Sikkim
				WB	Darjeeling, Jalpaiguri, Coochbehar
		Lachung	Yumthang	SIKKIM	North Sikkim
		Lasha		SIKKIM	North Sikkim
		Lohnak	Poke, Gome	SIKKIM	North Sikkim
		Rangyung	Ringpi, Rukel	SIKKIM	North Sikkim
		Chakung		SIKKIM	North Sikkim
		Dick		SIKKIM	North Sikkim
		Rangit	Rimbi	SIKKIM	West Sikkim
			Kalej	SIKKIM	West Sikkim
			Rammam	SIKKIM	West Sikkim
			Little Rangit	WB	Darjeeling

BASIN: BRAHAMAPUTRA		SUB-BASIN: LOWER BRAHAMAPUTRA			
Sl. No.	RIVER	Tributaries		Location	
		Primary	Secondary	STATE	District
1	2	3	4	5	6
4	Teesta	Rani		SIKKIM	East Sikkim
		Rangpo	Nathang	SIKKIM	East Sikkim
		Relli		WB	Darjeeling
		Rangio		WB	Darjeeling
		Leesh		WB	Darjeeling, Jalpaiguri
		Gheesh		WB	Darjeeling, Jalpaiguri
		Dharala		WB	Jalpaiguri
			Neora	WB	Darjeeling, Jalpaiguri
			Chel	WB	Darjeeling, Jalpaiguri
		Karla		WB	Jalpaiguri
BASIN: GANGA		SUB-BASIN: BHAGIRATHI LOWER & OTHERS			
1	Mahananda			WB	Darjeeling, Uttar Dinajpur, Malda
				BIHAR	Kishanganj, Purnia
		Balason	Rohini	WB	Darjeeling
		Lachka		WB	Darjeeling
		Taipu	Manjha	WB	Darjeeling
		Mechi	Biring	BIHAR	Kishanganj
		Kankai	Ratwa	BIHAR	Kishanganj, Purnia
		Panar		BIHAR	Araria, Purnia, Katihar
			Bakra	BIHAR	Araria, Purnia
			Kesaliya	BIHAR	Araria, Purnia
		Dauk		WB	Uttar Dinajpur
		Pitani	Bakuna	WB	Uttar Dinajpur
		Nagar	Sudhani	WB	Uttar Dinajpur
			Kulik	WB	Uttar Dinajpur
		Chiramati		WB	Uttar Dinajpur
		Sui		WB	Uttar Dinajpur
		Tangon		WB	Uttar & Dakshin Dinajpur, Malda
		Mora Mahananda		WB	Malda
		Kalindri		WB	Malda
2	Fulhar			BIHAR	Katihar
				WB	Malda
3	Punarbhaba			WB	Dakshin Dinajpur, Malda
4	Atreyee			WB	Dakshin Dinajpur
		Kartowa	Neem	WB	Jalpaiguri
			Sahoo	WB	Jalpaiguri
			Chauli	WB	Jalpaiguri
			Talma	WB	Jalpaiguri
		Panga		WB	Jalpaiguri
		Jamuna		WB	Dakshin Dinajpur
		Brahmani		WB	Dakshin Dinajpur

BASIN: GANGA		SUB-BASIN: BHAGIRATHI LOWER & OTHERS			
Sl. No.	RIVER	Tributaries		Location	
		Primary	Secondary	STATE	District
1	2	3	4	5	6
5	Ganga-Padma	Pagla		WB	Malda
		Gumani		WB	Murshidabad
				JHARKHAND	Godda, Sahebganj
6	Bansloi			JHARKHAND	Pakur
				WB	Birbhum, Murshidabad
		Bagmari		JHARKHAND	Pakur
				WB	Murshidabad
		Krilor		WB	Murshidabad
7	Pagla			JHARKHAND	Pakur
				WB	Birbhum, Murshidabad
		Buri		WB	Birbhum
8	Dwarka	Brahamani		JHARKHAND	Dumka
				WB	Birbhum, Murshidabad
			Gumra	JHARKHAND	Dumka
			Tripti	JHARKHAND	Dumka
				WB	Birbhum
		Gambhira	Gamri	WB	Birbhum, Murshidabad
		Chailan		JHARKHAND	Dumka
				WB	Birbhum
		Ghormora		WB	Birbhum
		Kajuli		WB	Birbhum
		Daoka	Manikarnika	WB	Birbhum, Murshidabad
		Banka		WB	Murshidabad
9	Mayurakshi			JHARKHAND	Deoghar, Dumka
				WB	Birbhum, Murshidabad
		Dhabai		JHARKHAND	Dumka
		Bhurbhuri		JHARKHAND	Dumka
		Tepra		JHARKHAND	Dumka
		Siddeswari		JHARKHAND	Jamtara, Deoghar, Dumka
			Noonbeel	JHARKHAND	Deoghar
		Kushkarini		JHARKHAND	Jamtara
				WB	Birbhum
		Kuia	Bakreswar	WB	Birbhum, Murshidabad
				JHARKHAND	Jamtara
			Kopai	WB	Birbhum
10	Babla	Mayurakshi		WB	Murshidabad
		Dwarka		WB	Murshidabad

BASIN: GANGA		SUB-BASIN: BHAGIRATHI LOWER & OTHERS			
Sl. No.	RIVER	Tributaries		Location	
		Primary	Secondary	STATE	District
1	2	3	4	5	6
11	Ajay			BIHAR	Munger
				JHARKHAND	Deoghar, Jamtara
		Dudhwa		BIHAR	Munger
				JHARKHAND	Deoghar
		Pathro		JHARKHAND	Giridih, Deoghar
		Pathro		JHARKHAND	Giridih, Deoghar
		Hinglow	Amba	JHARKHAND	Jamtara
				WB	Birbhum
		Tumoni		WB	Burdwan
		Kunur		WB	Burdwan
		Kana Ajay		WB	Birbhum, Burdwan
12	Jalangi			WB	Murshidabad, Nadia
		Silamari		WB	Murshidabad
		Suti	Chhoto Bhairab	WB	Murshidabad
			Bhandardaha	WB	Murshidabad
13	Churni	Anjana		WB	Nadia
14	Ichhamati	Jamuna		WB	Nadia, North 24-Parganas
15	Bidyadhari	Nowai		WB	North 24-Parganas
16	Khari	Brahmani		WB	Burdwan
		Banka		WB	Burdwan
17	Behula	Gangur		WB	Burdwan, Hooghly
18	Kunti			WB	Hooghly
19	Ghea	Kedarmati		WB	Burdwan, Hooghly
		Kana		WB	Burdwan, Hooghly
20	Saraswati			WB	Hooghly, Howrah
21	Kana Damodar			WB	Burdwan, Hooghly, Howrah
22	Amta Channel			WB	Burdwan, Hooghly, Howrah
23	Kalindri			WB	South 24-Parganas
24	Raimangal			WB	South 24-Parganas
25	Bidya			WB	South 24-Parganas
26	Matla			WB	South 24-Parganas
27	Thakuran			WB	South 24-Parganas
28	Saptamukhi			WB	South 24-Parganas
29	Muriganga			WB	South 24-Parganas
30	Bhagirathi-Hooghly			WB	Birbhum, Murshidabad, Nadia, Burdwan, Hooghly, Howrah, South & North 24 Parganas, Purba Medinipur

BASIN: GANGA		SUB-BASIN: DAMODAR			
Sl. No.	RIVER	Tributaries		Location	
		Primary	Secondary	STATE	District
1	2	3	4	5	6
1	Damodar			JHARKHAND	Latehar, Chatra, Hazaribag, Ramgarh, Bokaro Dhanbad
				WB	Burdwan, Purulia, Bankura, Hooghly, Howrah
		Barakar		JHARKHAND	Hazaribag, Giridih, Kodarma, Dhanbad
			Igra	JHARKHAND	Giridih
			Ushri		
			Dumohon	JHARKHAND	Giridih
			Barsoti	JHARKHAND	Hazaribag
		Barki		JHARKHAND	Latehar, Chatra, Hazaribag
		Haharo		JHARKHAND	Hazaribag
		Ghari		JHARKHAND	Hazaribag
		Bokaro		JHARKHAND	Hazaribag, Bokaro
		Konar		JHARKHAND	Hazaribag, Bokaro
			Siwani	JHARKHAND	Hazaribag
		Jamunia		JHARKHAND	Hazaribag, Giridih, Bokaro, Dhanbad
		Naikari, Bhera		JHARKHAND	Ranchi, Ramgarh
		Khanjo, Garga		JHARKHAND	Bokaro
		Khadia, Katri		JHARKHAND	Dhanbad
		Gowai, Ijri		JHARKHAND	Bokaro
				WB	Purulia
		Sali		WB	Bankura
		Singar, Tamal		WB	Burdwan
		Nuna		WB	
3	Mundeswari	Harinkhola		WB	Burdwan, Hooghly
4	Darakeswar			WB	Purulia, Bankura, Burdwan, Hooghly
		Futiary, Beko, Dudhibheria		WB	Purulia
		Arkasha	Kansachor	WB	Purulia, Bankura
		Dangra		WB	Purulia, Bankura
		Gandheswari, Berai, Khukra		WB	Bankura
		Shankari		WB	Paschim Medinipur
			Amodar	WB	Bankura, Paschim Medinipur
			Tarajuli	WB	Bankura, Paschim Medinipur
5	Shilabati			WB	Purulia, Bankura, Paschim Medinipur
		Jaiponda		WB	Bankura
		Puratan, Champayan, Ketia		WB	Bankura, Paschim Medinipur
		Ruparghghra		WB	Paschim Medinipur
		Donai		WB	Paschim Medinipur
		Kubai	Tamal, Parang	WB	Paschim Medinipur
		Katan		WB	Paschim Medinipur

BASIN: GANGA		SUB-BASIN: DAMODAR			
Sl. No.	RIVER	Tributaries		Location	
		Primary	Secondary	STATE	District
1	2	3	4	5	6
6	Kangsabati			WB	Purulia, Bankura, Paschim Medinipur
		Saharjore, Bandhu, Patloi		WB	Purulia
		Kumari	Hanumata, Kerro, Jore, Charan	WB	Purulia
		Jam		WB	Paschim Medinipur, Bankura, Purulia
			Tatko	JHARKHAND	Purba Singbhum
				WB	Purulia
		Bhairabbanki	Jhinuk	WB	Bankura, Paschim Medinipur
			Tarapheni	WB	Paschim Medinipur
		Kalaichu		WB	Paschim Medinipur
7	Old Cossye			WB	Paschim Medinipur
8	New Cossye	Kherai	Bakshi	WB	Paschim & Purba Medinipur
9	Rupnarayan	Kana Dwarakeswar		WB	Hooghly, Burdwan
		Polashpai		WB	Paschim Medinipur
		Durbachaty		WB	Purba Medinipur
10	Kaliaghai			WB	Paschim & Purba Medinipur
		Kapaleswari, Deuli		WB	Paschim Medinipur
		Chandia		WB	Paschim & Purba Medinipur
		Baghai		WB	Paschim & Purba Medinipur
11	Haldi			WB	Purba Medinipur
12	Rasulpur			WB	Purba Medinipur
13	Pichabani			WB	Purba Medinipur
14	Negua Channel			WB	Paschim & Purba Medinipur

BASIN: SUBARNAREKHA					
1	Subarnarekha			JHARKHAND	Ranchi, Seraikela-Kharswan, Purba Shingbhum
				WB	Paschim Medinipur
				ODISHA	Balasore
		Jhumur, Rupai		JHARKHAND	Ranchi
		Kakro	Rarhu	JHARKHAND	Ranchi
		Karru		JHARKHAND	Ranchi
				WB	Purulia
		Kanchi		JHARKHAND	Ranchi
		Damra		JHARKHAND	Ranchi, Seraikela-Kharswan
		Karkari		JHARKHAND	Ranchi, Seraikela-Kharswan
		Chinguru		WB	Purulia
				JHARKHAND	Seraikela-Kharswan
		Kharkai	Bankabol, Khadkari, Kandria, Nesa, Burhai	ODISHA	Mayurbhanj

BASIN: SUBARNAREKHA					
Sl. No.	RIVER	Tributaries		Location	
		Primary	Secondary	STATE	District
1	2	3	4	5	6
1	Subarnarekha	Kharkai	Bankabol, Khadkari, Kandria, Nesa, Burhai	ODISHA	Mayurbhanj
			Torlo, Illgara, Roro, Sanjai	JHARKHAND	Paschim Shingbhum
		Garra, Sankh, Kodia		JHARKHAND	Purba Shingbhum
		Gurma		JHARKHAND	Purba Shingbhum
				WB	Purulia
		Singaduba		JHARKHAND	Purba Shingbhum
				WB	Paschim Medinipur
		Dulung, Khaijori		WB	Paschim Medinipur

3. DETAILS OF RIVER BASINS AND SUB-BASINS

The state can be demarcated into three distinct drainage basins namely Ganga (CWC basin code no. 2A), Brahmaputra (CWC basin code no. 2B) and Subarnarekha (CWC basin code no. 6) basins respectively. Ganga basin has been further divided into two parts namely Bhagirathi lower & others and Damodar. These three main river basins can in turn be divided into sub-bains having individual catchment of their own. Index maps of different river sub-basins and basins are presented in Annexure-I1 to I23.

BRAHAMAPUTRA BASIN

The rainfall in the northern region of the state is generally high. The ground slope is steep, particularly in the Sub-Himalayan regions of the northern districts. Most of these northern districts belong to Brahmaputra basin. This system consists of a total area of 10, 584 sq.km nearly 12% of the geographical area of the state. This basin area is interspersed with a large number of drainage channels which join the main drainage arteries of the regions like the rivers Teesta, Torsa, Raidak, Jaldhaka etc. All these rivers originate from the Himalayas in Bhutan/Sikkim/Tibet and flow across the Terai region and reach the

plains of West Bengal and then flow to Bangladesh joining ultimately the Brahmaputra in Bangladesh. The catchment area distribution of this basin and sub-basins bounded within different neighbouring states and countries has been presented in the following table.

RIVER BASINS AND SUB-BASINS OF WEST BENGAL									
CWC Basin Code	River Basin	Sub-Basins	CATCHMENT AREA (Sq. Km)						TOTAL (Sq. Km)
			Assam	Sikkim	WB	Bangla-desh	Bhutan	Tibet	
2B	BRAHAMAPUTRA								
	Brahamaputra Lower	Jaldhaka		76	3916	351	959		5302
		Raidak			246		4590	16	4852
		Sankosh	175		162		9734	75	10146
		Teesta		7000	3012	12		29	10053
		Torsa			3248		2363	1581	7192
		Sub-Total	175	7076	10584	363	17646	1701	37545

Sankosh Sub-basin

The river Sankosh with its origin in Bhutan is the eastern most river of Brahmaputra river basin. It serves as the boundary between the two states West Bengal and Assam. It joins with Raidak-II and finally falls into Brahmaputra in Bangladesh by name Gangadhar. The length of Sankosh in West Bengal is 24 km. The total catchment area of this river sub-basin is 10,146 sq. km.

Raidak Sub-basin

It originates in Mt. Akungphu at an altitude of 6,400 m. in Bhutan. The river Raidak then bifurcates into two channels namely Raidak-I and Raidak-II at Bhutanghat, close to Indo-Bangladesh border. Raidak-I joins the united stream of Torsa and Kaljani, while Raidak-II is joined by Sankosh and finally outfalls into Brahmaputra in Bangladesh by the name Gangadhar. The length of Raidak-II is around 50 km in West Bengal. The total catchment area of Raidak-II river sub-basin is 4,852 sq. km.

Torsa Sub-basin

The river Torsa originates in Chumbi Valley of southern Tibet at an altitude of 7,065 m. It flows through Tibet, Bhutan, West Bengal and Bangladesh. Below Hasimara bridge on NH-31, it bifurcates into two channels viz. Sil-Torsa and Char-Torsa. They reunite at Patla Khowa forest. The river passes by the Coochbehar town and is joined by river Kaljani and Raidak-I. The combined flows outfalls into Brahmaputra near Nageswari at Rangpur in Bangladesh. The total length of this river is 222 km out of which 74 km is situated within West Bengal. The total catchment area of this river sub-basin is 7,192 sq. km.

Jaldhaka Sub-basin

The river Jaldhaka has its origin at Bitang Lake in Sikkim at an altitude of 4,400 m. It flows through Sikkim, Bhutan, West Bengal and Bangladesh. After the river is joined by a number of streams and tributaries both in mountainous and sub-mountainous regions, it finally flows into river Dharala and the combined system, by the name Dharala ultimately outfalls into Brahmaputra in Bangladesh. The total length of this river is 192 km out of which 122 km is situated within West Bengal. The total catchment area of this river Sub-basin is 5,302 sq. km.

Teesta Sub-basin

Teesta, the mighty river of North Bengal originates in the glaciers of North Sikkim at an altitude of 6,400 m and is formed by the union of two streams viz. Lachen and Lachung at Chungthung in Sikkim. It enters West Bengal at Rangpo and upto Mechi, it forms the boundary between West Bengal and Sikkim. Two of its tributaries, Great-Rangeet and Rammam also serve as the natural boundary between the two states. The river finally outfalls into Brahmaputra in Rangpur district of Bangladesh. The total length of this river is 309 km out of which 103 km is situated within Sikkim and 121 km in West Bengal. The total catchment area of this river Sub-basin is 10,053

sq. km. Under Teesta Barrage Project a barrage has been constructed at Gazoldoba under Jalpaiguri district.

GANGA BASIN

The two holy rivers - Bhagirathi and Alakananda originating from the glaciers of the Himalayas at an altitude of 7,000 m join at Devprayag and the combined stream is known as the Ganga. It emerges into the plains at Rishikesh in Uttaranchal. After flowing exclusively through Uttaranchal and Uttar Pradesh it receives the flow of Yamuna, one of its major tributaries near Allahabad. The other major tributaries of Ganga are Ton, Gomti, Gharghara, Son, Gandak, Kosi and Fulhar. The Ganga forms the boundary between Uttar Pradesh and Bihar for a length of about 110 km and the river then enters Bihar and flows more or less through the middle of the state. After its confluence with the Kosi, the Ganga continues its eastward flows in Bihar for about 40 km.

At Bhagalpur of Bihar, the river begins to flow south-southeast and as it enters West Bengal, the river swings round the Rajmahal hill range and it begins its attrition with the branching away of its first distributary, the Bhagirathi-Hooghly, which goes on to become the Hooghly River after meeting with Jalangi near Nabadwip and ultimately outfalls into the Bay of Bengal near Sagar Island. Just before the border with Bangladesh the Farakka Barrage controls the flow of the Ganges, diverting some of the water into a feeder canal linked to the Hooghly for the purpose of keeping it relatively silt-free.

The North-Central, South-Central, Western, South-Western and Southern parts of West Bengal constitute the Ganga Basin. This basin is largely divided into two major sub-basins namely Bhagirathi lower and Damodar. The total length of the river Ganga from its point of origin to the point where it falls into sea is about 2,575 km (measured along Bhagirathi and the Hooghly) of which 1,450 km lies in Uttaranchal and Uttar Pradesh, 110 km along Uttar Pradesh and Bihar border, 445 km in Bihar and 570 km in West Bengal.

The Ganga system comprises a total area of 74,575 sq. km within the state of West Bengal. The catchment area distribution of this basin and sub-basins bounded within different neighbouring states and countries has been presented in the following table.

Mahananda-Fulhar Sub-basin

The river Mahananda originates from Ghoom near Darjeeling town in the district of Darjeeling. It is bounded on the north by the Himalayas, in the east by the ridges separating it from Teesta river system, the river Ganga on the South and the Kosi river system in the east. The river bifurcates into two channels at Barsoi in Bihar. Out of the two branches one flows through Bihar by the name Fulhar and the other flows through West Bengal as Mahananda. The river Mahananda carrying the flow of four tributaries namely, Nagar, Kalindri, Tangon and Punarbhaba, drains into the river Ganga from the North-Western side at Godogarighat just downstream of the point where Ganga leaves the boundary of West Bengal. The combined catchment area of these two Sub-basins is 19,342 sq. km. Under Teesta Barrage Project a barrage has been constructed over Mahananda near Siliguri and another pick-up barrage has been constructed over river Dahuk near Chopra of North Dinajpur district which is a tributary of Mahananda.

RIVER BASINS AND SUB-BASINS OF WEST BENGAL										
CWC Basin Code	River Basin	Sub-Basins	CATCHMENT AREA (Sq. Km)							TOTAL (Sq. Km)
			Bihar	J'khand	Orissa	Sikkim	WB	B'desh	Nepal	
2A	GANGA									
	Bhagirathi and Others (Ganga Lower)	Atreyee					1627	2262		3889
		Fulhar	2940				325		2684	5949
		Mahananda	2739				6040	1319	3295	13393
		Punarbhaba					1125	1809		2934
		Tangon					1244	806		2050
		Ajay	386	3204			2503			6093
		Amta Channel-Kana Damodar					1490			1490
		Bansloi		1794			119			1913
		Behula					549			549
		Bhagirathi-Hooghly		1292			4160			5452
		Bidyadhari					2014			2014
		Brahamani		985			154			1139
		Churni					975	1304		2279
		Dwarka		329			2649			2978
		Ganga-Padma					1673			1673
		Ghea					1167			1167
		Ichamati					2313	1063		3376
		Jalangi					2537			2537
		Khari					2268			2268
		Mayurakshi		2949			2529			5478
		Pagla		239			337			576
		Sundarban					6747			6747
		Rivers & Creeks					3462			3462
	Damodar	Damodar		17087			4325			21412
		Dwarakeswar					4292			4292
		Haldi					614			614
		Kaliaghai					1913			1913
		Kangsabati		321			6324			6645
		Mundeswari					1439			1439
		Pichabani			17		791			808
		Rasulpur					1556			1556
		Rupnarayan					1226			1226
		Shilabati					4088			4088
		Sub-Total	6065	28200	17		74575	8563	5979	123399

Atreyee Sub-basin

Some rivers like Sahu, Neem, Talma, Chaoai, Panga originating from the high lands in districts of Jalpaiguri and meet together to form Kartowa which then enters into Bangladesh by the name Atreyee. The river Atreyee then bifurcates into two channels namely Dheepa and Atreyee. The Western Channel named Atreyee re-enters into West Bengal in South Dinajpur district covering a length of 40 km in the State. It again enters into Bangladesh and ultimately outfalls into river Jamuna after passing through Chalan beel. The total catchment area of this river sub-basin is 3,889 sq. km at the point of leaving West Bengal boundary.

Punarbhaba Sub-basin

The river Dheepa after emerging out from Atreyee in Bangladesh, has taken a South -Western course to enter into South Dinajpur district assuming the name Punarbhaba. Covering a length of about 40 km. in the district it touches the eastern boundary of Maldah district and finally enters into Bangladesh. Further down, Punarbhaba meets the river Mahananda in Bangladesh. The catchment area of this sub-basin is 2,934 sq. km.

Nagar-Kulick, Gamari-Chiramati, Tangon Sub-basins

All these rivers flow through the districts Malda and North Dinajpur and outfall into the river Mahananda. In course of their flow, somewhere they form the boundary either between West Bengal and Bihar or between West Bengal and Bangladesh. Nagar, originating in Bangladesh flows along the boundary of West Bengal and taking a South-eastern course, receives a spill channel of Mahananda and is joined by Kulick, which has also its origin in Bangladesh.

Gamari and Chiramati are two small rivers that flow through North Dinajpur district before they are united. This combined streams finally outfalls into the river Mahananda. Tangon is a tributary of river Mahananda.

It rises in Bangladesh. It flows through the district of North Dinajpur and Malda and meets Mahananda on the boundary of Malda and Bangladesh. The catchment area of Tangon is 2,050 sq. km.

Bhagirathi-Hooghly Sub-basin

Farakka Barrage diverts water from river Ganga into Bhagirathi through a channel known as Feeder canal near Tildanga town of Murshidabad district in order to ensure minimum flow in Bhagirathi especially during dry season. This canal flowing parallel to Ganga passes Dhulian and ends just above Jangipur where Bhagirathi takes it own course. Two right bank tributaries namely Pagla and Bansloi outfall into the Feeder canal before it turns into actual Bhagirathi. It has been renamed as river Hooghly as it passes on the eastern side of Hooghly district until it outfalls into the Bay of Bengal near Sagar island.

During its entire course from origin to outfall, Bhagirathi has formed boundaries between the districts of Burdwan & Nadia, Hooghly & North 24-Parganas, Howrah & Kolkata, Purba Medinipur & South 24-Parganas. River Ajay, Mayurakshi, Damodar (Amta Channel), Rupnarayan and Haldi are the major tributaries on its right bank while river Jalangi and Churni are the major tributaries on its left bank. Some other minor tributaries on its right bank are Khari, Behula, Ghea and Rasulpur. Moreover there are so many small drainage channels and khals which directly outfall into this river from its both banks thus forming local catchment areas of 5, 452 sq. km. The Tolly's Nullah or the Adi Ganga, as it is sometimes called is a small but important tidal creek draining into the river Hooghly from the left in the vicinity of the city of Kolkata.

One important factor which affects the drainage potential of river Hooghly is the effect of tides. The tide runs rapidly on Hooghly and produces a remarkable example of the fluvial phenomenon known as a ‘tidal bore’. This consists of the head-wave of the advancing tide, hemmed in where the estuary narrows suddenly into the river, and often exceeds 2.1

m in height. The difference from the lowest point of low-water in the dry season to the highest point of high-water in the rainy season is reported to be more than 6 m. It has been observed that the incident of flood devastation in the districts of Purba & Paschim Medinipur, Howrah and Hooghly occurs mostly when high flood discharges from Jharkhand districts alongwith those from Bankura, Birbhum, Burdwan and Purulia districts of West Bengal synchronizes with high tides in river Hooghly specially during the month of August and September.

Jalangi-Bhairab Sub-basin

The river Jalangi originates from the right bank of the river Padma in Murshidabad district, 165 km. downstream of Farakka. Jalangi is dead for all purposes except during the periods of heavy rain, when it receives water from Padma. The river ends its journey by finally outfalling into the river Bhagirathi near Nabadwip town of Nadia district. The major tributary of Jalangi is river Bhairab which starts its journey from the river Ganga near Lalbag of Murshidabad district. It is now almost a dead channel but during rainy season it receives water from Padma. Catchment area of Jalangi Sub-basin is 2,537 sq. km.

Mathabhanga-Churni Sub-basin

River Mathabhanga originates from the right bank of the Padma, at Munshiganj in Kushtia district of Bangladesh. It bifurcates near Majdia of Nadia in India, creating two channels. The western course, Churni runs a few km through Nadia in a south-west direction to meet Bhagirathi and the other course Ichamati, after traversing a length of 20 km in India, enters into Bangladesh near Mubarakpur. The length of Churni is almost 56 km. Catchment area of Mathabhanga-Churni Sub-basin is 2,279 sq. km.

Ichamati- Bidyadhari Sub-basins

After entering into Bangladesh near Mubarakpur, river Ichamati flows for 35 km in Bangladesh and again re-enters into India at Duttaphulia of Nadia. It forms the international border between India and Bangladesh for 21 km and finally outfalls into river Kalindi of Sundarban area. The length of Ichamati is 208 km with the catchment area of 2,313 sq. km within West Bengal and 1,063 sq. km within Bangladesh. Bidyadhari originates near Haringhata in Nadia district and then flows through Deganga, Habra and Barasat areas of North 24 Parganas before joining the Raimangal River in the Sundarbans. It has been the major drainage system of North 24-Parganas and Kolkata having catchment area of 2,014 sq. km.

Pagla-Bansloi Sub-basins

These rivers originate from the Rajmahal hills in the Sahebganj district of Jharkhand. Flowing eastern across Birbhum district, they entered Murshidabad district as the tributaries of the river Bhagirathi. The combined catchment area of these sub-basins is 2,489 sq. km.

Brahamani-Dwarka Sub-basin

Dwaraka originating in Dumka district of Jharkhand, flows through Birbhum and Murshidabad districts where it joins with Mayurakshi to form Babla which finally outfalls into the river Bhagirathi. Brahamani is the main tributary of Dwarka. It also originates in Dumka district of Jharkhand and flows through Birbhum and Murshidabad districts to meet with Dwarka. There are Baidhara and Deocha barrages across the river Brahamani and Dwarka respectively under the 'Mayurakshi Reservoir Project'. The total catchment area of this sub-basin is 4,117 sq. km.

Mayurakshi-Babla Sub-basin

River Mayurakshi or Mor, the major river in Birbhum district, has a long history of devastating floods. It has its source on Trikut hill, about 16 km from Deoghar in Jharkhand state. Several spill channels - the Manikarnika, Kana Mor etc. take off from the Mayurakshi in its lower reaches. All these rivers including river Dwarka flow into the lower pocket of Hijal beel in the district of Murshidabad. The combined flow when starts journey from the beel named as river Babla which finally drains into the river Bhagirathi. The drainage and flood level in the Hijal Beel is considerably influenced by the ruling level of Bhagirathi.

Massanjore dam and Tilpara barrage have been constructed across this river as a part of 'Mayurakshi Reservoir Project' which is the first major irrigation project in West Bengal after independence. Other important structures of this project situated in Birbhum are Kopai barrage on river Kopai, Bakreswar dam and Kandisala weir over river Bakreswar. The combined flows of Kopai and Bakreswar are called river Kuia which outfalls into Mayurakhshi near Kandi of Murshidabad. Mayurakshi is about 250 km long out of which nearly 100 km passes through West Bengal. The total catchment area of this sub-basin is 5,478 sq. km. River Siddheswari and Noonbeel are two major tributaries of Mayurakshi outfalling into it at 8 km downstream of Massanjore dam and largely contribute the high volume of uncontrolled flood discharge during monsoon.

Ajay Sub-basin

River Ajay originates on a small hill about 300 m high, southwest of Munger in Bihar. It then flows through Jharkhand and enters West Bengal at Simjuri, near Chittaranjan. It forms the border between Burdwan and Birbhum districts and finally joins the Bhagirathi River near Katwa town of Burdwan. Total length of the Ajay is 288 km out of which 152 km lays in West Bengal. The important tributaries of Ajay are Pathro and Jayanti in Jharkhand, Hinglow in Birbhum and Kunur in Burdwan district of West Bengal.

There is a barrage across river Ajay constructed by Govt. of Jharkhand at Sikatia. The floods of this river are flashy and of short duration. There are some pockets in the Ajay-Kunur catchment which suffer from frequent inundation. Large areas of Burdwan, Birbhum and Murshidabad districts experience inundation due to drainage congestion whenever flood of the Ajay coincides with those of the Mayurakshi and Dwarka. A dam has been constructed over the tributary Hinglow for the purpose of irrigation in some parts of Birbhum district. The total catchment area of this Sub-basin is 6,093 sq.km.

Khari-Behula-Ghea Sub-basins

Khari river a minor right bank tributary of river Bhagirathi originates from the swampy field of Kanksa-Panagarh region of Burdwan district and flows mainly eastward and later south-eastward to outfall into river Bhagirathi upstream of Kalna town. Its main tributary is Banka river which acts as a spill channel of river Damodar and after flowing almost parallel to Khari it meets with Khari just before its outfall into Bhagirathi. The catchment area of this sub-basin is 2,268 sq. km.

Behula, also a spill channel of river Damodar originates near Palla village of Burdwan district and after flowing eastward it outfalls into river Bhagirathi upstream of Balagarh town of Hooghly district. Its main tributary is Gangur river. The catchment area of this sub-basin is 549 sq. km.

Ghea is another spill channel of river Damodar, originating in the Burdwan district and after flowing southward and south-eastward through Hooghly district it outfalls into Hooghly river near Champdani town. The main tributaries of this river are Kana and Kunti having a catchment area of 1,167 sq. km.

Damodar Mundeswari Sub basins

River Damodar originating from Palamau hills in Jharkhand and flowing through a length of 541 km between several districts of Jharkhand and West

Bengal bifurcates into two channels at Beguahana of Burdwan district near Jamalpur. One channel carrying dominant flood discharge has been named as river Mundeswari which drains into Rupnarayan at Bakshi of Howrah district. The other channel after passing through Hooghly and Howrah districts as Amta channel carries its discharge and outfalls into the river Hooghly through an outfall sluice near Uluberia.

The river causes floods in its lower reaches in the districts of Burdwan, Hooghly and Howrah, mainly on the right bank of the river below Beguahana. Earlier known as the 'Sorrow of Bengal' because of its ravaging floods in the plains of West Bengal, the Damodar and its tributaries have been somewhat tamed with the construction of four dams (Mithon, Panchet, Konar and Tilayia) under the control of 'Damodar Valley Corporation (DVC)'. There is another dam at Tenughat across Damodar under the direct control of Government of Jharkhand and in the lower catchment there are one barrage at Durgapur and one weir at Randiha under the direct control of Irrigation & Waterways Department, Government of West Bengal.

Barakar and Bokaro are two major tributaries of Damodar in Jharkhand which meet Damodar from its left bank whereas river Shali in Bankura district of West Bengal is other major tributary situated on its right bank. Harinkhola, Short-Cut channel, Kana Dwarakeswar, Hurhura khal are other important drainage arteries of this catchment which play important role in draining out flood discharge into river Rupnarayan, having tidal influence. The total catchment area of Damodar sub-basin in Jharkhand is 17,087 sq. km and in West Bengal is 4,325 sq. km upto Beguahana point. The local catchment area of Mundeswari sub-basin is 1,439 sq. km and that of Amta Channel-Kana Damodar sub-basin is 1,490 sq.km.

Dwarakeswar Sub-basin

Darakeswar river (also known as Dhalkishore) is a major river in the western part of West Bengal. It originates from Tilboni hill of Chhota Nagpur Plateau in Purulia district and enters Bankura district near Chatna.

It mainly flows south-eastward and after entering into Hooghly district it turns south near Arambag town. Its main tributary Gandheswari rising from Bankura district meets Darakeswar near Bankura town. After receiving contributions from other minor tributaries like Arkasha, Berai, Shankari etc. Darakeswar finally joins with Shilabati at Bandar near Ghatal town of Paschim Medinipur district to form river Rupnarayan. There is proposal of "Darakeswar-Gandheswari Reservoir Project" within this sub-basin. The catchment area of this sub-basin is 4,292 sq. km.

Shilabati Sub-basin

Like Darakeswar, river Shilabati (also known as Shilai) emerging from hilly terrain of Chhota Nagpur Plateau in the Purulia district, traverses south-eastward through the districts of Bankura and Paschim Medinipur to meet with Darakeswar to form Rupnarayan. River Joyponda, Ketia, Donai, Kubai and Parang are major tributaries of Shilabati. There is a small barrage constructed across the river at Kadamdeuli in Bankura district as a part of 'Kangsabati Reservoir Project'. The catchment area of this sub-basin is 4, 088 sq. km.

Kangsabati Sub-basin

The river Kangsabati (also variously known as the Kasai and Cossye) originating from Chhota Nagpur Plateau in the Purulia district and flowing south-eastward, joins with its main tributary Kumari river at Mukutmanipur of Bankura district where a reservoir popularly known as Mukutmanipur dam has been constructed under the 'Kangsabati Reservoir Project' for the purpose of both irrigation and flood control. An Anicut dam built on this river near Midnapore town in 1872 was also added to the operations of the project. Further down, after entering into the district of Paschim Medinipur it joins with combined streams of Bhairab Banki and Tarafeni rivers. Both the rivers have barrages over them under the 'Kangsabati Reservoir Project'. After travelling further east in a tortuous course it bifurcates into two rivers at Kapastikri of Paschim Medinipur.

Northern branch, known as Old Cossye after flowing through certain distance, further bifurcates into two courses at Daspur of Paschim Medinipur. One course, named as Palaspai khal flow further east to outfall into the Rupnarayan and the main course, known as Durbachati flows south-easterly along the border of both Medinipur districts to outfall into river Rupnarayan. Old Cossye is also connected with river Shilabati through a small channel known as Kanki khal.

The southern course, known as New Cossye, flows further south-easterly direction to meet with river Kaliaghai at Dheubhanga of Purba Medinipur district and forms river Haldi which flows eastwardly into the river Hooghly at Haldia. Kherai and Bakshi khal is the main tributary of river New Cossye. The total length of Kangsabati is around 465 km. The catchment area of this sub-basin is 6,645 sq. km. Very often lower portion of this sub-basin specially Ghatal area of Paschim Medinipur and Panskura area of Purba Medinipur districts suffer from inundation due to high flood discharge from its uncontrolled catchment downstream of the Mukutmanipur dam synchronizing with high tide in river Rupnarayan.

Kaliaghai

The river Kaliaghai trickles out from Dudhkundi of Jhargram in Paschim Medinipur district and flows south-easterly through Purba Medinipur to meet the other arm of Kangsabati i.e. New Cossye to form Haldi. During the course of its journey, it is fed by the flow of its tributaries namely Kapaleswari, Baghai and Chandia. The length of this river is 121 km and catchment area is 1,913 sq. km. This river is mainly responsible for flood in Sabang area of Paschim Medinipur district.

Rupnarayan Sub-basin

River Rupnarayan is the major drainage artery of south-western districts of South Bengal. Being the main tributary of Hooghly river, it receives tidal discharge of Bay of Bengal throughout the year and plays

an important role in draining flood water from vast catchment area. Irrespective of discharges from its major tributaries like Mundeswari, Darakeswar, Shilabati and Kangsabati, it also receives flood water from many local drainage channels like Kata khal of Hooghly, Bakshi khal of Howrah, Chandreswar khal of Paschim Medinipur, Denan-Dehaty-Soadighi-Gangakhali-Pratapkhali-Shankrara khals of Purba Medinipur which directly outfall into Rupnarayan from its both banks. The length of this river is 80 km having local catchment area of 1,226 sq. km.

Haldi Sub-basin

Two rivers New Cossye and Kaliaghai join at Dheubhanga of Purba Medinipur to form river Haldi which after traversing south-eastward outfalls into river Hooghly near Haldia town. It divides the Purba Medinpur district into two parts, the Northern part can be categorized as drainage area of Tamluk and the southern part can be categorized as Rasulpur-Nandigram drainage area. Except upper catchment discharges from Kaliaghai-New Cossye sub-basins, river Haldi drains out water from parts of both the above mentioned drainage areas. The lower portion of the river Haldi is affected by over bank spills and drainage problem during the monsoon as entire stretch of 42 km of the river falls under the tidal influence of river Hooghly. The local catchment area of this sub-basin is 614 sq. km.

Rasulpur Sub-basin

The river Rasulpur is formed by union of two drainage channels namely Bagda and Sadar khals. It is the main drainage channel in Contai sub-division of Purba Medinipur district. The river having length 19 km drains out flood water of 1,556 sq. km into the river Hooghly.

Pichabani-Negua Channel Sub-basin

River Pichabani and Negua Diversion channel systems are used to discharge rain water out from Dubda basin of Purba Medinipur district.

The two channels outfall into Bay of Bengal. Catchment area of this sub-basin is 808 sq. km.

Sundarban Drainage Sub-basin

Apart from the rivers described earlier within the Ganga basin, there is a group of rivers in Southern part of the State which falls in the deltaic zone. These tidal rivers, estuaries and creeks are situated on the eastern side of Hooghly river popularly known as Sundarbans which is nothing but an intricate network of number of deltaic islands of the district of South 24-Parganas. These rivers drain off whatsoever fresh discharge comes from country sides, thus ultimately draining into Bay of Bengal. Some important rivers in Sundarban are Muriganga, Mridangabhanga, Saptamukhi, Raimangal, Matla, Bidya, Thakuran, Malancha, Kalindi, Gomar etc. The total land area of Sundarban sub-basin is 6,747 sq. km.

SUBARNAREKHA BASIN

The river Subarnarekha (also called Swarnarekha) though it has small catchment within this state, has got separate entity as it directly falls into the Bay of Bengal. Originating in the Chhotonagpur Range at an elevation of 609 m near Ranchi, it traverses through three states viz. Jharkhand, West Bengal and Orissa. It drains out rain water from a total area of 19, 684 sq. km out of which only 3,593 sq. km falls within Purulia and Paschim Medinipur districts of West Bengal.

One major dam at Chandil and one barrage at Galudi have been constructed across Subarnarekha in Jharkhand. The important tributaries on the right bank of this river are Kanchi and Karkari which meet Subarnarekha above Chandil dam and another right bank main tributary named as Kharkai meets this river near Jamshedpur upstream of Galudi barrage. Dulung is the main tributary which joins Subarnarekha from its left in the Paschim Medinipur district of West Bengal. The total length of this river is 395 km out of which 83 km falls within West Bengal.

4. RIVER AND RAIN GAUGES

Irrigation and Waterways Department (IWD), Govt. of West Bengal is responsible for maintenance, collection, compilation and dissemination of hydrological and meteorological data for the purpose of monitoring of flood situation for almost all river sub-basins of the State during monsoon. For this purpose network of river gauges and rain gauges have been established at the important locations and during monsoon flood control rooms in each district are set up including the Central Flood Control Room at Jalasampad Bhawan, Salt Lake, Kolkata-700091.

Apart from IWD, other organizations like Central Water Commission (CWC), Indian Meteorological Department (IMD), State Agricultural Department, Kolkata Port Trust (KoPT), Damodar Valley Corporation (DVC) have set up network of river gauges and rain gauges at different locations for the purpose of monitoring hydrological and meteorological status of the State. These field data mainly includes daily rainfall, water level of river and reservoir, river discharge and inflow-outflow from reservoir. In addition to that other information like inflow forecast, meteorological forecast and flood damage are also collected.

Existing Hydro-Met Monitoring System in the State

Sl. No.	Type	IWD			CWC			IMD			Others		
		P	S	T	P	S	T	P	S	T	P	S	T
1	Ordinary Rain Gauge	75	51	**126**	23		**23**	7		**7**	3		**3**
	ARG/AWS/FCS	0		**0**	0		**0**	58		**58**			
2	River Gauge	75		**75**	14		**14**				1		**1**
3	HOS	10	3	**13**	2		**2**						

P = Perennial	
S = Seasonal	
T = Total	
HOS = Hydrological Observation Station	

The present flood monitoring and management system in the State comprises

with the preparation of Daily Flood Report by Central Flood Control Room of IWD and transmission of the same to the State Disaster Management Department with the Head Quarter at Kolkata. This report is also shared with other organisation like Railway Auothrity, Defence, Kolkata Port Trust (KoPT) etc. on regularly.

During emergency separate Flood Bulletin is issued and the same is disseminated also to the District Disaster Management Cells via email, Fax or SMS. This Daily Flood Report generally contains rainfall, river gauge and discharge, reservoir level/inflow/outflow data of different Stations within and outside the State. Sometimes the location and extent of major damages, the status of affected areas under inundation etc. are also included. These data are collected from different district control rooms under IWD along with other agencies like IMD, CWC and DVC by telephone, email or fax. Daily flood report is also uploaded in the departmental web site www.wbiwd.gov.in.

A comprehensive list of existing Hydro-Met network within the State under the jurisdiction of Irrigation & Waterways Department, Central Water Commission, India Mateorological Department, and other State Govt. Departments is given in the following tables.

Sub-basin wise List of Hydro-Met Monitoring Stations in North Bengal

Gauge Station	River	Type of Gauge	District	Maintained by	DL (m)	EDL (m)
SUB-BASIN SANKOSH						
L.R.P. Crossing	Sankosh	Rain / River	Alipurduar	IMD / CWC	48.50	49.40
SUB-BASIN RAIDAK						
L.R.P. Crossing	Raidak-II	River	Alipurduar	IWD / CWC	48.40	49.30
L.R.P. Crossing	Raidak-I	River	do	IWD / CWC	47.00	47.90
Tufanganj	Raidak-I	Rain / River	Coochbehar	AGRI / CWC	35.30	35.90
SUB-BASIN TORSA						
Mahua Tea Garden	Torsa	Rain	Alipurduar	IMD	44.10	45.70
Jayanti	Gadadhar	Rain	do	IMD		
Alipurduar	Kaljani	Rain / River	do	IMD / IWD	44.10	45.70
Hasimara	Torsa	Rain / River	do	IWD / CWC	116.30	117.50
Banarhat	Dudua	Rain	Jalpaiguri	IWD		
Coochbehar	Torsa	Rain / River	Coochbehar	IMD / IWD	42.07	42.68
Pundibari	Torsa	Rain	do	IMD		
Dinhata	Torsa	Rain	do	IMD	42.07	42.68
SUB-BASIN JALDHAKA						
Chengmari	Diana	Rain / River	Jalpaiguri	IMD / CWC	200.50	201.40
Nagrakata	Jaldhaka	River	do	CWC	160.70	161.80
NH-31 Crossing	Jaldhaka	River	do	CWC	80.10	80.90
Mainaguri	Jarda	Rain	do	IMD		
Mathabhanga	Mansai	Rain / River	Coochbehar	CWC	47.70	48.20
SUB-BASIN TEESTA						
Gangtok	Teesta	Rain	Darjeeling	IMD		
Darjeeling	Teesta	Rain	do	IMD		
Kalimpong	Teesta	Rain	do	IMD		
Pedong	Teesta	Rain	do	IMD		
Malbazar	Mal	Rain	Jalpaiguri	IWD		
Jalapiguri	Teesta	Rain	do	IWD		
Teestabazar	Teesta	River	Darjeeling	CWC	211.00	213.00
Coronation Bridge	Teesta	River	do	CWC	150.00	153.60
Domohani	Teesta	River	Jalpaiguri	CWC	85.95	86.30
Mekhliganj	Teesta	Rain / River	do	IMD / CWC		

Gauge Station	River	Type of Gauge	District	Maintained by	DL (m)	EDL (m)
SUB-BASIN MAHANANDA-FULHAR						
Hill Cart Road	Mahananda	River	Darjeeling	IWD	115.98	116.59
Siliguri	Mahananda	Rain	Darjeeling	IWD		
Sonapur	Mahananda	River	North Dinajpur	IWD	75.77	76.38
Chopra	Dauk	River	do	IWD	69.46	70.07
Islampur	Dauk	Rain	do	AGRI		
Makdampur	Nagar	River	do	IWD	31.54	31.86
Raiganj	Kulik	Rain / River	do	AGRI / IWD	31.20	32.69
Pajol	Sui	River	do	IWD	27.43	28.00
Kachua	Sui	River	do	IWD	25.49	26.09
Radhikapur	Tangon	River	do	IWD	33.45	34.05
Itahar	Gamari	Rain / River	do	IMD / IWD	26.82	27.41
Bangshihari	Tangon	River	do	IWD	25.60	26.21
Teljana	Fulhar	River	Malda	IWD	27.43	28.35
Ratua	Fulhar	Rain	do	IMD		
Englishbazar	Mahananda	Rain / River	do	IMD / IWD	22.75	23.50
SUB-BASIN PUNARBHABA						
Gangarampur	Punarbhaba	Rain / River	South Dinajpur	IWD	25.82	26.42
Tapan	Punarbhaba	Rain	do	IWD		
SUB-BASIN ATREYEE						
Balurghat	Atreyee	Rain / River	South Dinajpur	IWD	23.15	23.76
Majhian	Atreyee	Rain	do	IWD		
SUB-BASIN GANGA						
Manikchakghat	Ganga	River	Malda	IWD	24.69	25.30
Farakka	Ganga	River	do	CWC	22.25	22.85

Sub-basin wise List of Hydro-Met Monitoring Stations in South Bengal

Name of Gauge Station	River	Type of Gauge	District	Maintained by	DL (m)	EDL (m)
SUB-BASIN GANGA-PADMA						
Nimtita	Ganga-Padma	River	Murshidabad	IWD	21.90	21.64
Nurpur	Ganga-Padma	River	do	IWD	21.03	21.64
Geria	Ganga-Padma	River	do	IWD	20.94	21.55
Chakghat	Ganga-Padma	River	do	CWC	20.88	21.49
Akheriganj	Ganga-Padma	River	do	CWC	18.44	19.05
SUB-BASIN BHAGIRATHI-HOOGHLY						
Jangipur	Bhagirathi	River	Murshidabad	IWD	20.27	20.88
Berhampore	Bhagirathi	Rain / River	do	IMD / IWD	17.22	17.83
Chakdah	Bhagirathi	Rain	Nadia	IMD		
Kalyani	Bhagirathi	Rain	do	IMD		
Katwa	Hooghly	Rain	Burdwan	IWD	13.71	14.32
Kalna	Hooghly	River	do	IWD	13.71	14.32
Chinsurah	Hooghly	Rain	Hooghly	IMD		
Najirganj	Hooghly	Rain	Howrah	IWD		
Siejberia	Hooghly	Rain	do	IWD		
Chitpur	Hooghly	Rain	Kolkata	IWD		
Alipur	Hooghly	Rain	do	IMD		
Charial	Hooghly	Rain	South 24 Parganas	IWD		
Diamond Harbour	Hooghly	Rain	do	IMD		
SUB-BASIN JALANGI-CHURNI						
Debogram	Jalangi	Rain	Nadia	IMD		
Krishnanagar	Jalangi	Rain	do	IMD		
Swarupganj	Jalangi	River	do	IWD	8.44	9.05
Hanskhali	Churni	River	do	IWD	7.53	8.14

Sub-basin wise List of Hydro-Met Monitoring Stations in South Bengal

Name of Gauge Station	River	Type of Gauge	District	Maintained by	DL (m)	EDL (m)
SUB-BASIN PAGLA-BANSLOI						
Pakur	Bagmari	Rain	Jharkhand	IMD		
Maheshpur	Bansloi	Rain	do	IMD		
Bansloi Ry. Bridge	Bansloi	River	Birbhum	IWD	31.85	32.76
Bahutuli	Bansloi	River	Murshidabad	IWD		
Paikar	Pagla	Rain	Birbhum	IWD		
SUB-BASIN BRAHAMANI-DWARKA						
Shikaripara	Dwarka	Rain	Jharkhand	IMD		
Nalhati	Brahmani	Rain	Birbhum	IWD		
Jagdhari Road Bridge	Brahmani	River	do	IWD	33.00	33.40
Rampurhat	Dwarka	Rain	do	IWD		
Mallarpur	Dwarka	Rain	do	IWD		
Md. Bazar	Dwarka	Rain	do	IWD		
Deocha Bararge	Dwarka	Rain	do	IWD		
Mayureswar	Dwarka	Rain	do	IWD		
Kuli	Manikarni	Rain	Murshidabad	IWD		
Sankoghat	Dwarka	River	do	IWD	20.40	21.30
Ranagram	Dwarka	River	do	IWD	17.36	17.86
SUB-BASIN MAYURAKSHI-BABLA						
Haripur	Mayurakshi	Rain	Jharkhand	CWC		
Khushiary	Mayurakshi	Rain	do	CWC		
Jama	Mayurakshi	Rain	do	IMD		
Maharo	Mayurakshi	Rain	do	CWC		
Dumka	Mayurakshi	Rain	do	IMD		
Massanjore	Mayurakshi	Rain	do	CWC / IWD		
Kundahit	Siddhe-swari	Rain	Jharkhand	IMD		
Tatloi	do	Rain	do	IMD		
Tilpara Barrage	Mayurakshi	Rain	Birbhum	CWC		
Suri	Mayurakshi	Rain	do	IMD		

Name of Gauge Station	River	Type of Gauge	District	Maintained by	DL (m)	EDL (m)
Sainthia	Mayurakshi	Rain	Birbhum	IWD		
Kadisala	Bakreswar	Rain	do	IWD		
Kultore Barrage	Kopai	Rain	do	IWD		
Shyambati	Kopai	Rain	do	IWD		
Shekhampur	Bakreswar	Rain	do	IMD		
Kirnahar	Kuia	Rain	do	IWD		
Tarapur	Kuia	River	Murshidabad	IWD	22.71	23.35
Narayanpur	Mayurakshi	Rain / River	do	CWC	27.988	28.79
Kandi	Mayurakshi	Rain	do	IWD		
Salar	Babla	Rain	do	IWD		
Bharatpur	Babla	Rain	do	IWD		
SUB-BASIN AJAY-HINGLOW						
Deoghar	Ajay	Rain	Jharkhand	IMD		
Jamtara	Ajay	Rain	do	IMD		
Sikatia Barrage	Ajay	Rain	do	CWC		
Hinglow Dam	Hinglow	Rain	Birbhum	IWD		
Khayrashole	Hinglow	Rain	do	IWD		
Debagram	Ajay	Rain	do	IWD		
Nanur	Ajay	Rain	do	IWD		
Gheropara	Ajay	Rain / River	do	CWC	39.42	40.42
Bahiri	Kana Ajay	Rain	Birbhum	IWD		
Amuliaghata	Ajay	Discharge	do	IWD		
Satkahania	Ajay	Rain	do	IWD		
Budra	Ajay	River	do	IWD	39.42	40.34
Bhedia	Ajay	Rain	do	CWC		
Katwa	Ajay	Rain / River	do	IWD	14.48	15.04
Gushkara	Kunur	Rain	do	IWD		
SUB-BASIN DAMODAR-MUNDESWARI						
Tilayia	Barakar	Rain	Jharkhand	IMD		
Koderma	Barakar	Rain	do	IMD		
Birni	Barakar	Rain	do	IMD		
Giridih	Barakar	Rain	do	IMD		

Name of Gauge Station	River	Type of Gauge	District	Maintained by	DL (m)	EDL (m)
Tundi	Barakar	Rain	Jharkhand	IMD		
Ichak	Konar	Rain	do	IMD		
Hazaribag	Konar	Rain	do	IMD		
Bokaro	Konar	Rain	do	IMD		
Topchanchi	Damodar	Rain	do	IMD		
Dhanbad	Damodar	Rain	do	IMD		
Tenughat	Damodar	Rain	do	CWC		
Maithon	Damodar	Rain	do	CWC		
Panchet	Damodar	Rain	do	CWC		
Barhi	Barakar	Rain	do	DVC		
Barakatha	Barakar	Rain	do	DVC		
Parsabad	Barakar	Rain	do	DVC		
Barkisuria	Barakar	Rain	do	DVC		
Dhanwar	Barakar	Rain	do	DVC		
Tuladih	Barakar	Rain	do	DVC		
Jamua	Barakar	Rain	do	DVC		
Palganj	Barakar	Rain	do	DVC		
Burmu	Damodar	Rain	do	DVC		
Barkagaon	Damodar	Rain	do	DVC		
Bhurkunda	Damodar	Rain	do	DVC		
Phusro	Damodar	Rain	do	DVC		
Nawadih	Damodar	Rain	do	DVC		
Chandrapura	Damodar	Rain	do	DVC		
Pupunki	Damodar	Rain	do	DVC		
Putki	Damodar	Rain	do	DVC		
Gansadih	Damodar	Rain	do	DVC		
Chandankiary	Damodar	Rain	do	DVC		
Asansol	Damodar	Rain	Burdwan	CWC		
Durgapur Barrage	Damodar	Rain	do	CWC		
Rondia	Damodar	Rain / River	do	IWD	52.13	52.89
Edilpur	Damodar	Rain / River	do	IWD	32.79	32.95
Burdwan	Damodar	Rain	do	IWD / IMD		

Name of Gauge Station	River	Type of Gauge	District	Maintained by	DL (m)	EDL (m)
Jamalpur	Damodar	Rain / River	Burdwan	IWD	23.24	23.54
Seherabazar	Damodar	Rain	do	IWD		
Lohai (Raina)	Damodar	Rain	do	IWD		
Pakhana	Damodar	Rain	do	IWD		
Galsi	Damodar	Rain	do	IWD		
Parga Dam	Damodar	Rain	Purulia	IWD		
Golamarajore Dam	Damodar	Rain	do	IWD		
Champadanga	Damodar	Rain / River	Hooghly	IWD	12.90	13.50
Harinkhola	Mundeswari	Rain / River	do	CWC / IWD	12.80	13.41
Muchighata	Hur Hura	Rain / River	do	IWD	6.16	6.77
Amta	Lower Damodar	Rain / River	Howrah	IWD	5.64	6.24
Domjur	Saraswati	Rain	do	IWD		
Jagatballavpur	Kana Damodar	Rain	do	IMD		
Uluberia	Kana Damodar	Rain	do	IMD		
SUB-BASIN KHARI-BEHULA-GHEA						
Sanko	Banka	Rain	Burdwan	IWD		
Balgona	Banka	Rain	do	IWD		
Memari	Behula	Rain	do	IWD		
Dhaniakhali	Ghea	Rain	Hooghly	IMD		
Singur	Ghea	Rain	Hooghly	IWD		
SUB-BASIN DWARAKESWAR						
Patrasayar	Dwarakeswar	Rain	Bankura	IWD		
Indus	Dwarakeswar	Rain	do	IWD		
Sonamukhi	Shali	Rain	do	IWD		
Bankura	Dwarakeswar	Rain / River	do	CWC / IWD		
Kotulpur	Dwarakeswar	Rain	do	IWD		
Kamarpukur	Dwarakeswar	Rain	Hooghly	IWD		
Arambag	Dwarakeswar	Rain / River	do	IWD	17.22	17.83
Sekhpur	Dwarakeswar	River	do	IWD	11.75	12.35
SUB-BASIN SHILABATI						
Kadamdeuli	Shilabati	Rain	Bankura	IMD		

Name of Gauge Station	River	Type of Gauge	District	Maintained by	DL (m)	EDL (m)
Taldangra	Jayponda	Rain	Bankura	IMD		
Amlagora	Shilabati	Rain	Pachim Medinipur	IWD		
Panikotar	Shilabati	Rain	do	IWD		
Adalia	Kubai	Rain	do	IWD		
Banka	Shilabati	River	do	IWD	15.08	15.69
Gadghat	Shilabati	River	do	IWD	8.99	9.60
SUB-BASIN RUPNARAYAN						
Ghatal	Rupnarayan	Rain	Pachim Medinipur	IWD		
Bandar	Rupnarayan	River	do	IWD	6.85	7.46
Ranichak	Rupnarayan	River	do	IWD	5.33	5.94
Gopiganj	Rupnarayan	River	do	IWD	5.03	5.65
Denan	Rupnarayan	River	Purba Medinipur	IWD	4.42	5.02
Kolaghat	Rupnarayan	Rain	do	IWD		
Tamluk	Rupnarayan	Rain	do	IMD		
Geonkhali	Rupnarayan	River	do	KOPT		
SUB-BASIN KANGSABATI						
Kotsila	Cossye	Rain	Purulia	IMD		
Jaipur	Cossye	Rain	do	IWD		
Bandhu Dam	Cossye	Rain	do	IWD		
Arsa	Cossye	Rain	do	IWD		
Purulia	Cossye	Rain	do	IWD / IMD		
Patloi Dam	Cossye	Rain	do	IWD		
Simulia	Cossye	Rain	do	CWC		
Tusuma	Cossye	Rain	do	CWC		
Balrampur	Kumari	Rain	do	IWD		
Kumari Dam	Kumari	Rain	do	IWD		
Phulberia	Kumari	Rain	do	CWC		
Purihansa	Kumari	Rain	do	CWC		
Kharidwar	Kumari	Rain	do	CWC		
Kangsabati Dam	Kangsabati	Rain	Bankura	CWC / IWD		
Jhargram	Kangsabati	Rain	Pachim Medinipur	IMD		

Name of Gauge Station	River	Type of Gauge	District	Maintained by	DL (m)	EDL (m)
Tarapheni Barrage	Tarapheni	Rain	Pachim Medinipur	IWD		
Midnapore	Kangsabati	Rain	do	IMD		
Mohanpur	Kangsabati	Rain / River	do	CWC / IWD	25.75	26.36
Lachhmapur	Kangsabati	Rain	do	IWD		
Kapastikri	Kangsabati	River	do	IWD	16.00	16.60
Kalmijole	Old Cossye	River	do	IWD	9.29	9.90
Balichak	New Cossye	Rain	do	IWD		
Khanyadihi	Durbachati	River	Purba Medinipur	IWD	5.03	5.65
Panskura	New Cossye	Rain / River	do	IWD	9.29	9.90
Dobandy	New Cossye	River	do	IWD	5.02	5.63
SUB-BASIN KALIAGHAI-HALDI						
Bakhrabad	Kaliaghai	River	Pachim Medinipur	IWD	8.40	8.85
Dehati	Kaliaghai	River	do	IWD	6.55	7.00
Kalimondop	Kaliaghai	River	do	IWD	5.03	5.65
Sabang	Kapaleswari	Rain	do	IWD		
Narayanbar	Kapaleswari	River	do	IWD	5.33	5.94
Barisha	Chandia	Rain / River	do	IWD	4.55	5.00
Amgachia	Kaliaghai	Rain / River	Purba Medinipur	IWD	5.79	6.40
Itamogra	Haldi	Rain	do	IWD		
Haldia	Haldi	Rain	do	IMD		
SUB-BASIN RASULPUR-PICHABANI						
Contai	Rasulpur	Rain	Purba Medinipur	IWD		
BASIN SUBARNAREKHA						
Jhalda	Subarna-rekha	Rain	Purulia	IWD		
Kestobazar Dam	do	Rain	do	IWD		
Khairabera Dam	do	Rain	do	IWD		
Rupai Dam	do	Rain	do	IWD		
Dimu Dam	do	Rain	do	IWD		
Karrior Dam	do	Rain	do	IWD		

Name of Gauge Station	River	Type of Gauge	District	Maintained by	DL (m)	EDL (m)
Kesiapata	do	Rain	Pachim Medinipur	IWD		
Gopiballavpur	do	Rain / River	do	IWD	46.87	47.40
Sonakonia	do	River	Purba Medinipur	IWD	16.15	16.75
Digha	do	Rain	do	IWD		
SUB-BASIN ICHAMATI-BIDYADHARI						
Majdia	Mathabhanga	River	Nadia	IWD	7.82	8.43
Bararckpore	Nowai	Rain	North 24 Parganas			
Dumdum	Nowai	Rain	do	IMD		
Deganga	Bidyadhari	Rain	do	IMD		
Barasat	Bidyadhari	Rain	do	IWD		
Gaighata	Jamuna	River	do	IWD	3.90	4.50
Gobardanga	Jamuna	River	do	IWD	3.77	4.37
Tentulia	Ichamati	Rain / River	do	IWD		5.10
Bangaon	Ichamati	Rain / River	do	AGRI / IWD	5.08	5.28
Basirhat	Ichamati	Rain	do	IMD		
Chowbaga	Bidyadhari	Rain	do	IWD		
SUB-BASIN SUNDARBAN						
Uttarbhag	Adi Ganga	Rain	South 24 Parganas	IWD		
Baruipur	Adi Ganga	Rain	do	IMD		
Canning	Matla	Rain	do	IMD		
Nimpith	Mani	Rain	do	IMD		
Raidighi	Sapatamukhi	Rain	do	IMD		
Kakdwip	Muriganga	Rain	do	IMD		
Sagar Island	Bay of Bengal	Rain	do	IMD		

5. RAINFALL IN 2016

Due to its physical and geographical position, the State of West Bengal has climatological variations as well. The average rainfall in the state is 1750 mm, of which more than 75% occurs during the monsoon period while the hilly regions at the foot hills of Himalaya receive the heaviest rainfall ranging from 2500 mm to 4000 mm. The southern districts in the plains receive average of 1125 mm to 1875 mm. The main rainfall season in this state is the South-West monsoon season during which the entire land (excepting the extreme north, the extreme north-east and extreme south) gets 75% of the annual rainfall. The gangetic plains of West Bengal get 78% of its annual rainfall during the monsoon period distributed normally from 1st day of June to the end of September. But during last few years, some parts of West Bengal have experienced premature heavy rainfall in the last week of May causing flood. However the late withdrawal of monsoon even after second week of October has also been observed during these years.

Normal Rainfall Pattern

The river Ganga divides the state into two parts, which are by and large homogeneous from the meteorological point of view. The northern half is designated as 'Sub-Himalayan West Bengal' and the southern half as 'Gangetic West Bengal'. Sub-Himalayan West Bengal is more susceptible to heavy rains both in respect of amount as well as in frequency of occurrence.

Very heavy rain is more frequent in first two months (June and July) than in subsequent, in the Sub-Himalayan West Bengal. In Gangetic West Bengal the frequency is maximum in August followed by June, July and September in that order. On the basis of rainfall distribution, the state can be divided into two broad zones - (i) The Himalayan and Sub-Himalayan Region (ii) The Gangetic Plains

i) Himalayan and Sub-Himalayan Region

The Himalayan and Sub-Himalayan Region comprising the districts-Darjeeling, Jalpaiguri, Coochbehar and Northern part of Islampur Sub-Division of Uttar Dinajpur district of high intensity of rainfall from 2000 mm. to over 4000 mm. about 80% of which is found to occur during monsoon season. On the average Darjeeling, Coochbehar and Jalpaiguri get 114,112,110 rainy days respectively in a year.

The monsoon generally follows a northern track to ultimately break up against Eastern Himalaya causing very heavy rainfall and thereafter trough of low pressure under break monsoon conditions. It then shifts northward to the Himalayan foothills. It has been found that a precipitation between 200 to 300 mm in two hours is not unusual here. For more than 40 occasions, rainfall of 250 mm and above has been registered during 1891-1965.

ii) Gangetic Plains

The gangetic plains which constitute the major portion of the state, can be further sub-divided into the following three sectors on the basis of average rainfall -

Sector - I: Bankura, Burdwan, Hooghly, Nadia and Purulia districts which receive an average rainfall - between 1140 mm and 1400 mm.

Sector - II: Birbhum, Midnapore, Murshidabad and North 24-Parganas having an average annual rainfall between 1400 mm and 1650 mm.

Sector - III: Kolkata, Howrah and South 24-Parganas having an average annual rainfall - between 1650 mm and 1900 mm.

Such regional variations in the precipitation pattern causes flood conditions from time to time.

Monsoon, 2016

For the State as a whole, the total monsoon rainfall from the month of June to September during the Year 2016 was normal with the variation of only -2.66% from its average normal. In North Bengal(Himalayan and Sub-Himalayan region, the total monsoon rainfall was 4.34% less than its normal average while that of South Bengal (Gangetic Plains) is only 1.35% less. The Sectoral variations of monthly rainfall in West Bengal during monsoon months have been given below.

Variation of monthly rainfall in Himalayan and Sub-Himalayan West Bengal during monsoon, 2016

RAINFALL (mm)	JUNE			JULY			AUGUST			SEPTEMBER		
SECTOR	Actual	Normal	Dep	Actual	Normal	Dep	Actual	Normal	Dep	Actual	Normal	Dep
NORTH BENGAL	3081.4	2692.7	14.44	4348.1	3622.0	20.05	1104.4	2890.3	-61.79	2594.3	2428.5	6.83

*Dep = Departure *Source: IMD

Variation of monthly rainfall in Gangetic Plains during monsoon, 2016

RAINFALL (mm)	JUNE			JULY			AUGUST			SEPTEMBER		
SECTOR	Actual	Normal	Dep (%)	Actual	Normal	Dep (%)	Actual	Normal	Dep (%)	Actual	Normal	Dep (%)
SECTOR-I	827.7	1112.8	-25.62	1365.8	1482.9	-7.90	2192	1384.1	58.37	1292	1217.5	6.12
SECTOR-II	874.4	1273.2	-31.32	1792.0	1720.5	4.16	1812.0	1626.6	11.40	1128.0	1504.0	-25.00
SECTOR-III	476.0	783.4	-39.24	1063.0	1021.4	4.07	1366.7	968.9	41.06	595.1	891.6	-33.25

*Dep = Departure *Source: IMD

From the above two tables, the monthly variation of monsoon rainfall between North and South Bengal can be assessed specially during the month of August. During this month while North Bengal received a monthly rainfall deficit of around 62% while most of the districts of South Bengal received huge excess rainfall upto the tune of 58% in the Sector-I as well as 41% in the Sector-II. Again for this scenario have been completely different in most of the districts of North Bengal which received excess rainfall during the months of June, July and September as compared with the South Bengal districts.

In the previous year during the same month of August, 2015 North Bengal received excess rainfall of 18.74% while South Bengal experienced a rainfall deficit. One important fact is that during monsoon 2016, neither West Bengal nor the neighbouring State Jharkhand didn't experience any severe depression like 'Philin' in 2013 or 'Komen' in 2015. Due to the excess rainfall that occurred in South Bengal during August, 2016, some pockets of Howrah and Hooghly districts were affected due to flood inundation and drainage congestion.

Zone wise distribution of average rainfall during 2016

PRE MONSOON RAINFALL (mm)			
ZONE	Actual	Normal	% Dep
North Bengal	1419.5	2276.9	**-37.66**
South Bengal	2399.2	2629.4	**-8.75**

MONSOON RAINFALL (mm)			
ZONE	Actual	Normal	% Dep
North Bengal	11128.2	11633.5	**-4.34**
South Bengal	14784.7	14986.9	**-1.35**

POST MONSOON RAINFALL (mm)			
ZONE	Actual	Normal	% Dep
North Bengal	910.6	852.0	**6.88**
South Bengal	1300	2019.4	**-35.62**

*Source: IMD

Districtwise monthly rainfall in West Bengal has been given in Annexure RF1 to RF3. The cumulative rainfall at different Rain gauge stations of different River Sub-Basins recorded for the period from 1st June to 30th September, 2016 have been given given in Annexure RF-4.

6. FLOOD SEASON 2016

The year i.e. 2016 may be considered as a year of normal rainfall for the State of West Bengal with departure (-7.14%) from its average normal. The seasonal rainfall over the entire State during monsoon has been recorded with a deficit of only 2.66% from its average normal. The

distribution of total monthly rainfall from June to September was also normal with the departure fluctuating within the normal rainfall limit of -19% to +19% as shown below:

Month	Actual Rainfall(mm)	Normal Rainfall(mm)	Departure
June	5259.50	5862.10	-10.28%
July	8568.90	7846.80	+9.20%
August	6475.10	6869.90	-5.75%
September	5609.40	6041.60	-7.15%

*Source: IMD

Flood frequency curves of different River Systems have been presented in Annexure-G.

Annexure-G1 shows that River **Sankosh-Raidak-II** system experienced a moderate flood spell during the period from 22nd to 27th July' 2016. The flood peaks in both the rivers fluctuated around the PDLs (Preliminary Danger levels) to attain seasonal maximum of 48.05 m for River Sankosh and 46.80 m in River Raidak-II at their respective gauge stations of L.R.P. crossings against corresponding DLs (Danger Levels) of 48.50 m and 48.40 m respectively.

River **Raidak-I** experienced two noticeable flood spells during the entire monsoon, first one of which occured from 23rd to 27th June' 2016 and the other one occurred during 22nd to 28th July' 2016. On first occasion, water level (35.24 m) almost touched DL 35.30 m and on the other occasion it attained the seasonal maximum of 35.48 m at the gauge Station of Tufanganj (Ref: Annexure-G2).

During the same flood spells, River **Kaljani**, one of the most important tributary of River Torsa, was recorded with maximum water level attaining 45.65 m against EDL of 45.70 m on 25th July, 2016 at gauge station Alipurduar (Ref: Annexure-G2).Maximum flood in River **Torsa** at gauge station Hasimara occurred on 22nd July, 2016 when peak flood attained 117.20 m against EDL (Extreme Danger Level) of 117.50 m (Ref: Annexure-G3).As a result of this high flood ischarge, a breach of length 75 m was occurred in the Subhasini

embankment of River Torsa at Hasimara in Klachini block of Alipurduar district on 26th July, 2016. On the same day, the flood peak in adjacent River **Jaldhaka** attained a maximum of 80.83 m against EDL at 80.90 m (Ref: Annexure-G3).The same flood, when reached further downstream at Mathabhanga two days later, raised the level of **River Mansai** to a seasonal maximum of 48.20 m on 24th July, 2016 against EDL 48.30 m (Ref: Annexure-G4).

The catchment area of river **Teesta** upstream of Teesta barrage is mainly distributed over the entire Sikkim and the eastern part of Darjeeling district. Several Hydel projects have been come up upstream of Teesta barrage and the flow in the River is significantly controlled by the time to time discharges from these Hydel dams.Therefore the flood frequency curve at the gauge station Domohani near Jalpaiguri has become more significant as it records the water levels both for controlled and uncontrolled catchment discharges. The variation of water levels in this River at gauge station Domohani has been presented in the Annexure-G4. Like other Rivers, the peak flood in River **Teesta** passed Domohani on 24th July, 2016 after attaining a seasonal maximum value of 86.03 m against EDL 86.30 m.

Frequency of flood in River **Mahananda** has been depicted in Annexure-G5. The River passed peak flood during the period from 20th to 27th July, 2016 for which the water level reached the seasonal maximum of 116.20 m against DL 115.98 m at the Hill Curt Road gauge site on 21st July, 2016. The same flood peak passed through the gauge station at Englishbazar during the period from 1st to 5th August by raising the water level 20.85 m against DL 21.00 m.

On the otherhand River **Fulhar** received prolonged flood spell from 19th July to 5th August, 2017 where flood peak attained the seasonal maximum level of 28.87 m against EDL 28.35 m on 28th July, 2017 (Ref:Annexure-G7). This page also enunciates the variation of water levels of River Ganga at gauge station Manickchakghat where the River received prolonged flood spell from 15th August to 15th Setember, 2017 when the maximum flood peak recorded as 25.78 m against EDL at 25.30 m.In this year the Rivers like

Atreyee, Tangon and **Punarbhaba** hardly received any noticeable flood spell during the entire monsoon period and the water levels remained well below their respective PDLs (Preliminary Danger Levels).

The flood frequency curves of River **Dwarka** at gauge station Sankoghat and River **Mayurakshi** at Narayanpur have been presented in Annexure-G7. Whereas the River Dwarka has received three distinct flood spells in the three successive months of July, August and September, the adjacent Mayurakshi Sub-basin has experienced only one significant flood spell of smaller duration when the water level attained a seasonal maximum of 27.93 m at Narayanpur against DL 27.99 m on 16th August, 2017.

This rise of water level was triggered by the release from uncontrolled catchment discharge from **Tilpara** barrage on 12th August, 2017 when a peak flood of 15655 Cusecs passed through the barrage.Subsequently the peak run-off from controlled catchment upstream of **Massanjore** dam was absorbed within the available reservoir storage and maximum flood release was restricted to only 9427 Cusecs against the maximum inflow of 25200 Cusecs thereby reducing the intensity of peak flood. The reservoir operation of Massanjore dam during flood season of 2016 has been given in following figure.

The flood frequency curve of River **Ajay** and River **Bhagirathi-Hooghly** have been presented in the Annexure-G8. The gauge in River Ajay at station Gheropara recorded a seasonal maximum level of 38.40 m against PDL at 38.42 m on day 12th August, 2016. River Bhagirathi-Hooghly experienced a prolonged flood spell during 13th to 28th August, 2016 in which gauge touched the DL mark of 8.44 m at station Swarupganj on 25th August, 2016.

Consequent upon the formation of a local depression, heavy to very heavy rainfall occurred on 21st August, 2016 over most of the districts in South Bengal which caused inundation due to flood and waterlogging in some areas of Howrah and Hooghly. The rainfall recorded at some of the rain gauge stations on 22nd August, 2016 at 8.30 a.m.are given below.

24 Hours Rainfall Record on 22nd August, 2016

RIVER	DISTRICT	Location of Rain Gauge Station	Rainfall (mm)
JALANGI	NADIA	Swarupganj	157.60
MAYURAKSHI-BABLA	BIRBHUM	Shyambati	140.00
AJAY-HINGLOW	BIRBHUM	Hinglow	112.00
	BURDWAN	Guskara	146.00
DAMODAR	BURDWAN	Asansol	105.40
	BURDWAN	Durgapur	163.60
	BURDWAN	Burdwan	169.00
	BANKURA	Sonamukhi	100.00
KHARI-BEHULA-GHEA	BURDWAN	Balgona	114.00
	BURDWAN	Memari	115.00
MUNDESWARI	BURDWAN	Seharabazar	148.00
AMTA CHANNEL (DAMODAR)	HOOGLY	Champadanga	53.00
	HOOGLY	Singur	85.50
	HOWRAH	Amta	70.00
	HOWRAH	Domjur	72.00
DWARAKESWAR	BANKURA	Bankura	171.40
	BANKURA	Indus	187.00
	HOOGLY	Arambag	120.00
SHILABATI	PASCHIM MEDINIPUR	Amlagora	68.20
	PASCHIM MEDINIPUR	Ghatal	104.20
KANGSABATI	PURULIA	Simulia	56.20
	PURULIA	Purihansa	84.20
	PURULIA	Tusuma	95.60
	PURULIA	Kharidwar	56.80
	PURULIA	Phulberia	63.20
	BANKURA	Mukutmanipur	82.40
	PASCHIM MEDINIPUR	Midnapore	68.20
	PURBA MEDINIPUR	Panskura	81.20
ICHHAMATI	NORTH 24-PARGANAS	Tentulia	121.00
BIDYADHARI	NORTH 24-PARGANAS	Dumdum	79.00
	SOUTH 24-PARGANAS	Chowbaga	63.00
SUNDARBAN AREA	SOUTH 24-PARGANAS	Uttarbhag	55.00

Flood frequency curves of River **Damodar** at some important gauge stations are given in Annexure-G9 & Annexure-G10. The lower portion of River Damodar experienced one major flood spell in August, 2016 when flood peak crossed EDL 13.50 m at gauge station Champadanga on 23rd August, 2016. Although the maximum release from Durgapur barrage was only 86955 Cusecs on 22nd August, 2016 but the heavy rainfall over uncontrolled catchment downstream of the barrage generated considearble run-off thereby raising the gauge level of River Damodar upto seasonal maximum of 13.80 m. The tidal lockage at the outfall also aggravated the situation as the River Hurhura at Muchighata was also running high and crossed EDL on 24th August, 2016 (Ref: Annexure-G10). Due to this rise, the right embankment of River Damodar was breached at two locations by overflowing flood water at Mouza-Ghola and Chak Thakurani thus causing inundation of approximately 47.53 sq. km. of area within in Udaynarayanpur block of district Howrah.

Due to heavy rainfall on 21st August, 2016 in the catchment area, River **Dwarakeswar** also experienced an unprecedented flood on 23rd August, 2016 when water level changed abruptly and attained a seasonal maximum value of 18.44 m against EDL 17.84 m at gauge station Arambag (Ref: Annexure-G11).As a result at two locations, right embankment of River Dwarakeswar was breached at Mouza-Gujrat and Ghasua resulting flood inundation over approximately 4.10 sq. km. of areas in Khanakul-I block of Hooghly district.

The adjacent River **Shilabati** also receieved two flash flood spells during 23rd to 25th August, 2016 & 8th to 10th September, 2016 and both occasions the gauge level at station Banka crossed DL (Ref: Annexure-G11).

This year River **Kangsabati** didn't experienced high volume of release of flood water from Kangsabati reservoir at Mukutmanipur. The Inflow-Outflow record reveals that the reservoir receieved maximum inflows of 47396 Cusecs & 49025 Cusecs on 19th August & 6th September, 2016 respectively. Both these peak floods were substantially absorbed within the available flood storage of the reservoir and the maximum flood release was restricted to only 16921 Cusecs from dam.The flood frequency curve of River Kangsabati at gauge station Kapastikri has been presented in

Annexure-G12 showing water level was much below the DL throughout the season. The flood frequency curve of River **Rupnarayan**, **New Cossye** & **Old Cossye**, **Kaliaghai** and River **Subarnarekha** of Purba and Paschim Medinipur districts have been depicted in Annexure-G12 to G16 respectively with one or two flood spells, the effects of which were uneventful.

Flood frequency curves of River **Mathabhanga**, **Churni**, **Ichamati** and **Jamuna** have been given in the Annexure-G17 to G18. Out of these channels, only River Jamuna continuously ruled high above DL 3.90 m for a considerably long period causing drainage conjestion in some areas of North 24-Pargana district. Incidents of breach of embankment of River Ichamati at Mouza-Taranipur and that of River Padma at Mouza-Charghat were reported causing inundation of approximately 8.59 sq. km area in Swarupnagar block of North 24-Parganas district.

Inundation due to waterlogging / drainage congestion of some areas also occurred during flood season of 2016.

The instantaneous Inflow-Outflow and Reservoir level data during this flood season for dams and barrages under the control of Irrigation & Waterways Department have been compiled in Annexure D1 to D4.

Approximate cost of restoration of flood damages to different infrastructures and assets under Irrigation & Waterways Department has been given in the table below.

An Index Map showing location and area of inundation during flood season 2016 for different districts of West Bengal has been prepared and given below.

Districtwise Damage Report during Flood Season, 2016

Sl. No.	District	Nature of Damage	Total Length of the Damaged Embankment & Protective Works (Km)	Length of Breach of the Embankment (m)	Estimated Cost of Restoration (Rs. In lakhs)	Total Area of Inundation (sq. km)
1	Alipurduar	Slip, Susidence, Erosion, Scour, Rain Cut, Ghog, Overtopping, Damage to Hydraulic Structures, Bridges and Culverts, Morrum Inspection Path etc.		75.00	NA	NA
2	Coochbehar		18.285		1049.00	
3	Hooghly		3.265	120.00	648.00	5.31
4	Howrah		53.661		989.26	47.53
5	Murshidabad		4.530		2730.00	18.00
6	North 24 Parganas			60.00	8.29	8.59
7	Purba Medinipur		11.250		691.49	
8	South 24 Parganas		87.604		1137.07	0.25
		TOTAL	178.595	255.00	7253.11	79.68

7. CONCLUSION

The West Bengal is basically receipient of run-off generated outside the state. The state has typical basin characteristics. In the north the rainfall is high and the ground slope is steep mainly in the Sub-Himalayan region. The rivers in the Terai region are wide with shallow depth. Due to continuous denudation of forest cover and dolomite mining in the hills, the silt loads are continuously deposited in the river beds, reducing the carrying capacity of the rivers causing the flood. In the South & Central Region heavy rainfall and run-off coming from the upper catchment cause drainage congestion and inundation due to very flat ground slope of the regions.

Main structural measures of flood control in West Bengal are embankments measuring 10,400 km (approx.) spread over different river systems, constructed over the years. There are major dams across the river Kangsabati, Mayurakshi and Damodar river system. But only in the Damodar system, moderation of the dams during the peak flood is possible to some extent. The other structural measures like catchment area treatment and afforestation in upper catchment require intervention at Government of India level as they are outside the state.

In North Bengal, an elaborate flood warning system maintained by the department warns the people about the trend of rise of the rivers and thus alarms them to take necessary safety measures. In Central & South Bengal the water level of different rivers together with their danger & extreme danger levels and releases from different dams and reservoirs are intimated to different authorities from time to time during rainy season.

Besides, the department also continuously maintains close liaison with the Regional Meteorological Centre (RMC), Kolkata and follows Indian Meteorological Department (IMD) web-site in order to collect information on adverse weather condition during the monsoon period and accordingly adopt suitable flood fighting measures. Central Water Commission (CWC) also extends their co-operation by providing the different river gauge as well as rain gauge data under their jurisdiction.

In addition to above, the department has already undertaken initiative to make available the daily flood data during entire monsoon period every year in public domain through the departmental website *www.wbiwd.gov.in*.

(Digant Maity)
Deputy Director
Advance Planning, Project
Evaluation & Monitoring Cell
Irrigation & Waterways Directorate

21/04/2017
(Sanjay Kundu)
Director
Advance Planning, Project
Evaluation & Monitoring Cell
Irrigation & Waterways Directorate

24.04.17
(Dipak Kumar Banerjee)
DP & Ex-officio Chief Engineer
Irrigation & Waterways Directorate

Annexure RF-1

Districtwise Monthly Rainfall Statistics of West Bengal for the Year 2016

Month	January			February			March			April			May		
Rainfall in mm	Actual	Normal	% Dep	Actual	Normal	% Dep	Actual	Normal	% Dep	Actual	Normal	% Dep	Actual	Normal	% Dep
District															
Coochbehar	6.6	8.9	-26.0	0.1	16.0	-99.0	64.8	32.2	101.0	99.0	138.9	-29.0	267.1	345.4	-23.0
Darjeeling	6.5	48.3	-87.0	3.0	33.8	-91.0	46.3	57.7	-20.0	33.6	130.5	-74.0	191.4	262.3	-27.0
Jalpaiguri	7.3	9.2	-21.0	2.0	17.8	-89.0	100.1	39.7	152.0	125.0	119.3	5.0	273.1	339.3	-20.0
Malda	16.9	13.6	24.0	0.0	10.5	-100.0	2.1	14.5	-86.0	21.6	34.8	-38.0	85.4	106.2	-20.0
North Dinajpur	0.0	21.5	-100.0	0.0	2.0	-100.0	0.0	8.0	-100.0	0.0	35.7	-100.0	0.0	162.9	-100.0
South Dinajpur	0.0	8.9	-100.0	0.0	13.3	-100.0	5.2	19.0	-73.0	12.3	58.9	-79.0	50.1	167.8	-70.0
Bankura	6.1	12.0	-49.0	10.2	18.0	-43.0	15.6	22.0	-29.0	0.8	36.3	-98.0	101.3	66.9	51.0
Birbhum	24.3	13.4	81.0	14.0	16.1	-13.0	12.7	21.2	-40.0	2.7	30.9	-91.0	94.9	78.7	21.0
Burdwan	13.5	10.7	26.0	29.3	22.2	32.0	15.0	19.8	-24.0	0.0	37.8	-100.0	120.0	78.8	52.0
East Midnapore	5.2	15.9	-67.0	58.4	18.6	214.0	13.2	31.8	-59.0	6.0	34.7	-83.0	138.5	108.1	28.0
Hooghly	1.3	11.9	-89.0	14.0	26.6	-47.0	20.3	28.2	-28.0	0.0	50.6	-100.0	85.3	108.5	-21.0
Howrah	0.4	12.2	-97.0	104.1	24.9	318.0	8.8	32.0	-73.0	0.0	52.6	-100.0	52.0	126.4	-59.0
Kolkata	0.0	14.4	-100.0	94.5	24.7	283.0	8.9	33.5	-73.0	0.2	53.1	-99.0	141.0	113.4	24.0
Murshidabad	41.0	16.8	144.0	7.5	11.2	-33.0	7.0	19.0	-63.0	24.0	34.0	-29.0	89.0	87.0	2.0
Nadia	0.8	12.2	-94.0	38.7	17.6	120.0	16.2	21.1	-23.0	3.2	42.1	-92.0	181.3	95.2	90.0
North 24 Parganas	0.7	15.6	-96.0	84.4	17.8	374.0	37.8	30.3	25.0	2.5	51.5	-95.0	146.0	113.4	29.0
Purulia	5.0	14.3	-65.0	15.5	20.7	-25.0	5.5	24.6	-77.0	0.1	36.1	-99.0	73.5	57.3	28.0
North 24 Parganas	7.2	13.6	-47.0	63.3	26.7	137.0	1.6	37.9	-96.0	7.6	41.7	-82.0	100.4	125.1	-20.0
West Midnapore	6.0	12.2	-51.0	48.0	24.1	99.0	27.4	39.0	-30.0	12.0	56.8	-79.0	133.5	107.6	24.0

Annexure RF-2

Districtwise Monthly Rainfall Statistics of West Bengal for the Year 2016

Month	June			July			August			September		
Rainfall in mm	Actual	Normal	% Dep	Actual	Normal	% Dep	Actual	Normal	% Dep	Actual	Normal	% Dep
District												
Coochbehar	829.1	668.8	24.0	828.6	864.9	-4.0	231.5	733.0	-68.0	433.0	470.9	-8.0
Darjeeling	725.4	534.7	36.0	1168.3	756.9	54.0	309.7	645.9	-52.0	535.0	502.8	6.0
Jalpaiguri	1016.1	667.3	52.0	1200.8	931.4	29.0	223.5	670.9	-67.0	679.2	488.3	39.0
Malda	157.4	216.6	-27.0	407.3	332.9	22.0	152.1	284.8	-47.0	337.9	283.0	19.0
North Dinajpur	266.6	316.0	-16.0	433.0	367.0	18.0	124.8	307.7	-59.0	364.6	403.8	-10.0
South Dinajpur	86.8	289.3	-70.0	310.1	368.9	-16.0	62.8	248.0	-75.0	244.6	279.7	-13.0
Bankura	175.1	215.0	-19.0	264.8	303.2	-13.0	445.5	290.7	53.0	268.9	242.3	11.0
Birbhum	214.6	222.3	-3.0	346.6	313.9	10.0	308.4	298.8	3.0	242.4	271.0	-11.0
Burdwan	182.5	198.2	-8.0	263.4	294.1	-10.0	463.5	285.3	62.0	274.5	251.1	9.0
East Midnapore	175.1	253.5	-31.0	309.5	284.9	9.0	426.4	338.7	26.0	268.4	343.2	-22.0
Hooghly	166.2	243.4	-32.0	253.0	316.1	-20.0	347.1	265.1	31.0	242.8	243.3	0.0
Howrah	119.0	233.2	-49.0	334.6	343.2	-3.0	309.5	329.4	-6.0	214.1	305.6	-30.0
Kolkata	131.2	278.3	-53.0	301.3	361.0	-17.0	583.8	335.2	74.0	246.0	306.6	-20.0
Murshidabad	141.7	237.6	-40.0	304.3	328.6	-7.0	171.0	256.9	-33.0	203.4	256.2	-21.0
Nadia	152.1	234.1	-35.0	334.5	270.8	24.0	429.1	236.0	82.0	176.2	214.1	-18.0
North 24 Parganas	225.8	271.9	-17.0	427.1	317.2	35.0	473.4	304.3	56.0	135.0	279.4	-52.0
Purulia	151.8	222.1	-32.0	250.1	298.7	-16.0	506.8	307.0	65.0	329.6	266.7	24.0
North 24 Parganas	181.9	316.0	-42.0	472.4	463.6	2.0	534.5	416.2	28.0	221.6	356.8	-38.0
West Midnapore	161.1	243.8	-34.0	359.2	329.5	9.0	371.7	316.0	18.0	192.2	276.8	-31.0

Annexure RF-3

Districtwise Monthly Rainfall Statistics of West Bengal for the Year 2016

Month	October			November			December		
Rainfall in mm	Actual	Normal	% Dep	Actual	Normal	% Dep	Actual	Normal	% Dep
District									
Coochbehar	122.5	141.3	-13.0	0.0	15.1	-100.0	1.1	8.3	-87.0
Darjeeling	306.2	118.9	157.0	0.0	16.8	-100.0	0.0	9.9	-100.0
Jalpaiguri	238.7	159.9	49.0	0.0	18.0	-100.0	0.3	7.2	-96.0
Malda	72.0	102.5	-30.0	0.0	13.2	-100.0	0.0	6.8	-100.0
North Dinajpur	90.9	90.7	0.0	0.0	9.1	-100.0	0.0	3.2	-100.0
South Dinajpur	78.9	112.5	-30.0	0.0	13.0	-100.0	0.0	5.6	-100.0
Bankura	46.9	105.2	-55.0	0.7	9.8	-93.0	0.0	9.5	-100.0
Birbhum	35.2	105.1	-67.0	0.0	15.8	-100.0	0.0	5.6	-100.0
Burdwan	44.3	99.8	-56.0	1.9	11.4	-84.0	0.0	6.0	-100.0
East Midnapore	153.6	196.9	-22.0	72.5	34.0	113.0	0.0	9.3	-100.0
Hooghly	75.9	102.1	-26.0	13.7	16.0	-14.0	0.0	6.9	-100.0
Howrah	74.4	99.1	-25.0	59.0	31.3	88.0	0.0	10.1	-100.0
Kolkata	117.0	155.3	-25.0	65.5	24.8	164.0	0.0	8.9	-100.0
Murshidabad	57.3	126.3	-55.0	0.0	11.0	-100.0	0.0	6.5	-100.0
Nadia	67.5	100.2	-33.0	17.1	10.4	64.0	0.0	7.8	-100.0
North 24 Parganas	111.3	130.9	-15.0	30.7	21.8	41.0	0.0	5.7	-100.0
Purulia	30.0	91.5	-67.0	0.0	16.7	-100.0	0.0	7.6	-100.0
North 24 Parganas	93.9	218.4	-57.0	51.4	62.3	-18.0	0.0	9.7	-100.0
West Midnapore	71.6	106.5	-33.0	8.6	17.9	-52.0	0.0	5.3	-100.0

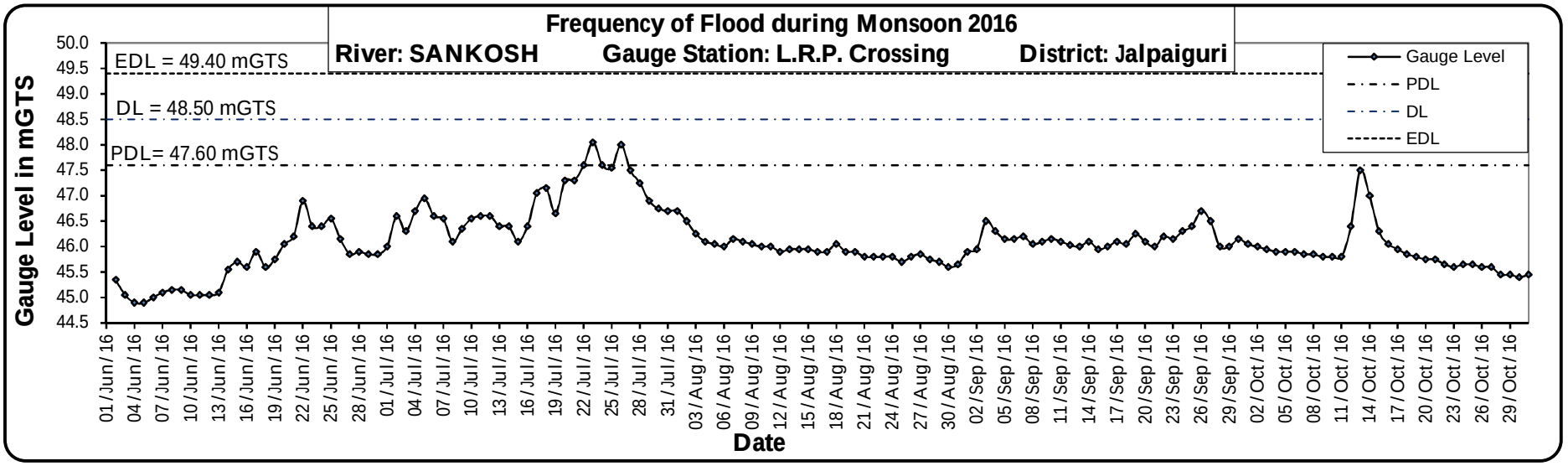
Annexure RF4:Total Seasonal Rainfall in different Raingauges during Monsoon, 2016

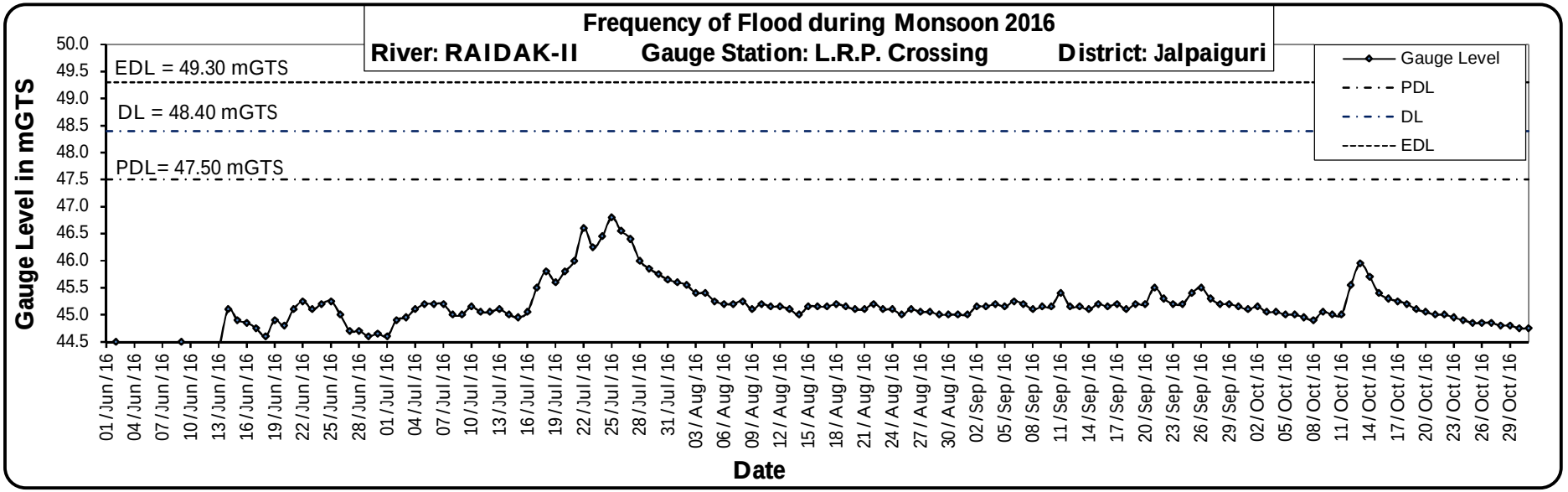
Sl. No.	RIVER	DISTRICT	Location of Rain Gauge Station	TYPE	Districtwise Normal Annual Rainfall (mm)	Total Seasonal Rainfall (mm)
1	TEESTA	SIKKIM	Gangtok	RMC	2739.00	2176.10
2		DARJEELING	Darjeeling	AWS	3118.50	2049.40
3		JALPAIGURI	Malbazar	ORG	3463.30	4202.12
4		JALPAIGURI	Jalpaiguri	ORG		2729.80
5	JALDHAKA	JALPAIGURI	Banarhat	ORG		5459.20
6		JALPAIGURI	Mainaguri	ARG		3146.00
7		COOCHBEHAR	Mathabhanga	ORG	3443.70	2274.60
8	SANKOSH	ALIPURDUAR	Barabisha	CWC	3463.30	3030.60
9	TORSA	JALPAIGURI	Hasimara	ORG		3687.40
10		JALPAIGURI	Alipurduar	ORG		3926.80
11		COOCHBEHAR	Coochbehar	ORG	3443.70	2824.50
12		COOCHBEHAR	Tufanganj	ORG		2522.00
13	MAHANANDA-FULHAR	DARJEELING	Siliguri	ORG	3118.50	3787.80
14		UTTAR DINAJPUR	Islampur	ORG	1727.60	1474.86
15		UTTAR DINAJPUR	Raiganj	ORG		1073.20
16		MALDA	English Bazar	ORG		834.70
17	ATREYEE	DAKSHIN DINAJPUR	Balurghat	ORG	1584.90	1034.65
18	PUNARBHABA	DAKSHIN DINAJPUR	Gangarampur	ORG		1086.18
19	GANGA-BHAGIRATHI	MURSHIDABAD	Berhampore	ORG	1391.10	916.70
20		BURDWAN	Katwa	ORG	1315.20	946.28
21	JALANGI	NADIA	Swarupganj	ORG	1261.60	1098.12
22	PAGLA-BANSLOI	BIRBHUM	Paikor	ORG	1392.80	720.00
23	BRAHAMANI-DWARKA	BIRBHUM	Md.Bazar	ORG		1176.50
24		BIRBHUM	Rampurhat	ORG		1293.50
25		BIRBHUM	Mallarpur	ORG		1372.80
26		BIRBHUM	Deocha	ORG		1151.00
27	MAYURAKSHI-BABLA	DUMKA	Haripur	CWC		952.40
28		DUMKA	Khusiary	CWC		1129.90
29		DUMKA	Maharo	CWC		902.20
30		DUMKA	Massanjore	CWC		1484.20
31		DUMKA	Tantloi	CWC		1024.10
32		BIRBHUM	Tilpara Barrage	ORG	1612.40	945.20
33		BIRBHUM	Shyambati	ORG		1511.20
34		BIRBHUM	Debagram	ORG		674.30
35		MURSHIDABAD	Kandi	ORG	1391.10	1113.27
36	AJAY-HINGLOW	DEOGHAR	Sikatia	CWC	1162.10	1578.20
37		BIRBHUM	Hinglow	ORG	1612.40	1569.00
38		BURDWAN	Satkahania	ORG	1315.20	467.75
39		BURDWAN	Guskara	ORG		1285.90
40	DAMODAR	KODARMA	Tilaiya	CWC	1116.20	1195.40
41		BOKARO	Tenughat	CWC	1247.50	1051.10
42		DHANBAD	Maithon	CWC	1355.20	1473.60
43		DHANBAD	Panchet	CWC		1423.80
44		BURDWAN	Asansol	CWC	1315.20	1227.40
45		BURDWAN	Durgapur	CWC		1257.92
46		BURDWAN	Burdwan	ORG		1125.50
47		BANKURA	Sonamukhi	ARG	1330.90	1128.95
48	KHARI-BEHULA-GHEA	BURDWAN	Balgona	ORG	1315.20	1045.00
49		BURDWAN	Memari	ORG		909.50
50		HOOGLY	Dhaniakhali	ARG	1418.70	107.00
51	MUNDESWARI	BURDWAN	Seharabazar	ORG	1315.20	827.00
52		BURDWAN	Raina	ORG		599.00

Annexure RF4:Total Seasonal Rainfall in different Raingauges during Monsoon, 2016

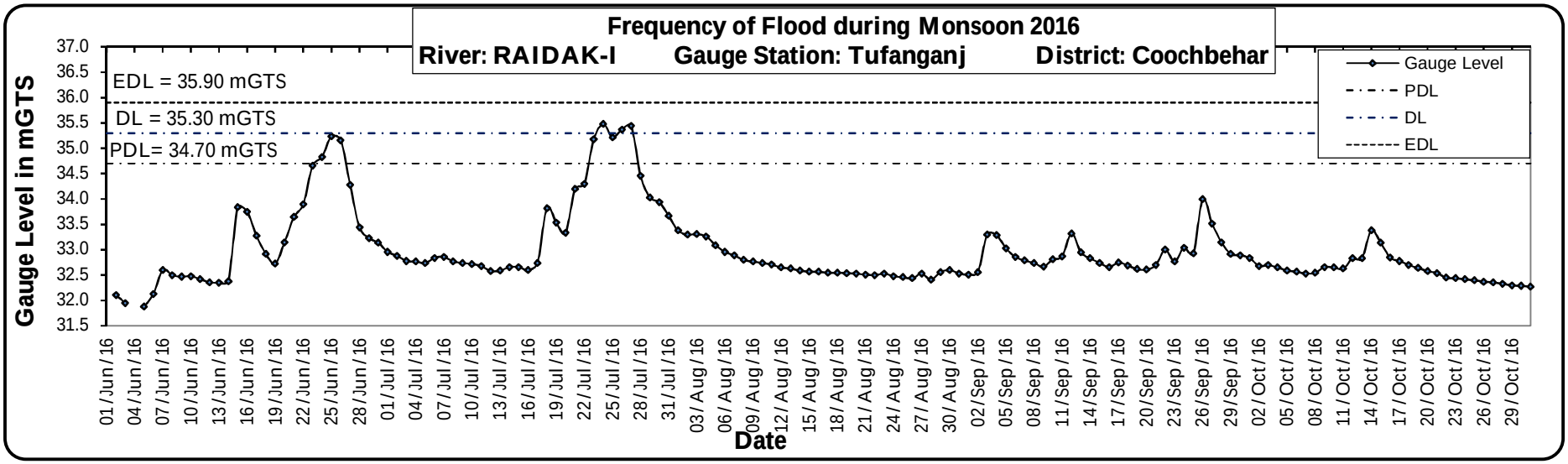
Sl. No.	RIVER	DISTRICT	Location of Rain Gauge Station	TYPE	Districtwise Normal Annual Rainfall (mm)	Total Seasonal Rainfall (mm)
53	AMTA CHANNEL (DAMODAR)	HOOGLY	Champadanga	ORG	1418.70	636.75
54		HOOGLY	Singur	ORG	1600.00	979.75
55		HOWRAH	Amta	ORG		1273.00
56		HOWRAH	Domjur	ORG		1002.72
57	DWARAKESWAR	BANKURA	Bankura	RMC	1330.90	1388.30
58		BANKURA	Indus	ORG		1210.70
59		HOOGLY	Arambag	ORG	1418.70	1101.50
60	SHILABATI	BANKURA	Amlagora	ARG	1330.90	
61		PASCHIM MEDINIPUR	Ghatal	ORG	1535.50	1387.40
62	KANGSABATI	PURULIA	Simulia	CWC	1363.30	1115.80
63		PURULIA	Purihansa	CWC		1545.80
64		PURULIA	Tusuma	CWC		1462.80
65		PURULIA	Kharidwar	CWC		1255.87
66		PURULIA	Phulberia	CWC		1146.80
67		BANKURA	Mukutmanipur	CWC	1330.90	1177.20
68		PASCHIM MEDINIPUR	Midnapore	RMC	1535.50	1270.00
69		PURBA MEDINIPUR	Panskura	ORG	1669.60	1703.70
70	RUPNARAYAN	PURBA MEDINIPUR	Tamluk	ORG	1669.60	1693.00
71	KALIAGHAI	PURBA MEDINIPUR	Amgachia	ORG	1669.60	1074.00
72		PASCHIM MEDINIPUR	Sabang	ORG		1124.20
73		PASCHIM MEDINIPUR	Jhargram	ORG	1535.50	NA
74	CHANDIA	PASCHIM MEDINIPUR	Barisha	ORG		1081.00
75	HALDI	PURBA MEDINIPUR	Itamogra	ORG	1669.60	1366.80
76	RASULPUR	PURBA MEDINIPUR	Contai	ORG	1669.60	1679.50
77	HOOGHLY	KOLKATA	Alipore	RMC	1709.20	1180.10
78	ICHHAMATI	NORTH 24-PARGANAS	Bangaon	ORG	1559.80	1227.70
79		NORTH 24-PARGANAS	Tentulia	ORG	1560.80	934.50
80	BIDYADHARI	NORTH 24-PARGANAS	Dumdum	RMC		1212.30
81		SOUTH 24-PARGANAS	Chowbaga	ORG	2088.00	813.52
82	SUNDARBAN AREA	SOUTH 24-PARGANAS	Uttarbhag	ORG		885.00
83		SOUTH 24-PARGANAS	Sagar Island	AWS		1222.60
84	SUBARNAREKHA	PURBA MEDINIPUR	Digha	RMC	1669.60	1078.50

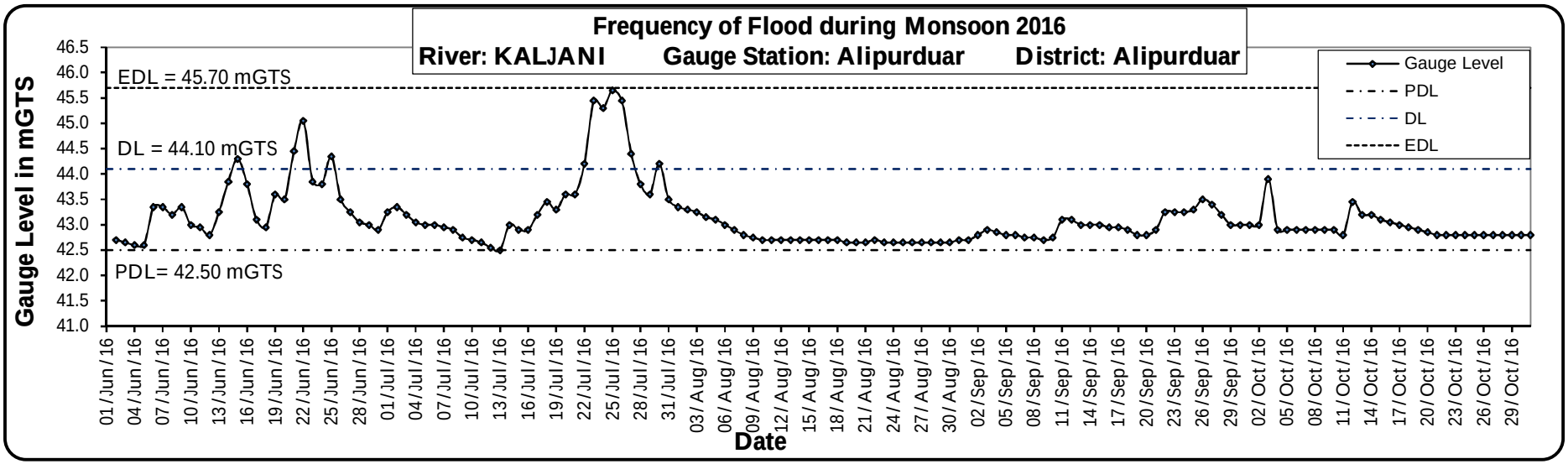
ANNEXURE-G1


Frequency of Flood during Monsoon 2016
River: SANKOSH
Gauge Station: L.R.P. Crossing
District: Jalpaiguri
EDL = 49.40 mGTS
DL = 48.50 mGTS
PDL= 47.60 mGTS
Gauge Level
PDL
DL
EDL
Gauge Level in mGTS
Date

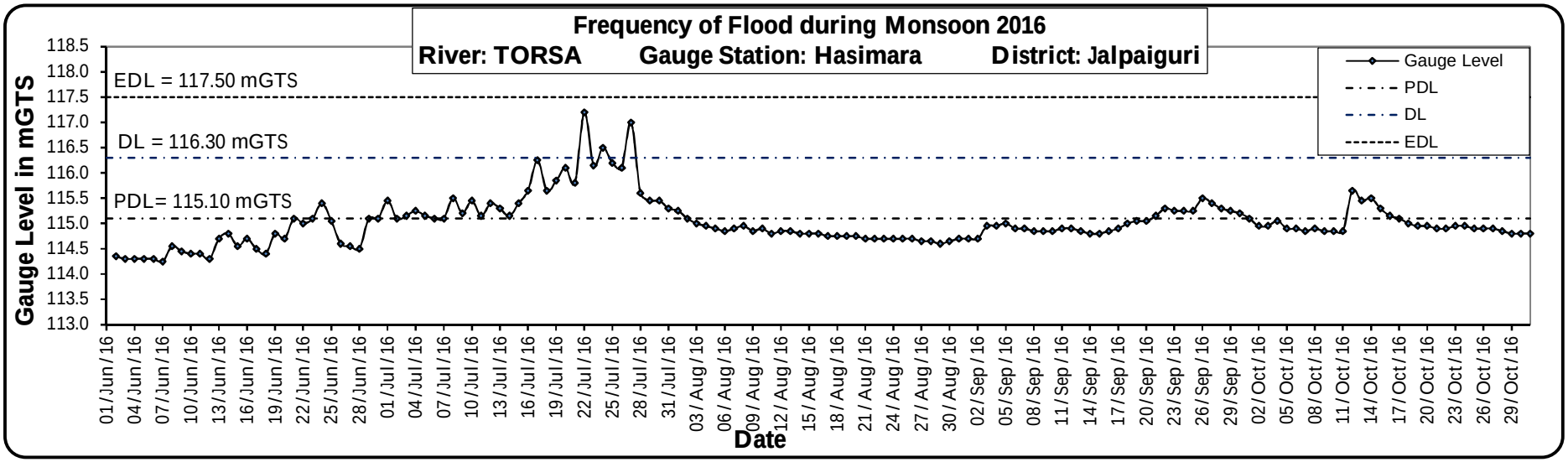

Frequency of Flood during Monsoon 2016
River: RAIDAK-II
Gauge Station: L.R.P. Crossing
District: Jalpaiguri
EDL = 49.30 mGTS
DL = 48.40 mGTS
PDL= 47.50 mGTS
Gauge Level
PDL
DL
EDL
Gauge Level in mGTS
Date

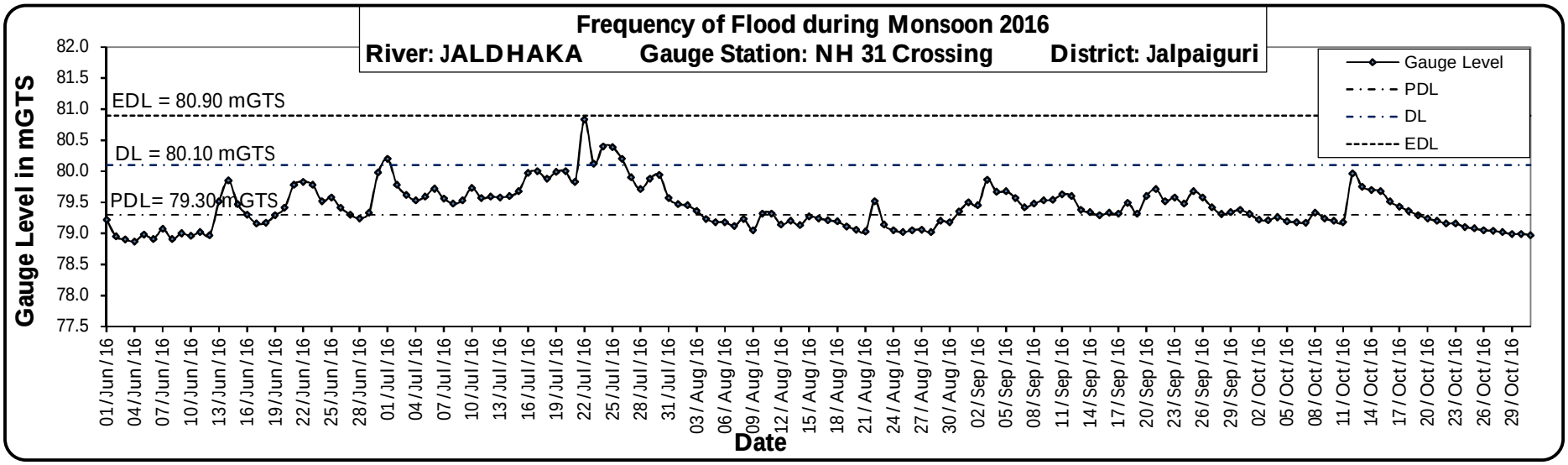
ANNEXURE-G2


Frequency of Flood during Monsoon 2016
River: RAIDAK-I Gauge Station: Tufanganj District: Coochbehar
EDL = 35.90 mGTS
DL = 35.30 mGTS
PDL= 34.70 mGTS
Gauge Level
PDL
DL
EDL
Gauge Level in mGTS
Date

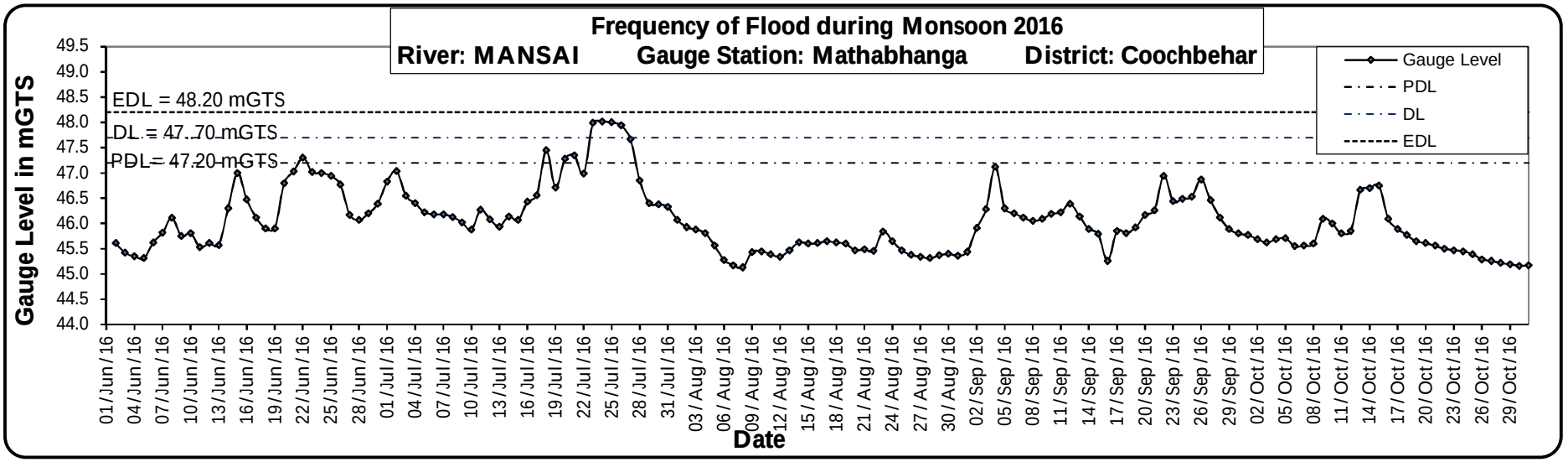

Frequency of Flood during Monsoon 2016
River: KALJANI Gauge Station: Alipurduar District: Alipurduar
EDL = 45.70 mGTS
DL = 44.10 mGTS
PDL= 42.50 mGTS
Gauge Level
PDL
DL
EDL
Gauge Level in mGTS
Date

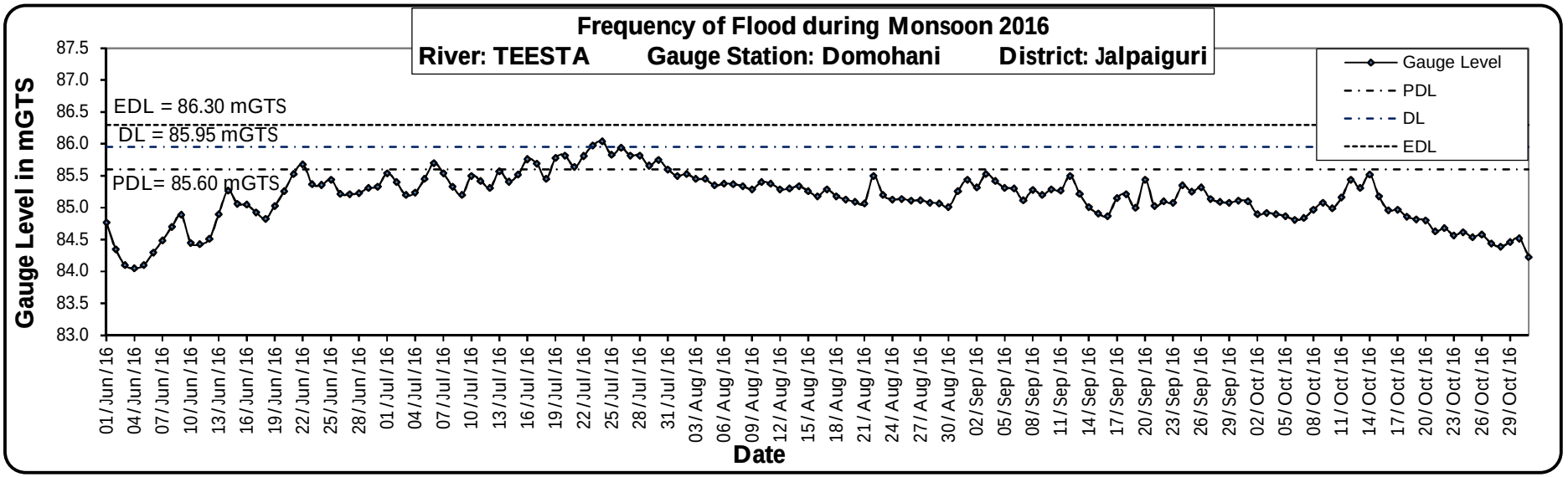
ANNEXURE-G3


Frequency of Flood during Monsoon 2016
River: TORSA Gauge Station: Hasimara District: Jalpaiguri
EDL = 117.50 mGTS
DL = 116.30 mGTS
PDL= 115.10 mGTS
Gauge Level
PDL
DL
EDL
Gauge Level in mGTS
Date

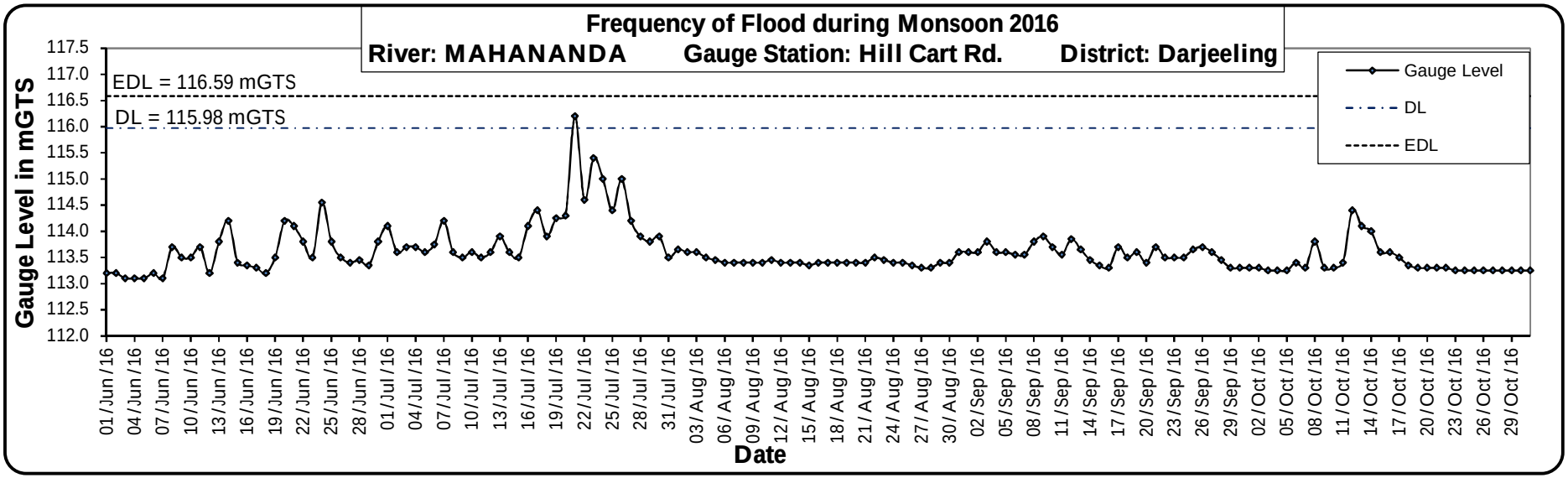

Frequency of Flood during Monsoon 2016
River: JALDHAKA Gauge Station: NH 31 Crossing District: Jalpaiguri
EDL = 80.90 mGTS
DL = 80.10 mGTS
PDL= 79.30 mGTS
Gauge Level
PDL
DL
EDL
Gauge Level in mGTS
Date

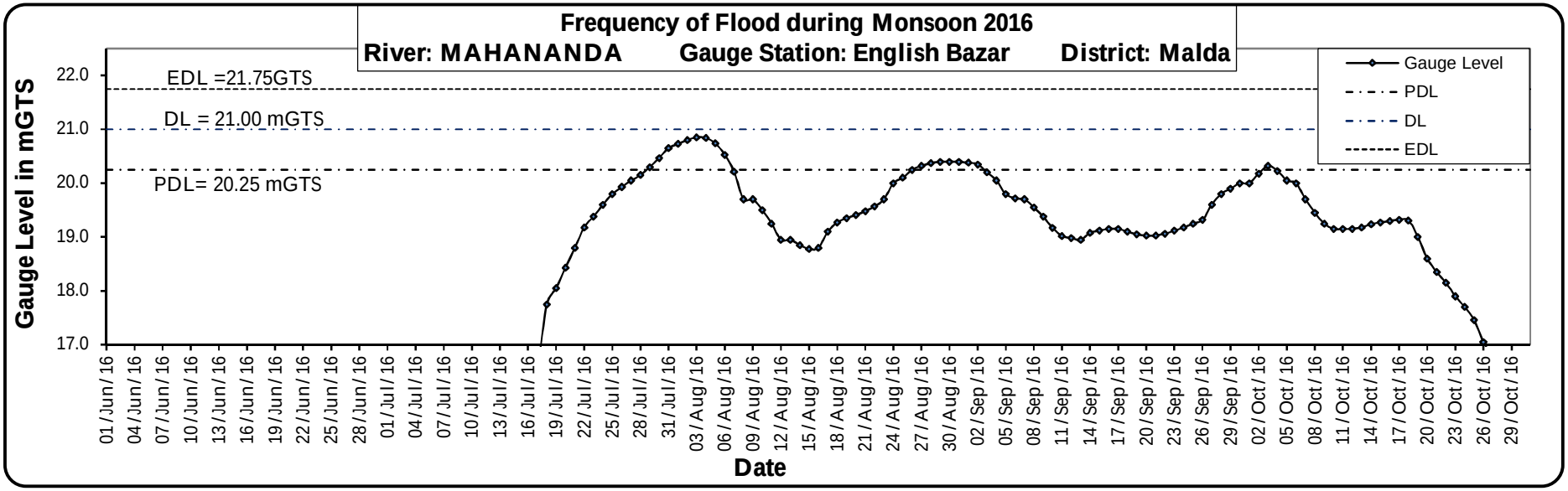
ANNEXURE-G4


Frequency of Flood during Monsoon 2016
River: MANSAI Gauge Station: Mathabhanga District: Coochbehar
Gauge Level in mGTS
EDL = 48.20 mGTS
DL = 47.70 mGTS
PDL= 47.20 mGTS
Gauge Level
PDL
DL
EDL
Date

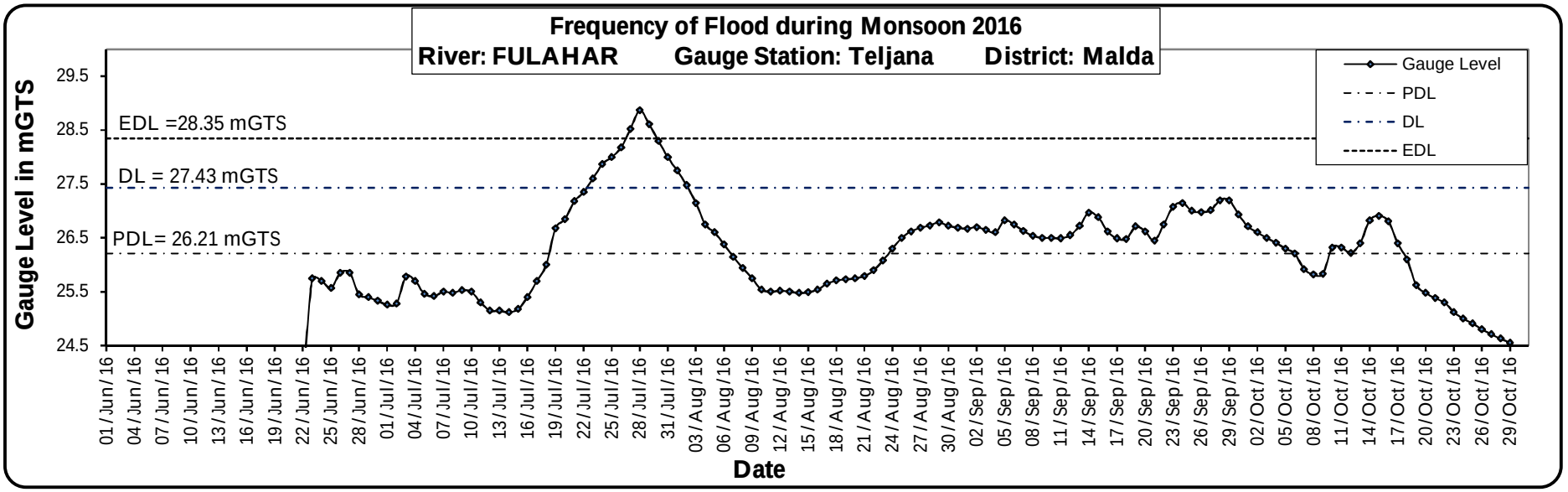

Frequency of Flood during Monsoon 2016
River: TEESTA Gauge Station: Domohani District: Jalpaiguri
Gauge Level in mGTS
EDL = 86.30 mGTS
DL = 85.95 mGTS
PDL= 85.60 mGTS
Gauge Level
PDL
DL
EDL
Date

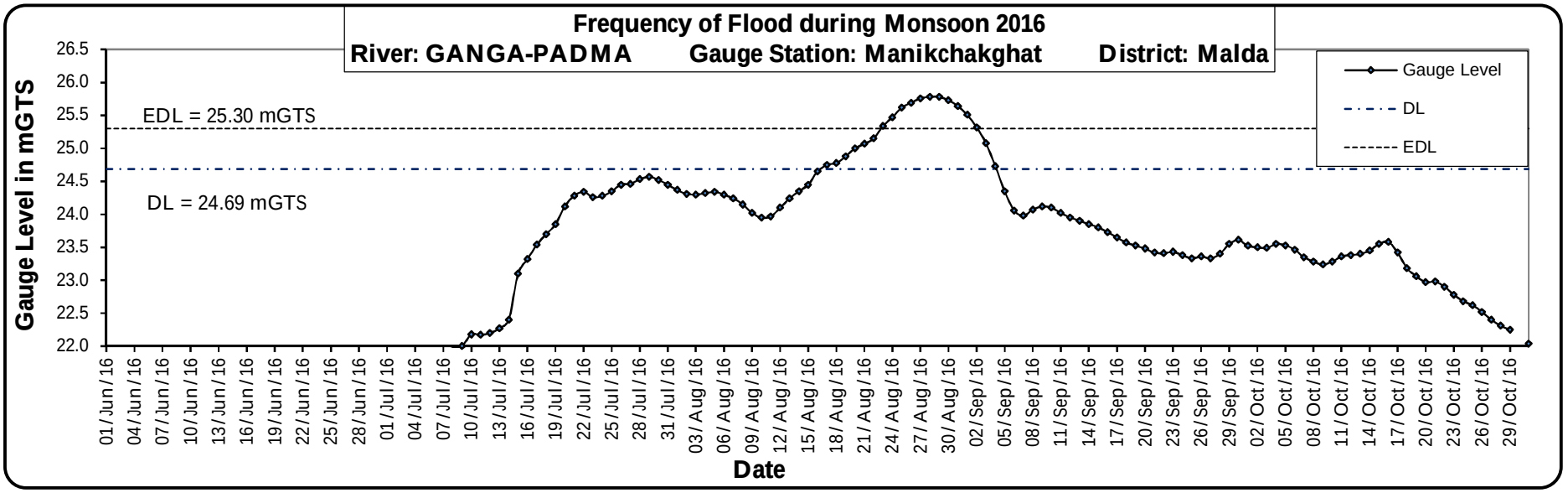
ANNEXURE-G5


Frequency of Flood during Monsoon 2016
River: MAHANANDA Gauge Station: Hill Cart Rd. District: Darjeeling
EDL = 116.59 mGTS
DL = 115.98 mGTS
Gauge Level
DL
EDL
Gauge Level in mGTS
Date

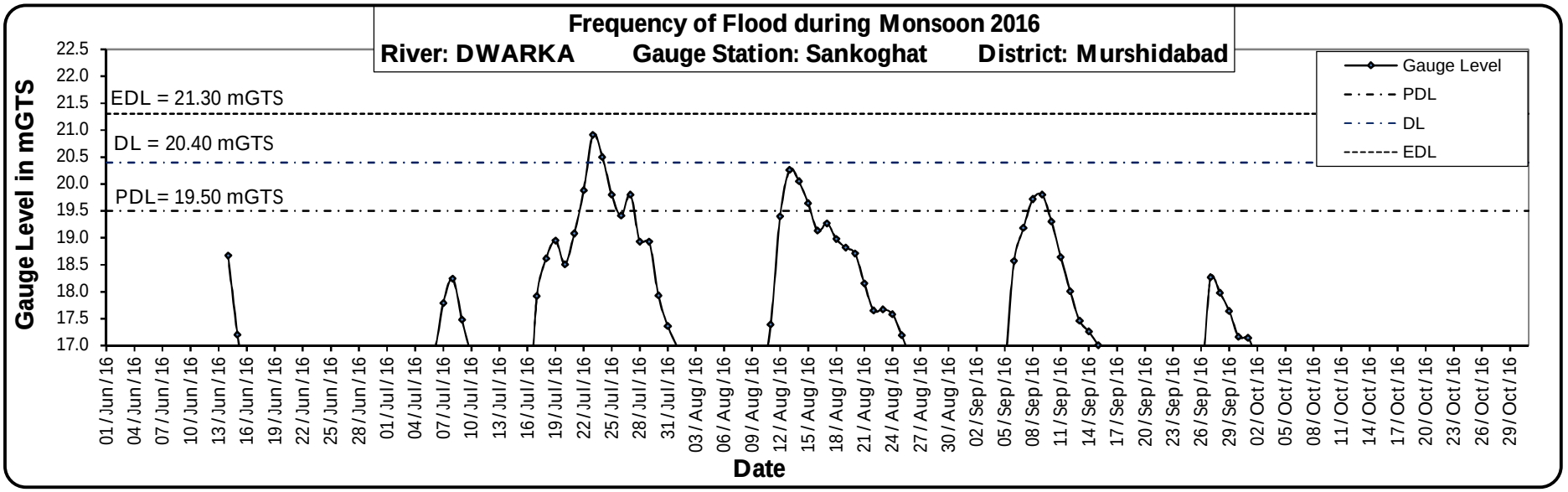

Frequency of Flood during Monsoon 2016
River: MAHANANDA Gauge Station: English Bazar District: Malda
EDL =21.75GTS
DL = 21.00 mGTS
PDL= 20.25 mGTS
Gauge Level
PDL
DL
EDL
Gauge Level in mGTS
Date

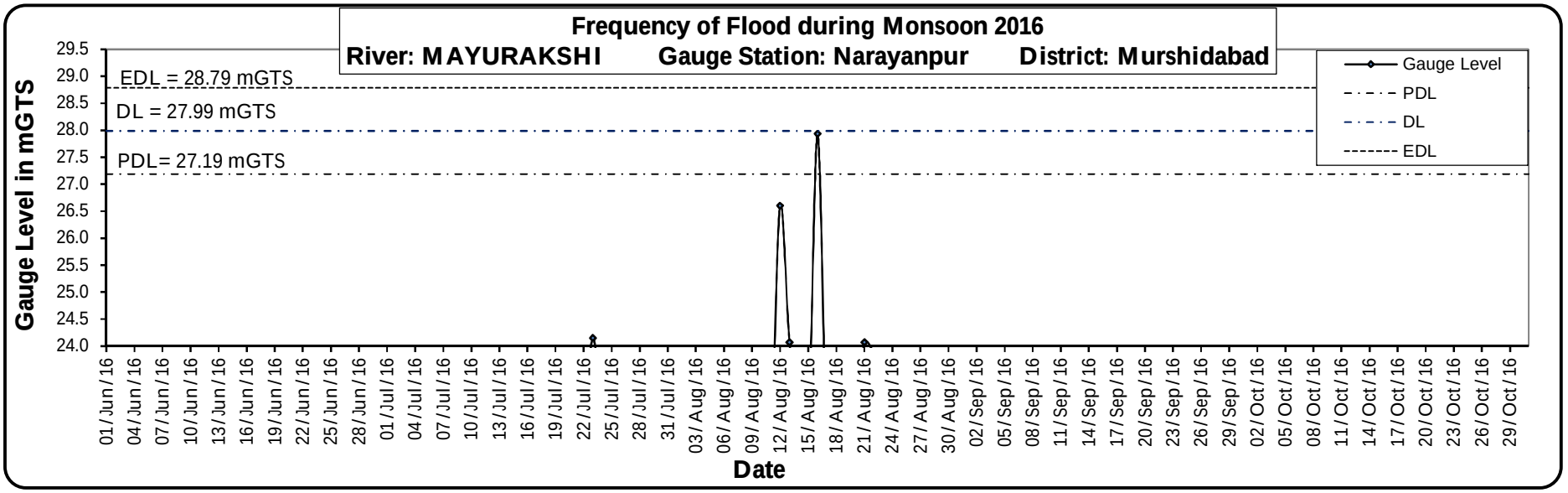
ANNEXURE-G6


Frequency of Flood during Monsoon 2016
River: FULAHAR Gauge Station: Teljana District: Malda
Gauge Level in mGTS
EDL =28.35 mGTS
DL = 27.43 mGTS
PDL= 26.21 mGTS
Gauge Level
PDL
DL
EDL
Date

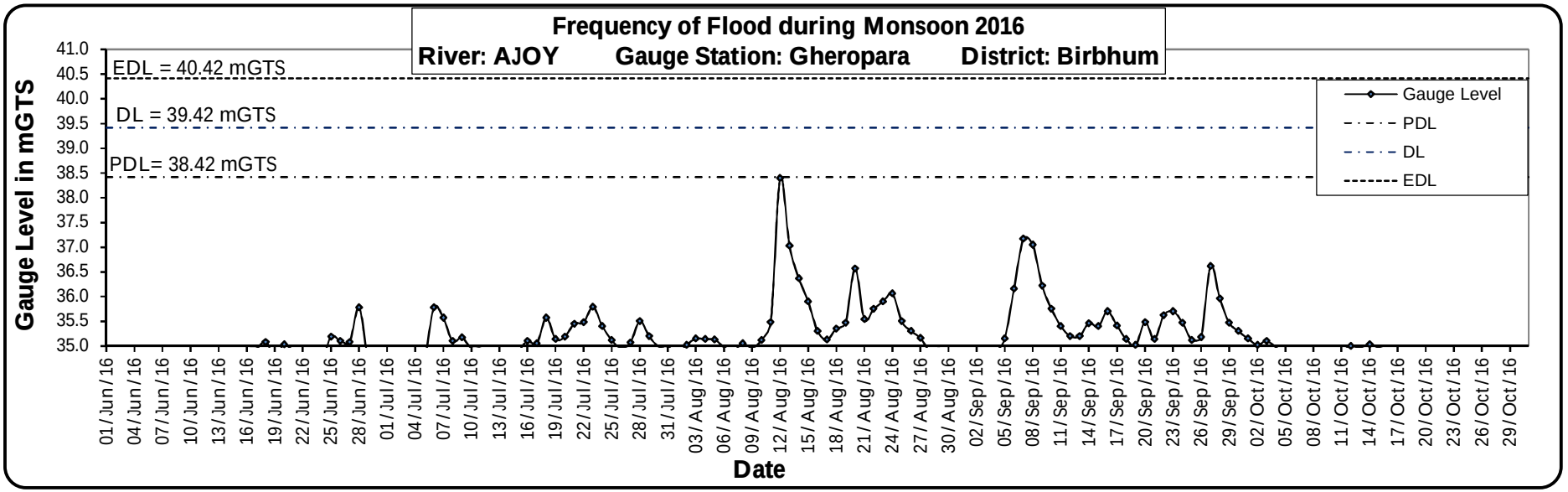

Frequency of Flood during Monsoon 2016
River: GANGA-PADMA Gauge Station: Manikchakghat District: Malda
Gauge Level in mGTS
EDL = 25.30 mGTS
DL = 24.69 mGTS
Gauge Level
DL
EDL
Date

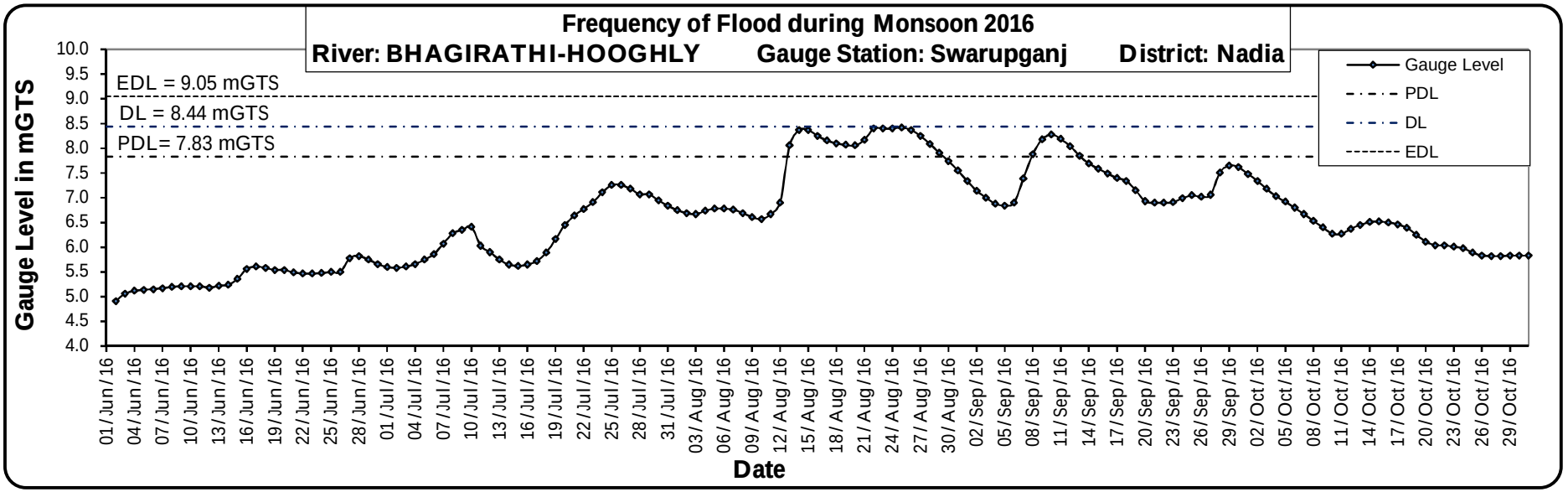
ANNEXURE-G7


Frequency of Flood during Monsoon 2016
River: DWARKA Gauge Station: Sankoghat District: Murshidabad
Gauge Level in mGTS
EDL = 21.30 mGTS
DL = 20.40 mGTS
PDL= 19.50 mGTS
Gauge Level
PDL
DL
EDL
Date

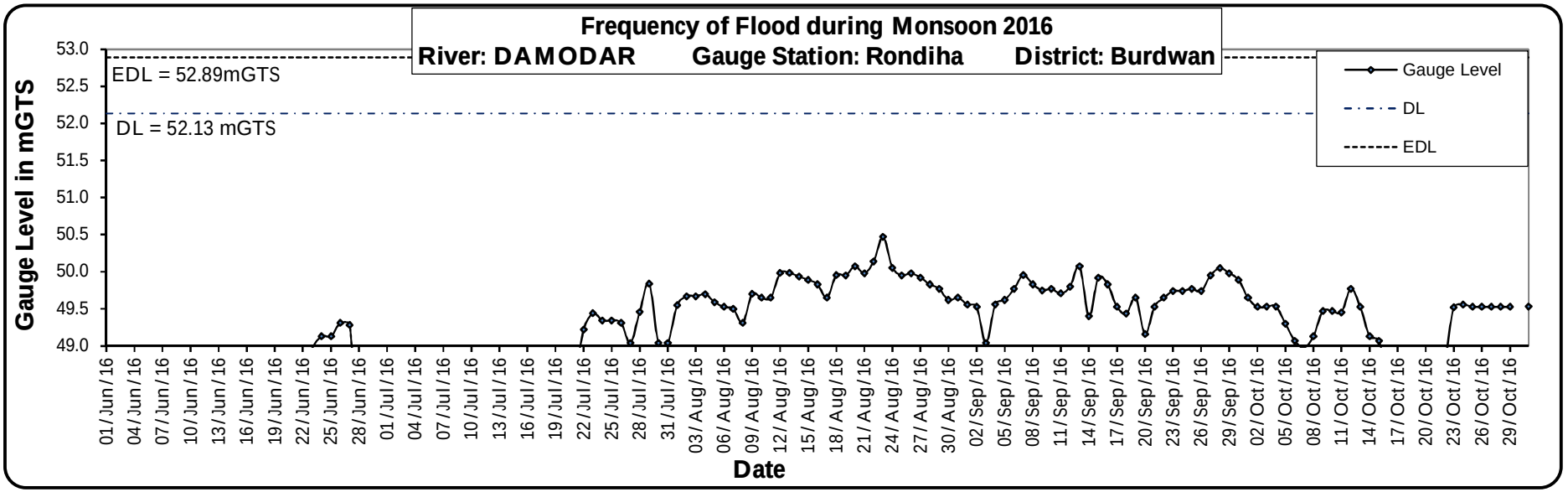

Frequency of Flood during Monsoon 2016
River: MAYURAKSHI Gauge Station: Narayanpur District: Murshidabad
Gauge Level in mGTS
EDL = 28.79 mGTS
DL = 27.99 mGTS
PDL= 27.19 mGTS
Gauge Level
PDL
DL
EDL
Date

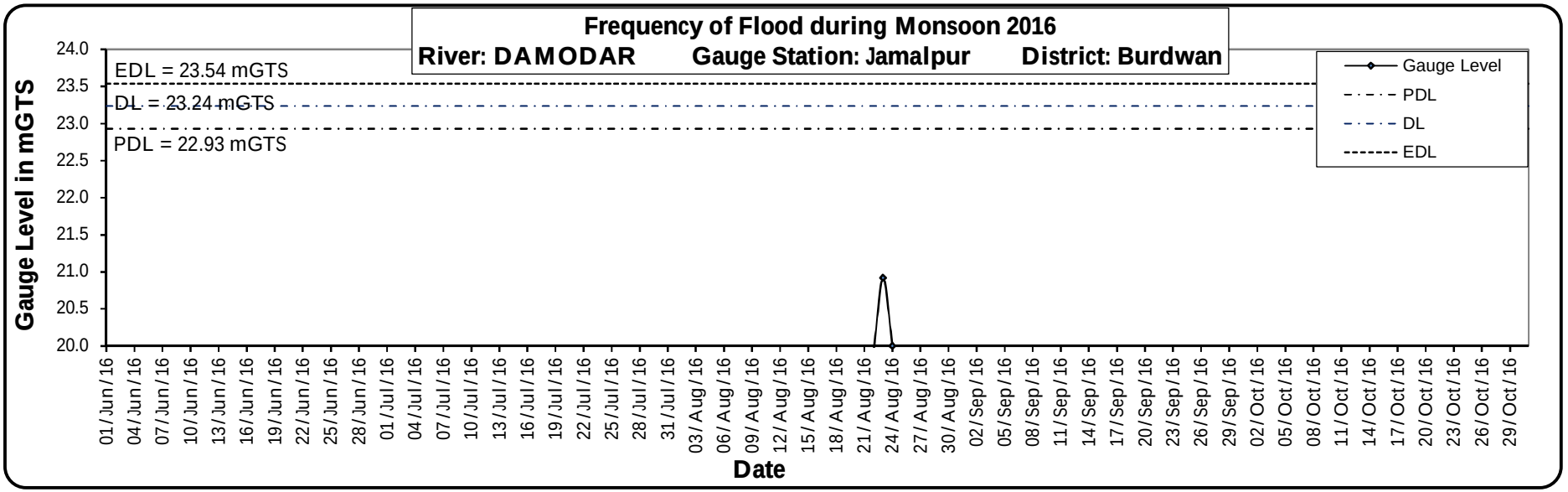
ANNEXURE-G8


Frequency of Flood during Monsoon 2016
River: AJOY Gauge Station: Gheropara District: Birbhum
EDL = 40.42 mGTS
DL = 39.42 mGTS
PDL= 38.42 mGTS
Gauge Level
PDL
DL
EDL
Gauge Level in mGTS
Date

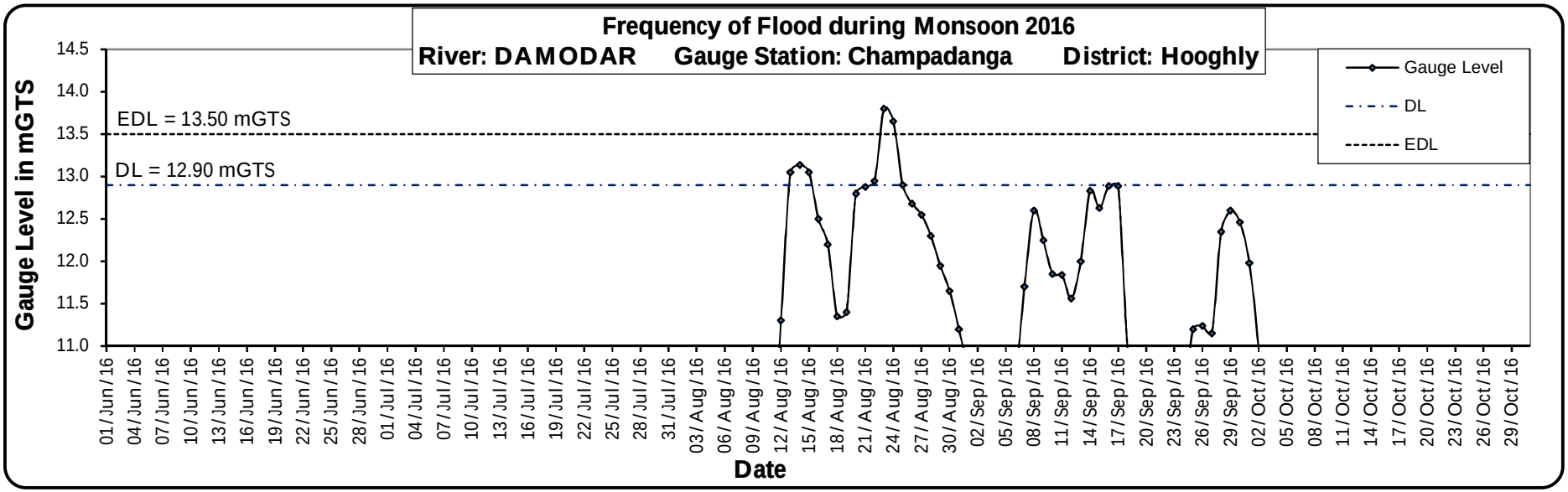

Frequency of Flood during Monsoon 2016
River: BHAGIRATHI-HOOGHLY Gauge Station: Swarupganj District: Nadia
EDL = 9.05 mGTS
DL = 8.44 mGTS
PDL= 7.83 mGTS
Gauge Level
PDL
DL
EDL
Gauge Level in mGTS
Date

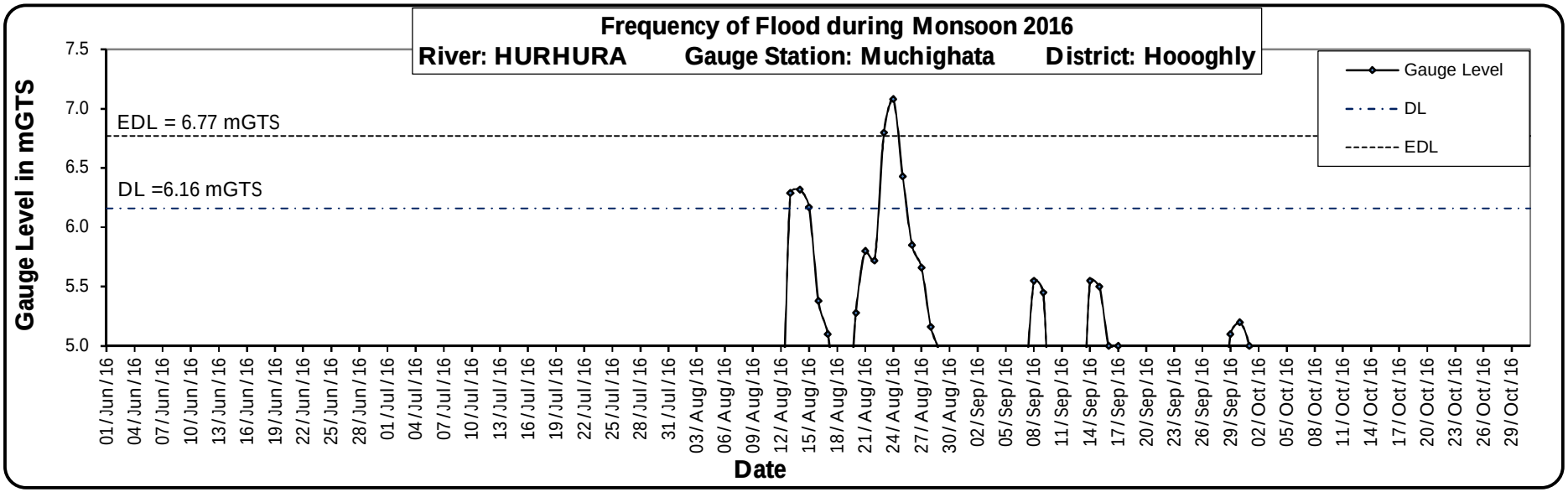
ANNEXURE-G9

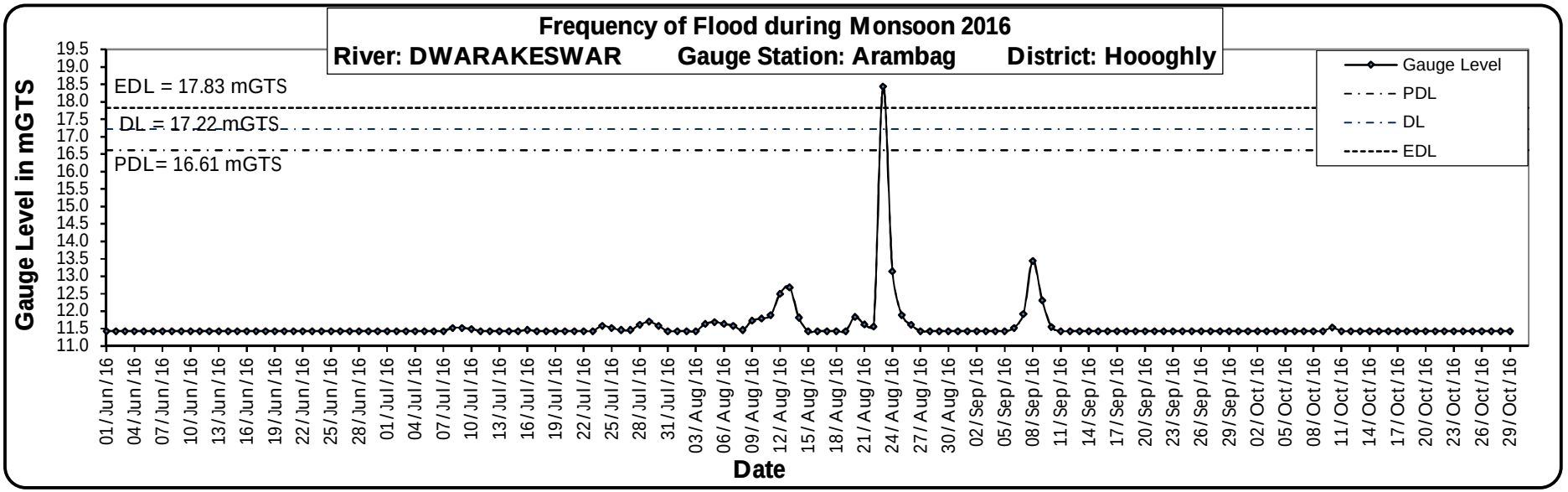

Frequency of Flood during Monsoon 2016
River: DAMODAR Gauge Station: Rondiha District: Burdwan
EDL = 52.89mGTS
DL = 52.13 mGTS
Gauge Level
DL
EDL
Gauge Level in mGTS
Date

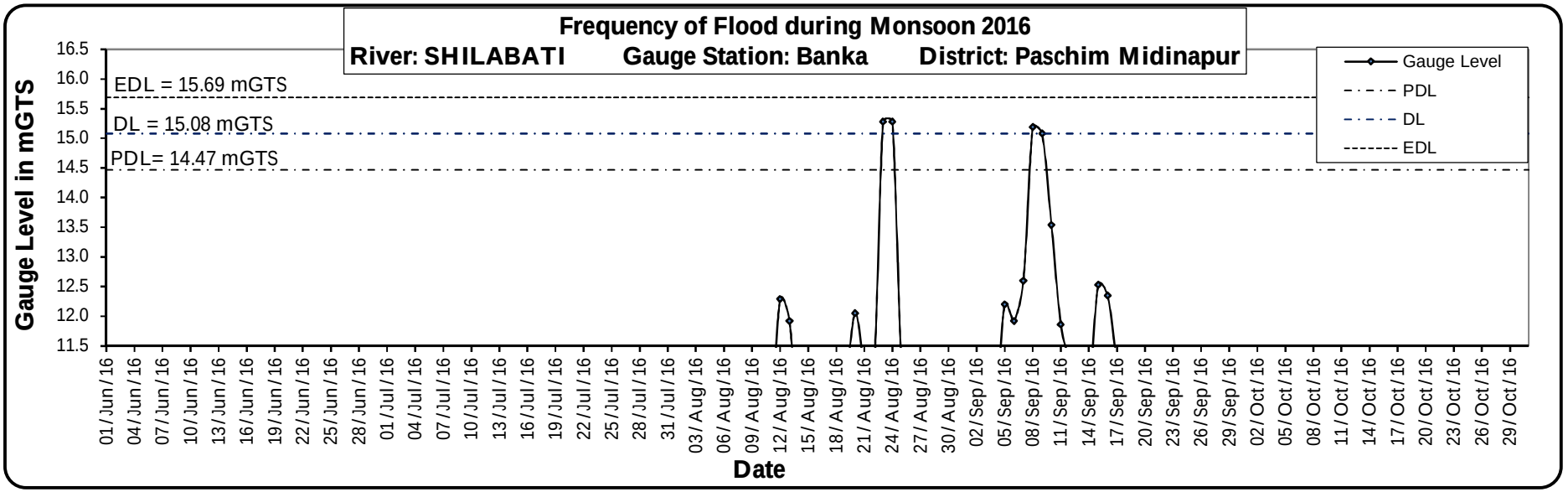

Frequency of Flood during Monsoon 2016
River: DAMODAR Gauge Station: Jamalpur District: Burdwan
EDL = 23.54 mGTS
DL = 23.24 mGTS
PDL = 22.93 mGTS
Gauge Level
PDL
DL
EDL
Gauge Level in mGTS
Date

ANNEXURE-G10

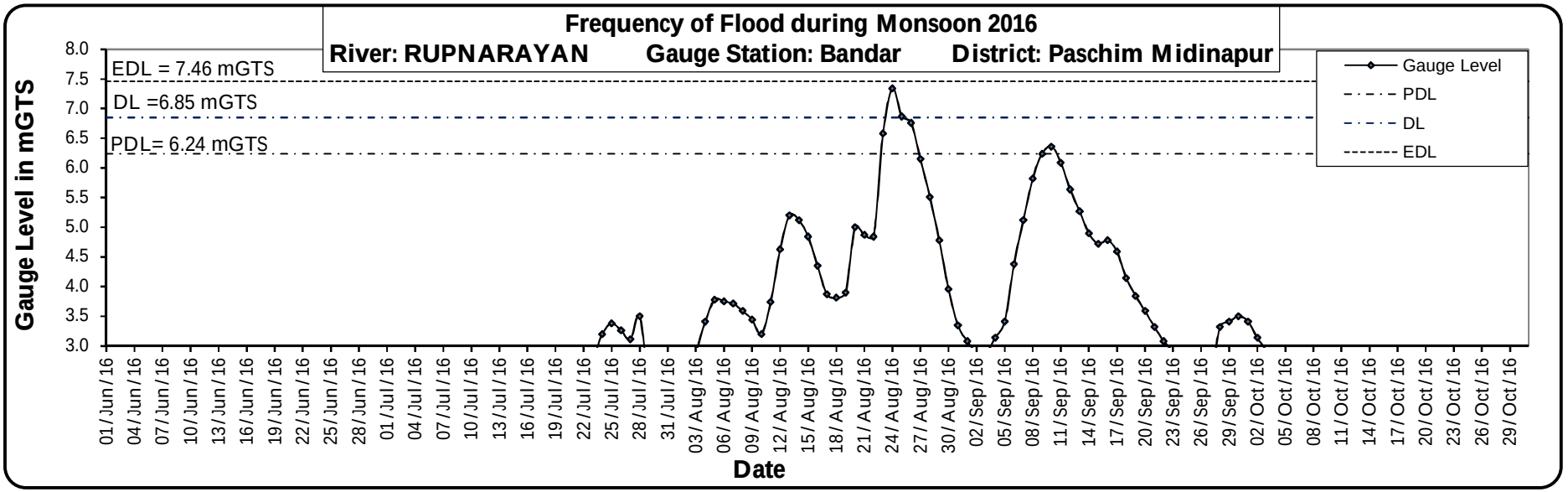


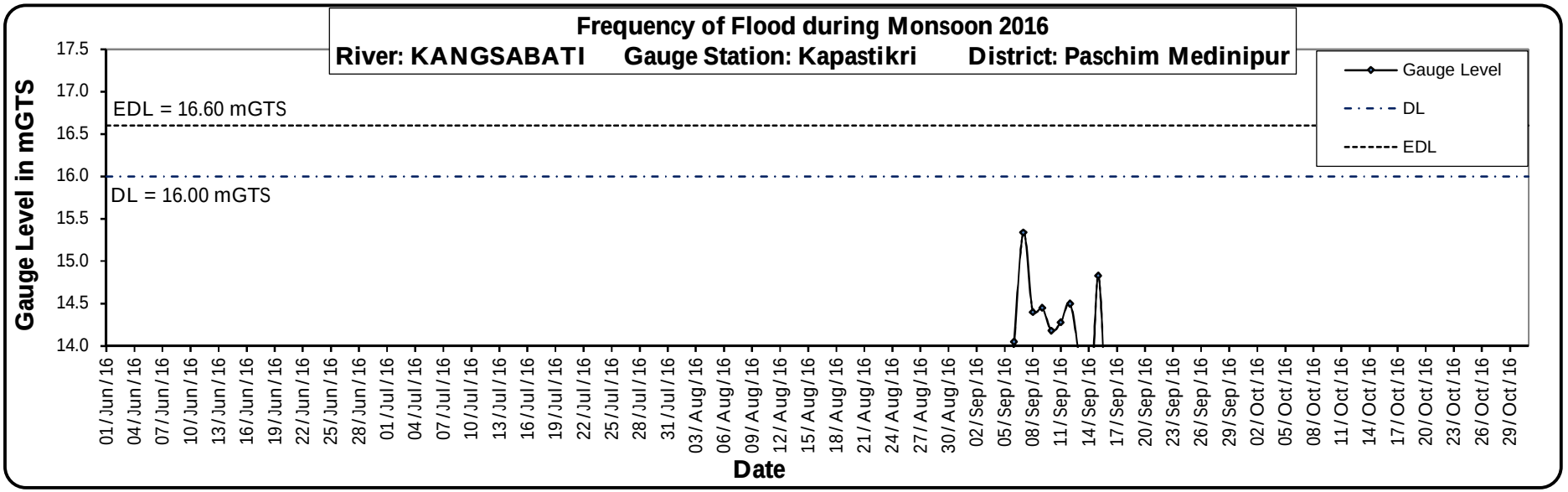



Frequency of Flood during Monsoon 2016
River: DWARAKESWAR Gauge Station: Arambag District: Hoooghly
EDL = 17.83 mGTS
DL = 17.22 mGTS
PDL= 16.61 mGTS
Gauge Level
PDL
DL
EDL
Gauge Level in mGTS
Date

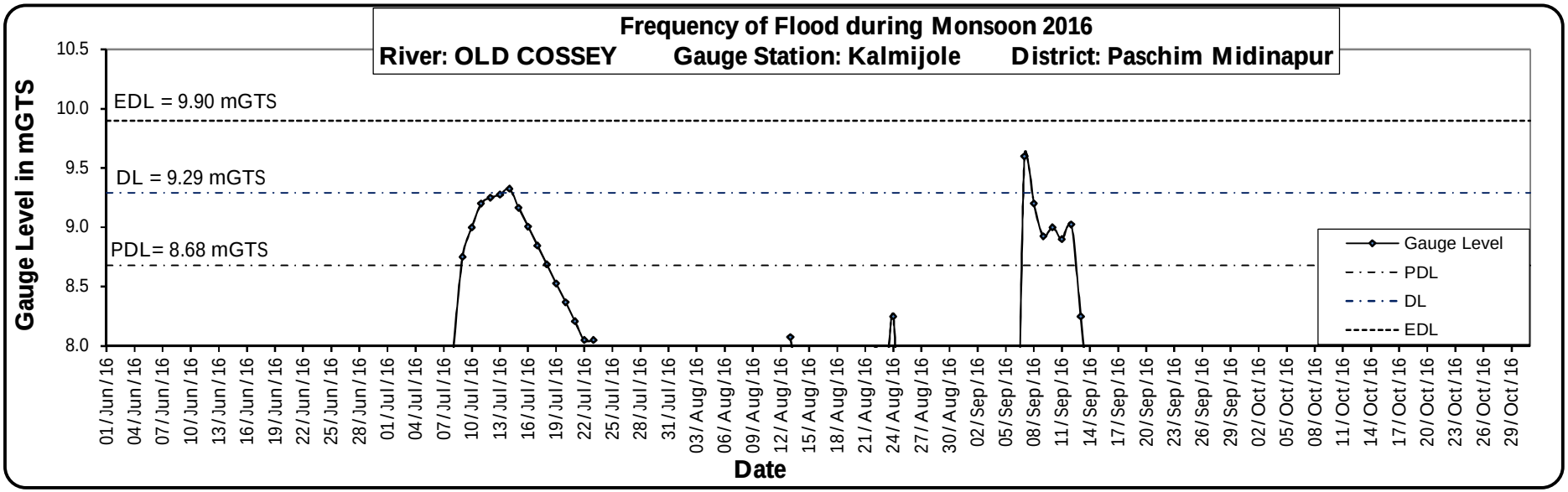

Frequency of Flood during Monsoon 2016
River: SHILABATI Gauge Station: Banka District: Paschim Midinapur
EDL = 15.69 mGTS
DL = 15.08 mGTS
PDL= 14.47 mGTS
Gauge Level
PDL
DL
EDL
Gauge Level in mGTS
Date

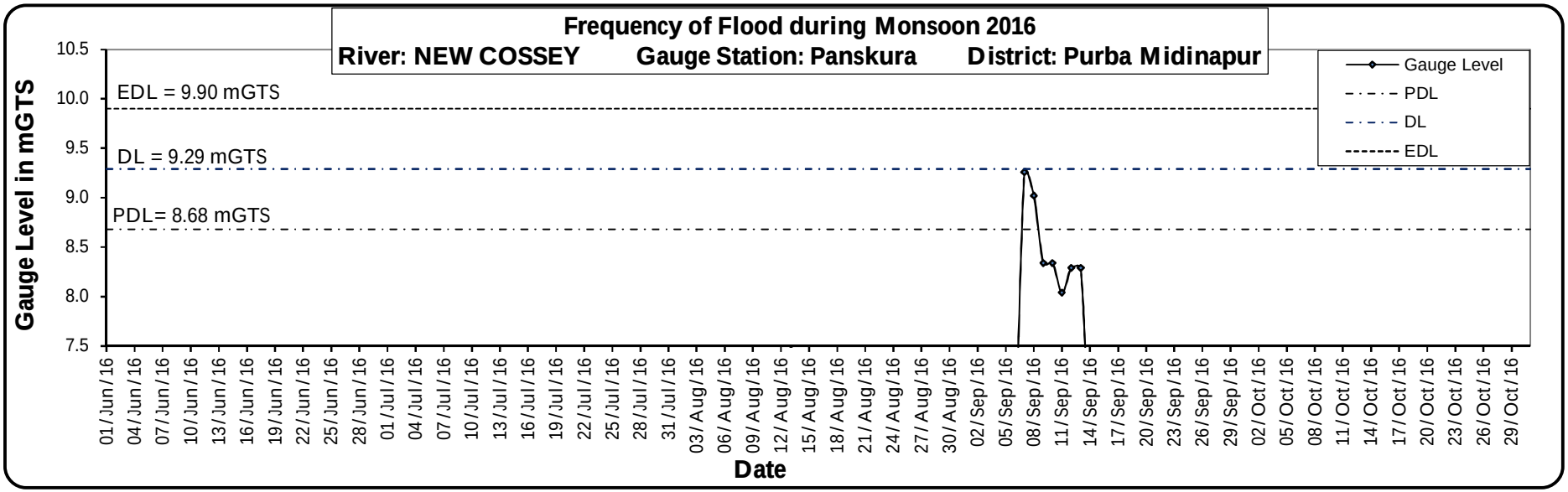
ANNEXURE-G12



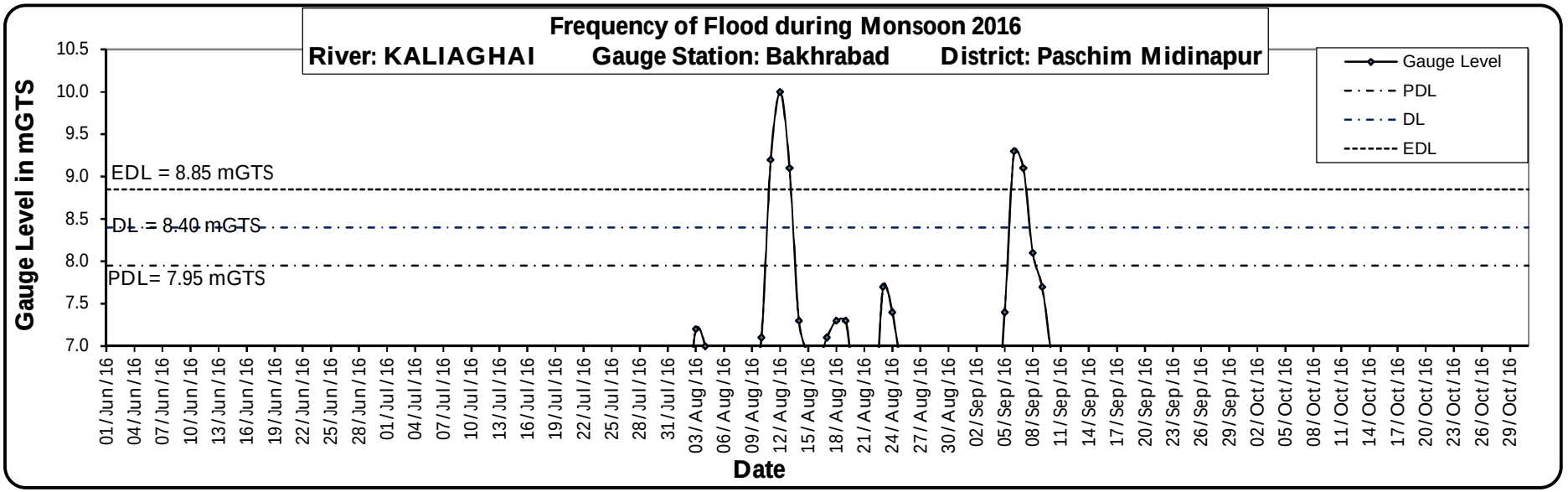


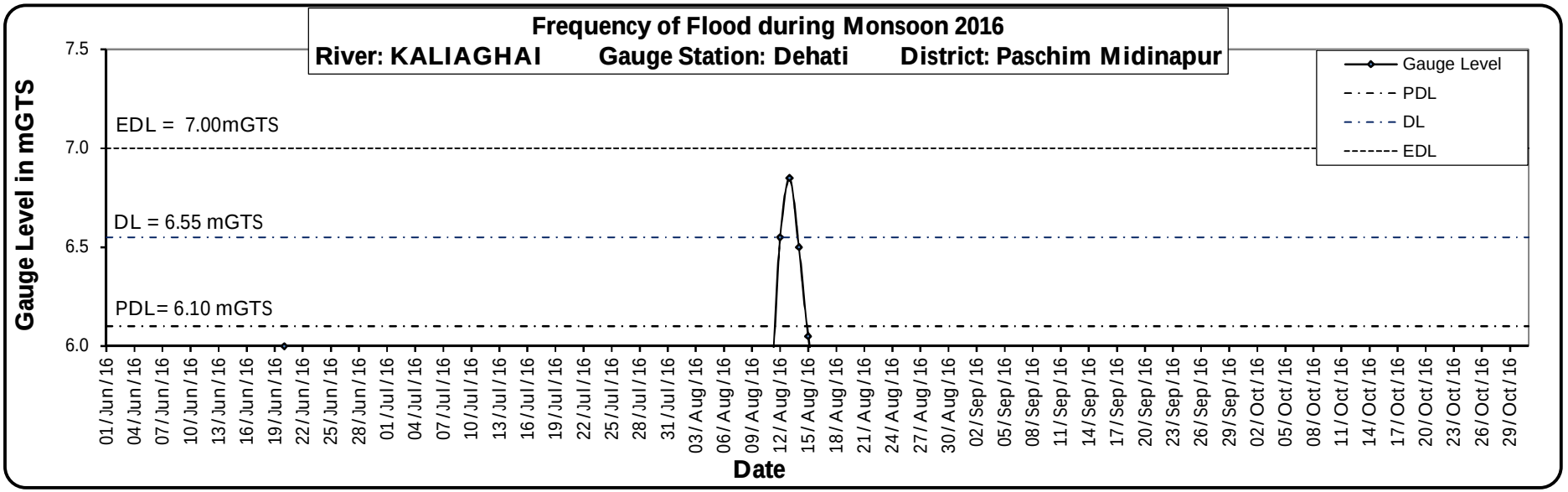
ANNEXURE-G13





ANNEXURE-G14





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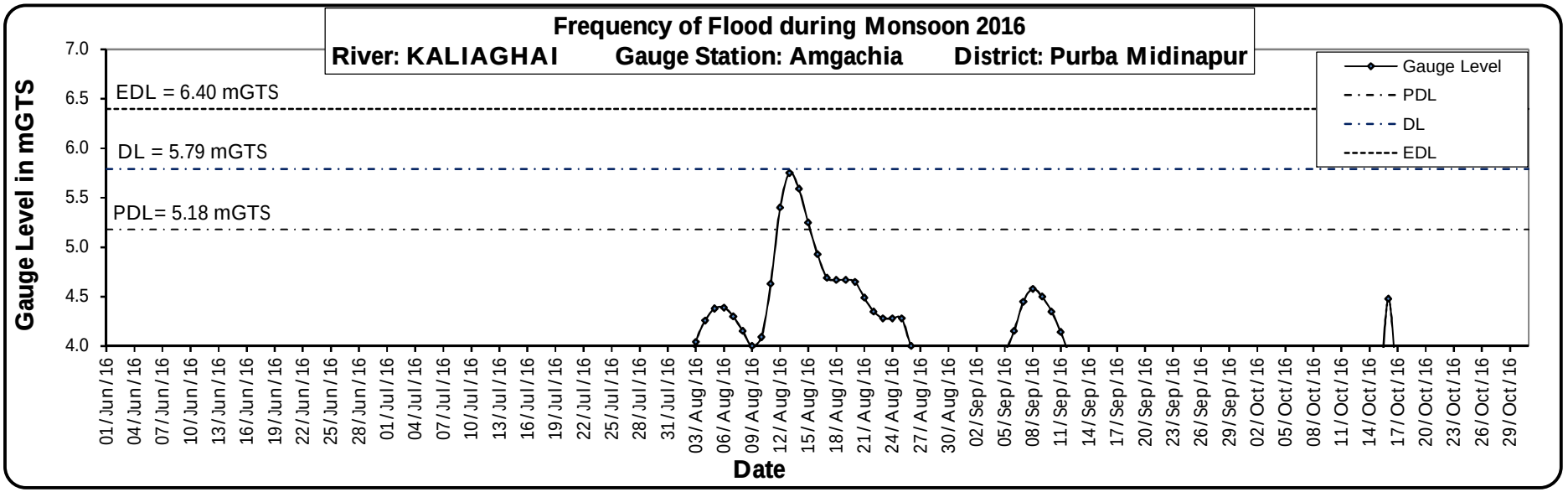

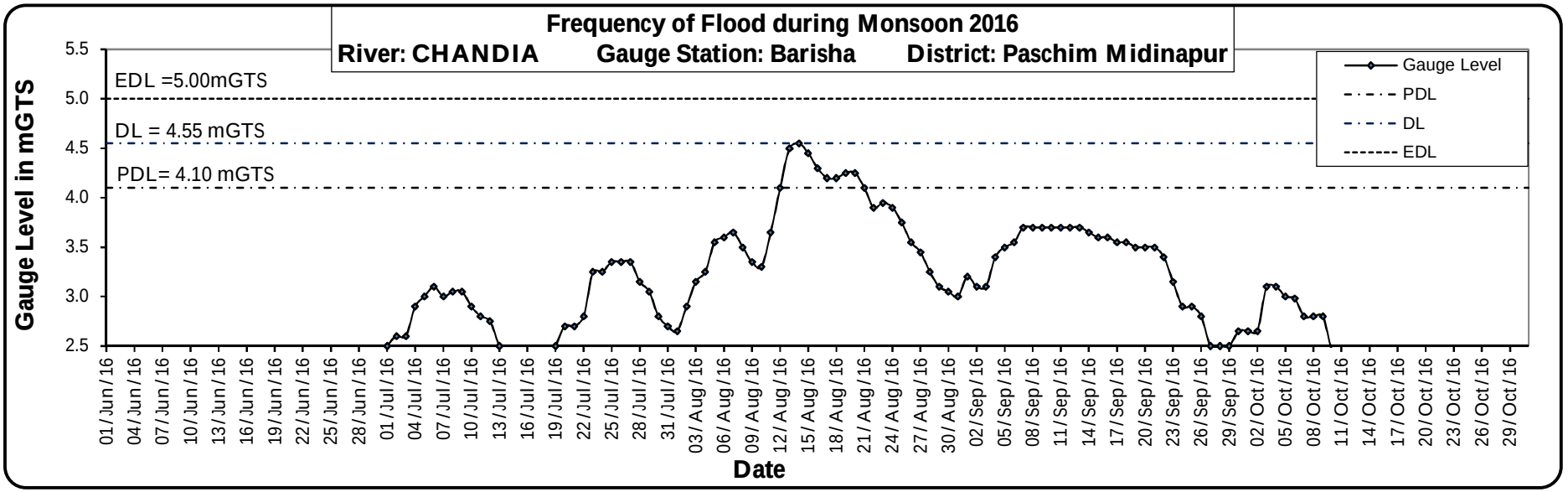

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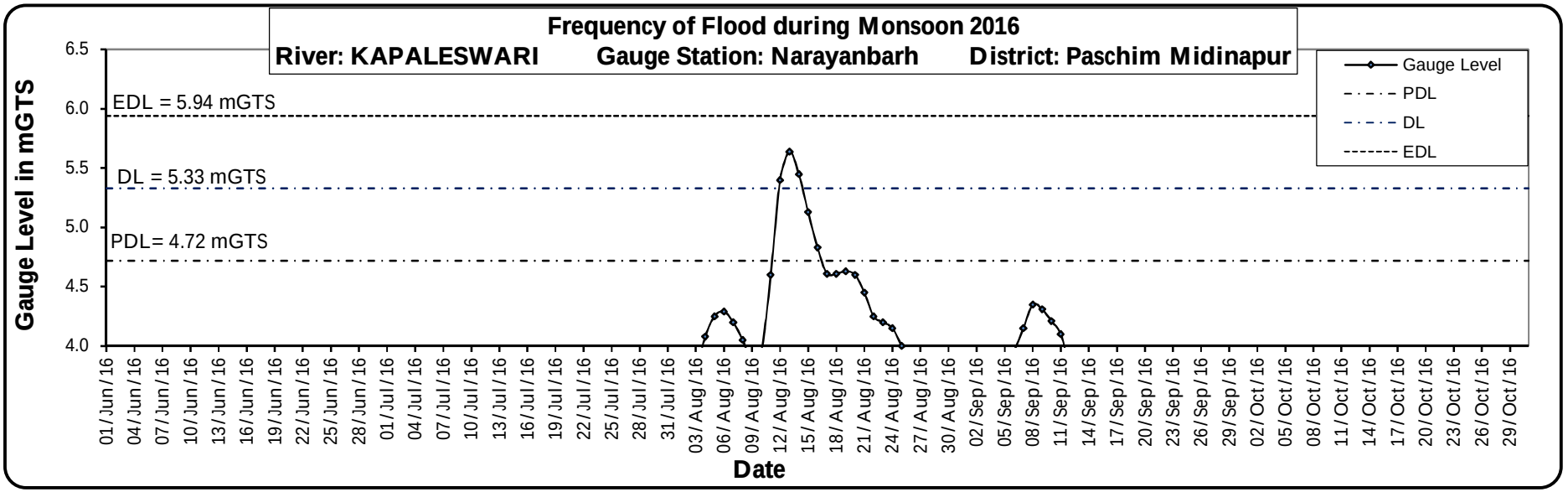

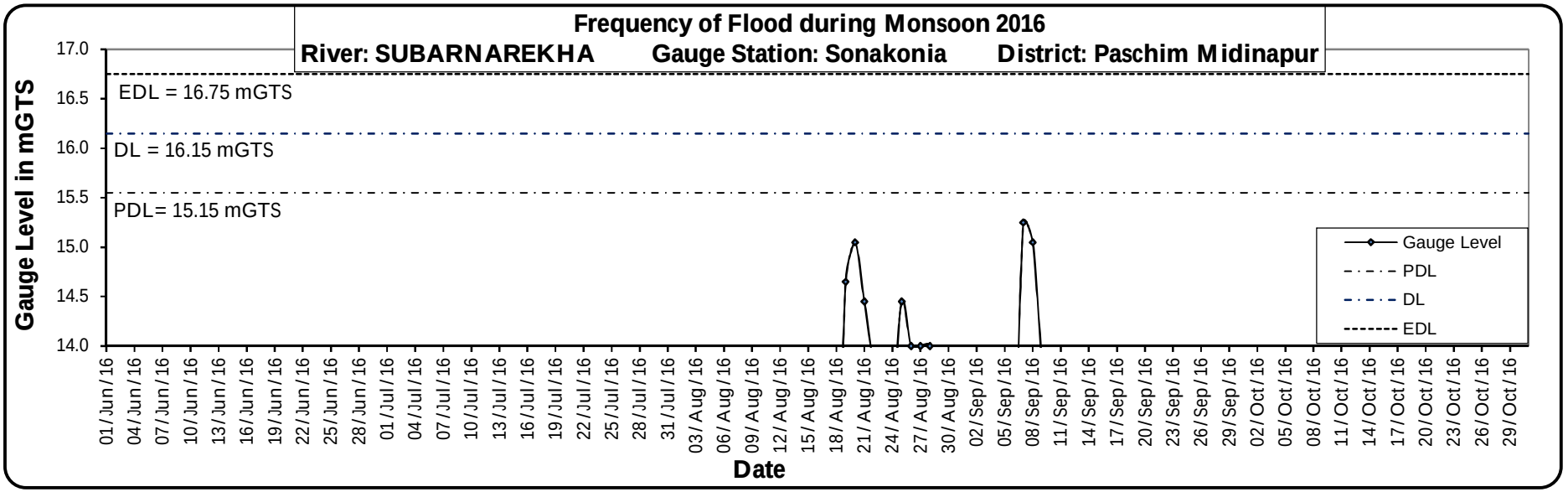

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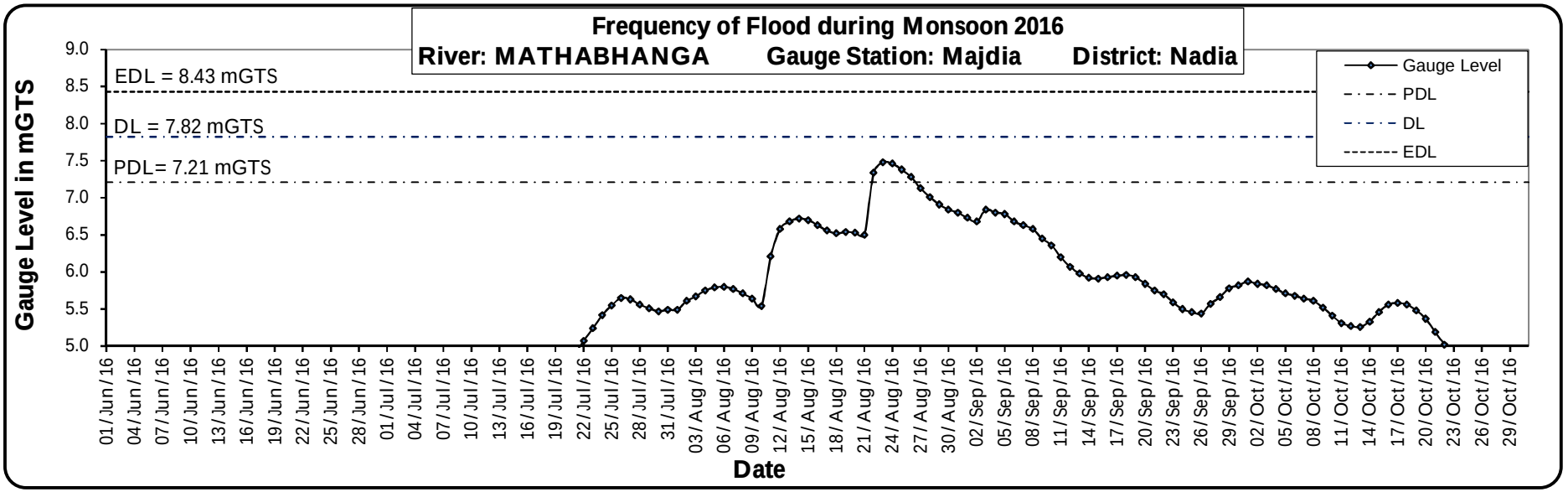
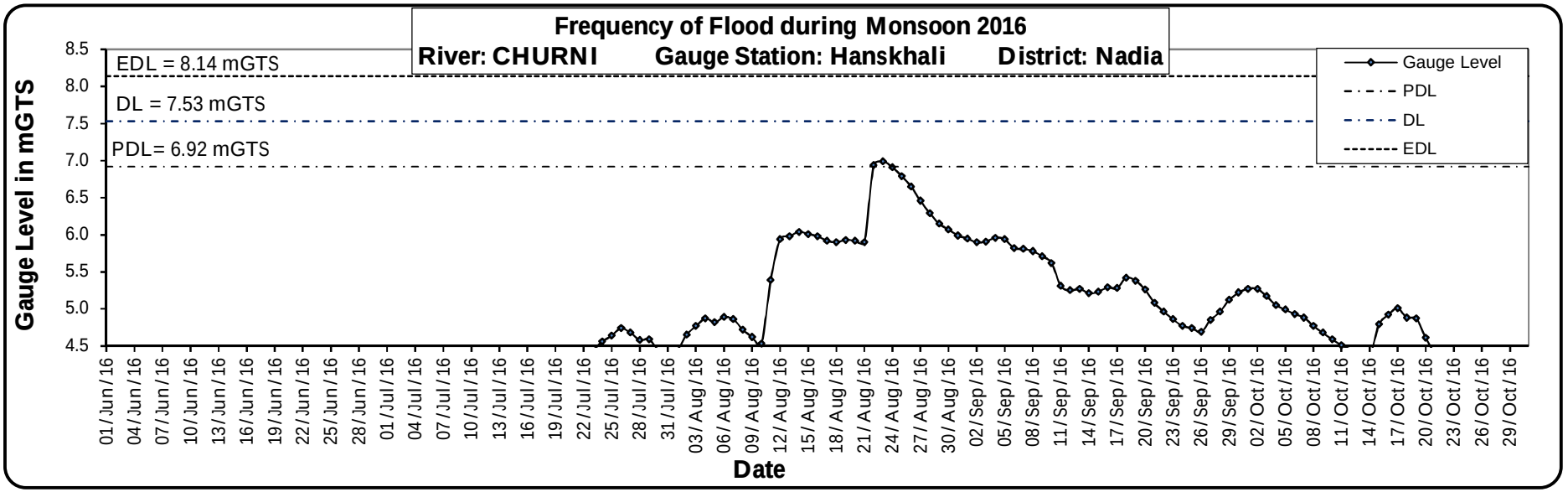
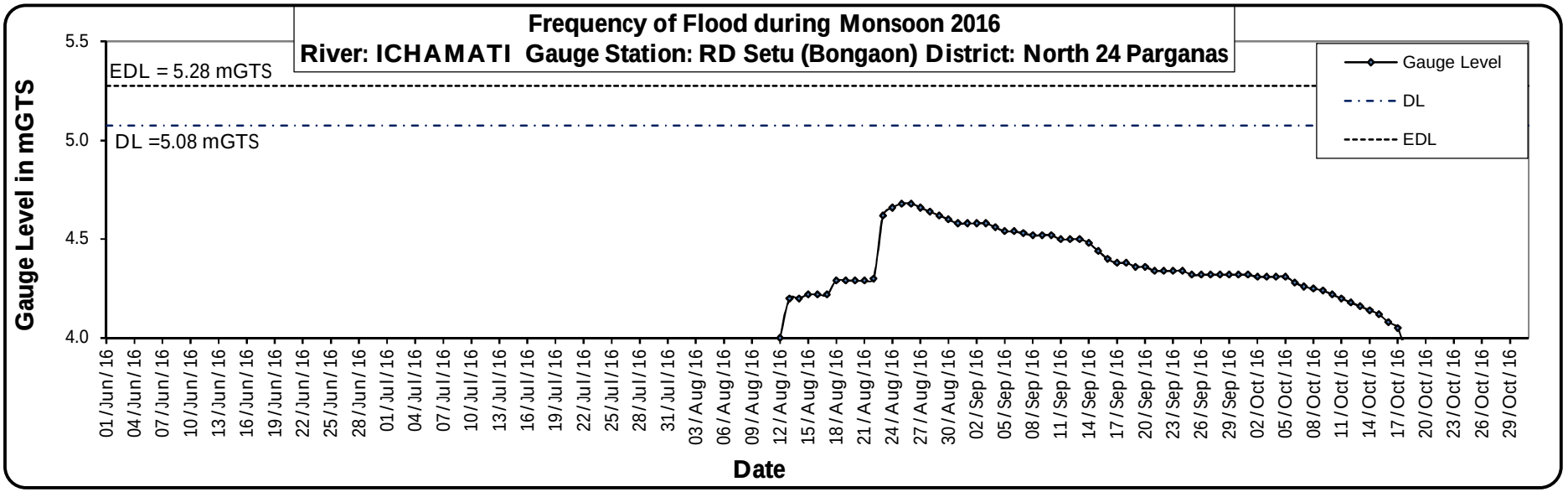
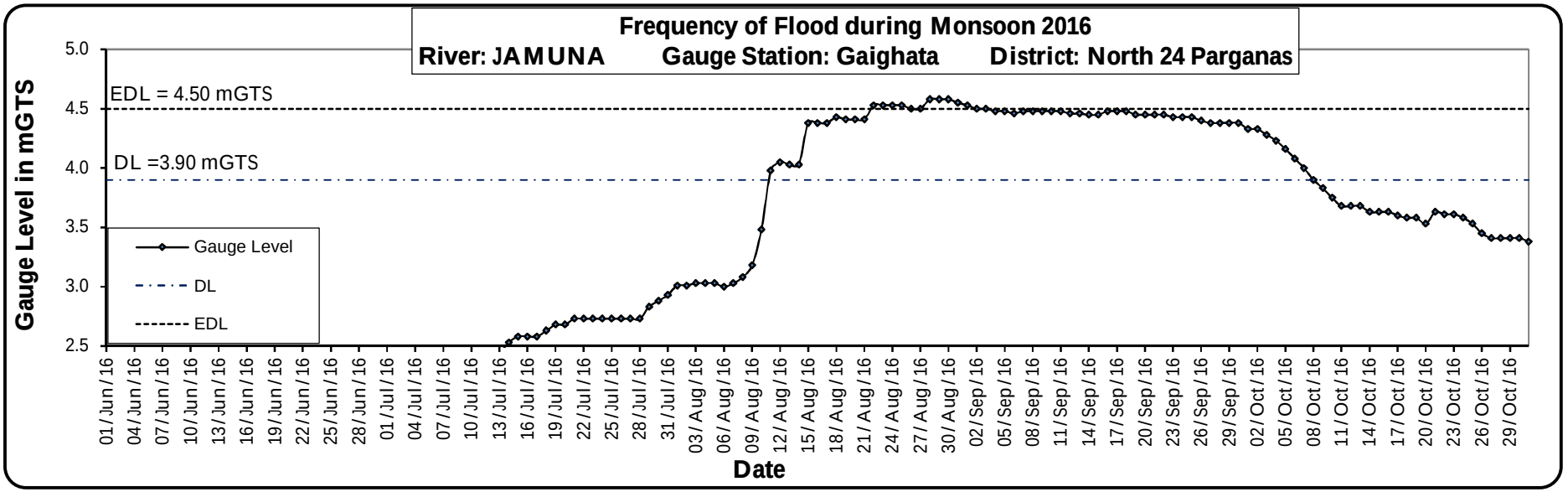




ANNEXURE-G18





ANNEXURE D1

Date	Dugapur Barrage			Massanjore Dam			Tilpara Barrage			Kangsabati Dam			REMARKS
	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	
1-Jun-15	211.50	550	50	359.70	100	0	202.00	0	0	402.59	0	0	
2-Jun-15	211.50	550	50	360.00	600	0	198.90	0	0	402.59	0	0	
3-Jun-15	211.50	550	50	360.00	0	0	195.75	0	0	402.59	0	0	
4-Jun-15	211.50	550	50	360.15	0	0	194.30	0	0	402.59	0	0	
5-Jun-15	211.50	550	50	360.25	198	0	190.50	0	0	402.49	0	0	
6-Jun-15	211.50	550	50	360.29	0	0	190.48	0	0	402.59	0	0	
7-Jun-15	211.50	550	50	360.40	0	0	190.50	0	0	402.59	0	0	
8-Jun-15	211.50	550	50	360.35	0	0	190.50	0	0	402.59	0	0	
9-Jun-15	211.50	550	50	360.35	0	0	190.50	0	0	402.59	0	0	
10-Jun-15	211.50	550	50	360.35	0	0	190.50	0	0	402.59	0	0	
11-Jun-15	211.40	550	50	360.35	0	0	190.50	0	0	402.59	0	0	
12-Jun-15	211.40	550	50	360.35	0	0	190.50	0	0	402.59	0	0	
13-Jun-15	211.40	550	50	363.70	0	0	190.50	0	0	402.59	0	0	
14-Jun-15	211.50	550	50	366.30	0	0	190.50	0	0	402.59	0	0	
15-Jun-15	211.50	1575	1075	366.90	1800	0	190.50	0	0	402.59	0	0	
16-Jun-15	211.50	2650	2150	367.05	5185	0	190.50	0	0	402.59	0	0	
17-Jun-15	211.50	2076	1575	367.14	0	0	190.50	0	0	402.65	464	0	
18-Jun-15	211.50	1575	1075	367.24	0	0	190.50	0	0	402.65	0	0	
19-Jun-15	211.50	1575	1075	367.50	0	0	190.50	0	0	402.65	0	0	
20-Jun-15	211.50	1575	1075	367.60	300	0	190.50	0	0	402.65	0	0	
21-Jun-15	211.50	1575	927	367.65	150	0	190.50	0	0	402.65	0	0	
22-Jun-15	211.50	1000	1000	367.85	600	0	190.48	0	0	402.65	0	0	
23-Jun-15	211.50	550	50	368.14	0	0	190.50	0	0	402.65	0	0	
24-Jun-15	211.50	1000	500	368.79	1800	0	190.50	0	0	402.75	457	0	
25-Jun-15	211.50	1000	500	369.40	3601	0	190.50	0	0	402.85	309	0	
26-Jun-15	211.50	1000	500	369.90	1500	0	190.50	0	0	402.85	0	0	
27-Jun-15	211.50	550	50	370.10	650	0	190.50	0	0	402.75	0	0	
28-Jun-15	211.50	550	50	370.20	350	0	190.50	0	0	402.88	232	0	
29-Jun-15	211.50	550	50	370.20	0	0	190.50	0	0	402.90	0	0	
30-Jun-15	211.50	1000	500	370.20	0	0	190.50	0	0	402.90	0	0	

ANNEXURE-D2

Date	Dugapur Barrage			Massanjore Dam			Tilpara Barrage			Kangsabati Dam			REMARKS
	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	
1-Jul-15	211.50	1000	500	370.20	0	0	190.50	0	0	402.90	0	0	
2-Jul-15	211.50	1000	500	370.25	175	0	190.50	0	0	402.90	0	0	
3-Jul-15	211.50	550	550	370.25	0	0	190.50	0	0	402.98	232	0	
4-Jul-15	211.50	1575	1075	370.40	525	0	190.50	0	0	403.21	928	0	
5-Jul-15	211.50	3726	3226	370.54	0	0	190.50	0	0	403.25	0	0	
6-Jul-15	211.50	2650	2150	371.15	4200	0	205.20	3060	0	403.25	0	0	
7-Jul-15	211.50	2650	2650	371.75	2100	2100	205.00	130	130	403.54	0	0	
8-Jul-15	211.50	1575	1075	371.90	525	0	205.20	202	0	403.64	457	0	
9-Jul-15	211.50	1575	1075	372.00	350	0	204.30	0	0	403.74	464	0	
10-Jul-15	211.50	1575	1075	372.10	350	0	204.30	500	0	403.80	229	0	
11-Jul-15	211.50	1575	1575	372.10	0	0	204.50	500	500	403.83	0	0	
12-Jul-15	211.50	1575	1075	372.20	175	0	204.80	692	0	403.83	0	0	
13-Jul-15	211.50	2650	2150	372.20	0	0	204.80	912	785	403.95	464	0	
14-Jul-15	211.50	3725	3225	372.30	350	0	204.60	504	0	404.00	232	0	
15-Jul-15	211.50	3725	3225	372.30	0	0	204.60	508	0	404.25	1159	0	
16-Jul-15	211.50	3725	3225	372.35	175	0	204.90	792	0	404.30	232	0	
17-Jul-15	211.50	3726	3726	373.45	3963	0	205.50	2351	1862	404.39	464	0	
18-Jul-15	211.50	2651	2150	374.10	2813	0	204.40	751	0	404.55	696	0	
19-Jul-15	211.50	3725	3225	374.80	2250	0	204.60	1167	0	404.59	229	0	
20-Jul-15	211.50	3725	3225	375.00	408	0	204.30	1062	0	404.65	228	0	
21-Jul-15	211.50	5875	5375	375.60	1600	0	205.30	1900	1059	404.69	229	0	
22-Jul-15	211.50	9101	8601	376.85	5000	0	203.80	8371	19807	404.85	686	0	
23-Jul-15	211.50	13400	12900	377.45	0	0	202.70	4281	984	405.00	696	0	
24-Jul-15	211.50	11251	10751	377.74	0	0	204.00	1128	2658	405.18	1391	0	
25-Jul-15	211.50	11251	10751	377.95	0	0	204.00	0	0	405.55	1622	0	
26-Jul-15	211.5	11251	10751	378	225	0	202.5	1525	0	405.74	915	0	
27-Jul-15	211.50	8777	7527	378.20	900	0	204.10	2902	0	405.90	928		
28-Jul-15	211.5	7802	4301	378.35	675	0	204.5	3045	0	406	461	0	
29-Jul-15	211.50	7077	1075	378.45	466	0	203.50	1713	0	406.10	0	0	
30-Jul-15	211.5	6052	50	378.5	225	0	203.10	1335	0	406.2	457	**0**	
31-Jul-15	211.50	10401	2150	378.55	225	0	202.1	1301	**0**	406.26	229	0	

ANNEXURE-D3

Date	Dugapur Barrage			Massanjore Dam			Tilpara Barrage			Kangsabati Dam			REMARKS
	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	
1-Aug-15	211.50	9051	50	378.85	1554	204	202.00	1297	0	406.49	1144	0	
2-Aug-15	211.50	8301	50	378.85	1328	0	205.20	3918	0	406.90	1854	0	
3-Aug-15	211.50	8301	50	379.15	1950	562	204.80	2228	0	407.20	1392	0	
4-Aug-15	211.50	12200	4300	379.19	569	569	203.90	1700	0	407.71	286	0	
5-Aug-15	211.50	13350	6450	379.30	1047	572	203.40	1562	0	408.30	2733	0	
6-Aug-15	211.50	10200	4300	379.40	1047	572	203.70	1867	0	409.20	4172	0	
7-Aug-15	211.50	11950	6450	379.40	575	0	204.80	2190	0	410.00	3660	0	
8-Aug-15	211.50	6076	1075	379.45	803	0	205.00	1897	0	410.99	3660	8059	
9-Aug-15	211.50	8800	4300	379.45	575	575	205.30	3292	0	412.00	3616	0	
10-Aug-15	211.50	7726	3225	379.55	610	0	205.20	3499	1587	412.89	4031	0	
11-Aug-15	211.50	24506	27950	380.40	403	0	204.50	2611	3633	414.00	994	0	
12-Aug-15	211.50	59635	59135	385.40	25200	0	203.80	21370	15655	415.70	11416	0	
13-Aug-15	211.50	61254	65185	387.30	10600	0	203.60	7985	4026	416.79	7289	0	
14-Aug-15	211.50	57059	56559	388.20	5750	0	202.90	4262	488	417.75	6380	0	
15-Aug-15	211.50	44225	43725	388.55	2100	0	203.10	1365	494	418.15	6380	0	
16-Aug-15	211.00	37880	37880	388.79	7200	0	203.90	1951	511	418.55	2686	0	
17-Aug-15	211.50	18525	18025	389.00	1200	0	203.40	1341	1295	419.00	3022	0	
18-Aug-15	211.50	31925	31425	389.35	2625	0	204.10	1979	2060	419.90	6044	0	
19-Aug-15	210.50	64446	63946	390.50	7625	0	204.00	5505	6024	425.00	47396	0	
20-Aug-15	210.50	62378	61877	390.05	4862	9427	203.30	6453	8890	425.95	12427	15036	
21-Aug-15	211.50	62378	63026	389.00	1199	8287	202.90	8908	7740	425.68	8062	0	
22-Aug-15	210.00	87455	86955	388.05	2446	7276	203.60	7846	9393	425.98	11214	0	
23-Aug-15	210.00	83975	81925	389.15	7701	583	203.00	8113	7784	430.05	33642	0	
24-Aug-15	211.50	52470	49852	389.45	2832	582	203.40	3633	1994	431.75	25077	0	
25-Aug-15	210.50	56902	56402	389.70	1916	41	203.00	1163	1403	432.40	7926	0	
26-Aug-15	210.50	53545	53054	389.89	0	0	204.10	787	0	431.85	1986	10492	
27-Aug-15	211.00	45450	44450	390.05	1025	0	204.50	319	0	431.59	347	0	
28-Aug-15	211	39500	38000	390.1	275	0	205.1	392	0	431.55	1740	0	
29-Aug-15	211.50	35450	32200	390.15	275	0	205.10	0	0	431.50	1893	0	
30-Aug-15	211.50	32804	25803	390.00	1104	0	204.30	373	0	431.40	1555	0	
31-Aug-15	211.50	24050	15050	389.40	0	4294	205.50	4672	0	431.35	1228	0	

ANNEXURE-D4

Date	Dugapur Barrage			Massanjore Dam			Tilpara Barrage			Kangsabati Dam			REMARKS
	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	Reservoir Level (ft)	Inflow (Cusecs)	Outflow (Cusecs)	
1-Sep-15	211.50	17025	7525	388.90	512	4112	206.00	4225	0	431.10	1697	0	
2-Sep-15	211.50	18600	8600	388.77	432	1632	205.20	2355	0	430.60	451	0	
3-Sep-15	211.50	17025	7525	388.90	512	4112	206.00	4225	0	431.10	1697	0	
4-Sep-15	211.50	18605	8602	387.70	1650	0	205.80	4631	0	429.80	4748	6152	
5-Sep-15	211.50	29350	19350	387.35	1651	0	205.70	4245	0	430.05	14330	6190	
6-Sep-15	211.50	42900	34400	387.75	4424	0	205.20	4304	1585	432.80	49025	15879	
7-Sep-15	211.50	51500	44100	389.15	8750	0	204.80	6564	5186	433.90	27856	0	
8-Sep-15	211.00	40500	35500	389.90	5625	0	204.30	6438	3614	435.85	31905	10089	
9-Sep-15	211.00	46950	41950	390.35	2675	0	203.80	2778	0	436.64	11903	10238	
10-Sep-15	211.00	42650	37950	390.60	1375	0	204.60	2149	0	436.30	14544	16921	
11-Sep-15	211.00	38800	32800	390.85	1375	0	204.00	1318	0	434.85	6376	16508	
12-Sep-15	211.50	58026	50966	390.90	1258	0	203.40	1340	0	434.20	0	0	
13-Sep-15	210.50	71369	62369	390.84	609	0	203.80	1901	0	434.44	4662	0	
14-Sep-15	210.50	62027	53027	390.85	967	0	203.60	1780	0	434.80	4665	0	
15-Sep-15	211.00	58700	49700	390.90	1238	0	204.40	1885	0	435.25	7111	0	
16-Sep-15	211.50	39382	27950	390.90	573	0	205.80	2163	0	435.55	4678	0	
17-Sep-15	211.50	24050	15050	391.00	655	0	205.70	1128	0	435.65	2242	0	
18-Sep-15	211.50	21900	13975	391.40	2600	0	204.10	101	0	435.70	1632	0	
19-Sep-15	211.50	11650	2150	391.85	3827	0	202.80	426	0	435.70	1516	0	
20-Sep-15	211.50	11650	2150	391.55	2048	0	204.70	3841	0	435.65	1423	0	
21-Sep-15	211.50	10052	50	391.25	2038	0	205.20	4137	0	435.60	2032	0	
22-Sep-15	211.50	20750	10750	390.95	4588	0	206.00	4870	0	435.56	1421	0	
23-Sep-15	211.50	36300	26300	391.05	1828	0	204.50	2619	0	435.30	2613	0	
24-Sep-15	211.50	39275	29775	390.80	2580	0	205.30	4179	0	435.10	5764	0	
25-Sep-15	211.50	39285	29783	390.40	1764	3964	205.50	6005	0	435.00	4786	0	
26-Sep-15	211.50	46550	37050	390.20	7022	0	205.70	2804	2140	435.00	5914	0	
27-Sep-15	210.50	64470	54969	391.80	4168	0	205.00	4267	1969	435.10	7218	0	
28-Sep-15	210.50	72573	63073	391.85	2298	0	205.70	3007	0	435.20	7540	0	
29-Sep-15	210.50	61263	51763	392.00	1825	0	205.00	1992	0	435.15	7541	0	
30-Sep-15	211.50	44725	35225	392.10	1568	0	205.20	2645	0	434.94	3847	0	

Government of West Bengal

Irrigation & Waterways Directorate

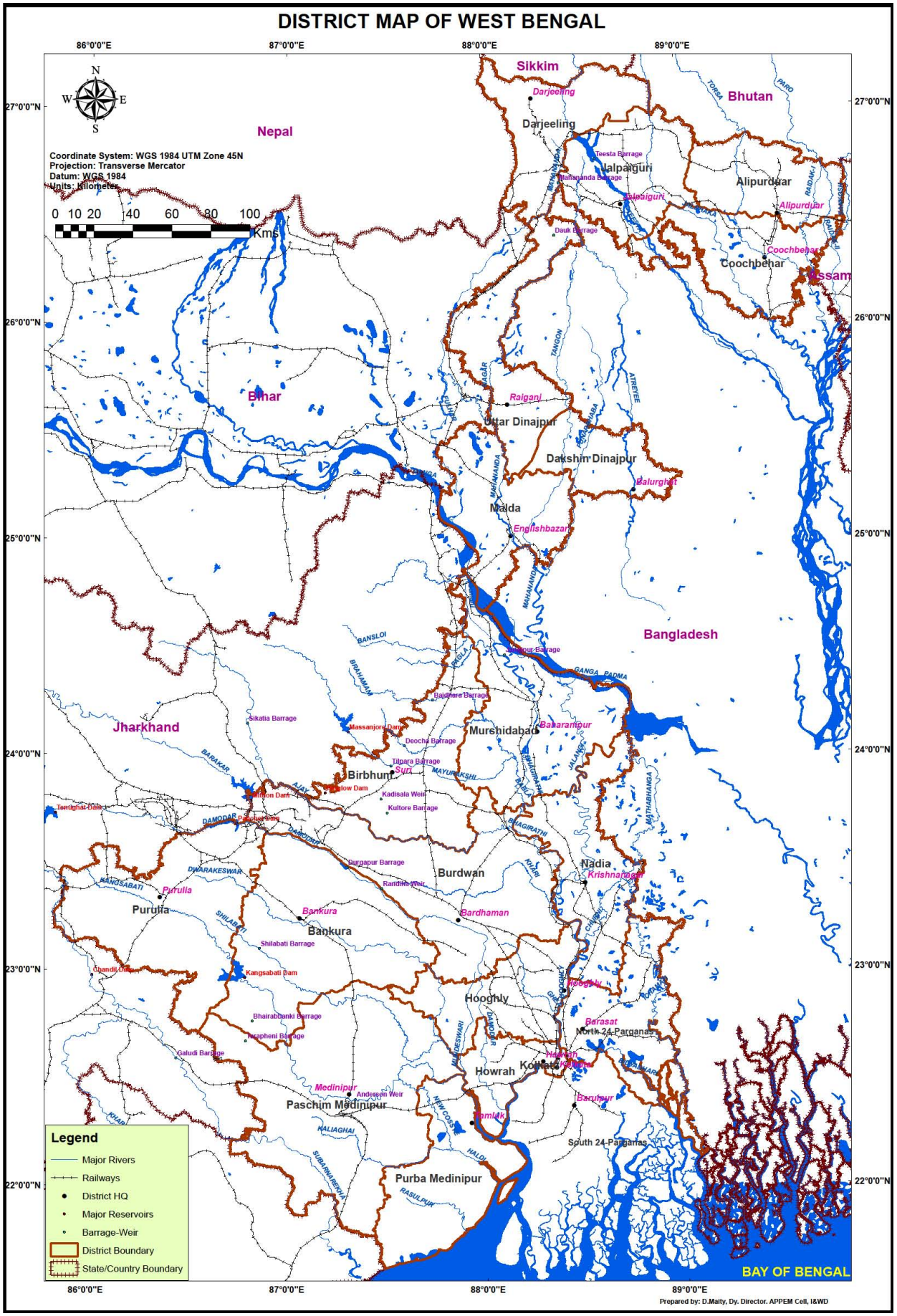
ANNUAL FLOOD REPORT FOR THE YEAR 2016

DIRECTOR

Advance Planning, Project Evaluation
& Monitoring Cell
Jalasampad Bhavan, Salt Lake
Kolkata – 7000 091

****

APRIL, 2016


DISTRICT MAP OF WEST BENGAL
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88°0'0"E
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S
E
W
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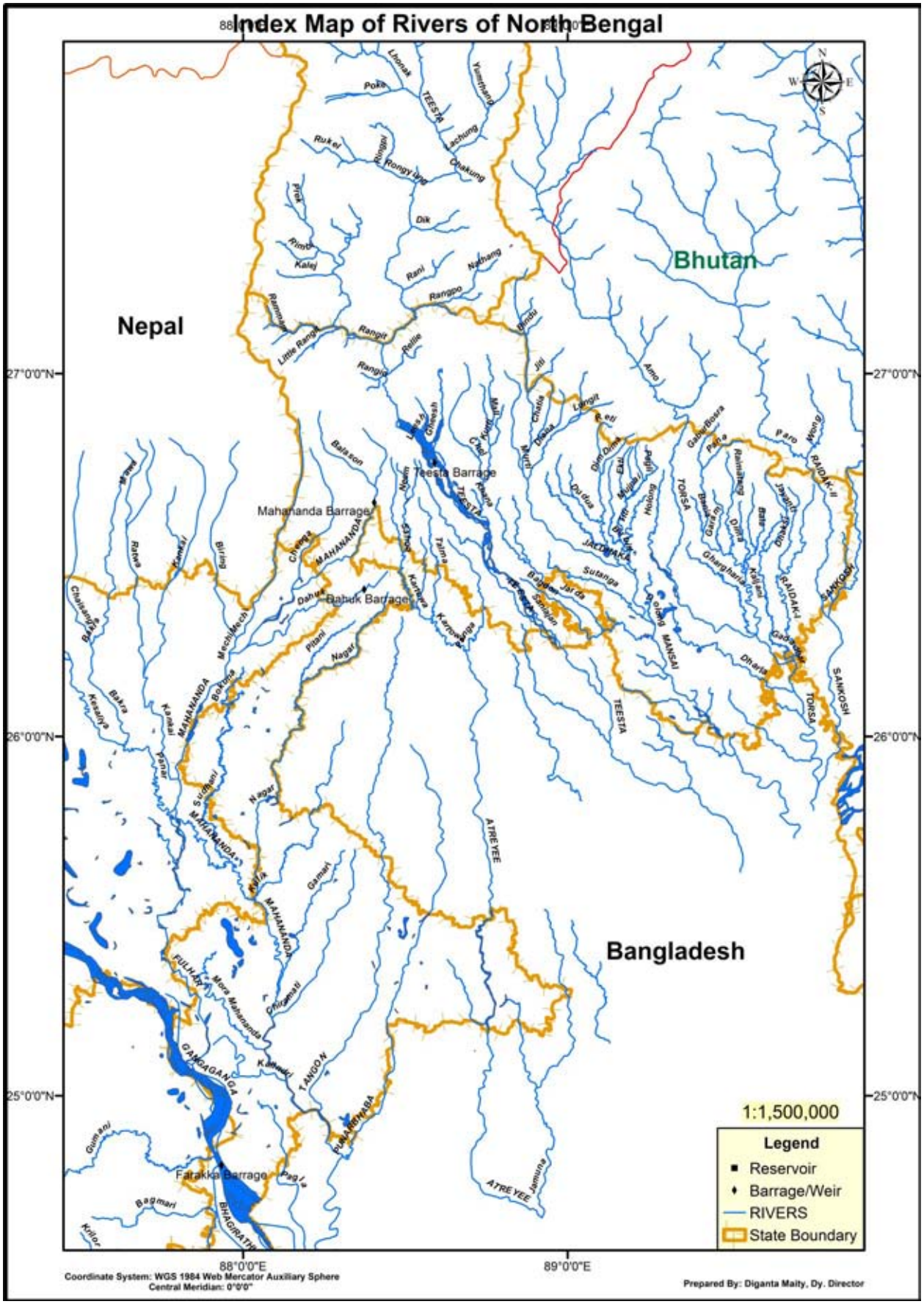
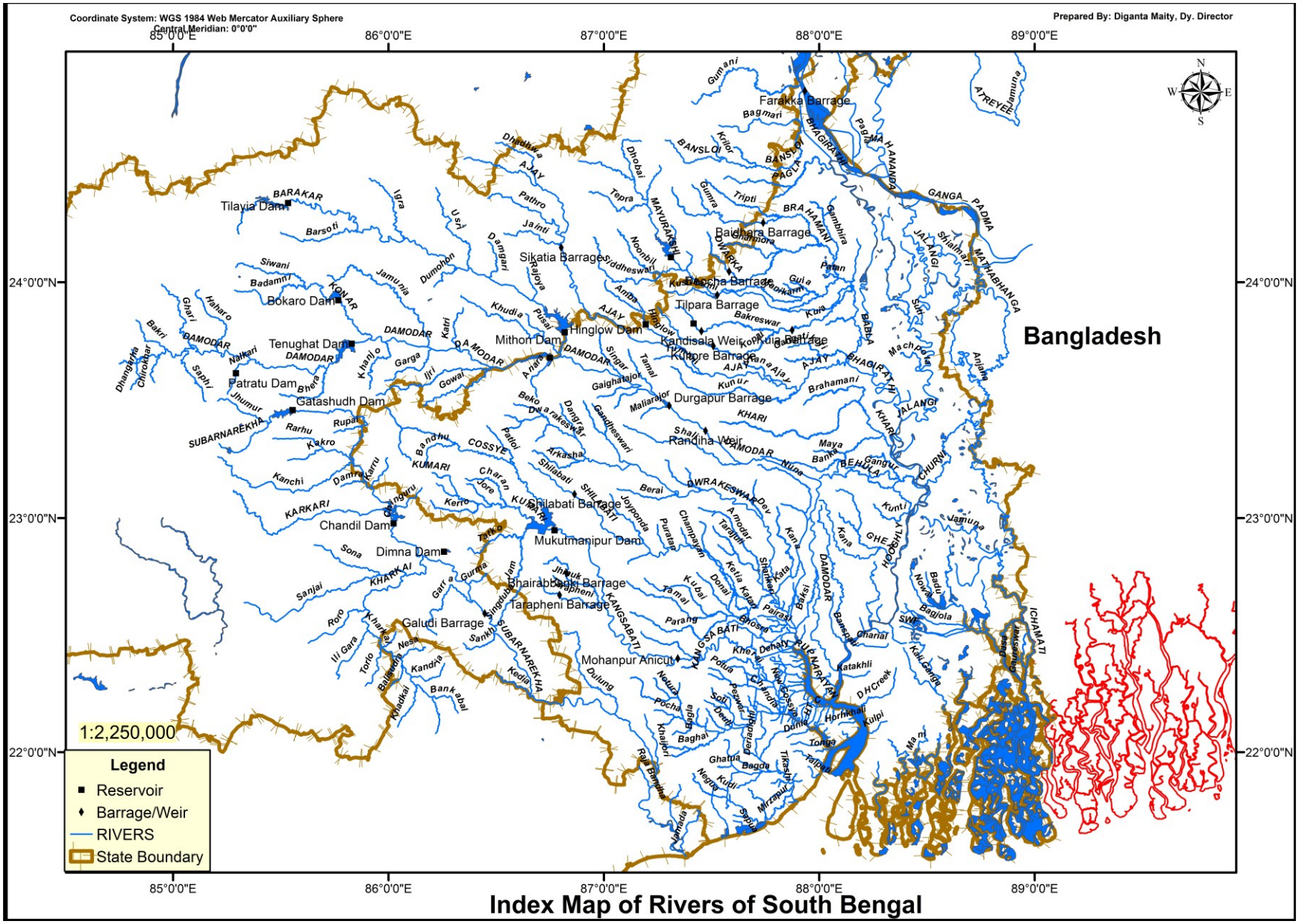
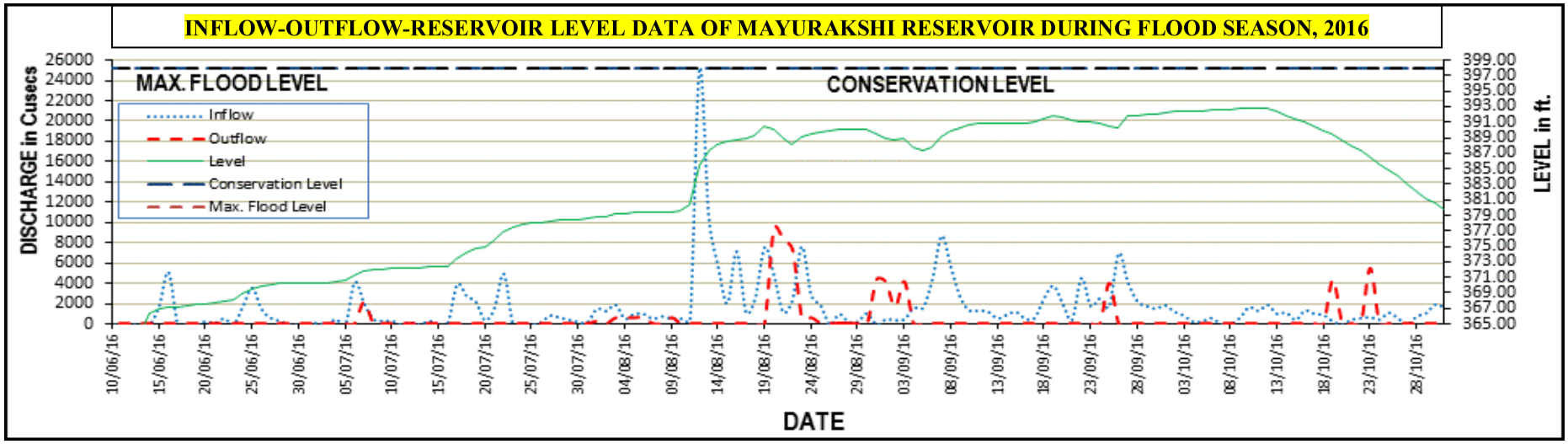
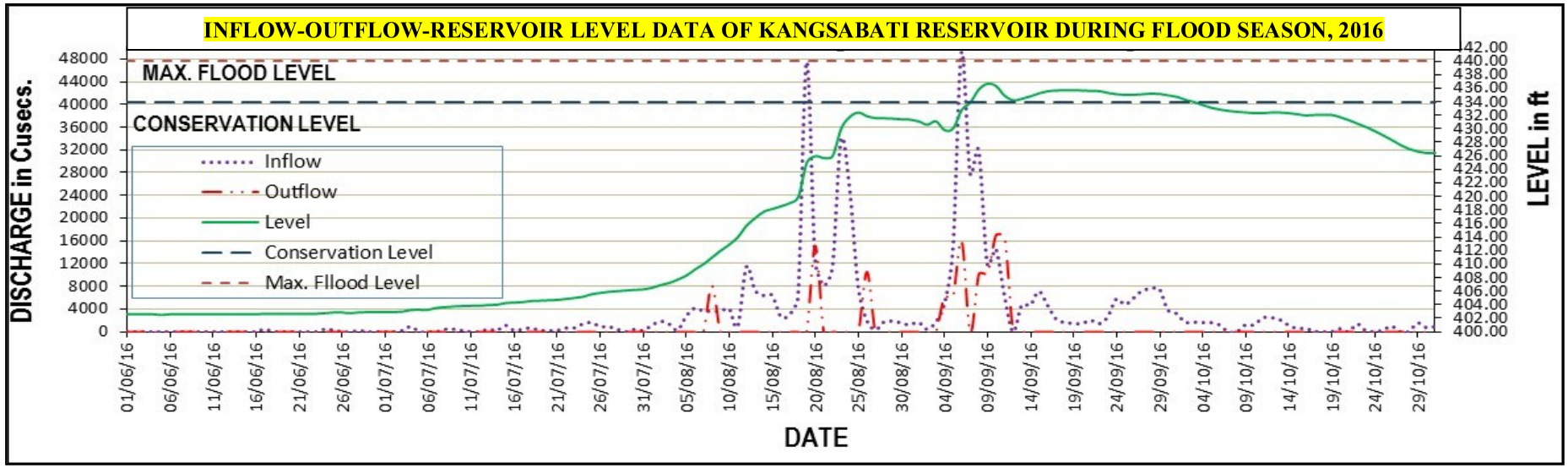
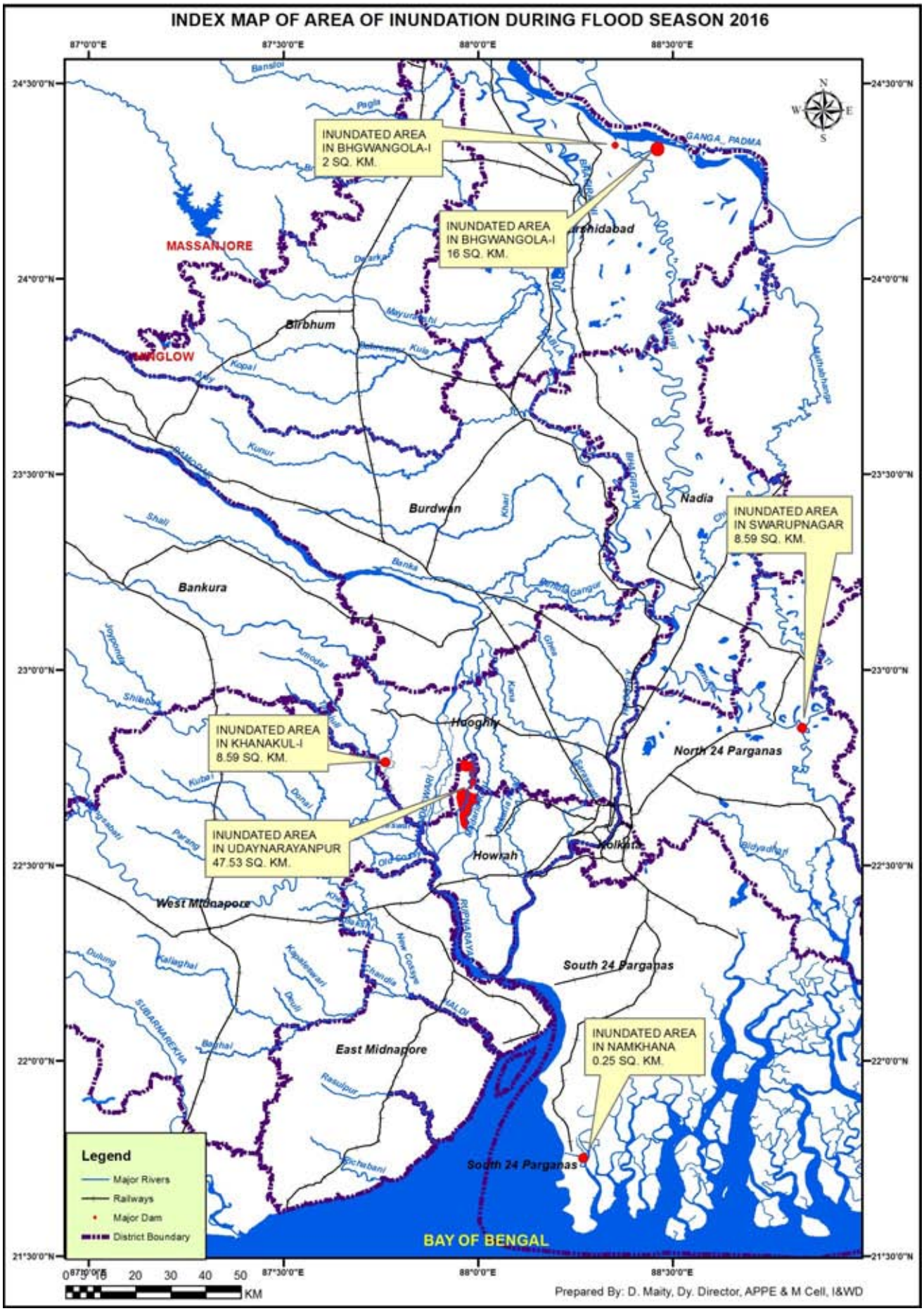
Kms
Sikkim
Darjeeling
Bhutan
Nepal
Jalpaiguri
Alipurduar
Coochbehar
Assam
Bihar
Raiganj
Uttar Dinajpur
Dakshin Dinajpur
Balurghat
Malda
Englishbazar
Bangladesh
Jharkhand
Murshidabad
Baharampur
Birbhum
Suri
Nadia
Krishnanagar
Burdwan
Purulia
Bankura
Bardhaman
Hooghly
Howrah
Kolkata
Barasat
North 24-Parganas
Medinipur
Paschim Medinipur
Purba Medinipur
South 24-Parganas
Haldia
Diamond Harbour
Basirhat
Baruipur
Teesta Barrage
Mahananda Barrage
Dauk Barrage
Farakka Barrage
Gazole
Sikatia Barrage
Massanjore Dam
Deocha Barrage
Tilpara Barrage
Mayurakshi
Kadisala Weir
Kultore Barrage
Durgapur Barrage
Ramnia Weir
Shilabati Barrage
Kangsabati Dam
Bhairabbanki Barrage
Kapheni Barrage
Galudi Barrage
Anderson Weir
Baidhara Barrage
Sonakhali
Legend
Major Rivers
Railways
District HQ
Major Reservoirs
Barrage-Weir
District Boundary
State/Country Boundary
BAY OF BENGAL
Prepared by: D.Maity, Dy. Director. APPEM Cell, I&WD


Index Map of Rivers of North Bengal
Nepal
Bhutan
Bangladesh
Teesta Barrage
Mahananda Barrage
Babuk Barrage
Farakka Barrage
TEESTA
MAHANANDA
ATREYEE
TANGON
PUNARBHABA
BHAGIRATHI
JALDHAKA
TORSA
RAIDAK-I
RAIDAK-II
SANKOSH
MANSAI
1:1,500,000
Legend
Reservoir
Barrage/Weir
RIVERS
State Boundary
88°0'0"E
89°0'0"E
27°0'0"N
26°0'0"N
25°0'0"N
Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Central Meridian: 0°0'0"
Prepared By: Diganta Maity, Dy. Director

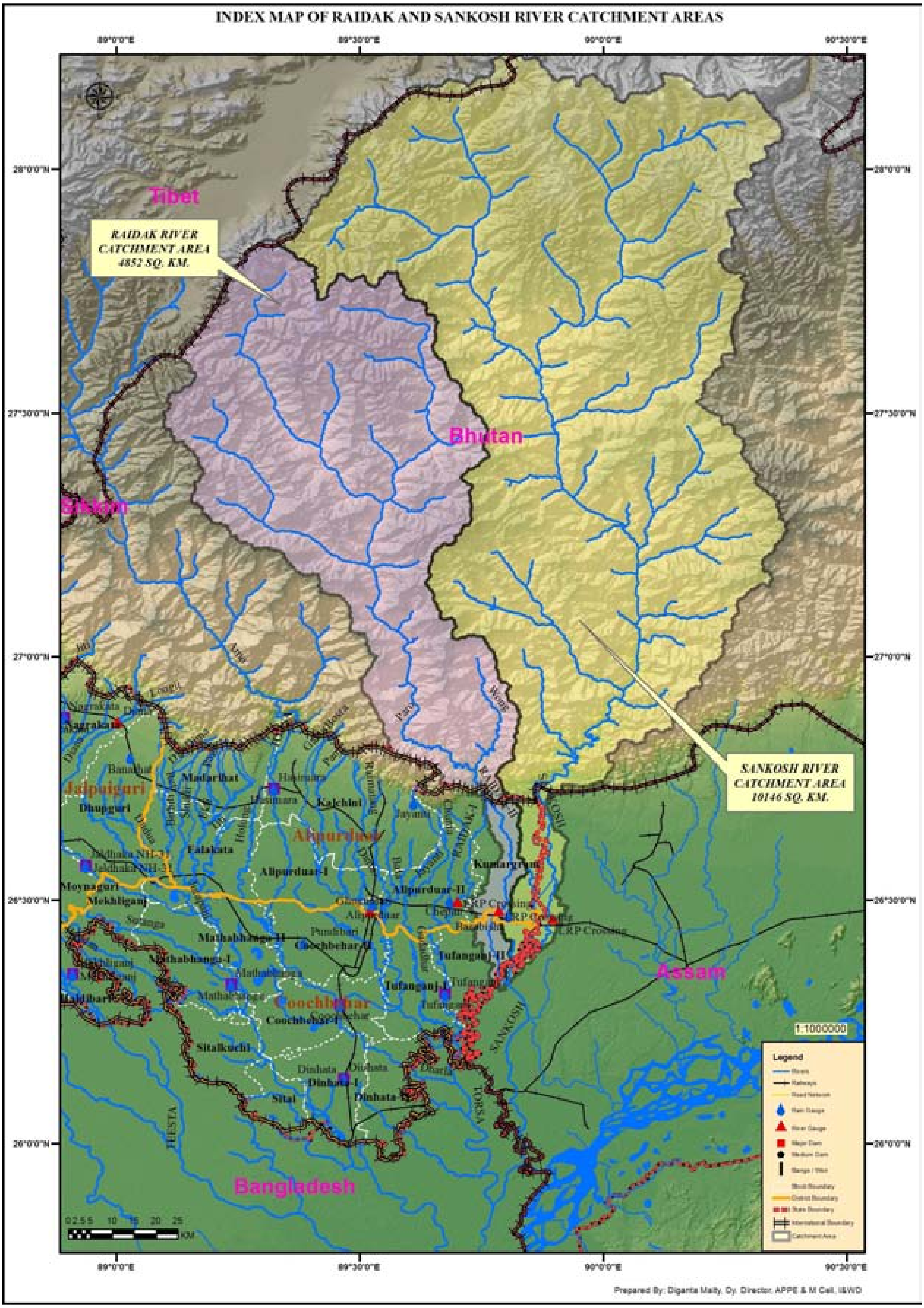

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere
Central Meridian: 0°0'0"
Prepared By: Diganta Maity, Dy. Director
85°0'0"E
86°0'0"E
87°0'0"E
88°0'0"E
89°0'0"E
24°0'0"N
23°0'0"N
22°0'0"N
N
S
W
E
Bangladesh
Farakka Barrage
Baidhara Barrage
Sikatia Barrages
Tilpara Barrage
Kandisala Weir
Kulpare Barrage
Durgapur Barrage
Randiha Weir
Shilabati Barrage
Mukutmanipur Dam
Jhairabbaid Barrage
Tarapheni Barrage
Galudi Barrage
Mohanpur Anicut
Tilaiya Dam
Bokaro Dam
Tenughat Dam
Patratu Dam
Gatashudh Dam
Mithon Dam
Hinglow Dam
Chandil Dam
Dimna Dam
1:2,250,000
Legend
Reservoir
Barrage/Weir
RIVERS
State Boundary
Index Map of Rivers of South Bengal


INFLOW-OUTFLOW-RESERVOIR LEVEL DATA OF MAYURAKSHI RESERVOIR DURING FLOOD SEASON, 2016
MAX. FLOOD LEVEL
CONSERVATION LEVEL
Inflow
Outflow
Level
Conservation Level
Max. Flood Level
DISCHARGE in Cusecs
LEVEL in ft.
DATE


INFLOW-OUTFLOW-RESERVOIR LEVEL DATA OF KANGSABATI RESERVOIR DURING FLOOD SEASON, 2016
MAX. FLOOD LEVEL
CONSERVATION LEVEL
Inflow
Outflow
Level
Conservation Level
Max. Fllood Level
DISCHARGE in Cusecs.
LEVEL in ft
DATE


INDEX MAP OF AREA OF INUNDATION DURING FLOOD SEASON 2016
INUNDATED AREA IN BHGWANGOLA-I 2 SQ. KM.
INUNDATED AREA IN BHGWANGOLA-I 16 SQ. KM.
INUNDATED AREA IN SWARUPNAGAR 8.59 SQ. KM.
INUNDATED AREA IN KHANAKUL-I 8.59 SQ. KM.
INUNDATED AREA IN UDAYNARAYANPUR 47.53 SQ. KM.
INUNDATED AREA IN NAMKHANA 0.25 SQ. KM.
MASSANJORE
BANGLOW
Birbhum
Burdwan
Bankura
Nadia
Hooghly
Howrah
North 24 Parganas
South 24 Parganas
West Midnapore
East Midnapore
BAY OF BENGAL
Legend
Major Rivers
Railways
Major Dam
District Boundary
KM
Prepared By: D. Maity, Dy. Director, APPE & M Cell, I&WD

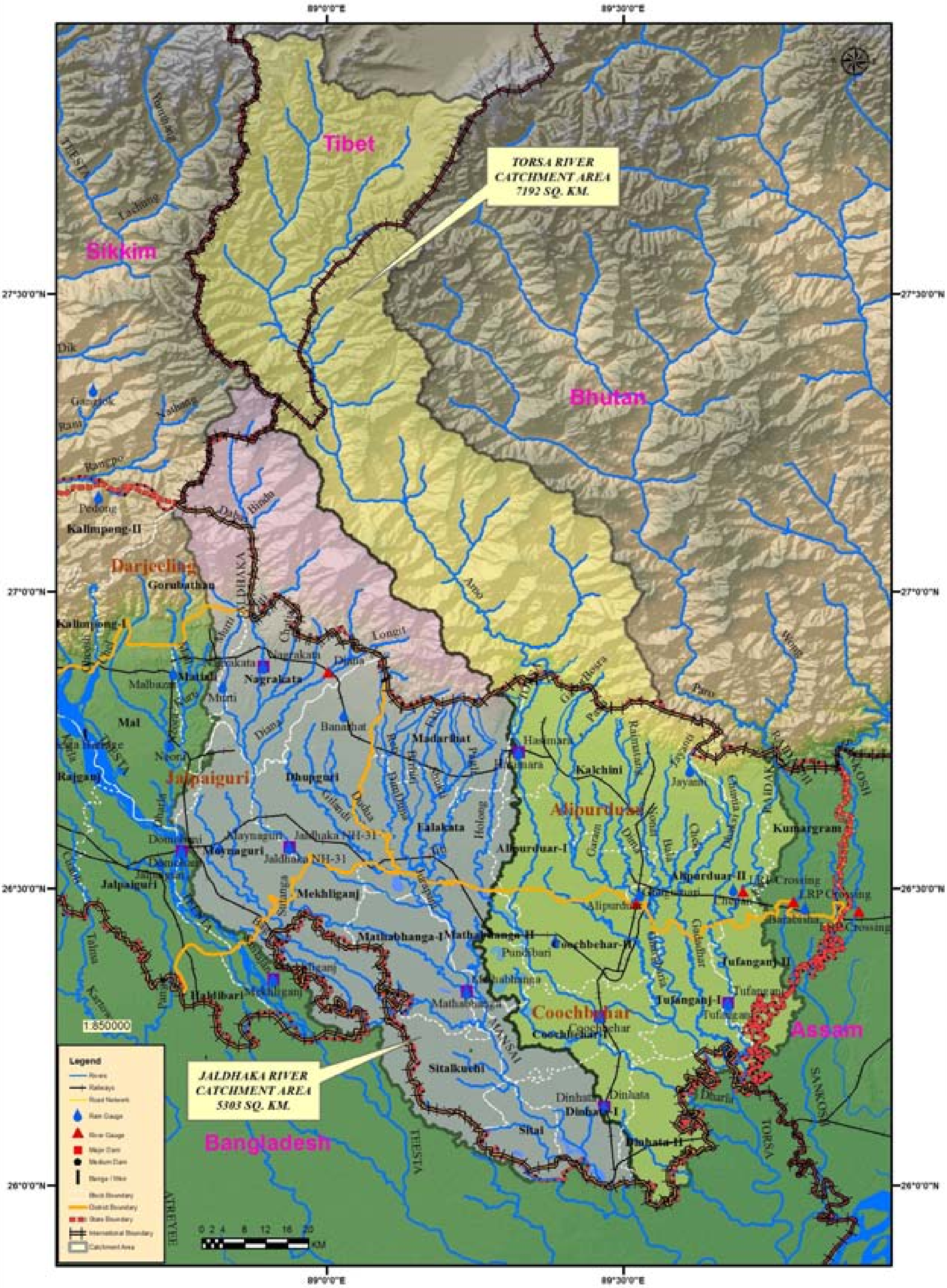
ANNEXURE-I1



INDEX MAP OF RAIDAK AND SANKOSH RIVER CATCHMENT AREAS
Tibet
RAIDAK RIVER CATCHMENT AREA 4852 SQ. KM.
Bhutan
Sikkim
SANKOSH RIVER CATCHMENT AREA 10146 SQ. KM.
Jalpaiguri
Alipurduar
Coochbehar
Assam
Bangladesh
1:1000000
Legend
Prepared By: Diganta Maity, Dy. Director, APPE & M Cell, I&WD

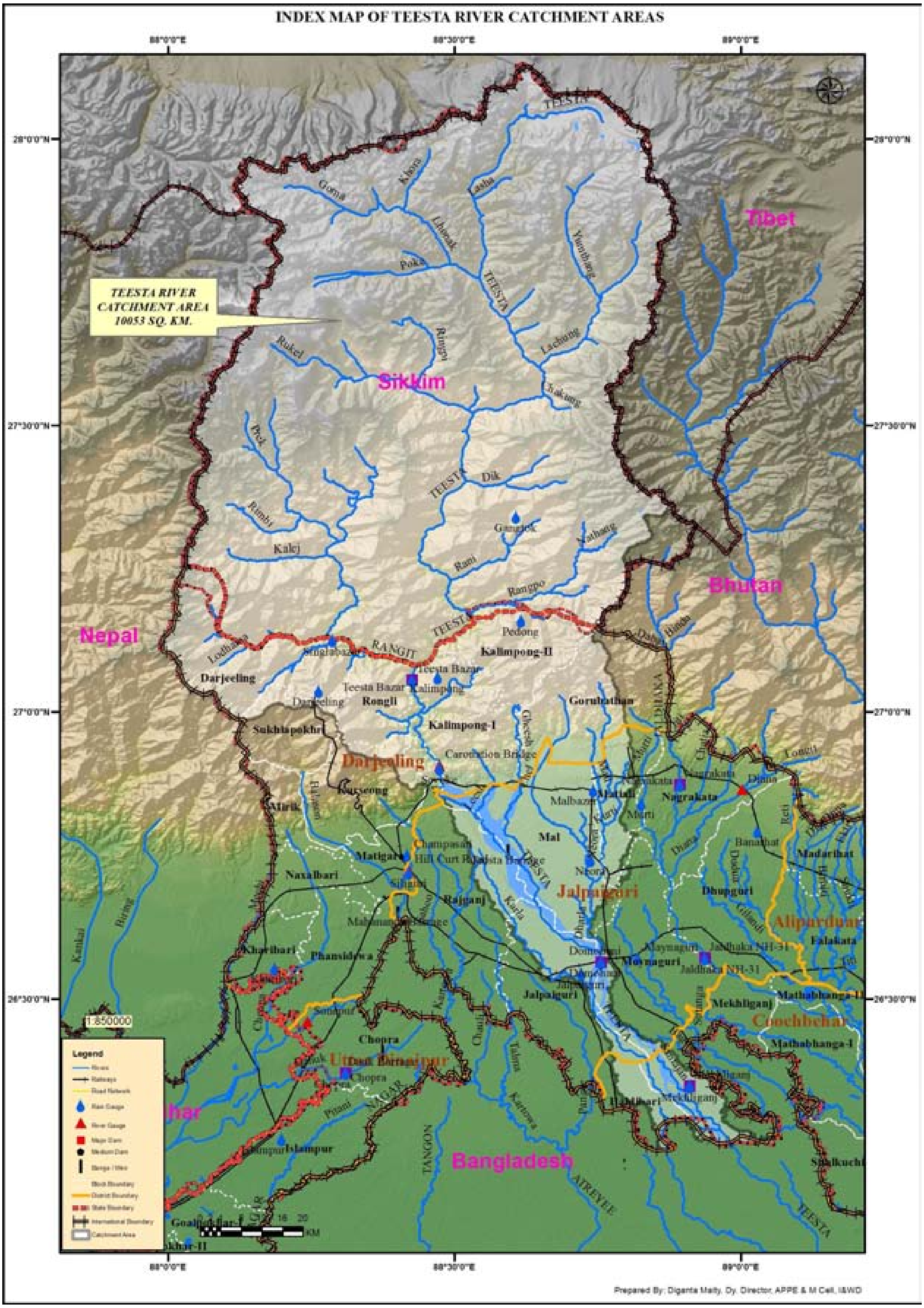
ANNEXURE-12

INDEX MAP OF JALDHAKA AND TORSA RIVER CATCHMENT AREAS

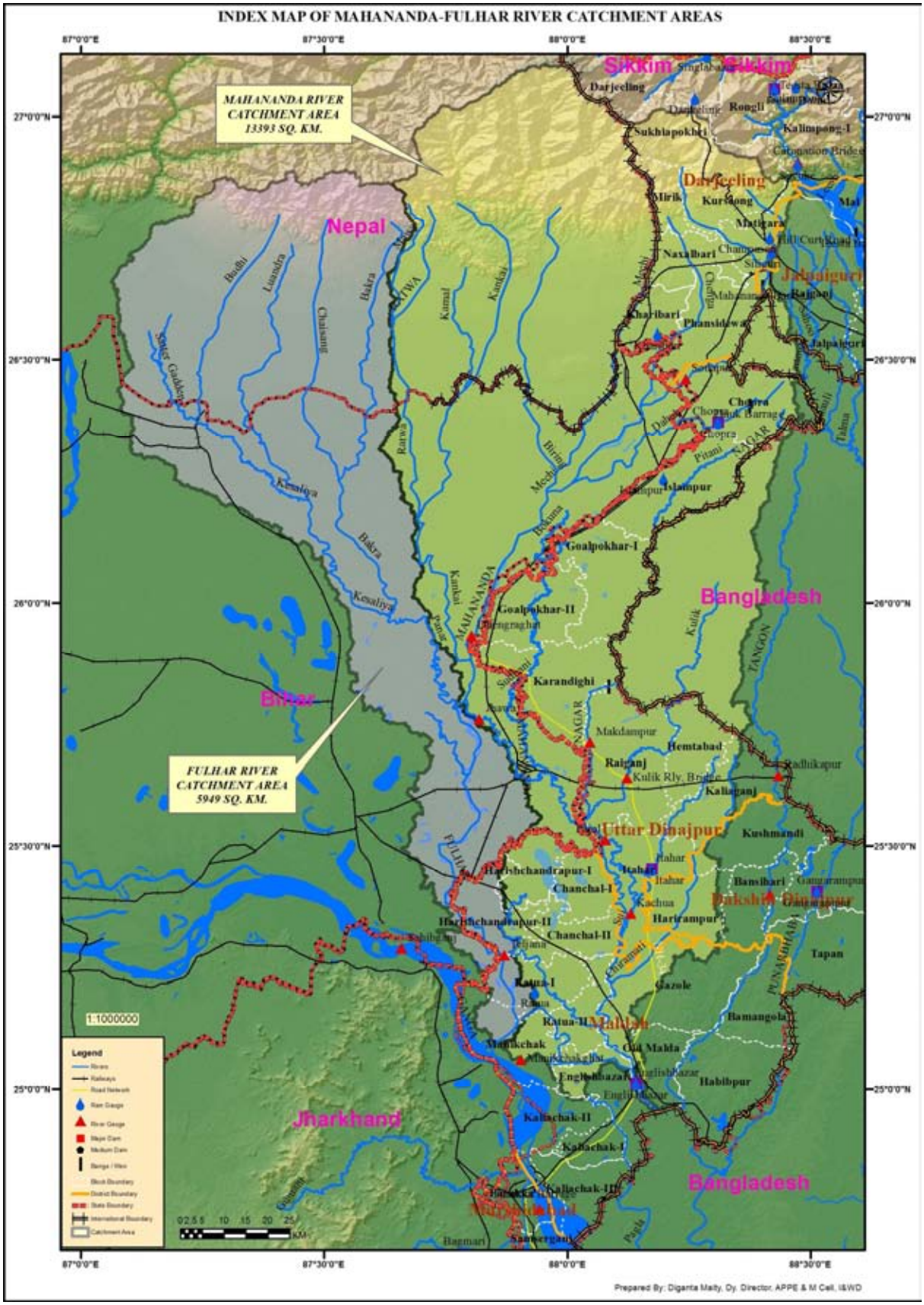


Prepared By: Diganta Maity, Dy. Director, APPE & M Cell, I&WD

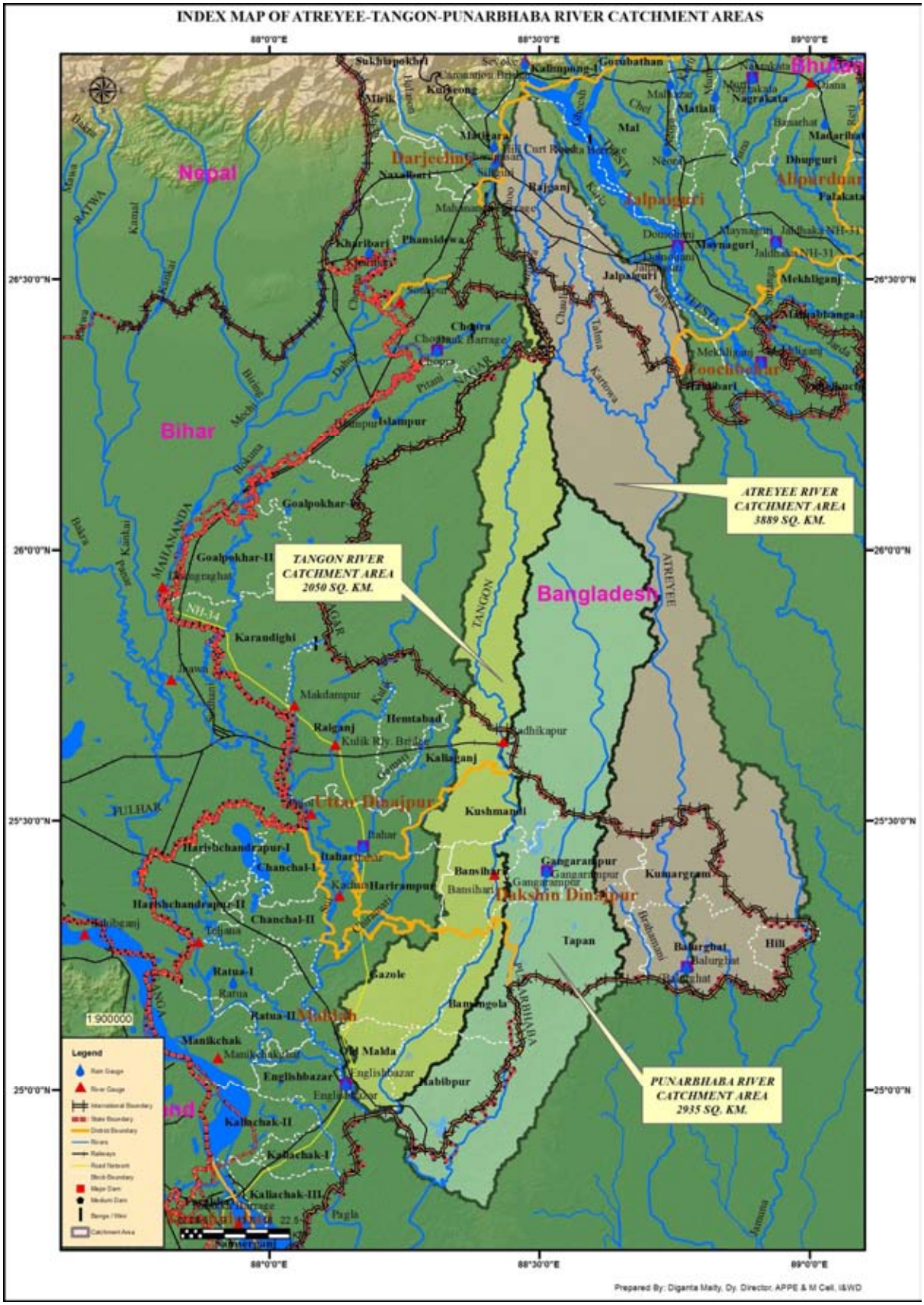
ANNEXURE-13


INDEX MAP OF TEESTA RIVER CATCHMENT AREAS
TEESTA RIVER CATCHMENT AREA 10053 SQ. KM.
Sikkim
Tibet
Bhutan
Nepal
Bangladesh
Darjeeling
Jalpaiguri
Alipurduar
Coochbehar
Kalimpong-II
Kalimpong-I
Gorubathan
Sukhiapokhri
Kurseong
Mirik
Matigara
Naxalbari
Rajganj
Mal
Nagrakata
Dhupguri
Maynaguri
Mekhliganj
Mathabhanga-I
Mathabhanga-II
Madarihat
Falakata
Kharibari
Phansidewa
Chopra
Islampur
Jalpaiguri
Bangladesh
1:850000
Legend
Prepared By: Diganta Maity, Dy. Director, APPE & M Cell, I&WD

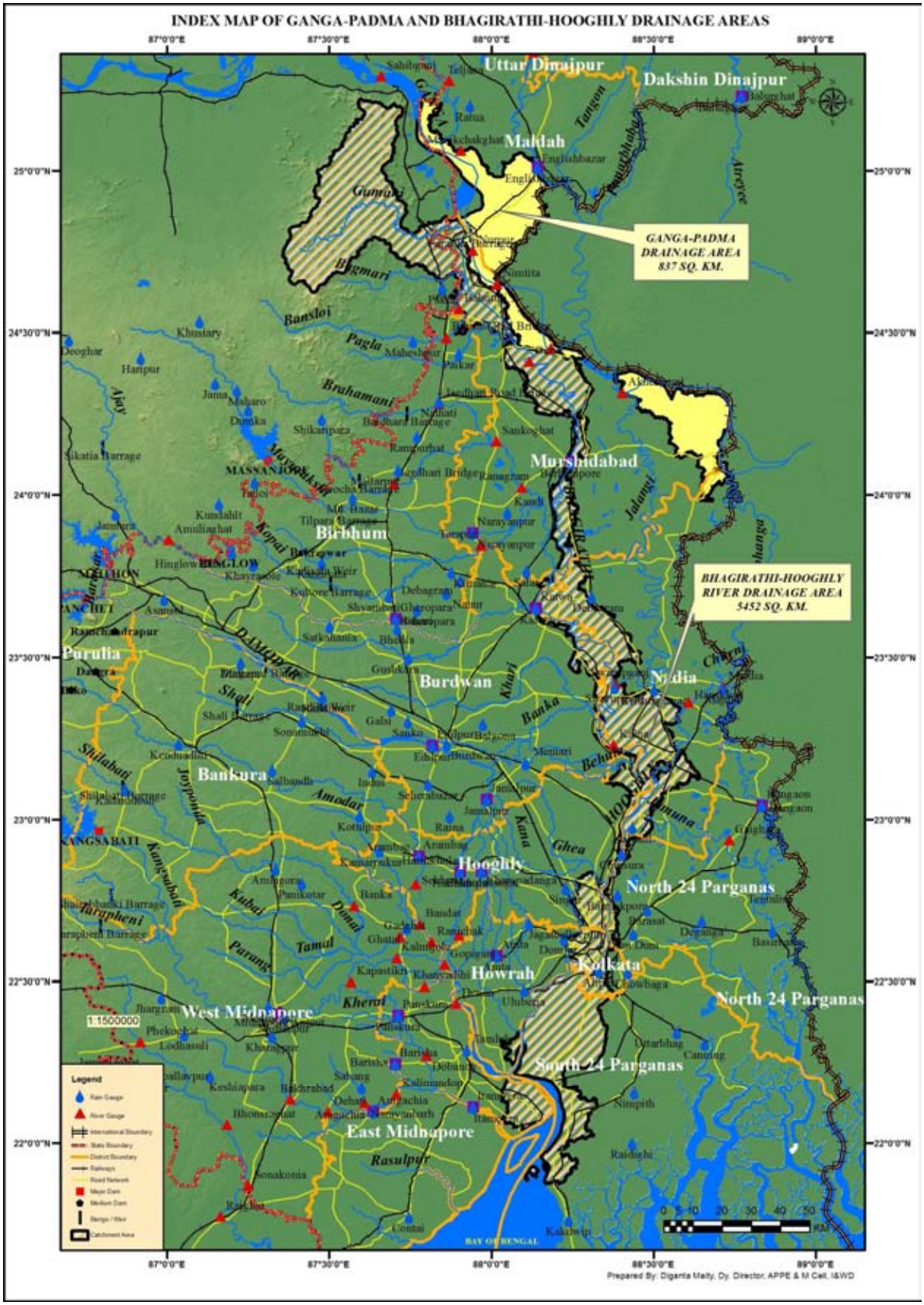
ANNEXURE-I4


INDEX MAP OF MAHANANDA-FULHAR RIVER CATCHMENT AREAS
MAHANANDA RIVER CATCHMENT AREA 13393 SQ. KM.
FULHAR RIVER CATCHMENT AREA 5949 SQ. KM.
Sikkim
Nepal
Bihar
Jharkhand
Bangladesh
Darjeeling
Jalpaiguri
Uttar Dinajpur
Dakshin Dinajpur
Malda
Legend
1:1000000
Prepared By: Diganta Maity, Dy. Director, APPE & M Cell, I&WD

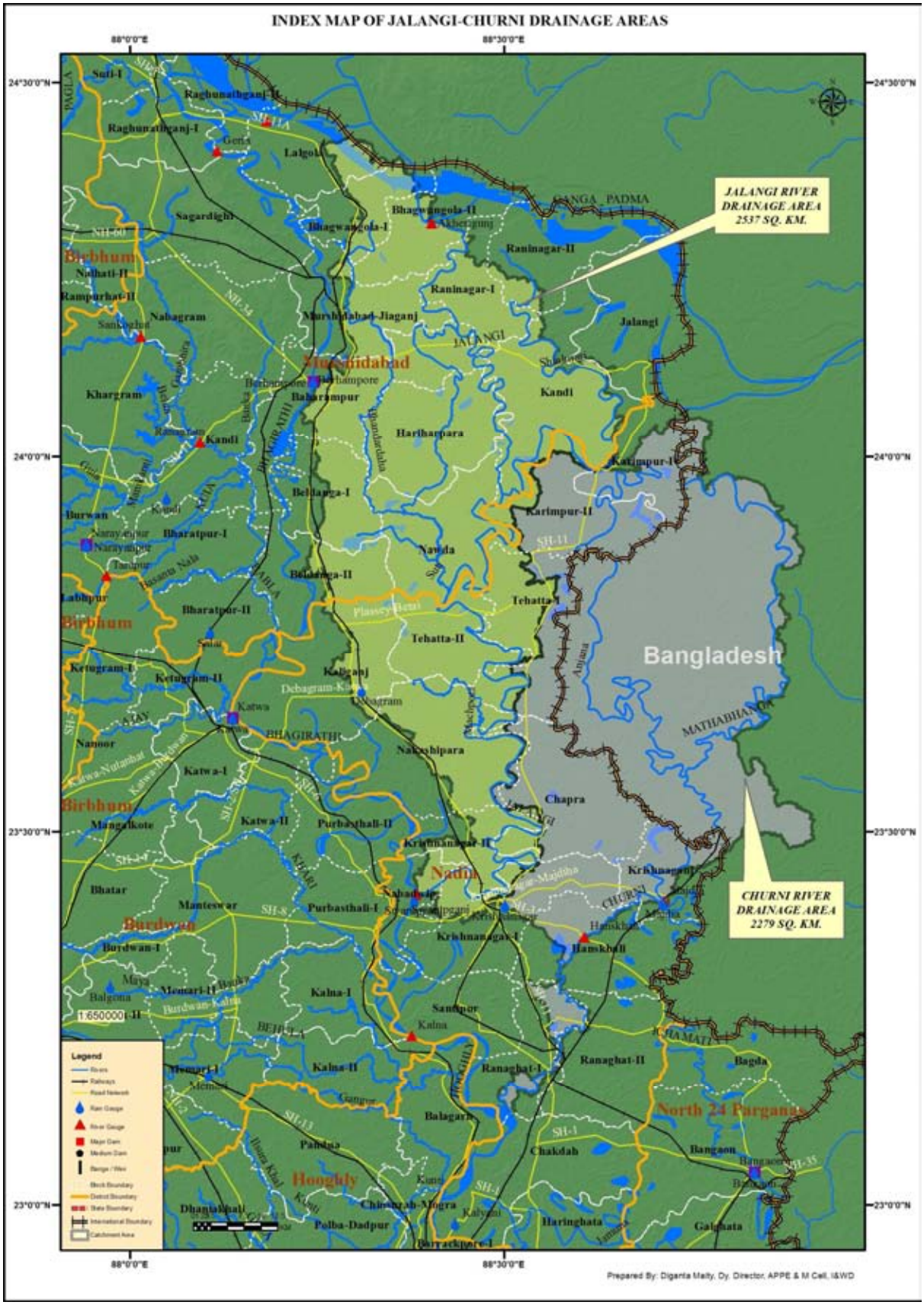
ANNEXURE-I5


INDEX MAP OF ATREYEE-TANGON-PUNARBHABA RIVER CATCHMENT AREAS
Nepal
Bihar
Bangladesh
Darjeeling
Jalpaiguri
Alipurduar
Cooch Behar
Uttar Dinajpur
Dakshin Dinajpur
Malda
ATREYEE RIVER CATCHMENT AREA 3889 SQ. KM.
TANGON RIVER CATCHMENT AREA 2050 SQ. KM.
PUNARBHABA RIVER CATCHMENT AREA 2935 SQ. KM.
Legend
1:900000
Prepared By: Diganta Maity, Dy. Director, APPE & M Cell, I&WD

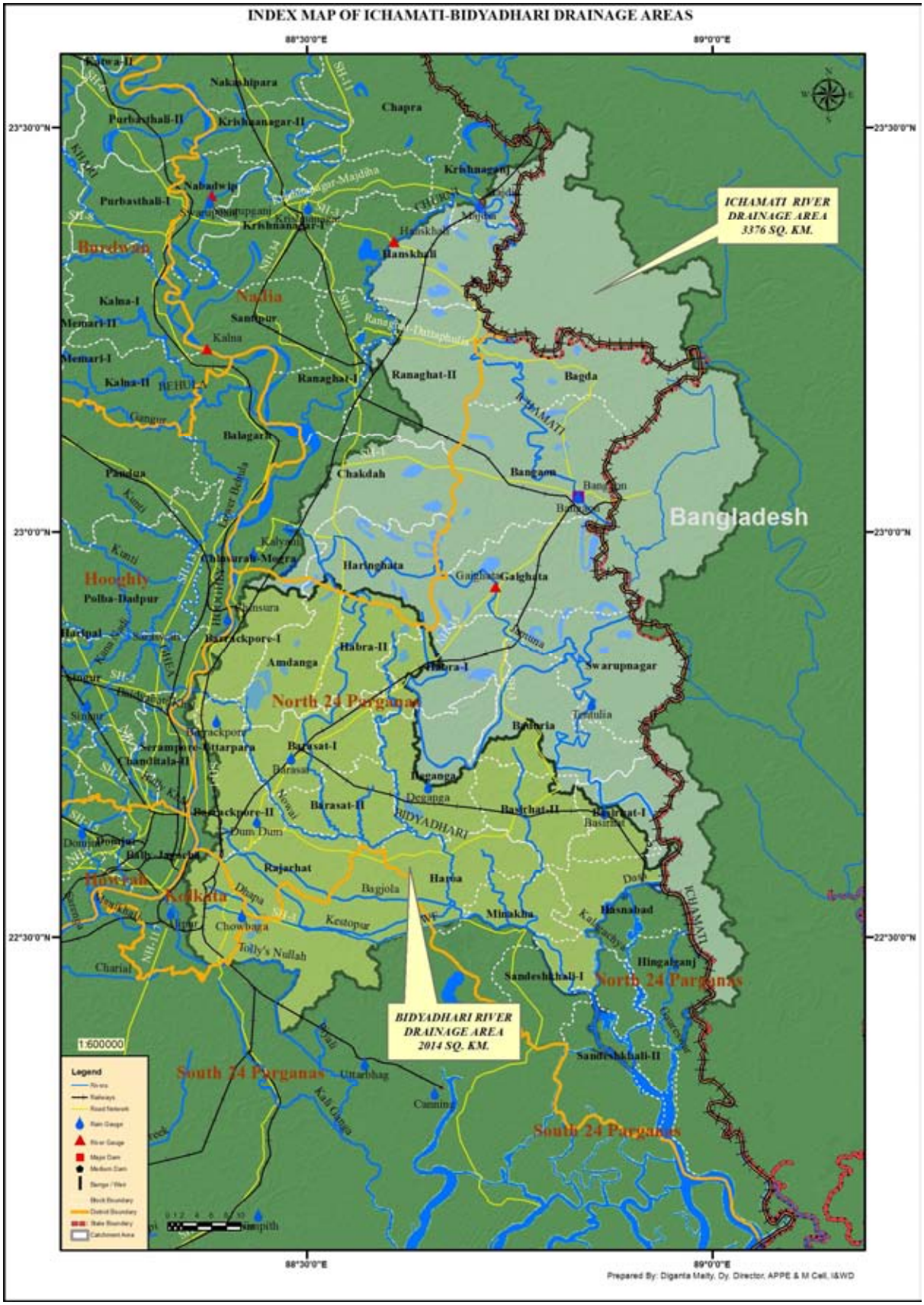
ANNEXURE-I6


INDEX MAP OF GANGA-PADMA AND BHAGIRATHI-HOOGHLY DRAINAGE AREAS
Uttar Dinajpur
Dakshin Dinajpur
Maldah
Murshidabad
Birbhum
Burdwan
Nadia
Purulia
Bankura
Hooghly
North 24 Parganas
Howrah
Kolkata
West Midnapore
East Midnapore
South 24 Parganas
GANGA-PADMA DRAINAGE AREA 837 SQ. KM.
BHAGIRATHI-HOOGHLY RIVER DRAINAGE AREA 5452 SQ. KM.
Legend
1:1500000
BAY OF BENGAL
Prepared By: Diganta Maity, Dy. Director, APPE & M Cell, I&WD

ANNEXURE-I7

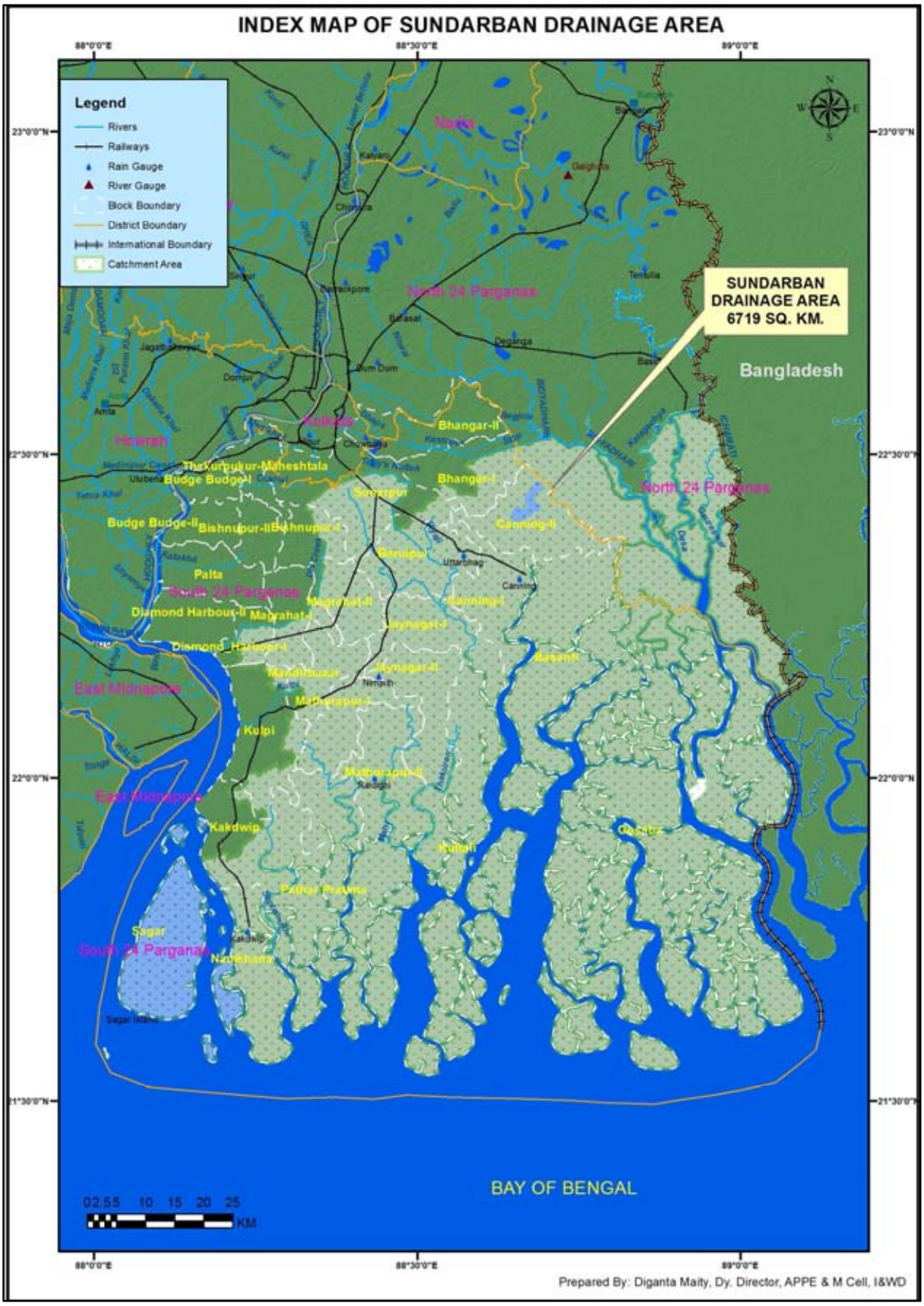

INDEX MAP OF JALANGI-CHURNI DRAINAGE AREAS
JALANGI RIVER DRAINAGE AREA 2537 SQ. KM.
CHURNI RIVER DRAINAGE AREA 2279 SQ. KM.
Bangladesh
Birbhum
Murshidabad
Nadia
Burdwan
Hooghly
North 24 Parganas
Legend
Prepared By: Diganta Maity, Dy. Director, APPE & M Cell, I&WD

ANNEXURE-I8

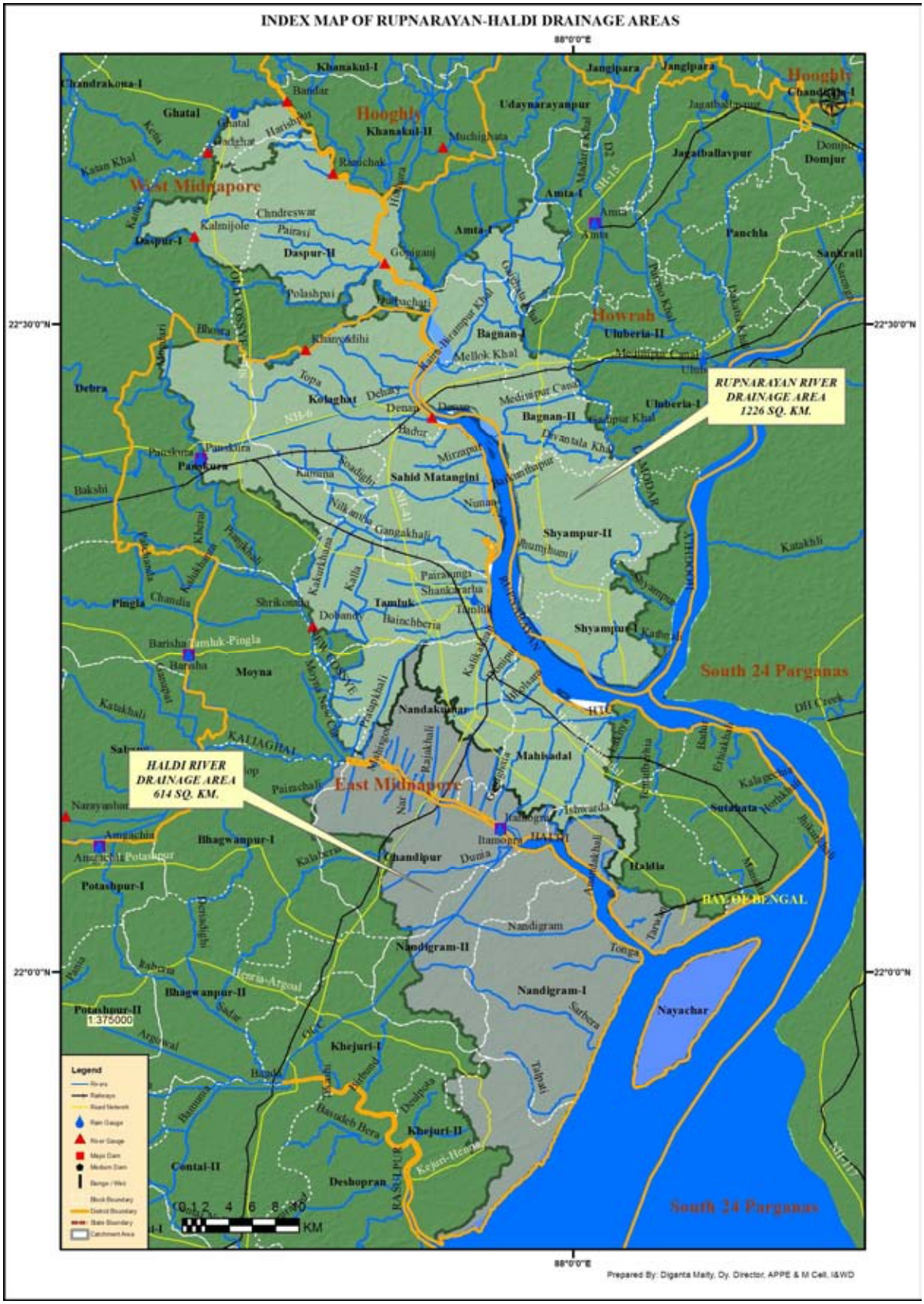


Prepared By: Diganta Maity, Dy. Director, APPE & M Cell, I&WD

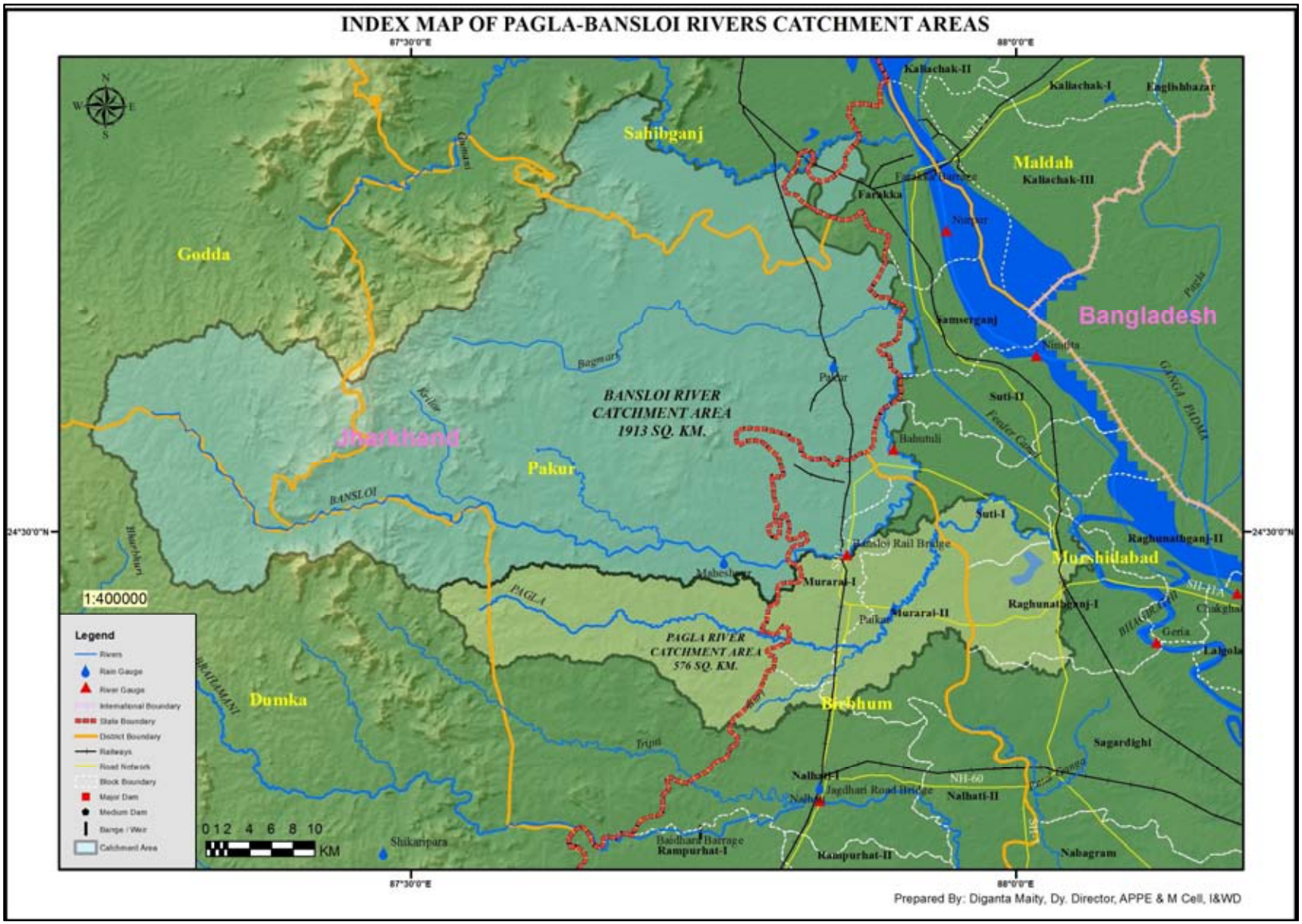
ANNEXURE-I9


INDEX MAP OF SUNDARBAN DRAINAGE AREA
Legend
Rivers
Railways
Rain Gauge
River Gauge
Block Boundary
District Boundary
International Boundary
Catchment Area
SUNDARBAN DRAINAGE AREA 6719 SQ. KM.
Bangladesh
North 24 Parganas
Howrah
Kolkata
South 24 Parganas
East Midnapore
BAY OF BENGAL
Prepared By: Diganta Maity, Dy. Director, APPE & M Cell, I&WD

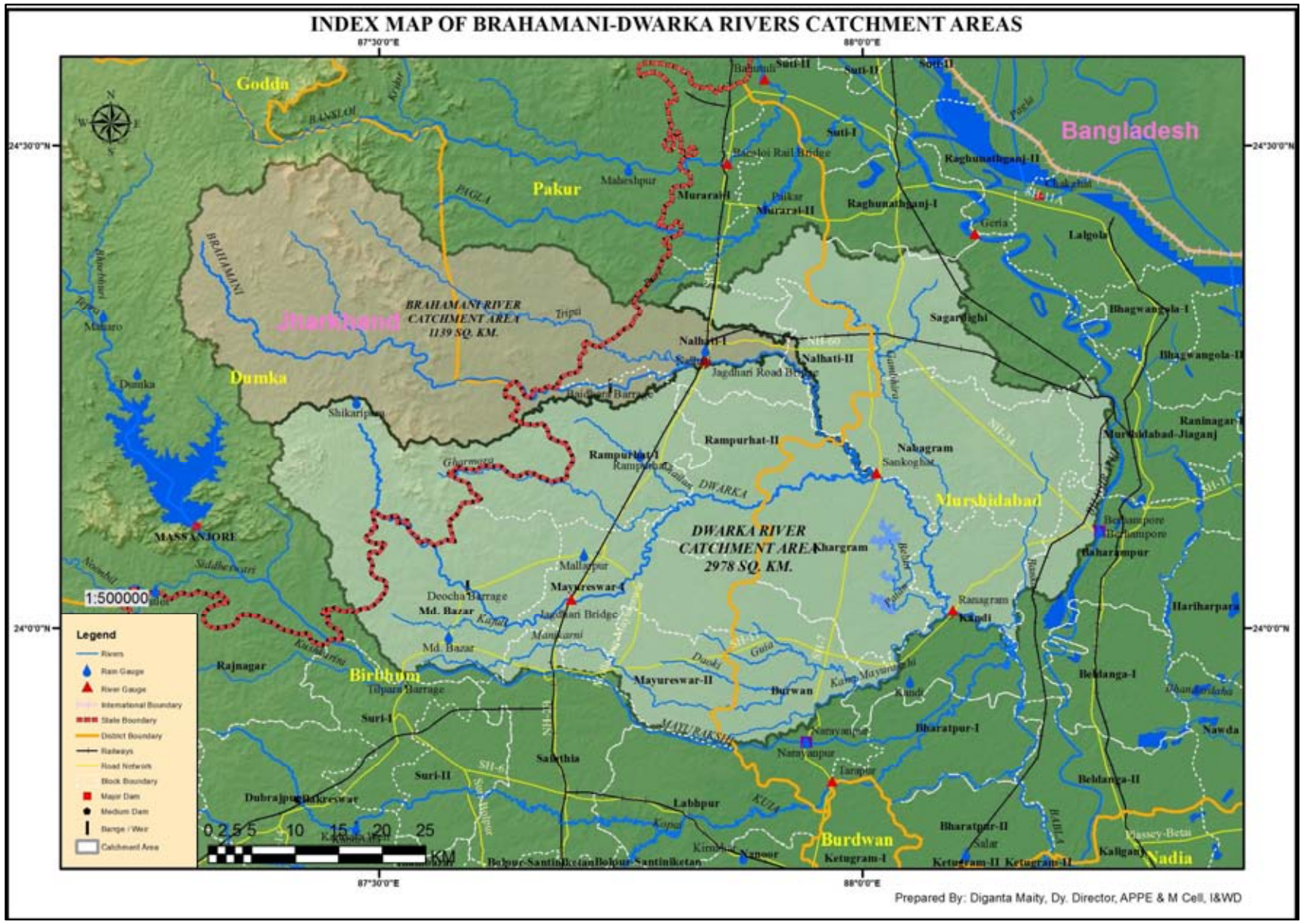
ANNEXURE-I10



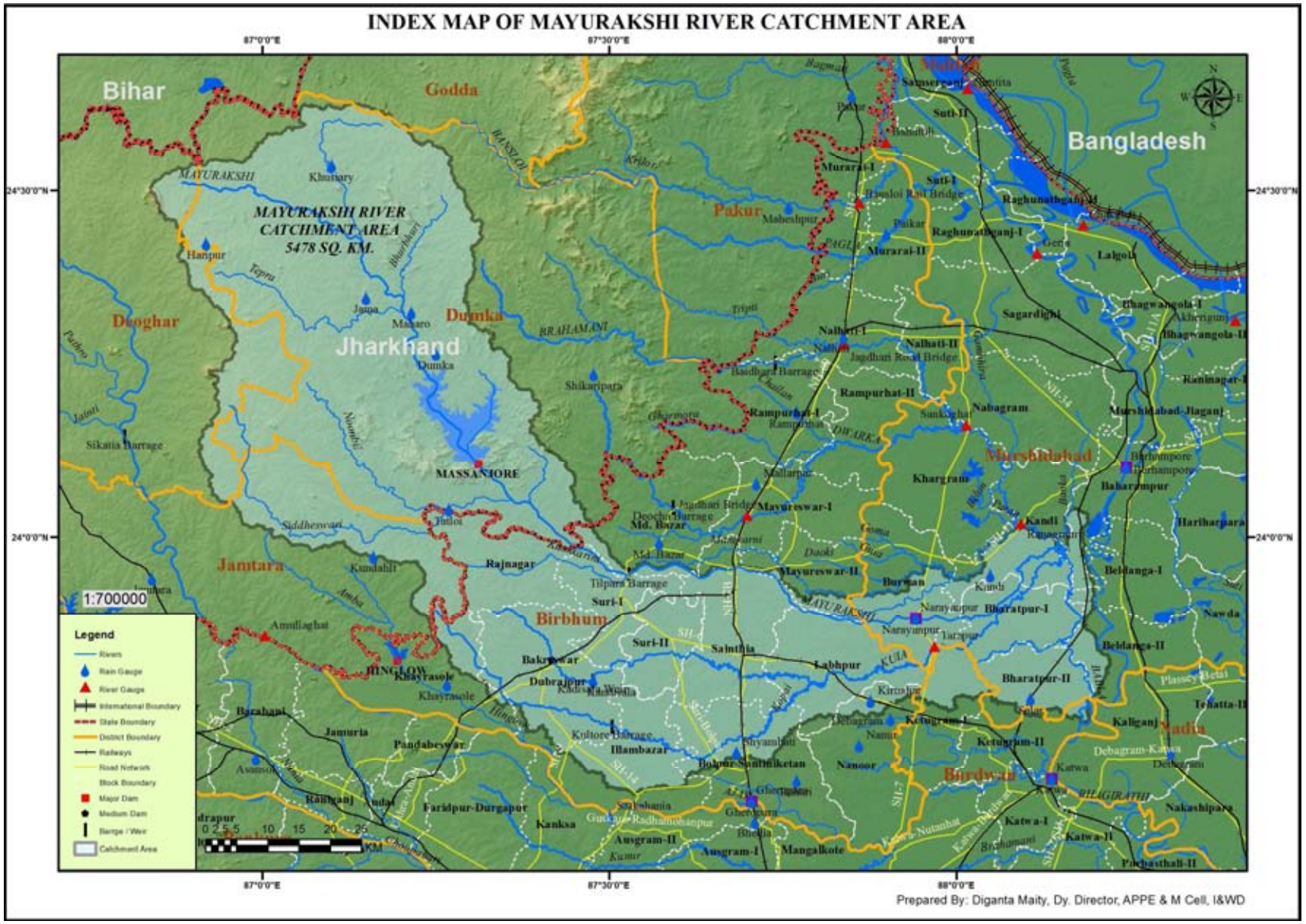
ANNEXURE-I11



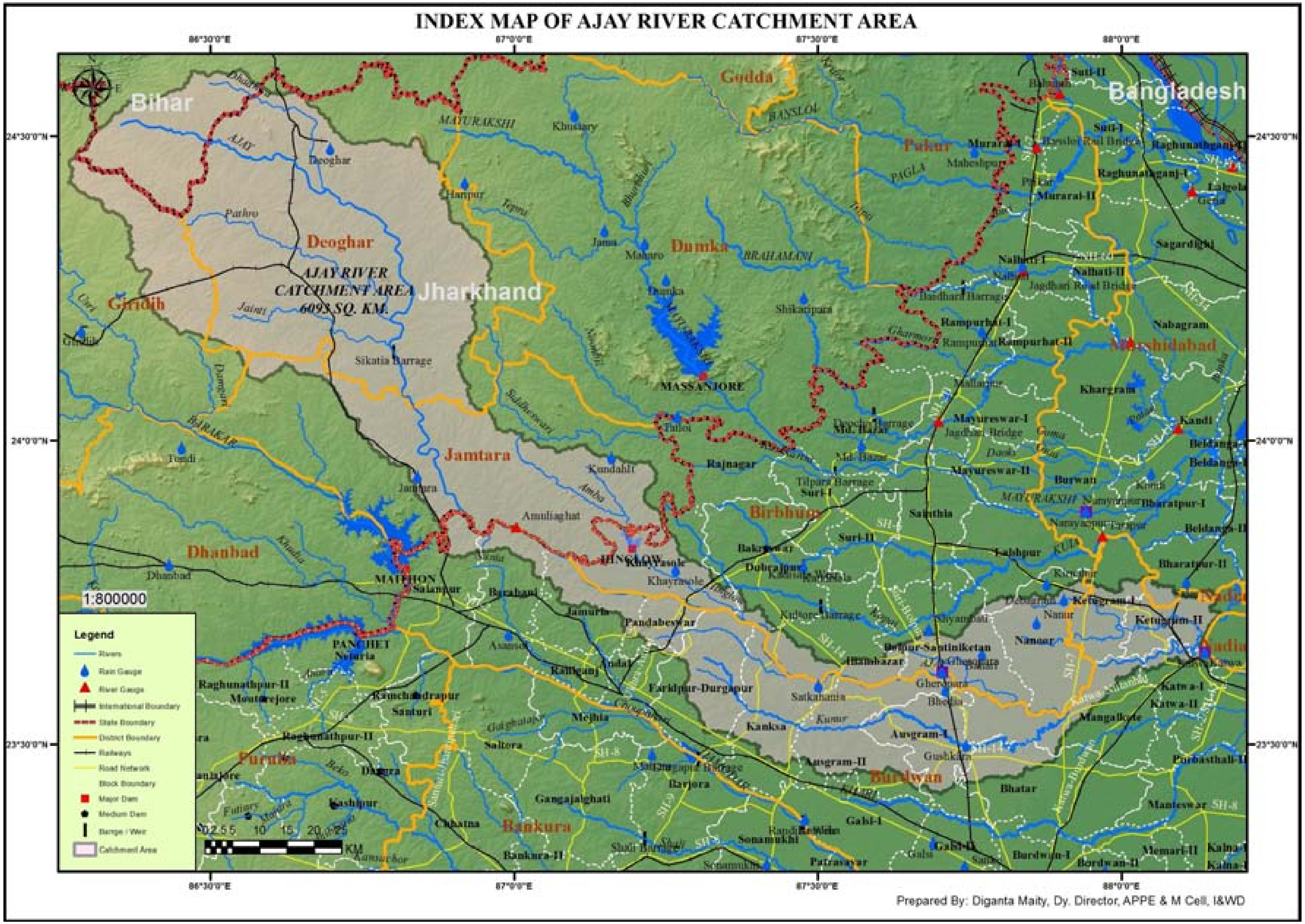
ANNEXURE-I12



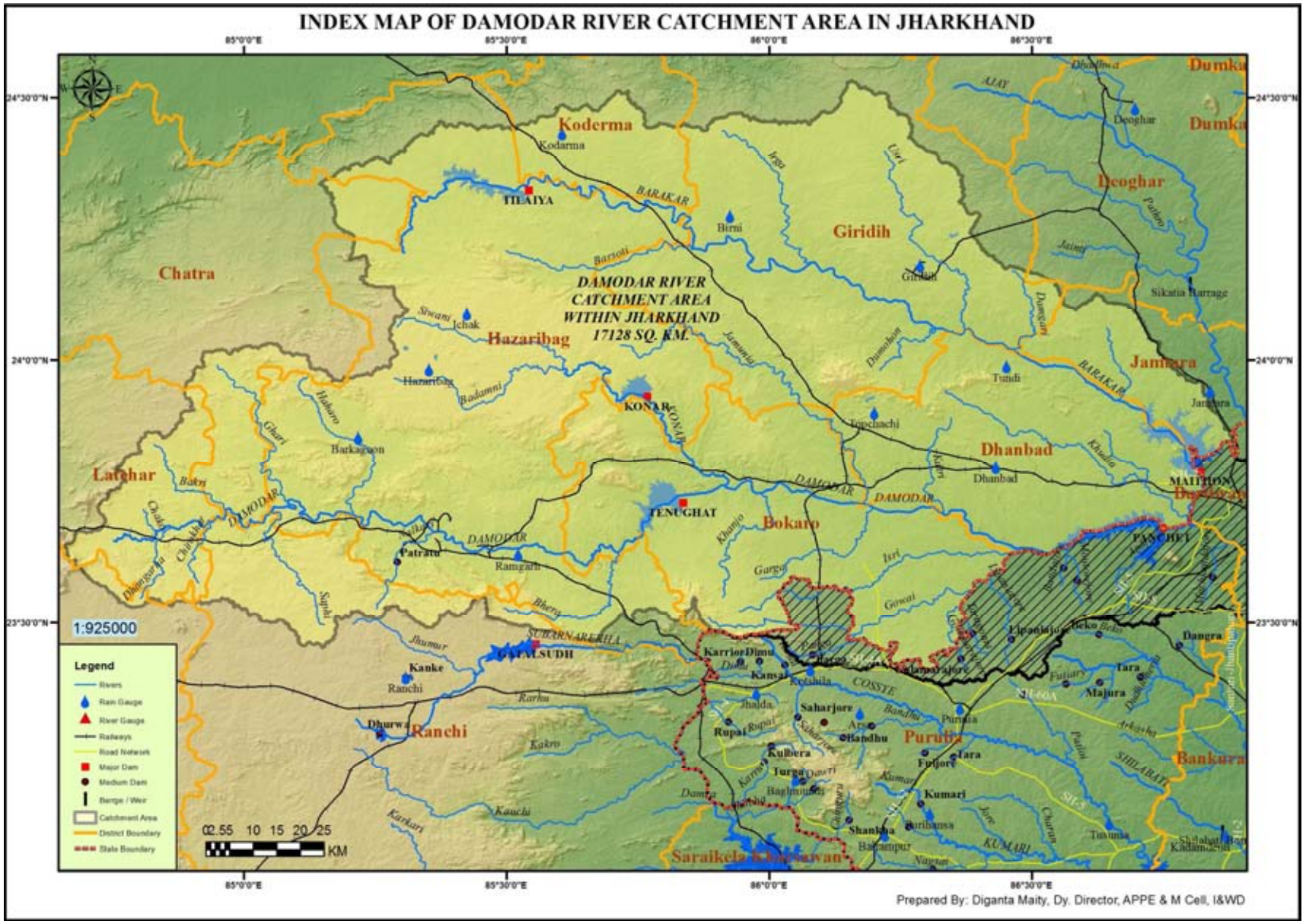
ANNEXURE-I13



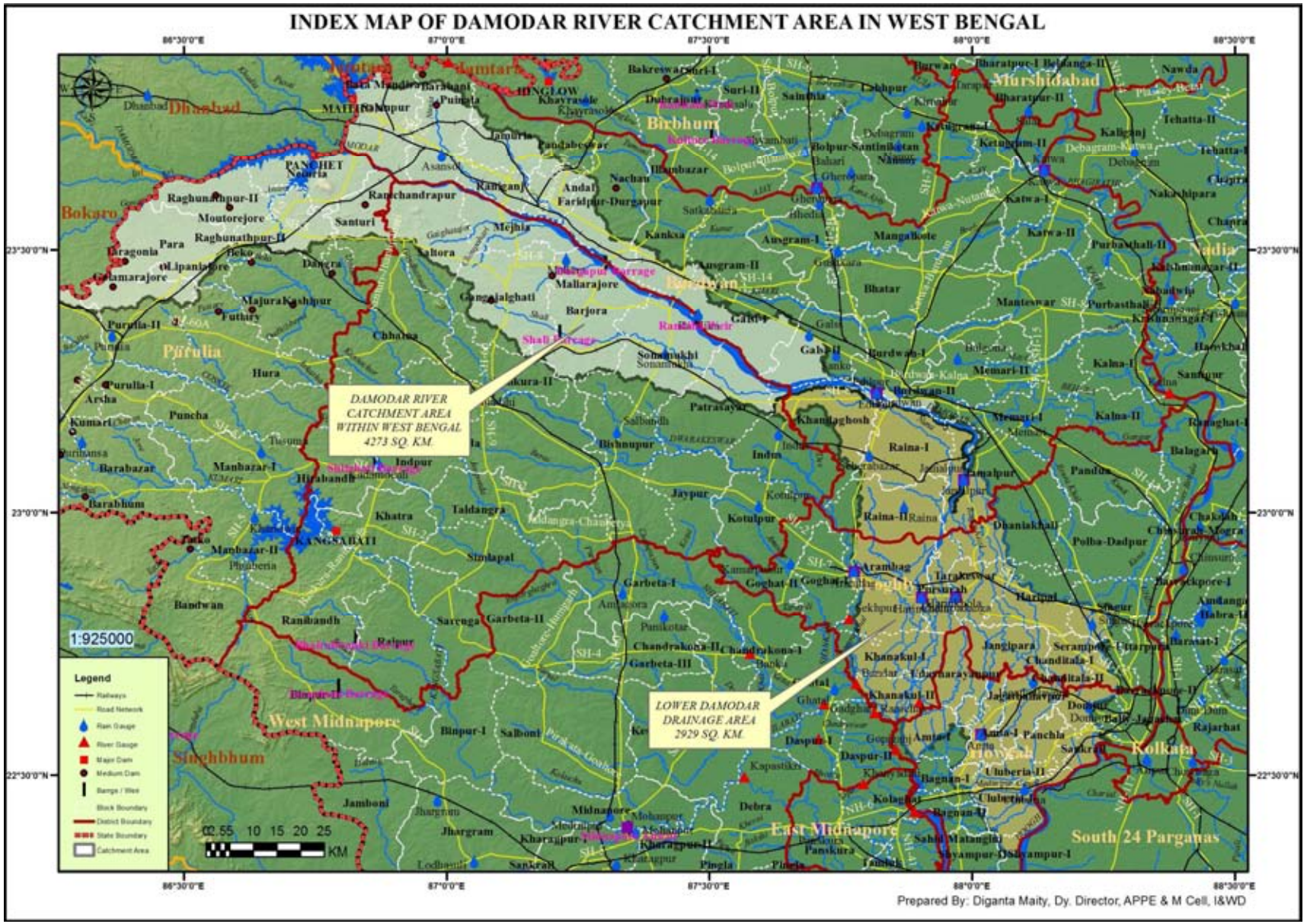
ANNEXURE-I14



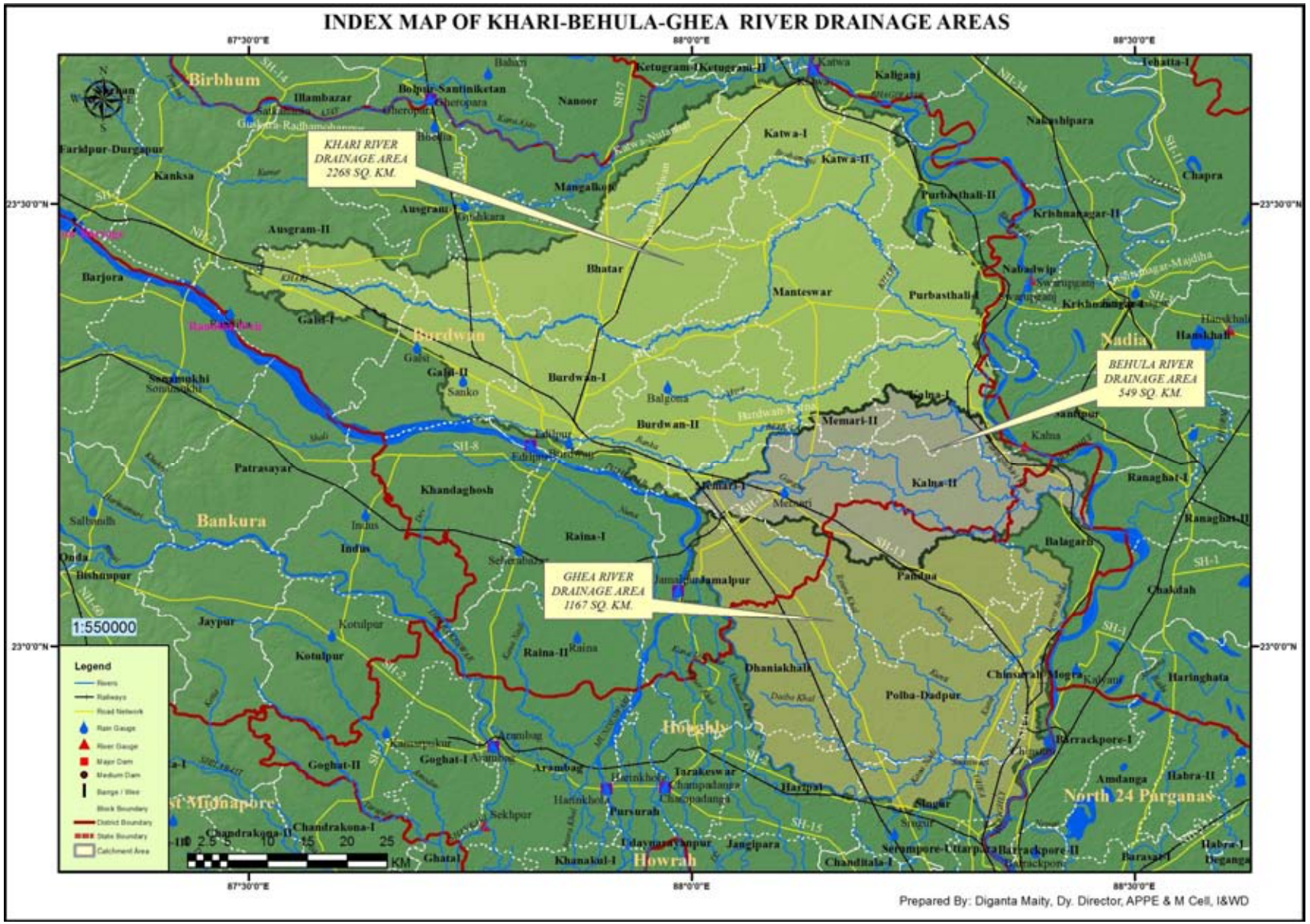
ANNEXURE-I15



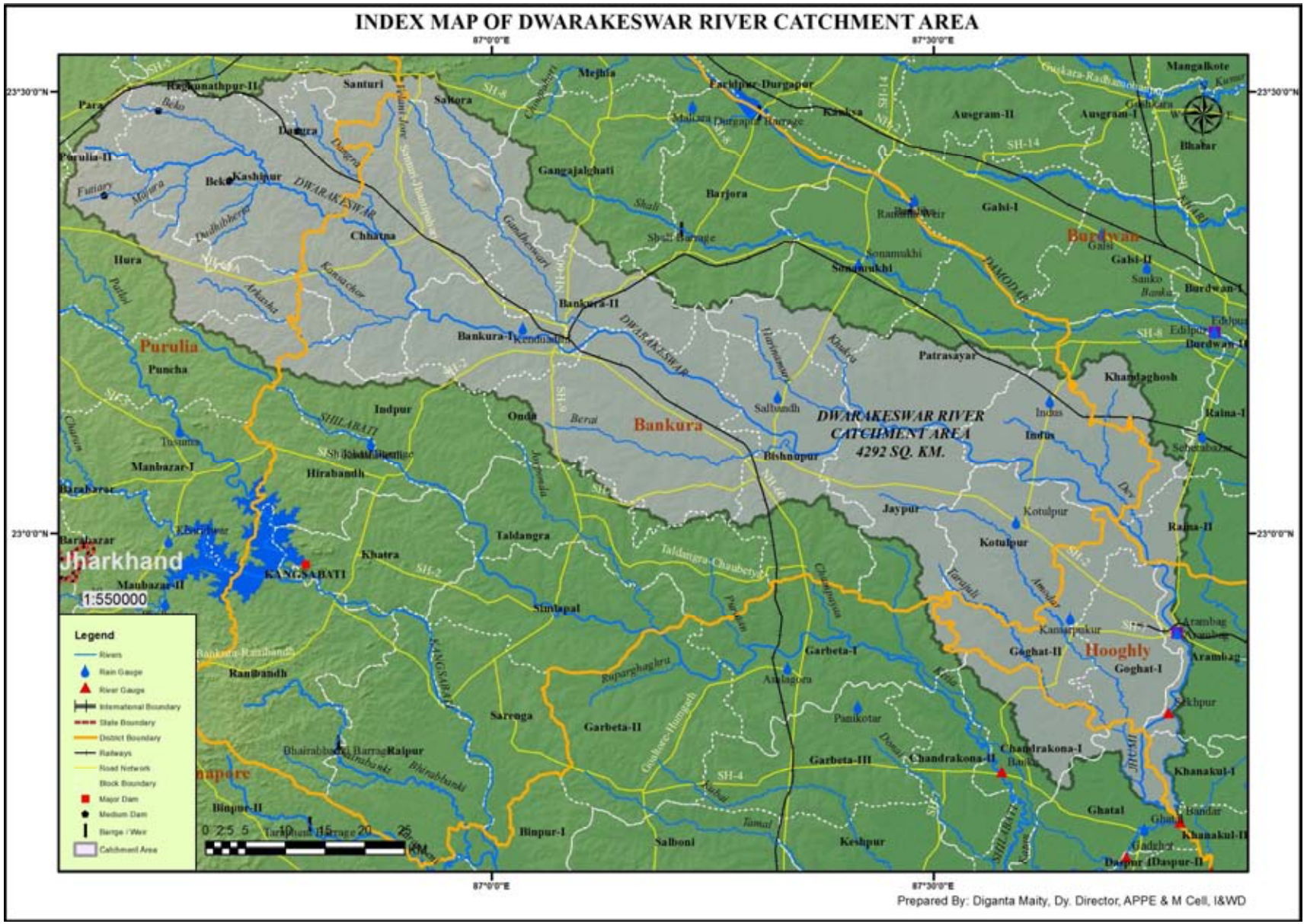
ANNEXURE-I16



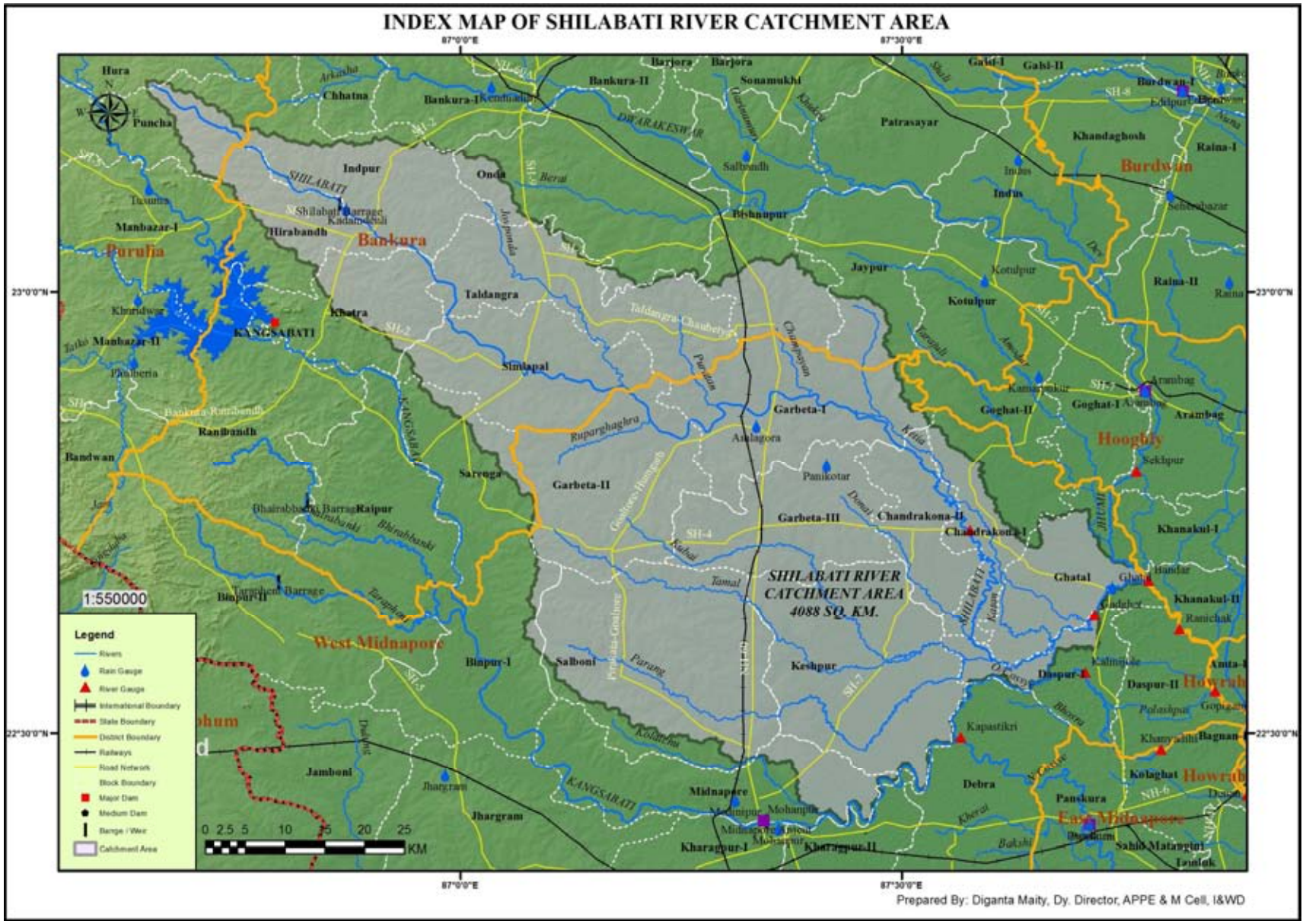
ANNEXURE-I17



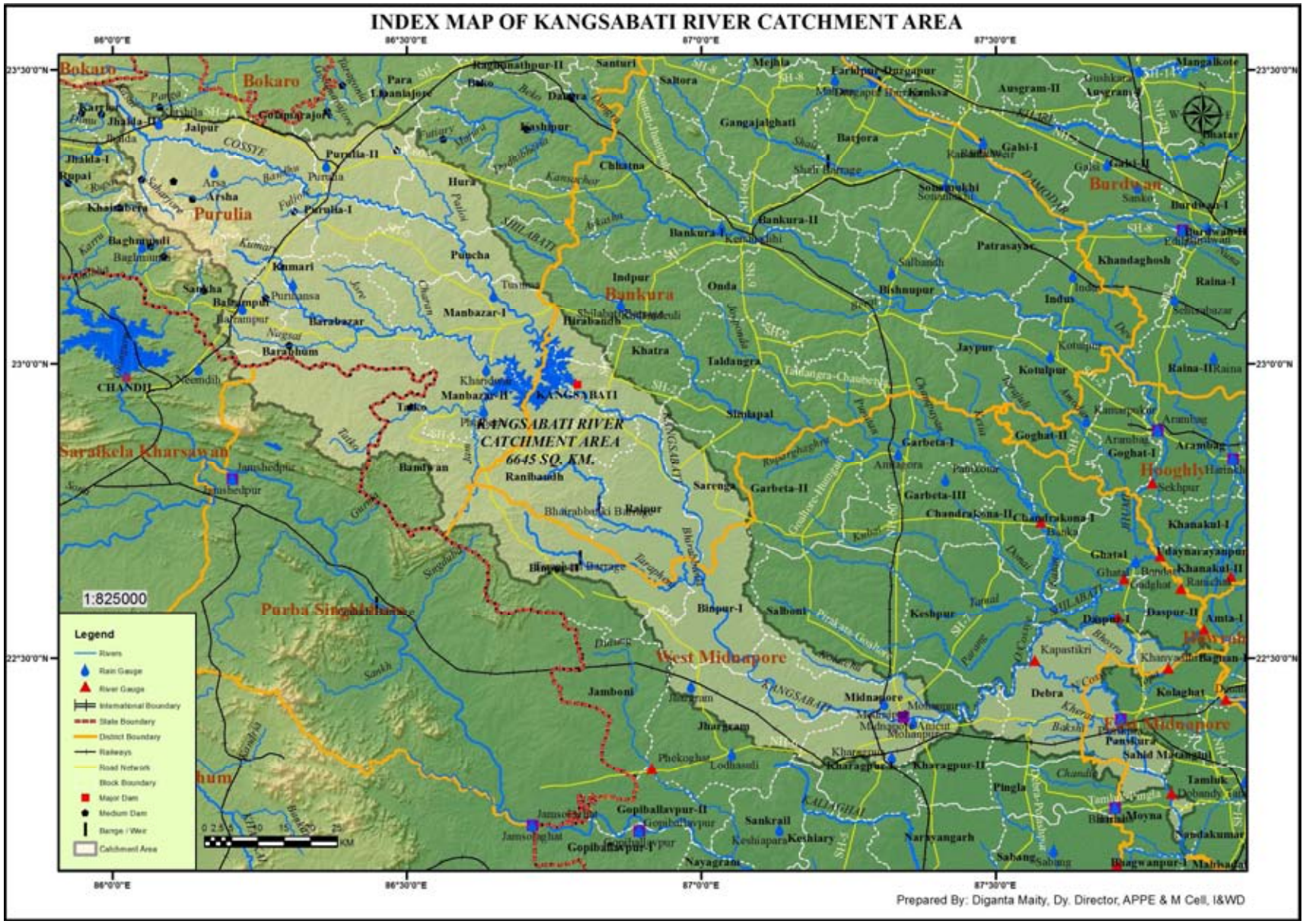
ANNEXURE-I18



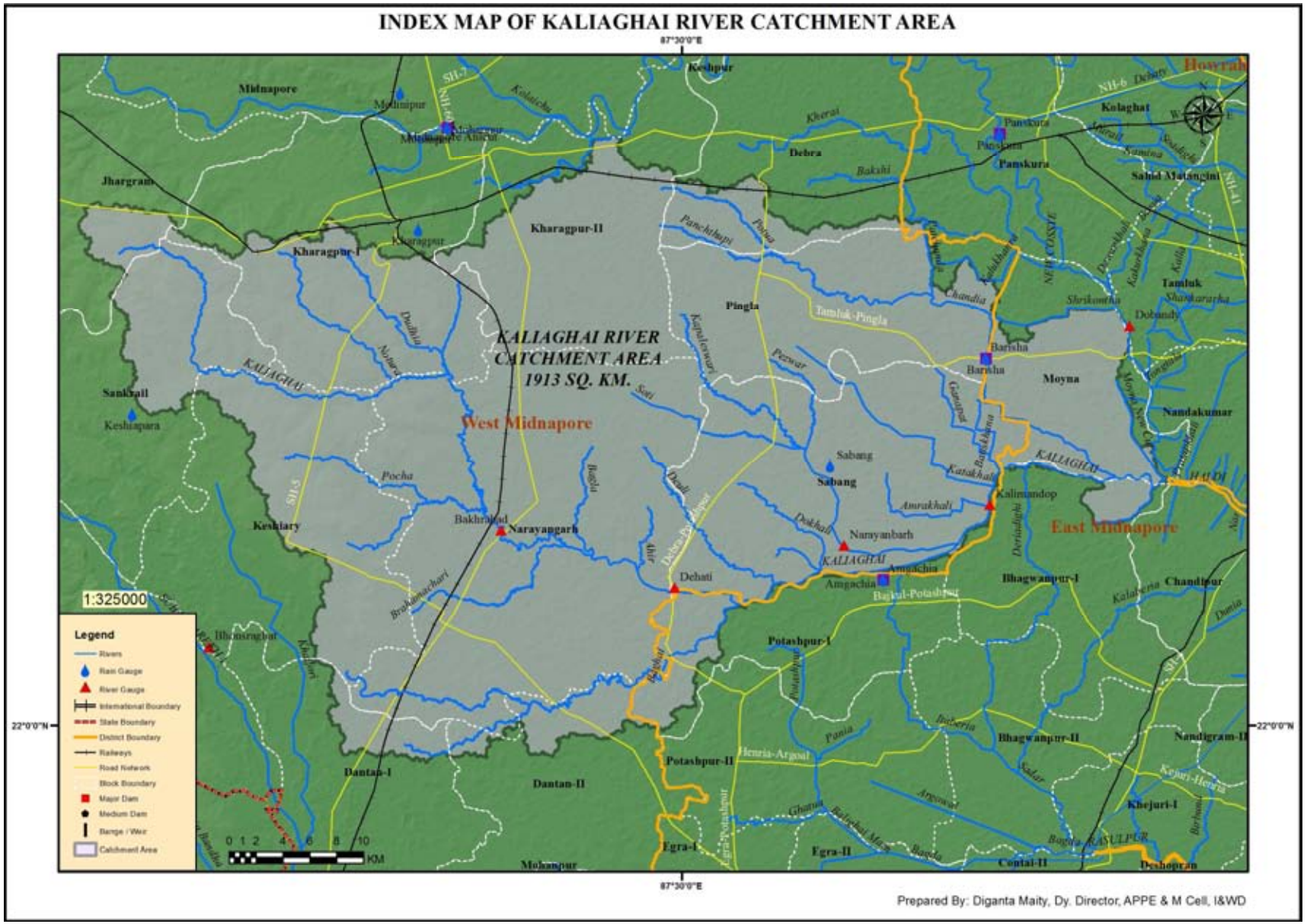
ANNEXURE-I19



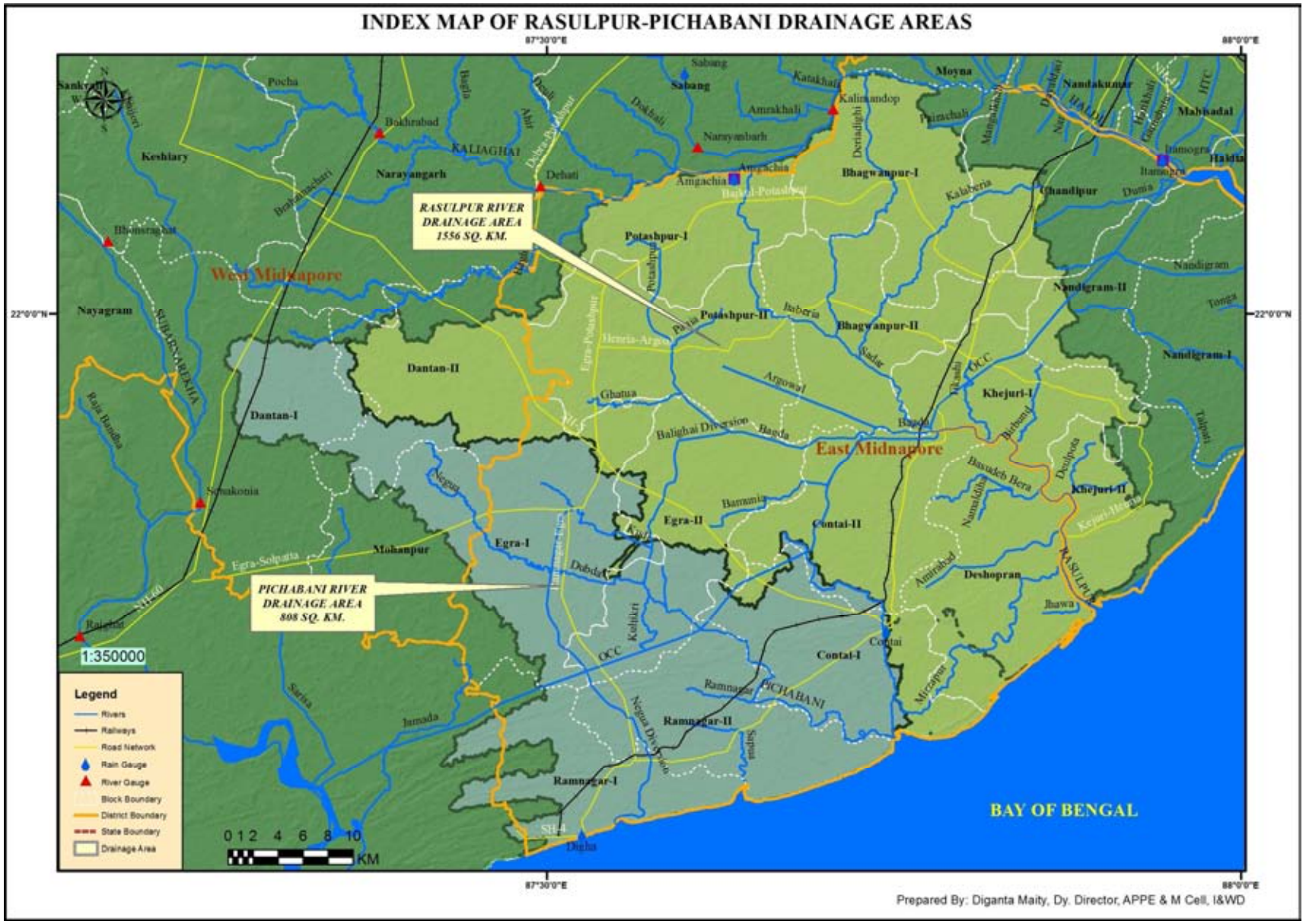
ANNEXURE-I20



ANNEXURE-I21



ANNEXURE-I22



ANNEXURE-I23