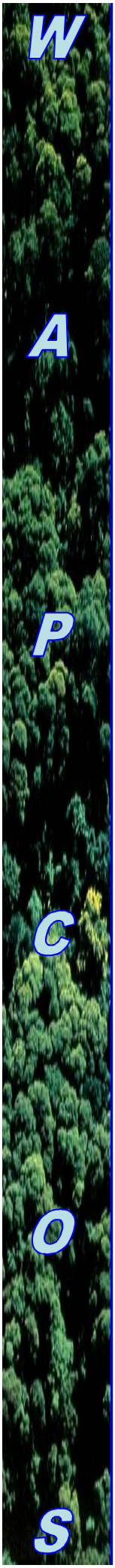

MINISTRY OF ENVIRONMENT AND FORESTS, GOVERNMENT OF INDIA

EFFECT OF PEAKING POWER GENERATION BY SIANG LOWER HEP, DEMWE LOWER HEP AND DIBANG MULTIPURPOSE HEP ON DIBRU-SAIKHOWA NATIONAL PARK

WAPCOS LIMITED

(A GOVERNMENT OF INDIA UNDERTAKING)

PLOT NO. 76 - C, SECTOR 18, GURGAON - 122 015, HARYANA

NOVEMBER 2011

CONTENTS

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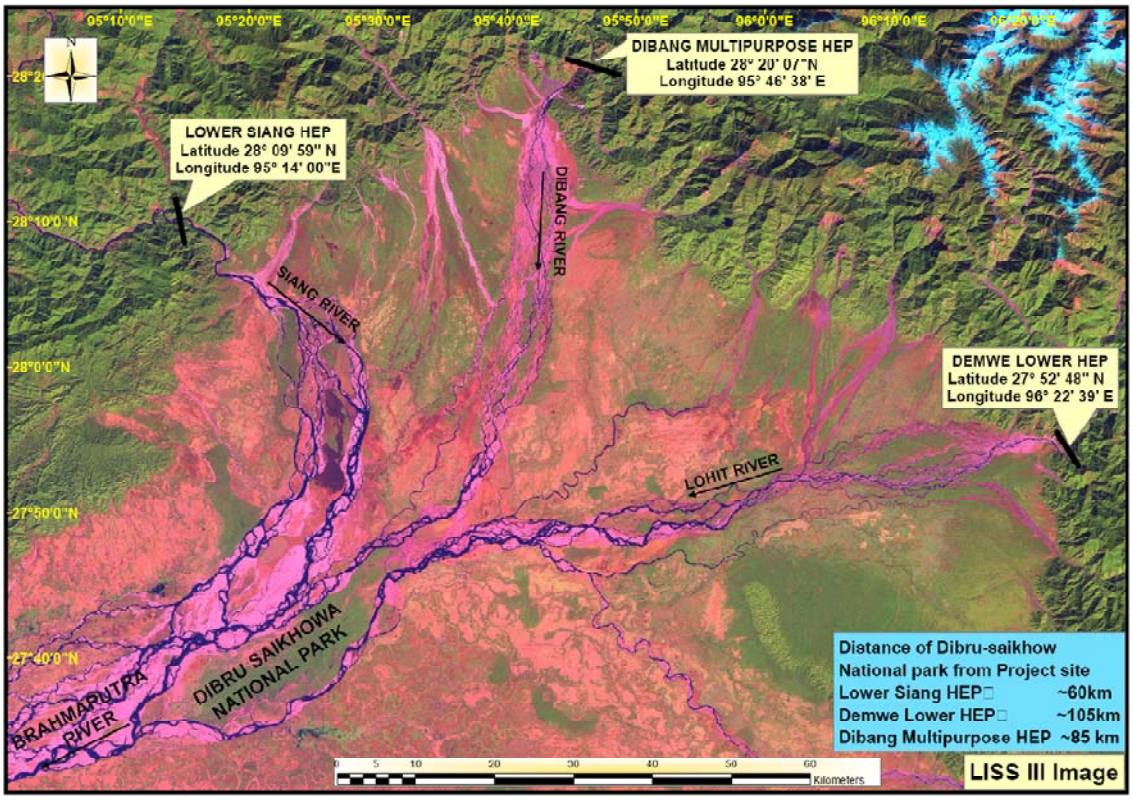

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(A GOVERNMENT OF INDIA UNDERTAKING)

PLOT NO. 76-C, SECTOR 18, GURGAON -122015, HARYANA

Effect of peaking power generation by Siang Lower HEP, Demwe Lower HEP and Dibang Multipurpose HEP on Dibru-Saikhowa National Park

1. INTRODUCTION

The Dibru-Saikhowa National Park is situated on the Left Bank of the river Brahmaputra in the extreme east of Assam and falls between the following geographical coordinates: Latitudes: 27° 30' – 27° 45'N, Longitudes: 95°10' – 95° 45'E. Brahmaputra River is mainly formed by confluence of three rivers namely Siang River, Dibang River and Lohit River. Series of hydropower projects are proposed on these three tributaries of Brahmaputra River upstream of confluence point out of which the three large projects located closest to it are, Demwe Lower HEP (1750 MW) on Lohit River, Dibang Multipurpose HEP (3000 MW) on Dibang River and Lower Siang HEP (2700 MW) on Siang River. The schematic of all HEP's is shown in **Figure 1**. During monsoon season due to availability of high discharge in the rivers, all the three projects may operate through most part of the day to produce the power and thus there will not be much flow variation downstream of these dam-toe schemes due to regulation for power generation. In fact Demwe Lower in mansoon months will operate in such a fashion that the Lohit River will be flowing in its natural regime. However during the lean season months, i.e. from December to February, when the river discharges are considerably reduced, these projects may operate at their installed capacities during peaking hours of the day (which may vary from 3 Hrs to 5 Hrs depending upon the water availability). This essentially means that in the worst possible scenario, these projects will release only environmental flows during the non-peaking hours (non peaking hours could be as high as 21 hours every day) and conserve the river discharges in its reservoir so as to supply peaking power by generating at their installed capacities during the remaining 3 hour period of the day. It is thus apprehended by many that during peaking hours of the day, water flow below the downstream of each of these dams will vary on a daily basis and this will cause artificial floods during those 3 hours when these plants are in the peaking mode. The purpose of this study is to examine the entire situation and based on available data for these 3 projects simulate the hydraulic conditions to quantify the flows and stage during the lean months. The effect of the winter peaking is proposed to be studied on the Brahamputra river near the Dibru-Saikhowa National park which is a place of importance from the point of view of natural habitat of many species. Dibru-Saikhowa is actually a riverine island having rich bio-diversity.

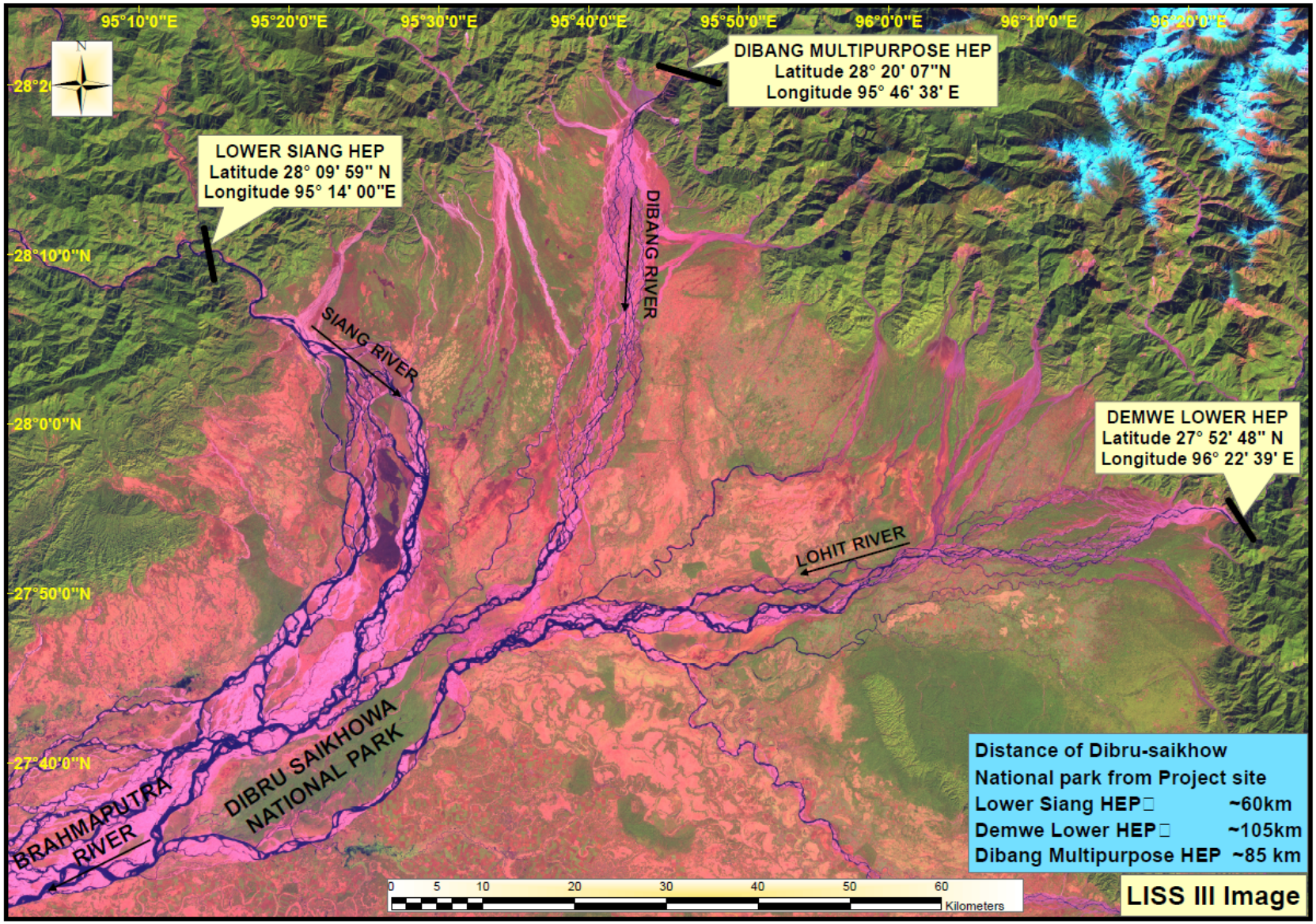


Figure 1: Map showing location of Lower Siang HEP, Demwe Lower HEP and Dibang Multipurpose HEP w.r.t. DibruSaikhowa National Park

2. RIVER MORPHOLOGY

Before the year 1998, the flow scenario of Lohit, Dibang and Siang was different as compared to present day. Before year 1998, Lohit River used to meet with Dibang River and then the combined flow of Lohit and Dibang River used to meet with Siang River before Dibru Saikhowa National Park. But from the year 1998 to 2003, the transition of flow path has occurred in Lohit River and as consequence to this, the flow path of Lohit has changed. From the year 2003, Dibang river directly meets with Siang River on the northern boundary and before Dibru Saikhowa National Park while Lohit River flows along the Southern boundary of Dibru Saikhowa National Park and then after passing along the southern boundary of Dibru Saikhowa National Park, flow of Lohit River meets with the combined flow of Siang and Dibang River i.e. Brahmaputra River. The two scenario i.e. Flow scenario before 1998 and after 2003 are given in **Figure 2 and Figure 3.**

3. TOPOGRAPHY, HYDROLOGY AND HYDRAULICS INPUT –

For analyzing the effect of flow variation of Hydro Electric Projects (HEP), two major cases have been considered as below:

CASE I: The flow path of Rivers after 2003 which is the present scenario.

CASE II: Flow path of rivers before year 1998 which may occur in future. Both these flood cases are envisaged for studying the effect of all three project on Dibru Saikhowa National Park.

Following inputs have been used for setting up of this Model in the US Army Corps of Engineers software HEC-RAS - 4.0.

(a) 31 Nos. of River cross sections on Lohit River ranging from Demwe Lower dam site and upto the Dibru-Saikhowa National Park.

(b) 15 Nos. of River cross sections on Dibang River ranging from Dibang dam site and up to the Dibru-Saikhowa National Park.

(c) 12 Nos. of River cross sections on Siang River ranging from Lower Siang dam site and upto the Dibru-Saikhowa National Park.

(d) Average distance of the Projects from the nearest boundary of Dibru-Saikowa park is as given below:

S. No.	Project	Distance of Dibru-saikhow National park from Project site
1	Lower Siang HEP	~60km
2	Demwe Lower HEP	~105km
3	Dibang Multipurpose HEP	~85 km

(e) The Catchment area of Rivers at various locations is as given below:

River	**Lohit River**		**Siang River**		**Dibang River**	
Location	At Demwe Lower dam site	At Confluence of Lohit with Brahamputra	At Siang Lower dam site	At Confluence of Lohit with Brahamputra	At Dibang dam site	At Confluence of Lohit with Brahamputra
Catchment Area (Sq Km)	20,174	28,094	2,50,594	2,51,719	11,276	13,351

(f) The design discharge for these projects for power generation are as tabulated below

S. No.	Project	Design discharge for power generation, Cumec	Installed Capacity, MW
1	Lower Siang HEP	5462	2700
2	Demwe Lower HEP	1729	1750
3	Dibang Multipurpose HEP	1430	3000

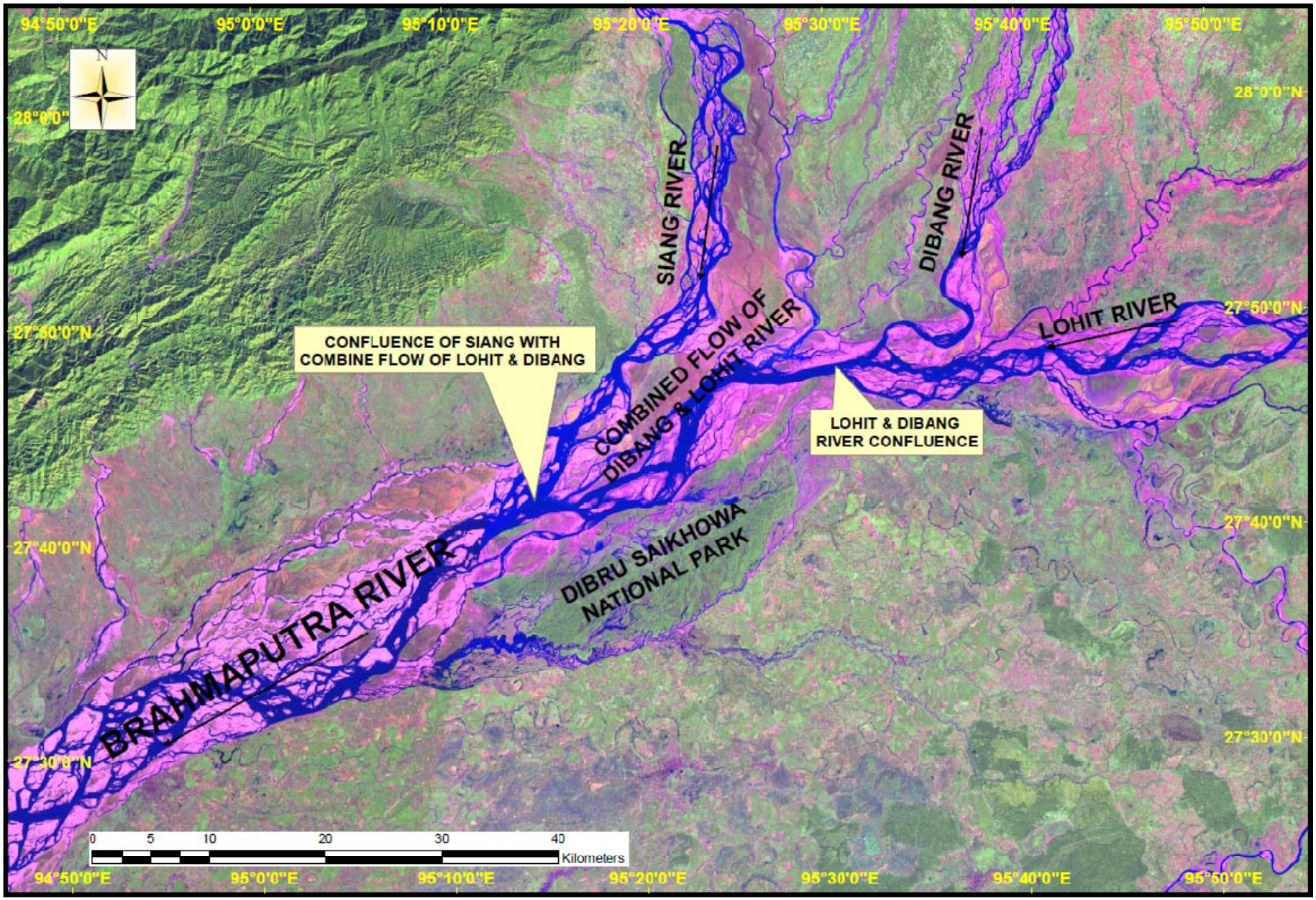


Figure 2: Flow scenario of Lohit, Siang and Dibang River before year 1998

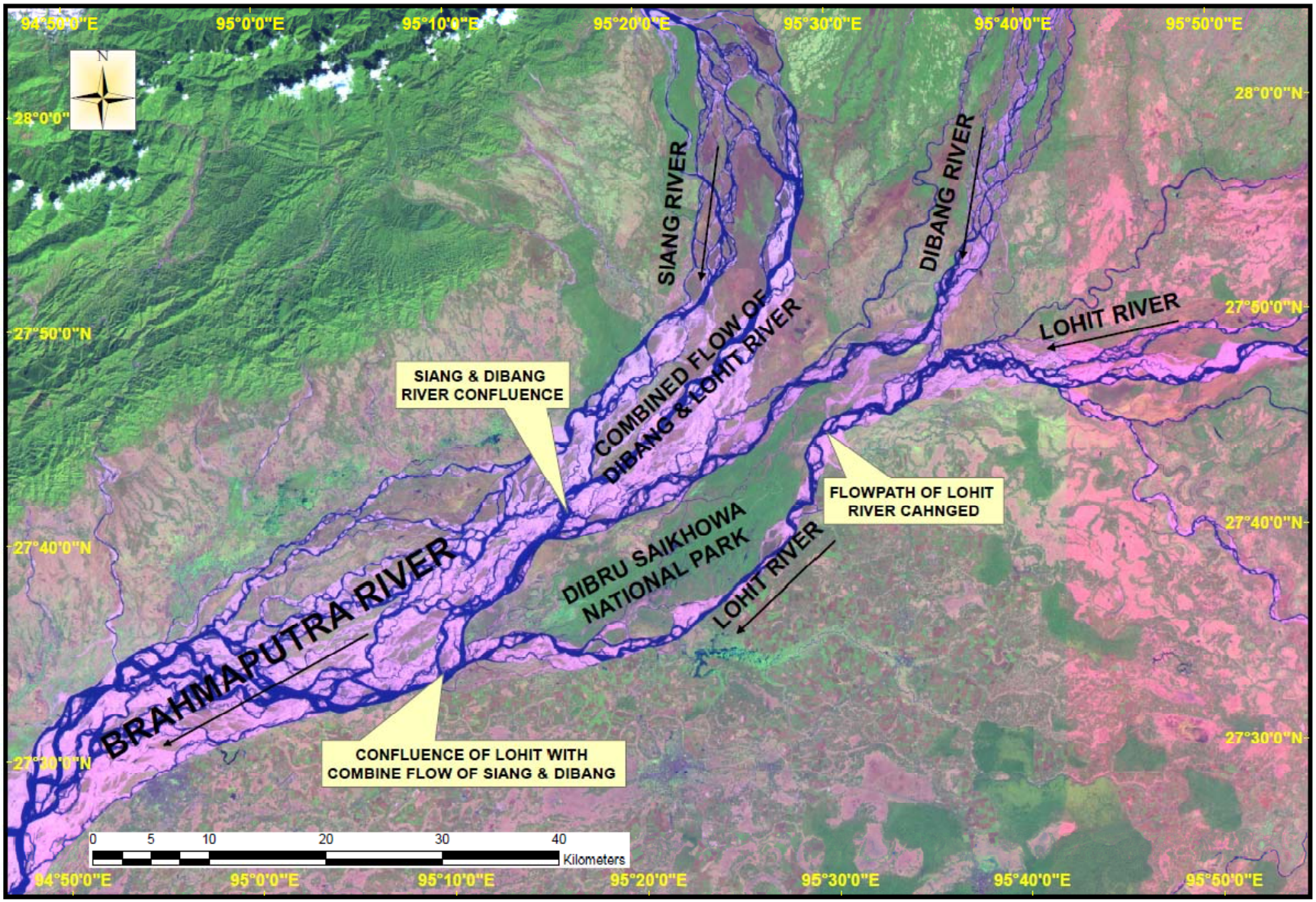


Figure 3: Flow scenario of Lohit, Siang and Dibang River after year 2003

(g) The environmental flows that may be required to be released downstream of these projects on a continuous basis is assumed to be as tabulated below,

S. No.	Project	Minimum flow release, Cumec
1	Lower Siang HEP	328
2	Demwe Lower HEP	70
3	Dibang Multipurpose HEP	50

(h) The monthly River flows for the average year for each of the three projects at their respective dam sites are as tabulated below.

Sl. No.	Month	Discharge (cumecs) of Siang River at Lower Siang dam site	Discharge (cumecs) of Lohit River at Demwe Lower dam site	Discharge (cumecs) of Dibang River at Dibang dam site
1	June	6529.74	2260.61	1110.40
2	July	7144.30	2644.14	2947.10
3	Aug	7834.87	1965.76	1303.20
4	Sep	7109.98	1339.86	875.80
5	Oct	4491.18	1081.34	727.80
6	Nov	2389.65	801.70	344.40
7	Dec	1539.82	677.27	315.10
8	**Jan**	**1030.17**	**302.87**	**330.80**
9	**Feb**	**1037.47**	**311.46**	**652.40**
10	Mar	1310.91	738.49	395.30
11	Apr	1823.36	749.52	385.20
12	May	2805.44	1741.15	1629.40

(i) The flow contribution in respective rivers in the downstream of the proposed dam sites during lean months (average of January and February) is considered as below on catchment area proportion basis:

Lohit River - 90 m^3/s

Dibang River - 120 m^3/s

Siang River - 10 m^3/s

(j) So the Average discharges of Brahamputra River for the average year at Dibru-Saikhowa based on catchment area proportion is given below:

Sl no	Month	Discharge (cumecs) of Brahamputra River at Dibru-Saikowa site
1	June	11021.88
2	July	14347.99
3	Aug	12150.54
4	Sep	10044.74
5	Oct	6878.93
6	Nov	3924.59
7	Dec	2862.97
8	Jan	1848.24
9	Feb	2248.31
10	Mar	2813.24
11	Apr	3331.39
12	May	7171.97

(k) It is important to mention here that these flows are averaged over the 10 daily period obtained from the water availability series and do not show the high flood peaks that occurs in these months. These flood peaks are smoothened due to 10 daily and monthly averaging of the daily observed discharges. To illustrate this, the peak flows of Lohit during the period 1987-1993 & 1996-2004 (16 years) for each of the month and their comparison with the average flow computed from water availability run-off is tabulated below,

Months	Average Year Discharge based on Water Availability series at Demwe Lower dam site (As per Para (h) above) (in cumecs)	Flood peak at Demwe Lower Dam Site (In cumecs)		
		Maximum Peak	Minimum Peak	Average Peak
June	2260.61	8199.69	858.90	3075.54
July	2644.14	12315.45	974.19	3684.16
August	1965.76	7040.67	620.76	2756.52
September	1339.86	6532.33	653.84	2334.59

October	1081.34	5552.56	559.76	1900.89
November	801.70	2074.87	418.22	909.09
December	677.27	1373.68	317.01	658.28
January	302.87	866.66	315.34	519.10
February	311.46	943.82	292.44	567.88
March	783.49	2692.34	331.41	937.07
April	749.52	4528.17	470.36	1520.67
May	1741.15	6239.34	616.77	2370.25

To get the idea about winter floods and flow during winter season, the daily discharge data at Demwe Lower HEP Dam Site for 19 years i.e. 1987-1993, 1996-2004 & 2008-2010 during December to February is analyzed. In total 19 years of data, that the frequency of the discharges at Demwe Lower dam site is:

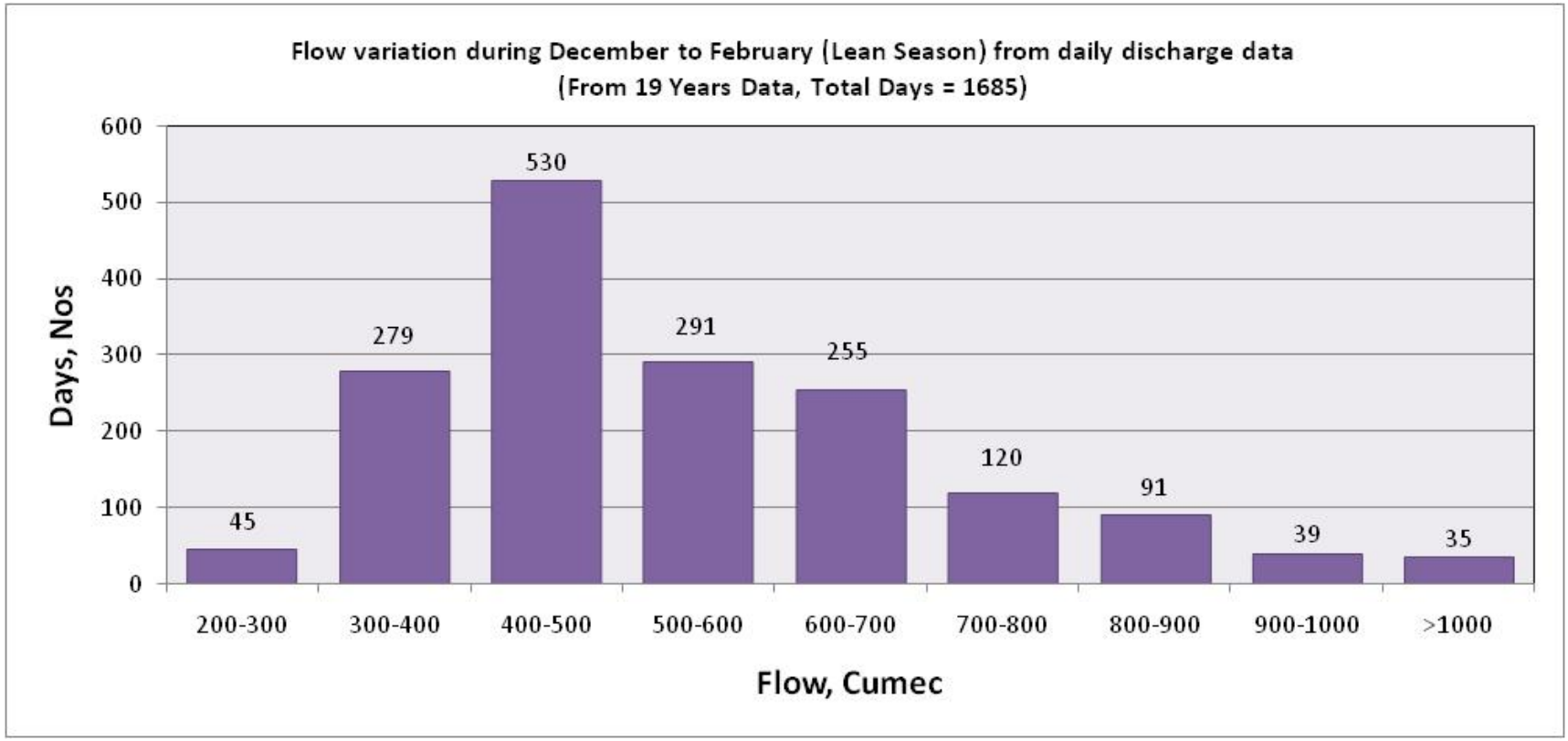
Discharge Range in cumecs (Dec-Feb)	**%age of occurances**
200 -300	2.67
300-400	16.56
400-500	31.45
500-600	17.27
600-700	15.13
700-800	7.12
800-900	5.40
900-1000	2.31
>1000	2.08

From the above table, it may be seen that during the lean months of December-February the winter peaks at Demwe Lower dam site are above 500 cumecs for about 50% of time whereas the winter discharges about 600 cumecs is available for about 32% time. Thus it is seen that during virgin condition also the peak winter discharges above 600 cumecs are not very uncommon.

The detailed frequency table is as given below:

December to February													
S No.	Year	Days	Flow (cumec)										
			Maximum	Minimum	200-300	300-400	400-500	500-600	600-700	700-800	800-900	900-1000	>1000
1	1987	90.00	501.26	323.85	0	59	28	3	0	0	0	0	0
2	1988	91.00	1373.68	292.44	3	48	2	1	3	3	5	6	20
3	1989	90.00	896.94	462.04	0	0	19	33	35	1	2	0	0
4	1990	90.00	879.21	399.06	0	2	49	13	9	9	8	0	0
5	1991	90.00	1003.29	440.99	0	0	33	23	9	8	9	6	2
6	1992	91.00	558.51	317.01	0	26	56	9	0	0	0	0	0
7	1993	90.00	931.22	315.34	0	26	3	11	7	11	30	2	0
8	1996	60.00*	1138.03	600.79	0	0	0	0	23	6	7	15	9
9	1997	90.00	943.82	636.27	0	0	0	0	16	56	17	1	0
10	1998	90.00	911.38	575.28	0	0	0	28	47	10	3	2	0
11	1999	90.00	959.87	495.39	0	0	13	46	5	9	10	7	0
12	2000	91.00	686.82	512.38	0	0	0	33	58	0	0	0	0
13	2001	90.00	566.32	457.73	0	0	54	36	0	0	0	0	0
14	2002	90.00	529.81	442.47	0	0	77	13	0	0	0	0	0
15	2003	90.00	490.12	413.19	0	0	90	0	0	0	0	0	0
16	2004	91.00	486.11	383.37	0	23	68	0	0	0	0	0	0
17	2008	91.00	774.00	210.00	39	20	1	4	23	4	0	0	0
18	2009	90.00	1242.00	359.00	0	5	20	38	20	3	0	0	4
19	2010	90.00	475.00	298.00	3	70	17	0	0	0	0	0	0
Total		1685.00	1373.68	210.00	45	279	530	291	255	120	91	39	35
		Percentage of Total			2.67	16.56	31.45	17.27	15.13	7.12	5.40	2.31	2.08

* Data during January 1996 is not available


Flow variation during December to February (Lean Season) from daily discharge data
(From 19 Years Data, Total Days = 1685)
Days, Nos
600
500
400
300
200
100
0
45
279
530
291
255
120
91
39
35
200-300
300-400
400-500
500-600
600-700
700-800
800-900
900-1000
>1000
Flow, Cumec

4. BRIEF DESCRIPTION OF THE RIVER MODEL AND THE METHODOLOGY –

Following important points are mentioned for the River Model that has been set-up for simulating the peaking conditions for the system and its hydraulic impact in terms of the increase/decrease/variation in water levels and discharges in Brahamputra River at Dibru-Saikowa National Park.

(a) For studying the effect of variation due to peaking power generation on Dibru Saikhowa national Park the worst case of 3 hours peaking and 21 hours of non peaking is considered.

(b) Effect of individual projects has been considered in addition to cumulative effect of all the 3 projects peaking at the same time.

(c) It is assumed that in the worst case scenario all the 3 projects are peaking for 3 hours in a day (24 hours) and their peaking time is same. This is a valid assumption since the peaking time shall be decided by the demand curve of the electricity which would remain same for all these projects. For instance we can say that peak demand in the Northern/Western/Southern region would be say from 8 AM to 11 AM and all these 3 projects will continue generating at their installed capacities during this duration. For the balance 21 hours of the day, they will release the mandatory releases as stipulated above at sub-para 3(g) above.

(d) So for the 3 hours peaking of individual/combined projects, a hydrograph having its ordinate at design discharge for all these 3 hours will be impinging on the river at the dam site and downstream contributions of the Catchment area below the respective dam site would add to the discharge.

(e) Similarly for the 21 hours non-peak hours of the day, a hydrograph having its ordinate at mandatory environmental release will be impinging on the river channel just downstream of the dam axis. This would be added by downstream catchment area contributions.

(f) For the Model to be stable a time period of 10 days has been considered for all the cases.

(g) Since the location of the National park is at the distances mentioned at para 3(d) above and time taken during the travel of the released water is of utmost importance, in addition to the quantum of water being released from individual projects (For

(h) Three River cross sections at Dibru-Saikowa have been considered to study the impact of the flow variations. These sections are named Dibru-saikowa cross section –I, Dibru saikowa cross section – II and Dibru-Saikowa cross section – III. These cross sections are of Brahamputra River and Lohit River, same are enclosed at **Appendix – I**.

(i) From the cross sections of Brahamputra at Dibru-Saikowa it may be seen that the riverine islands are fairly stable and the lowest elevations of the Dibru-Saikowa park at these 3 sections are at the following elevations.

Name of Section	Dibru - Saikowa cross section no - I	Dibru - Saikowa cross section no - II	Dibru - Saikowa cross section no - III
Lowest Brahamputra River Elevation (masl)	112.09	108.00	107.89
Lowest Lohit River Elevation (masl)	116.13	114.00	111.25
Lowest Bank elevation; Lowest Elevation of the Park (masl)	125.70	117.30	115.50

(j) There are two cases for present study as discussed in section 3 earlier, the flow path after 2003 which is present days case of flowpath and one is of before year 1998 which may occur in future and is worst case for studying the effect of all three project on DibruSaikhowa National Park.

(k) Five scenarios have been considered in the study for each of the 3 Dibru-Saikowa cross sections. These scenarios are:

(i) When only Demwe Lower HEP is constructed and is doing peaking for 3 hours in a day while Dibang and Siang are flowing in their natural regimes.

(ii) When only Lower Siang HEP is constructed and is doing peaking for 3 hours in a day while Lohit and Dibang are flowing in their natural regimes.

(iii) When only Dibang Multipurpose HEP is constructed and is doing peaking for 3 hours in a day while Lohit and Siang are flowing in their natural regimes.

(iv) All three projects are constructed and are peaking for 3 hours.

(v) No Project scenario

5. RESULT OF THE STUDY –

CASE I: FLOWPATH OF RIVER AS PER PRESENT DAY (Lohit Flowing Along the Southern Bank of Dibru-Saikowa Park)

(a) **When only Demwe Lower is constructed**:

In the present case, Lohit river is flowing freely without any interference from Dibang River and Siang River at Dibru-Saikhowa national park. Three cross sections at Dibru-Saikhowa National park (on southern boundary) have been considered and for this condition when the design discharge of 1729 cumecs is released in the river for 3 hours after 21 hours of non-peak (when only mandatory environmental flow is released downstream of the dam) then it is seen that the flow hydrograph at various cross sections of Dibru-Saikowa is attenuated significantly due to the long 105 km distance. From the hydrograph it may be seen that the maximum flow in the Lohit River near dam site (1729 cumecs) is attenuated to 510.14 cumecs at the Dibru Saikowa Cross section no –I with downstream contribution being considered for Lohit River during lean season. The discharge cycle hydrograph at all three cross sections and the table are enclosed at **Appendix-II**. The brief results for water level due to attenuated flow of Lohit river with downstream contribution are tabulated as below:

S. No.	Cross Section on the Southern Boundary of Park		Cross Section I	Cross Section II	Cross Section III
1	Minimum Bed level		116.13	114.00	111.25
2	Discharge	Maximum	510.14	500.59	489.45
		Minimum	208.06	213.54	220.23
3	Water level	Maximum	118.30	116.09	112.61
		Minimum	117.52	115.46	112.15

(b) **When only Lower Siang is constructed and Lohit and Dibang rivers are in their natural regimes**:

For this condition when the design discharge of 5462 cumecs is released in the Siang river for 3 hours after 21 hours of non-peak then it is seen that the flow hydrograph at various cross sections of Dibru-saikowa is attenuated due to the 60 km travel distance. From the hydrograph it may be seen that the maximum flow in the Siang river near dam site (5462 cumecs) is attenuated to 2190.31 cumecs at the Dibru

Saikowa Cross section no –I (on northern boundary of the Park) with downstream contribution being considered for Siang river during lean season. The discharge cycle hydrograph at all three cross sections and the table are enclosed at **Appendix-III**. The brief results for water level due to combine effect of natural flow regime of Dibang River and attenuated flow of Siang River with downstream contribution are tabulated as below:

S. No.	Cross Section on the Northern Boundary of Dibru-Saikowa		Cross Section I	Cross Section II	Cross Section III
1	Minimum Bed level		112.09	108.00	107.89
2	Discharge	Maximum	2802.31	2570.07	2280.33
		Minimum	954.75	985.76	1076.41
3	Water level	Maximum	118.80	116.14	113.52
		Minimum	117.13	115.18	112.63

(c) When only Dibang Multipurpose HEP is constructed and Siang and Lohit rivers are in their natural regimes:

For this condition when the design discharge of 1430 cumecs is released in the Dibang river for 3 hours after 21 hours of non-peak then it is seen that the flow hydrograph at various cross sections of Dibru-Saikowa is attenuated due to the 85 km travel distance. From the hydrograph it may be seen that the maximum flow in the Dibang river near dam site (1430 cumecs) is attenuated to 765.22 cumecs at the Dibru Saikowa Cross section no –I with downstream contribution being considered for Dibang river during lean season. The discharge cycle hydrograph at all three cross sections and the table are enclosed at **Appendix-IV**. The brief results for water level due to combine effect of natural flow regime of Siang River and attenuated flow of Dibang River with downstream contribution are tabulated as below:

S. No.	Cross Section on the Northern Boundary of Park		Cross Section I	Cross Section II	Cross Section III
1	Minimum Bed level		112.09	108.00	107.89
2	Discharge	Maximum	1809.22	1688.89	1523.98
		Minimum	1214.06	1216.66	1227.84
3	Water level	Maximum	118.15	115.71	113.03
		Minimum	117.53	115.40	112.77

(d) All three projects are constructed and are peaking for 3 hours

For this scenario, the flow in Lohit river will be as per scenario (a) considered earlier and for Siang and Dibang there will be a combine flow from Lower Siang and Dibnag Multipurpose HEP. For analyzing the maximum effect that can occur at Dibru saikhowa national Park due to operation of both Dibang Multipurpose and Lower Siang projects, discharges at respective cross sections for both projects are added up with temporal variation and same has been routed through the river stretch to get the maximum possible variation. The combined discharge cycle hydrograph with both projects operating at same time peaking is enclosed as **Appendix V.**

S. No.	Cross Section on the Northern Boundary of Park		Cross Section I	Cross Section II	Cross Section III
1	Minimum Bed level		112.09	108.00	107.89
2	Discharge	Maximum	2360.53	2132.15	1877.26
		Minimum	518.89	571.61	700.04
3	Water level	Maximum	118.56	115.95	113.27
		Minimum	116.22	114.54	112.16

(e) No Project scenario

When no project is developed and all the rivers i.e. Lohit River, Siang River and Dibang River are flowing in their natural regimes, the water level at different cross sections of Dibru-Saikhowa national park are tabulated as below

S. No.	Cross Section	Cross Section I	Cross Section II	Cross Section III	Remarks
Lohit River					
1	Minimum Bed level	116.13	114.00	111.25	These are on the Southern Boundary of Dibru-Saikowa Park
	Discharge, cumec	398			
3	Water level	118.06	115.90	112.47	
Siang and Dibang River					
1	Minimum Bed level	112.09	108.00	107.89	These are on the Northern Boundary of Dibru-Saikowa Park
2	Discharge	1656			
3	Water level	118.01	115.69	113.12	

CASE II: FLOWPATH OF RIVER AS PER BEFORE YEAR 1998 AND MAY OCCUR IN FUTURE (Lohit Flowing Along the Northern Bank of Dibru-Saikowa Park)

The Model was run for all the four conditions and the brief results are mentioned below:

(a) When only Demwe Lower is constructed and Siang and Dibang rivers are in their natural regimes:

For this condition when the design discharge of 1729 cumecs is released in the river for 3 hours after 21 hours of non-peak (when only mandatory environmental flow is released downstream of the dam) then it is seen that the flow hydrograph at various cross sections of Dibru-saikowa is attenuated significantly due to the long 105 km distance. From the hydrograph it may be seen that the maximum flow in the Lohit river near dam site (1729 cumecs) is attenuated to 632.75 cumecs at the Confluence of Lohit and Dibang and further to 496.94 cumecs at the Dibru Saikowa Cross section no –I with downstream contribution being considered for Lohit river during lean season. The discharge cycle hydrograph at all three cross sections are enclosed at **Appendix-VI**. The brief results for water level due to combine effect of natural flow regime of Siang and Dibang River and attenuated flow of Lohit river with downstream contribution are tabulated as below:

S. No.	Cross Section on Northern Boundary of Park		Cross Section I	Cross Section II	Cross Section III
1	Minimum Bed level		112.09	108.00	107.89
2	Discharge	Maximum	2152.94	2123.27	2277.58
		Minimum	1866.38	1878.87	1903.14
3	Water level	Maximum	118.42	115.95	113.39
		Minimum	118.20	115.81	113.28

(b) When only Lower Siang is constructed and Lohit and Dibang rivers are in their natural regimes:

For this condition when the design discharge of 5462 cumecs is released in the Siang river for 3 hours after 21 hours of non-peak then it is seen that the flow hydrograph at various cross sections of Dibru-Saikowa is attenuated due to the 60 km travel distance. From the hydrograph it may be seen that the maximum flow in the Siang

River near dam site (5462 cumecs) is attenuated to 2190.31 cumecs at the Dibru Saikowa Cross section no –I with downstream contribution being considered for Siang river during lean season. The discharge cycle hydrograph at all three cross sections are enclosed at **Appendix-III**. The brief results for water level due to combine effect of natural flow regime of Lohit and Dibang River and attenuated flow of Siang river with downstream contribution are tabulated as below:

S. No.	Cross Section on Northern Boundary of Park		Cross Section I	Cross Section II	Cross Section III
1	Minimum Bed level		112.09	108.00	107.89
2	Discharge	Maximum	3200.31	2968.07	2678.33
		Minimum	1352.75	1383.76	1474.41
3	Water level	Maximum	118.99	116.30	113.72
		Minimum	117.70	115.52	112.99

(c) When only Dibang Multipurpose HEP is constructed and Siang and Lohit rivers are in their natural regimes:

For this condition when the design discharge of 1430 cumecs is released in the Dibang river for 3 hours after 21 hours of non-peak then it is seen that the flow hydrograph at various cross sections of Dibru-saikowa is attenuated due to the 85 km travel distance. From the hydrograph it may be seen that the maximum flow in the Dibang river near dam site (1430 cumecs) is attenuated to 765.22 cumecs at the Dibru Saikowa Cross section no –I with downstream contribution being considered for Dibang river during lean season. The discharge cycle hydrograph at all three cross sections and the table are enclosed at **Appendix-IV**. The brief results for water level due to combine effect of natural flow regime of Lohit and Siang River and attenuated flow of Dibang River with downstream contribution are tabulated as below:

S. No.	Cross Section on Northern Boundary of Park		Cross Section I	Cross Section II	Cross Section III
1	Minimum Bed level		112.09	108.00	107.89
2	Discharge	Maximum	2207.22	2086.89	1921.98
		Minimum	1612.06	1614.66	1625.84
3	Water level	Maximum	118.46	115.93	113.29
		Minimum	117.97	115.67	113.10

(d) All three projects are constructed and are peaking for 3 hours

For analyzing the maximum effect that can occur at Dibru saikhowa national Park due to operation of all three projects, discharges at respective cross sections for all projects are added up with temporal variation and same has been routed through the river stretch to get the maximum possible variation. The combined discharge cycle hydrograph with all three projects operating at same time peaking is enclosed as **Appendix VII**.

S. No.	Cross Section on Northern Boundary of Park		Cross Section I	Cross Section II	Cross Section III
1	Minimum Bed level		112.09	108	107.89
2	Discharge	Maximum	2794.28	2551.96	2275.58
		Minimum	792.38	887.78	1061.54
3	Water level	Maximum	118.80	116.14	113.52
		Minimum	116.85	115.07	112.61

(e) No Project scenario

When no project is developed and all the rivers i.e. Lohit River, Siang River and Dibang River are flowing in their natural regimes, the water level at different cross sections of Dibru-Saikhowa national park are tabulated as below

S. No.	Cross Section on Northern Boundary of Dibru-Saikowa	Cross Section I	Cross Section II	Cross Section III
1	Minimum Bed level	112.09	108	107.89
2	Discharge	2054		
3	Water level	118.35	115.91	113.38

6. SUMMARY OF ALL SIMULATION RESULTS AND THEIR TABULATIONS

The summary of all the simulation results is tabulated below:

CASE I: FLOW PATH OF RIVER AS PER PRESENT DAY (Lohit Flowing Along Southern Boundary of Dibru-Saikowa Park)

S. No.	Project in Operation	Design Discharge, cumec	Cross Section I				
			Maximum Routed Channel Discharge, cumec	Minimum Routed Channel Discharge, cumec	Minimum Bed Level, m	Maximum water level due to operation, m	Minimum water level due to operation, m
1	Only Demwe Lower HEP, Lohit River	1729	510.14	208.06	116.13	118.30	117.52
2	Only Lower Siang HEP	5462	2802.31	954.75	112.09	118.80	117.13
3	Only Dibang Lower HEP	1430	1809.22	1214.06		118.15	117.53
4	Lower Siang and Dibang Multi. HEP operating at same time	6892	2360.53	518.89		118.56	116.22
5	No Project is constructed, Lohit River	--	398		116.13	118.06	
	No Project is constructed, Dibang & Siang River	--	1656		112.09	118.01	

S. No.	Project in Operation	Design Discharge, cumec	Cross Section II				
			Maximum Routed Channel Discharge, cumec	Minimum Routed Channel Discharge, cumec	Minimum Bed Level, m	Maximum water level due to operation, m	Minimum water level due to operation, m
1	Only Demwe Lower HEP, Lohit River	1729	500.59	213.54	114.00	116.09	115.46
2	Only Lower Siang HEP	5462	2570.07	985.76	108.00	116.14	115.18
3	Only Dibang Lower HEP	1430	1688.89	1216.66		115.71	115.40
4	Lower Siang and Dibang Multi. HEP operating at same time	6892	2132.15	571.61		115.95	114.54
5	No Project is constructed, Lohit River	--	398		114.00	115.90	
	No Project is constructed, Dibang & Siang River	--	1656		108.00	115.69	

S. No.	Project in Operation	Design Discharge, cumec	Cross Section III				
			Maximum Routed Channel Discharge, cumec	Minimum Routed Channel Discharge, cumec	Minimum Bed Level, m	Maximum water level due to operation, m	Minimum water level due to operation, m
1	Only Demwe Lower HEP, Lohit River	1729	489.45	220.23	111.25	112.61	112.15
2	Only Lower Siang HEP	5462	2280.33	1076.41	107.89	113.52	112.63
3	Only Dibang Lower HEP	1430	1523.98	1227.84		113.03	112.77

4	Lower Siang and Dibang Multi. HEP operating at same time	6892	1877.26	700.04		113.27	112.16
5	No Project is constructed, Lohit River	--	398		111.25	112.47	
	No Project is constructed, Dibang & Siang River	--	1656		107.89	113.12	

CASE II: FLOWPATH OF RIVER AS PER BEFORE YEAR 1998 AND MAY OCCUR IN FUTURE

S. No.	Project in Operation	Design Discharge, cumec	Cross Section I				
			Maximum Routed Channel Discharge, cumec	Minimum Routed Channel Discharge, cumec	Minimum Bed Level, m	Maximum water level due to operation, m	Minimum water level due to operation, m
1	Only Demwe Lower HEP	1729	2152.94	1866.38	112.09	118.42	118.20
2	Only Lower Siang HEP	5462	3200.31	1352.75		118.99	117.70
3	Only Dibang Lower HEP	1430	2207.22	1612.06		118.46	117.97
4	All HEP's operating at same time	8621	2794.28	792.38		118.80	116.85
5	No Project is constructed	--	2054.00			118.35	

S. No.	Project in Operation	Design Discharge, cumec	Cross Section II				
			Maximum Routed Channel Discharge, cumec	Minimum Routed Channel Discharge, cumec	Minimum Bed Level, m	Maximum water level due to operation, m	Minimum water level due to operation, m
1	Only Demwe Lower HEP	1729	2123.27	1878.87	108.00	115.95	115.81
2	Only Lower Siang HEP	5462	2968.07	1383.76		116.30	115.52
3	Only Dibang Lower HEP	1430	2086.89	1614.66		115.93	115.67
4	All HEP's at same time	8621	2551.96	887.78		116.14	115.07
5	No Project is constructed	--	2054.00			115.91	

S. No.	Project in Operation	Design Discharge, cumec	Cross Section III				
			Maximum Routed Channel Discharge, cumec	Minimum Routed Channel Discharge, cumec	Minimum Bed Level, m	Maximum water level due to operation, m	Mimnimum water level due to operation, m
1	Only Demwe Lower HEP	1729	2277.58	1903.14	107.89	113.39	113.28
2	Only Lower Siang HEP	5462	2678.33	1474.41		113.72	112.99
3	Only Dibang Lower HEP	1430	1921.98	1625.84		113.29	113.10
4	All HEP's at same time	8621	2275.58	1061.54		113.52	112.61
5	No Project is constructed	--	2054.00			113.38	

7. DISCUSSION OF SIMULATION RESULTS AND CONCLUSION

From the Detailed Simulation studies carried out for the two cases – One of the present day scenario and another of the pre 1998 scenario, following important aspects emerge,

(a) From the Point of view of assessing the impact of peaking of hydro projects on the Dibru-Saikowa Park, it is important to compare the scenario before and after the Project construction. Since the species of the Park are accustomed over the past hundreds of year towards the water level fluctuations in monsoon and non-monsoon months, their adaptability will depend upon the variations that is caused by the Project. The water level variation for both the cases – One of the present day scenario and another of the pre 1998 scenario- is shown in Appendix IX and X, respectively. Accordingly the Maximum Water Level variations in the two cases are:-

Case I – Present Scenario Post 2003 – When Lohit has Changed to Southern Boundary of Dibru-Saikowa:

S. No.	Project In Operation	Cross Section No.	Minimum Elevation of Dibru-Saikowa Park	Maximum Water Level due to Non-Monsoon Peaking	Maximum Water Level in Virgin (No Project) Condition	Maximum Variation in Water Level
1	Only Demwe Lower (These 3 Cross Sections are on the Southern Boundary of Dibru-Saikowa)	I	El.121.92m	El.118.30m	El.118.06m	0.24m
		II	El.120.70m	El.116.09m	El.115.90m	0.19m
		III	El.121.01m	El.112.61m	El.112.47m	0.14m
2	All 3 Projects, Demwe Lower, Dibang and Lower Siang (These cross sections are on the northern boundary of Dibru-Saikowa Park	I	El.125.70m	El.118.56m	El.118.01m	0.55m
		II	El.117.30m	El.115.95m	El.115.69m	0.26m
		III	El.115.50m	El.113.27m	El.113.12m	0.15m

Case II – Pre 1998 scenario – When Lohit was flowing along the Northern Boundary of Dibru-Saikowa Park.

SI.No.	Project In Operation	Cross Section No.	Minimum Elevation of Dibru-Saikowa Park	Maximum Water Level due to Non-Monsoon Peaking	Maximum Water Level in Virgin (No Project) Condition	Maximum Variation in Water Level
1	Only Demwe Lower	I	El.125.70m	El.118.42m	El.118.35m	0.07m
		II	El.117.30m	El.115.95m	El.115.91m	0.04m
		III	El.115.50m	El.113.39m	El.113.38m	0.01m
2	All 3 Projects, Demwe Lower, Dibang and Lower Siang	I	El.125.70m	El.118. 80m	El.118.35m	0.45m
		II	El.117.30m	El.116.14m	El.115.91m	0.23m
		III	El.115.50m	El.113.52m	El.113.38m	0.14m

From the above two tables it may be seen that the effect on Dibru-Saikowa Park due to water level fluctuation in winter season peaking period is maximum of 0.24m in case of Demwe Lower and 0.55m in case of all the 3 projects Demwe Lower, Dibang and Lower Siang are completed. However the water level in all the cases at various locations of Dibru-Saikowa park remains well below the lowest elevation of Dibru-Saikowa Park at those locations. Thus the apprehension of "Winter Flood" submerging any part of Dibru-Saikowa Park and adversely affecting some species is not correct.

(b) When the Projects are completed the diurnal peaking will also cause water elevations to fluctuate as a consequence of diurnal peaking. The Maximum difference of water level at various sections due to the worst possible scenario is:-

Case I – Present Scenario Post 2003 – When Lohit has Changed to Southern Boundary of Dibru-Saikowa:

S. No.	Project In Operation	Cross Section No.	Discharges (in m^3/S)		Maximum Variation in Water Level
			Maximum Routed	Minimum Routed	
1	Only Demwe Lower (These 3 Cross Sections are on the Southern Boundary of Dibru-Saikowa)	I	510.14	208.06	0.78m
		II	500.59	213.54	0.63m
		III	489.45	220.23	0.46m
2	All 3 Projects, Demwe Lower, Dibang and Lower Siang (These cross sections are on the northern boundary of Dibru-Saikowa Park	I	2360.53	518.89	2.34m
		II	2132.15	571.61	1.41m
		III	1877.26	700.04	1.11m

Case II – Pre 1998 scenario – When Lohit was flowing along the Northern Boundary of Dibru-Saikowa Park.

SI.No.	Project In Operation	Cross Section No.	Discharges (in m^3/S)		Maximum Variation in Water Level
			Maximum Routed	Minimum Routed	
1	Only Demwe Lower (These 3 Cross Sections are on the Southern Boundary of Dibru-Saikowa)	I	2152.94	1866.38	0.22m
		II	2123.27	1878.87	0.14m
		III	2277.58	1903.14	0.11m
2	All 3 Projects, Demwe Lower, Dibang and Lower Siang (These cross sections are on the northern boundary of Dibru-Saikowa Park	I	2794.28	792.38	1.95m
		II	2551.96	887.78	1.07m
		III	2275.58	1061.54	0.91m

From the above two tables it is clear that the maximum water level variation during the day due to non-monsoon peaking operations is 0.78m in case of Demwe Lower and 2.34m in case of all the 3 projects. However all this variation remains below the lowest elevation of Dibru-Saikowa Park and as such cannot affect any wildlife species found in the Park.

(c) While computing the water elevations due to non-monsoon peaking it also needs to be kept in mind that the winter high flows during the virgin condition is also a reality. To illustrate this, the Demwe Lower winter flow peaks are compared with the channel routed flows and the results are tabulated below,

Case I – Present Scenario Post 2003 – When Lohit has Changed to Southern Boundary of Dibru-Saikowa:

Project in Operation	**Period**	**Peak Discharges in m^3/s (Virgin Condition)**		**Peak Discharges (in m^3/s) due to Operation at Dibru-Saikowa Section - I (Southern Boundary) Maximum Routed discharge**
		Maximum Winter Flow Peak at Demwe Lower Dam Site	**Minimum Winter Flow Peak at Demwe Lower Dam Site**	
Demwe Lower Only	Dec	1374	317	510.14
	Jan	867	315	510.14
	Feb	944	292	510.14

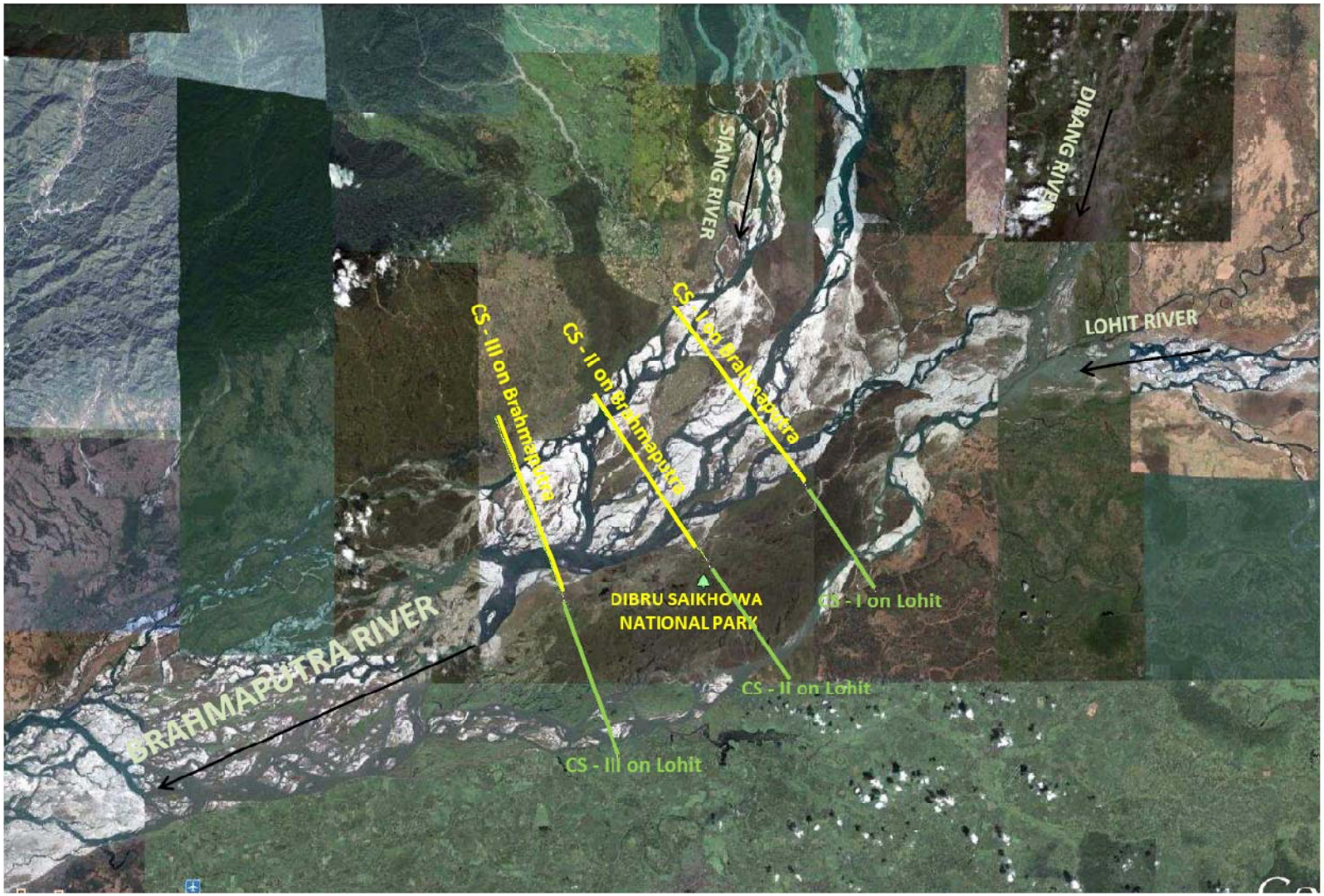
Also from the table of winter peaks at Demwe Lower dam site it may be seen that a peak of more than 500 cumecs has occurred about 50% of the time. Thus it may be inferred that the winter high floods (more than 600 cumecs and occurring more than 30% of time at Demwe Lower dam site) are in fact moderated due to the peaking operations of the project. The same will hold good even for the combined effect of all the 3 projects.

Based on the above simulation discussion we can safely conclude that,

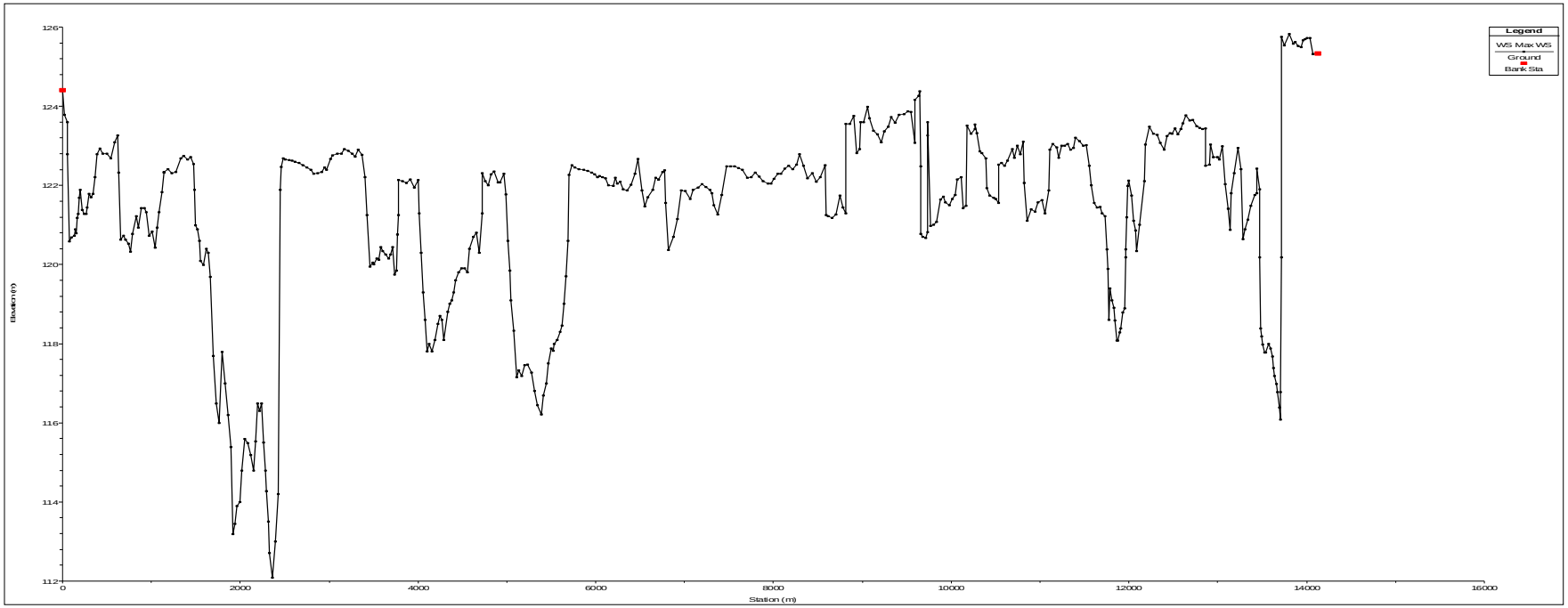
A. THERE IS NO ADVERSE EFFECT OF NON-MONSOON PEAKING OPERATION ON DIBRU-SAIKOWA PARK DUE TO THE FACT THAT THE SUBMERGENCE LEVEL AT ALL TIMES REMAINS BELOW THE LOWEST ELEVATION OF THE PARK.
B. AS COMPARED TO THE VIRGIN CONDITION, DEMWE LOWER H.E. PROJECT'S NON-MONSOON PEAKING CAUSES A MAXIMUM WATER LEVEL RISE OF 0.24m AT DIBRU-SAIKOWAPARK.
C. THE MAXIMUM WATER LEVEL VARIATION AT DIBRU-SAIKOWA DUE TO DEMWE LOWER H.E. PROJECTS DIURNAL PEAKING IN NON-MONSOON IS 0.78m. HOWEVER THIS WATER LEVEL VARIATION REMAINS BELOW THE LOWEST ELEVATION OF THE PARK.

APPENDIX - I

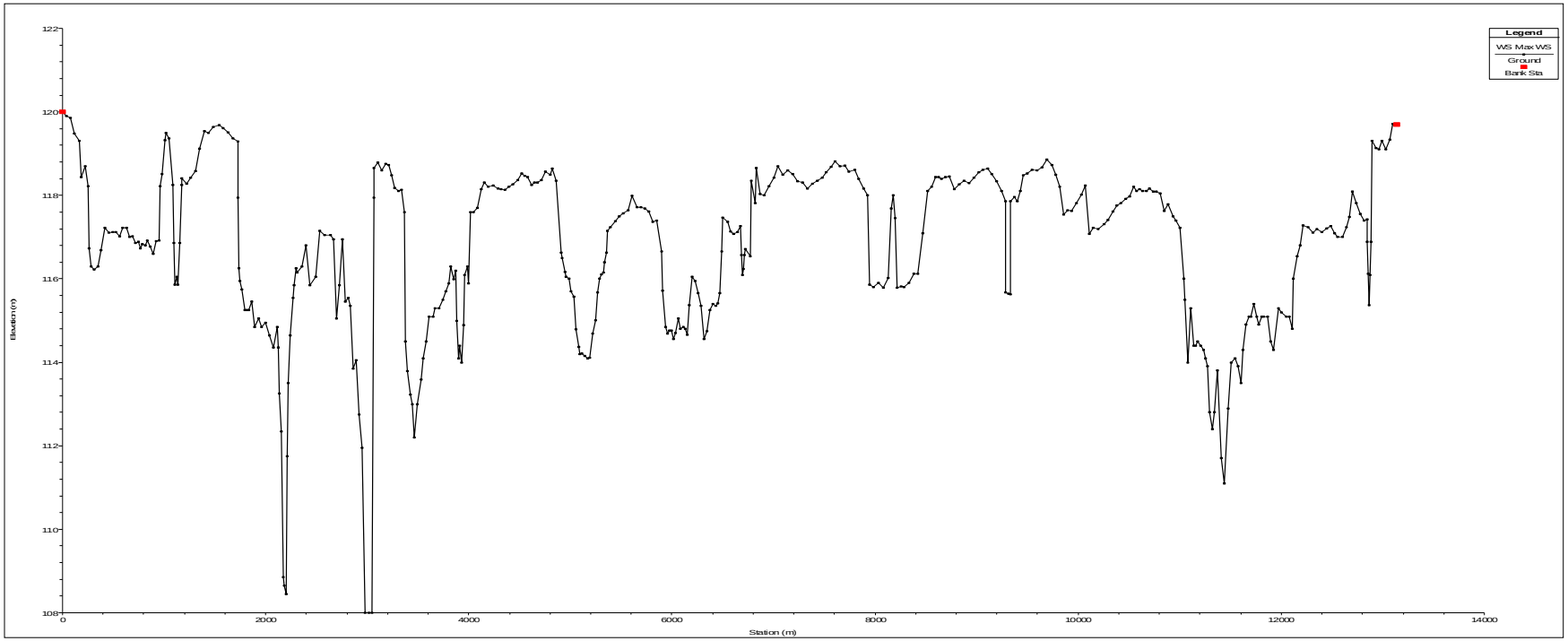
Location of Cross Section I, II & III on Brahmaputra and Lohit River



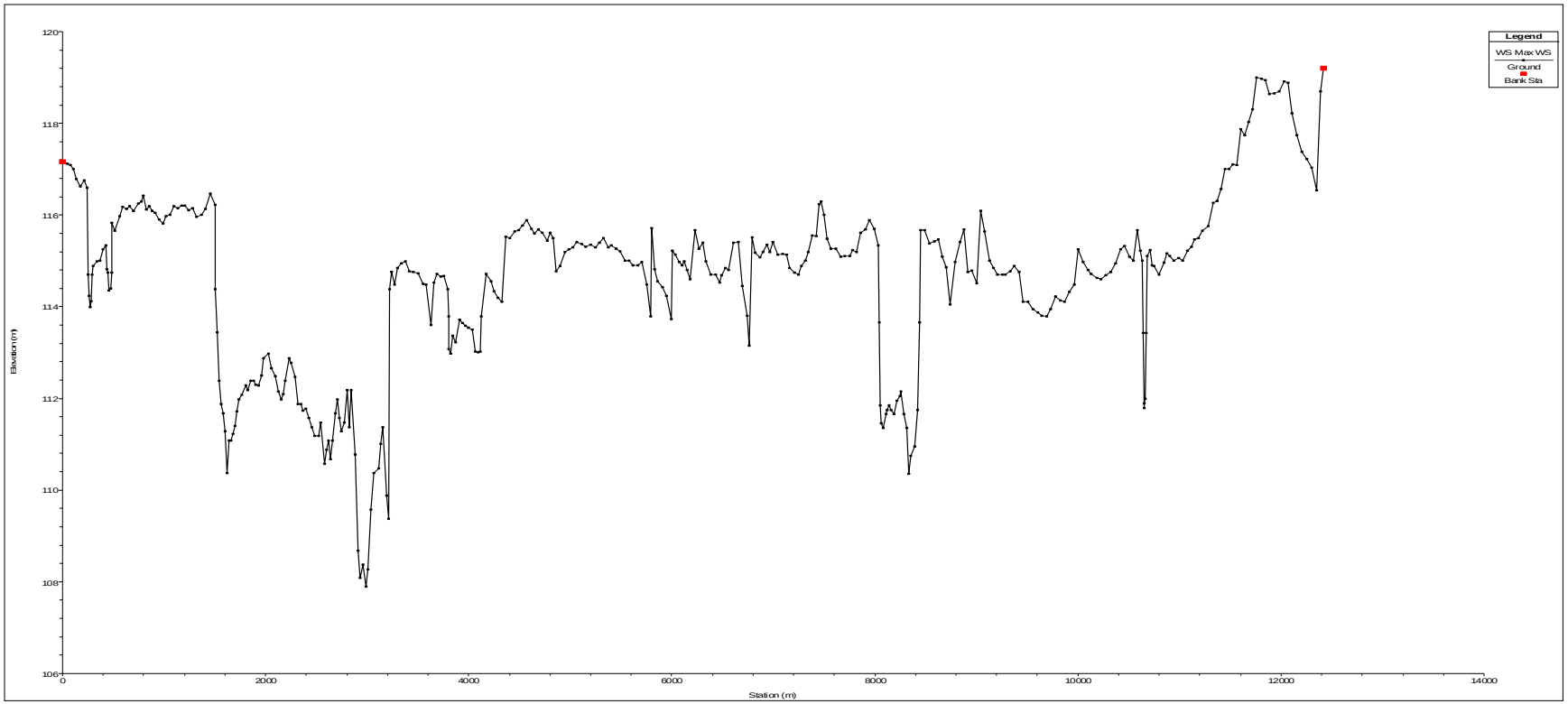
Cross Section-I at Dibru Saikhowa National Park on Brahmaputra River



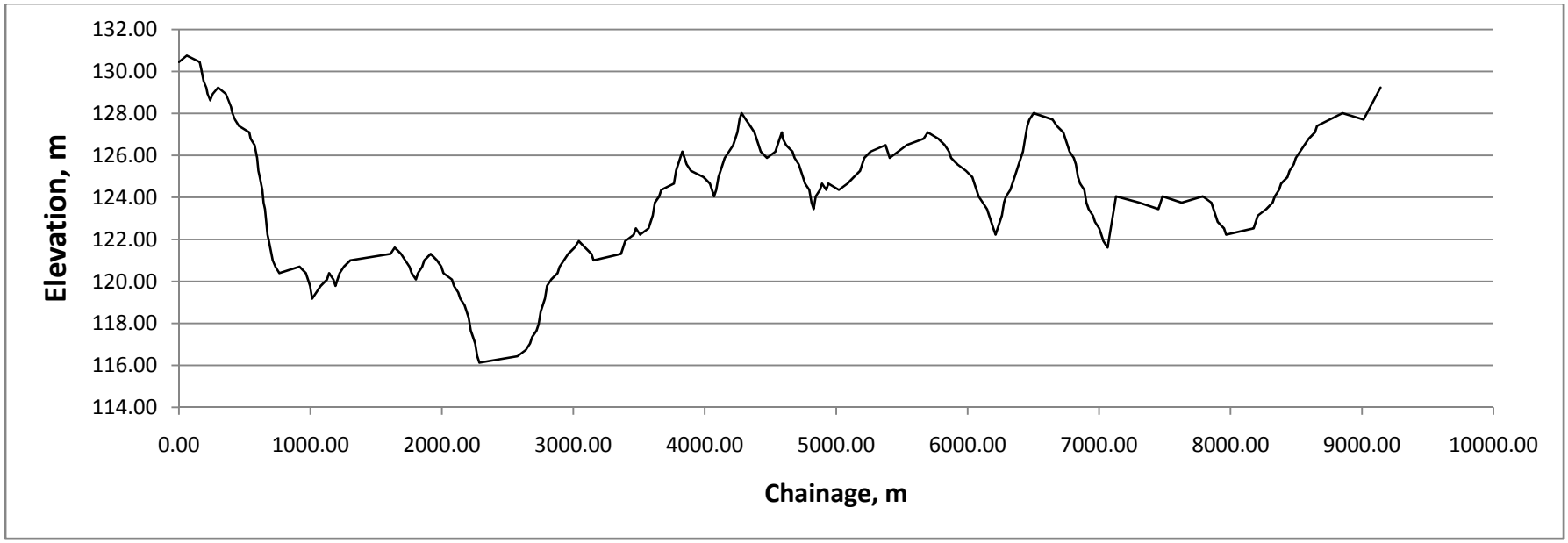
Cross Section-II at Dibru Saikhowa National Park on Brahmaputra River



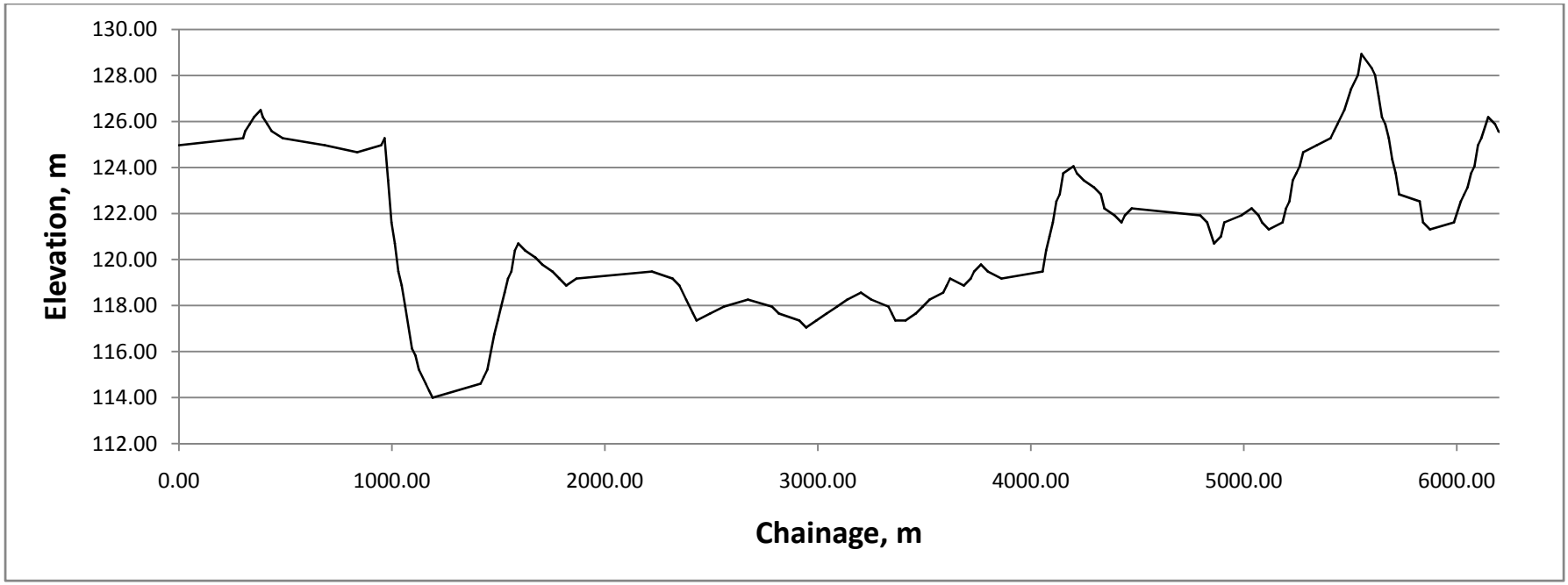
Cross Section-III at Dibru Saikhowa National Park on Brahmaputra River



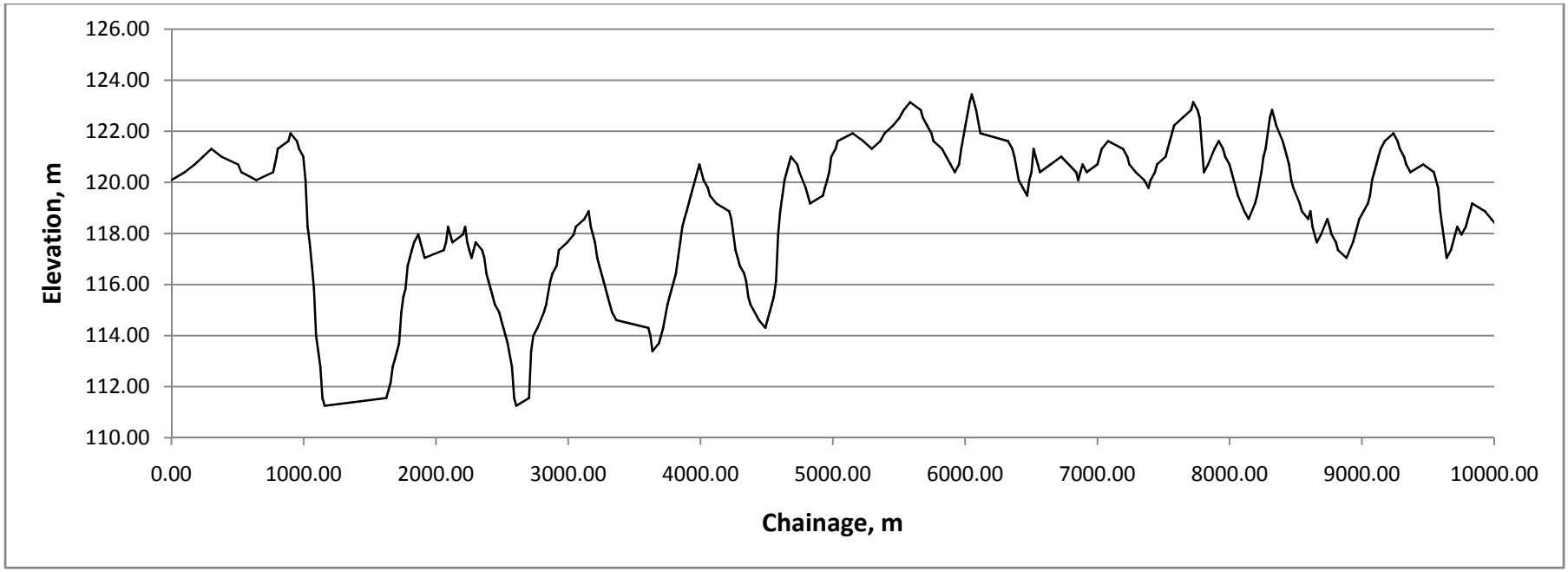
Cross Section-I at Dibru Saikhowa National Park on Lohit River



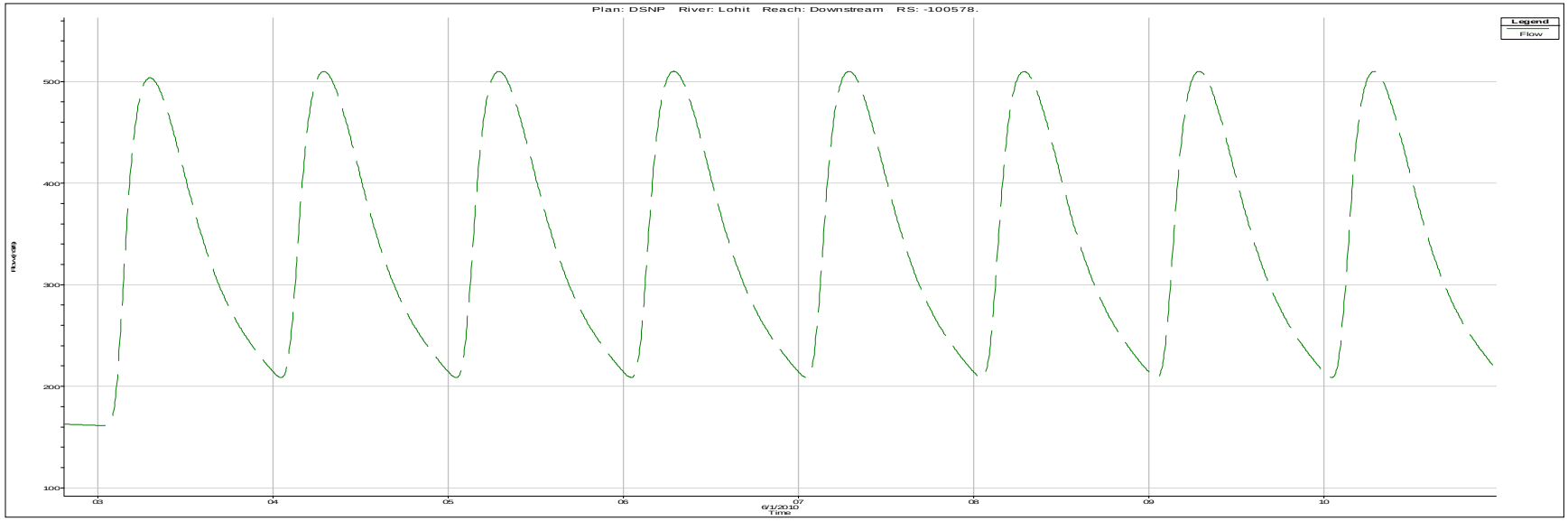
Cross Section-II at Dibru Saikhowa National Park on Lohit River



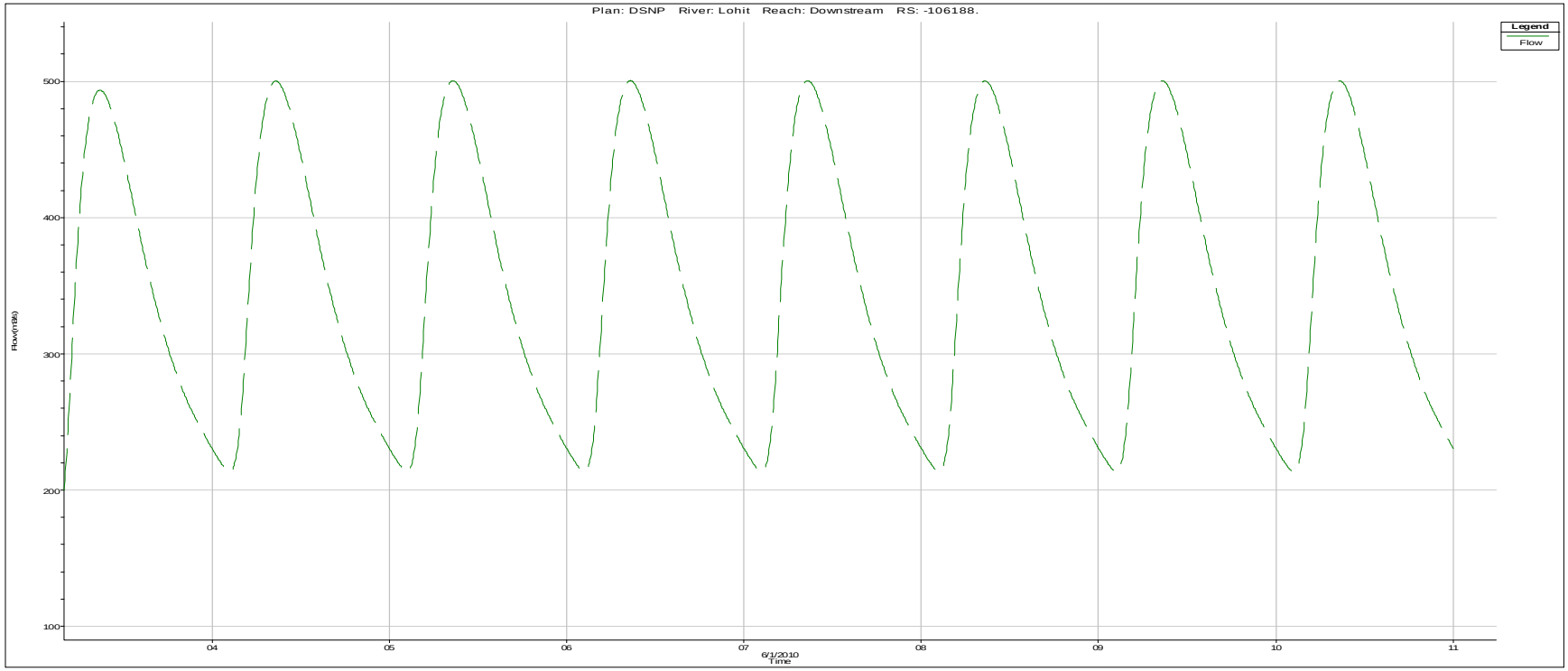
Cross Section-III at Dibru Saikhowa National Park on Lohit River



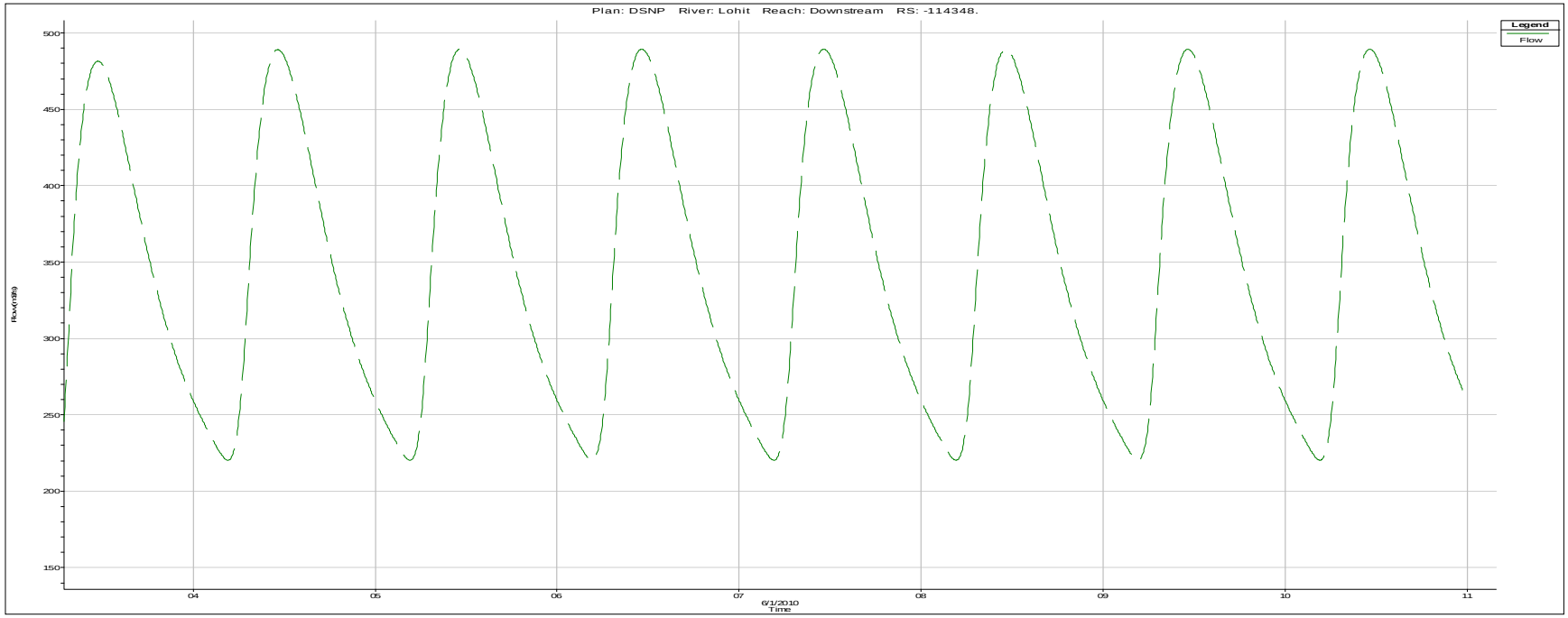
Flow hydrograph at Dibru Saikhowa National Park Cross Section - I due to 3hrs peaking and 21 hrs minimum flow at Demwe Lower HEP with considering downstream flow contribution of Lohit river: The design discharge of 1729 cumec attenuated to 510.14 cumec.



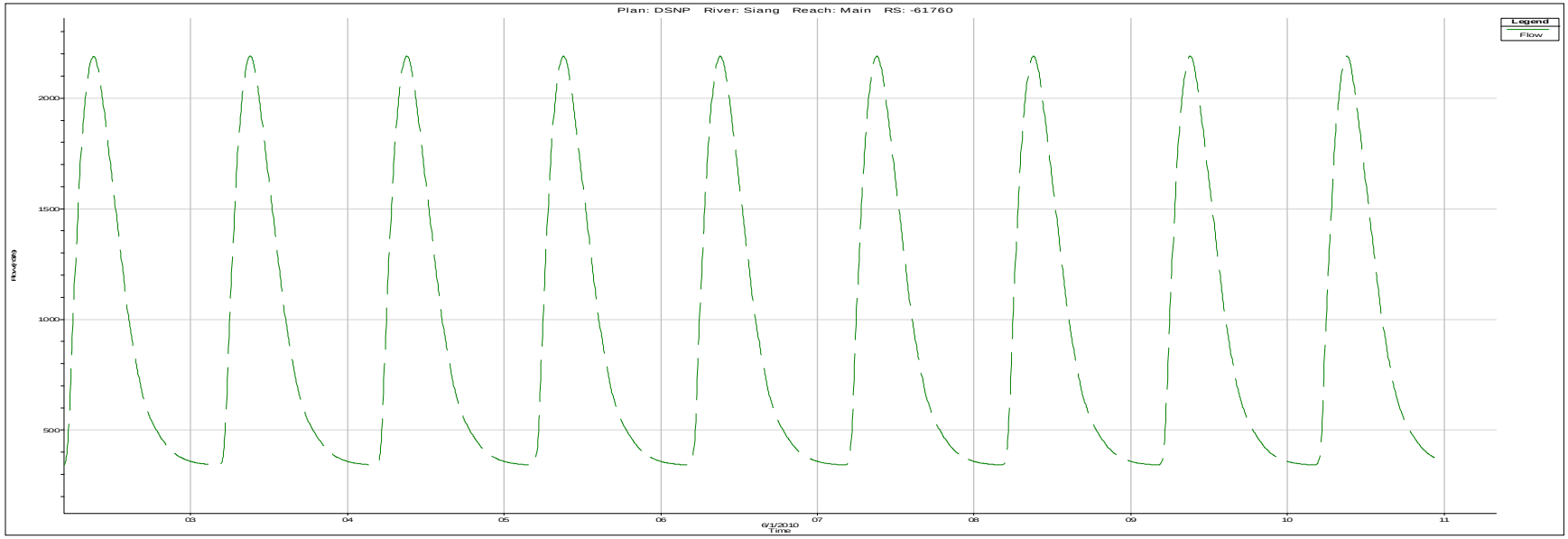
Flow hydrograph at Dibru Saikhowa National Park Cross Section - II due to 3hrs peaking and 21 hrs minimum flow at Demwe Lower HEP with considering downstream flow contribution of Lohit river: The design discharge of 1729 cumec attenuated to 500.59 cumec.



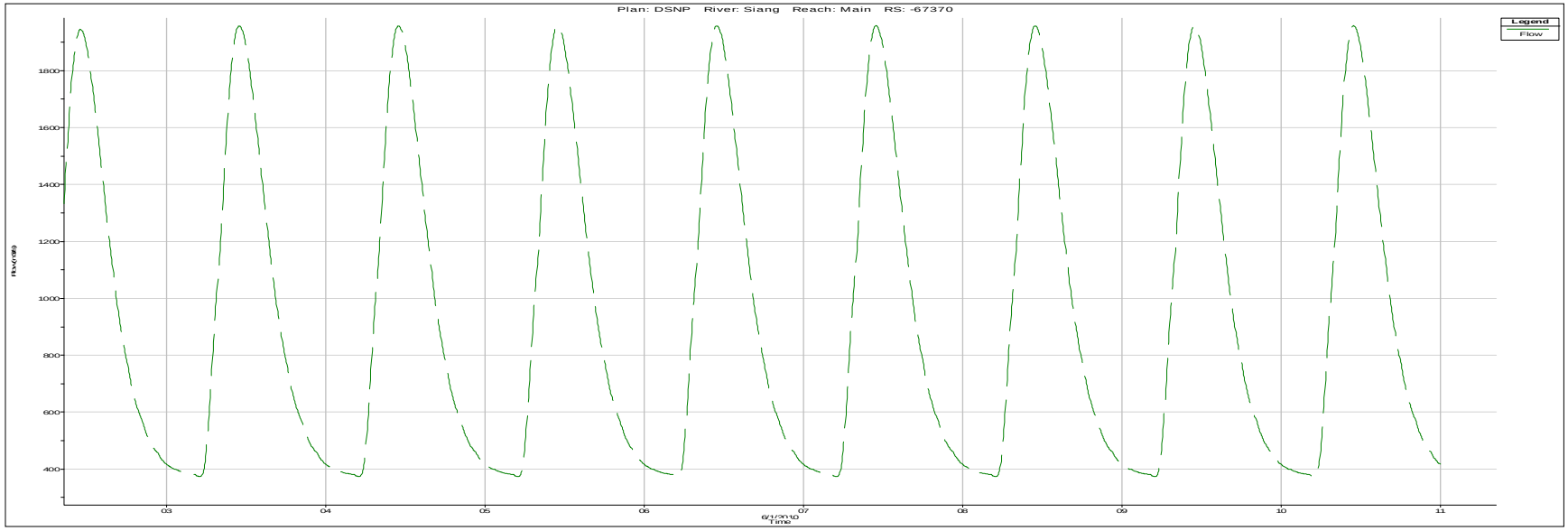
Flow hydrograph at Dibru Saikhowa National Park Cross Section - III due to 3hrs peaking and 21 hrs minimum flow at Demwe Lower HEP with considering downstream flow contribution of Lohit river: The design discharge of 1729 cumec attenuated to 489.45 cumec.



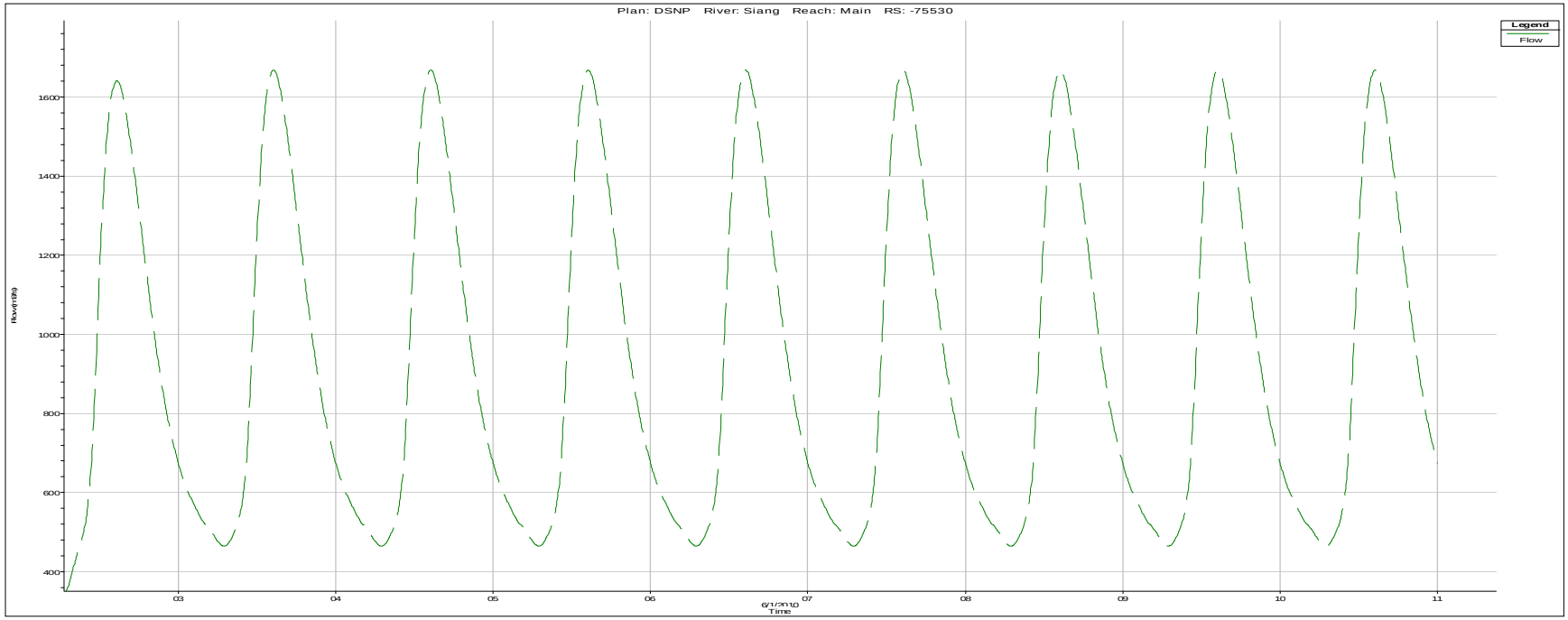
Flow hydrograph at Dibru Saikhowa National Park Cross Section - I due to 3hrs peaking and 21 hrs minimum flow at Lower Siang HEP with considering downstream flow contribution of Siang river: The design discharge of5462 cumec attenuated to 2190.31 cumec.



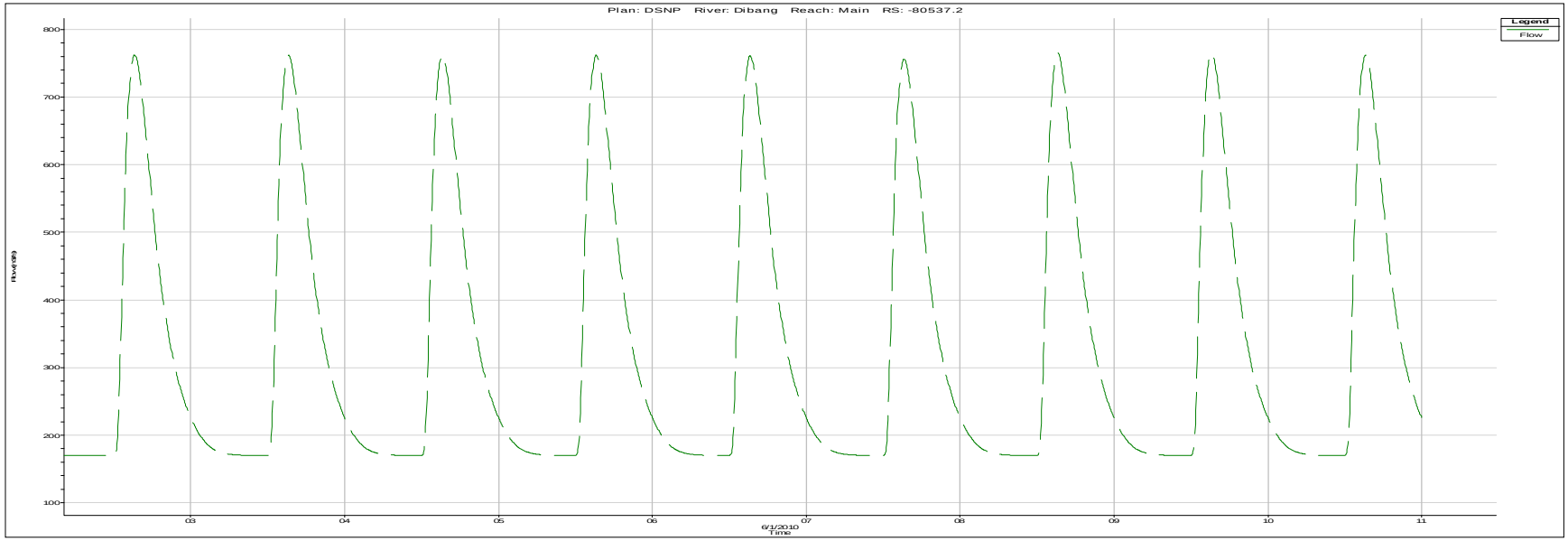
Flow hydrograph at Dibru Saikhowa National Park Cross Section - II due to 3hrs peaking and 21 hrs minimum flow at Lower Siang HEP with considering downstream flow contribution of Siang river: The design discharge of5462 cumec attenuated to 1958.07 cumec.



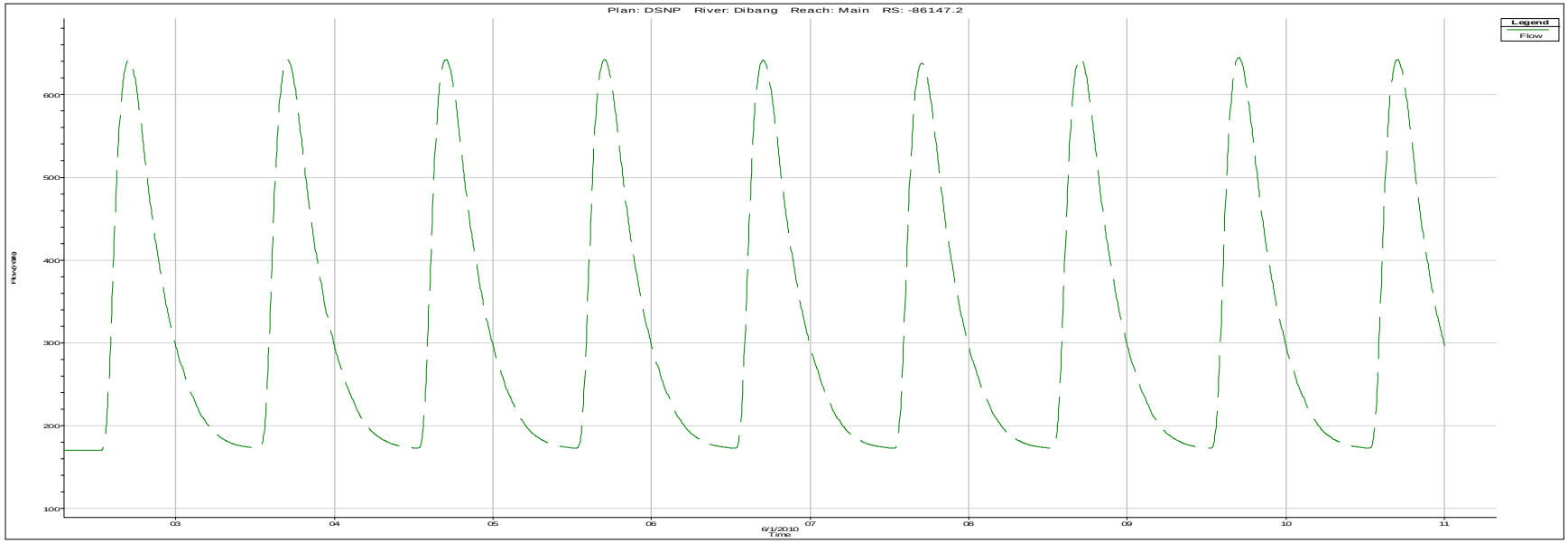
Flow hydrograph at Dibru Saikhowa National Park Cross Section - III due to 3hrs peaking and 21 hrs minimum flow at Lower Siang HEP with considering downstream flow contribution of Siang river: The design discharge of5462 cumec attenuated to 1668.33 cumec.



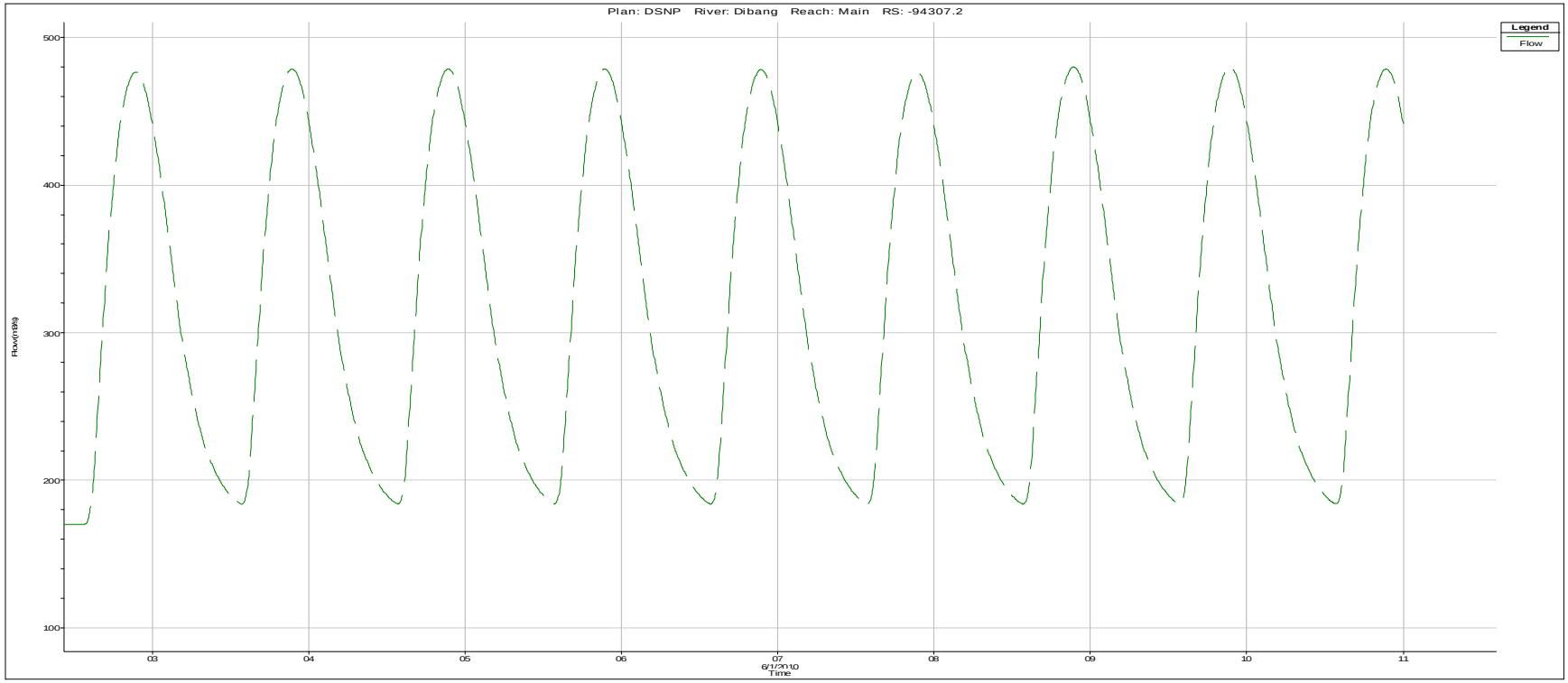
Flow hydrograph at Dibru Saikhowa National Park Cross Section - I due to 3hrs peaking and 21 hrs minimum flow at Dibang Multipurpose HEP with considering downstream flow contribution of Dibang river: The design discharge of 1430 cumec attenuated to 765.22 cumec.



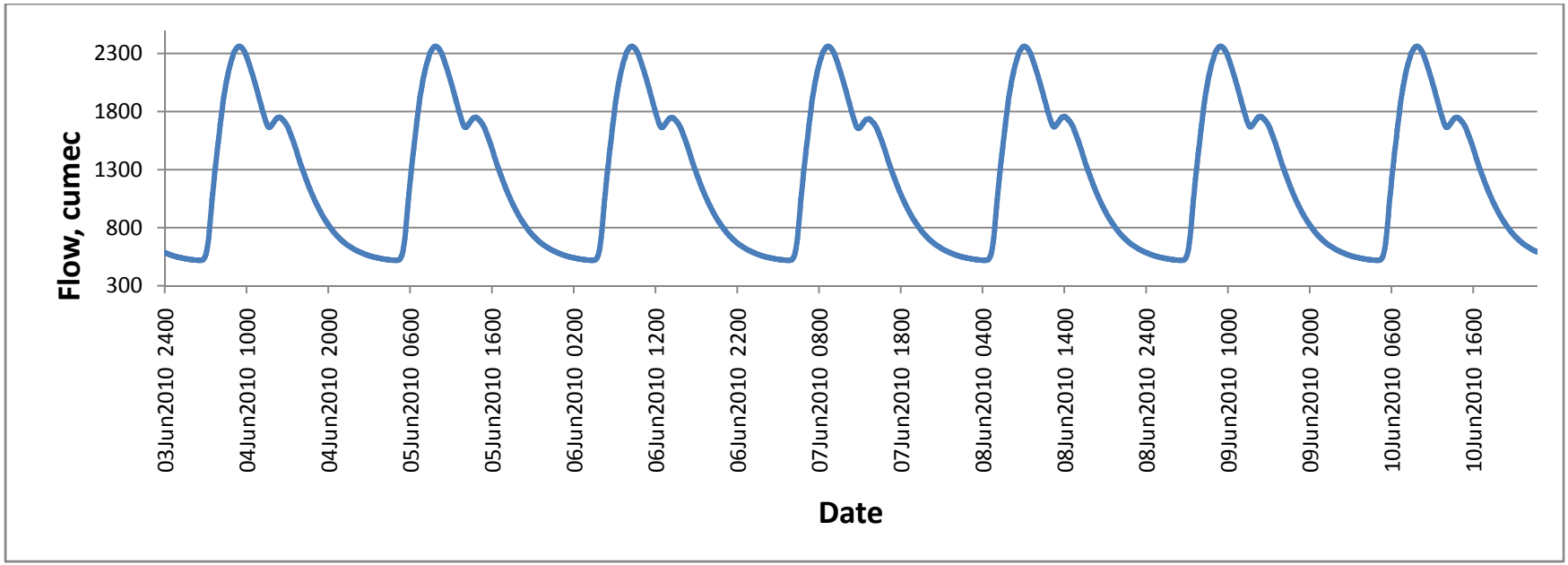
Flow hydrograph at Dibru Saikhowa National Park Cross Section - II due to 3hrs peaking and 21 hrs minimum flow at Dibang Multipurpose HEP with considering downstream flow contribution of Dibang river: The design discharge of 1430 cumec attenuated to 644.89 cumec.



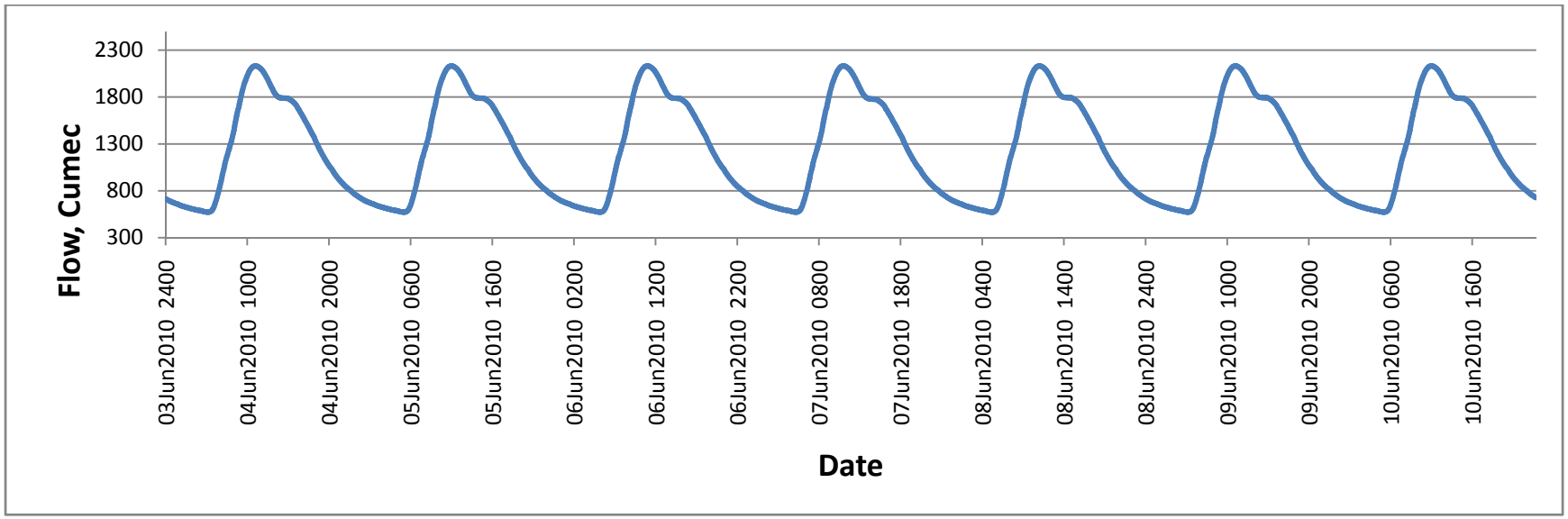
Flow hydrograph at Dibru Saikhowa National Park Cross Section - III due to 3hrs peaking and 21 hrs minimum flow at Dibang Multipurpose HEP with considering downstream flow contribution of Dibang river: The design discharge of 1430 cumec attenuated to 479.98 cumec.



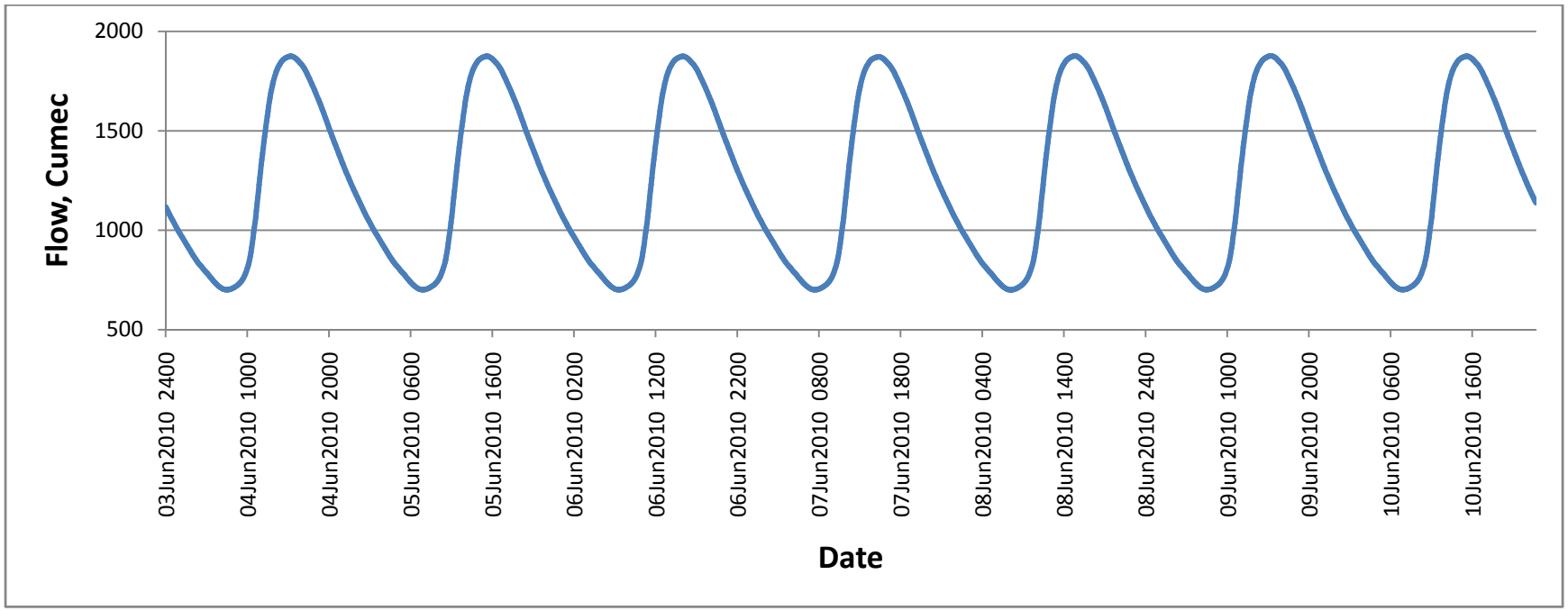
Flow hydrograph at Dibru Saikhowa National Park Cross Section - I due to 3hrs peaking and 21 hrs minimum flow at Lower Siang and Dibang Multipurpose HEP with considering downstream flow contribution of both rivers: The combined design discharge of 6892 cumec attenuated to maximum 2360.53 cumec.



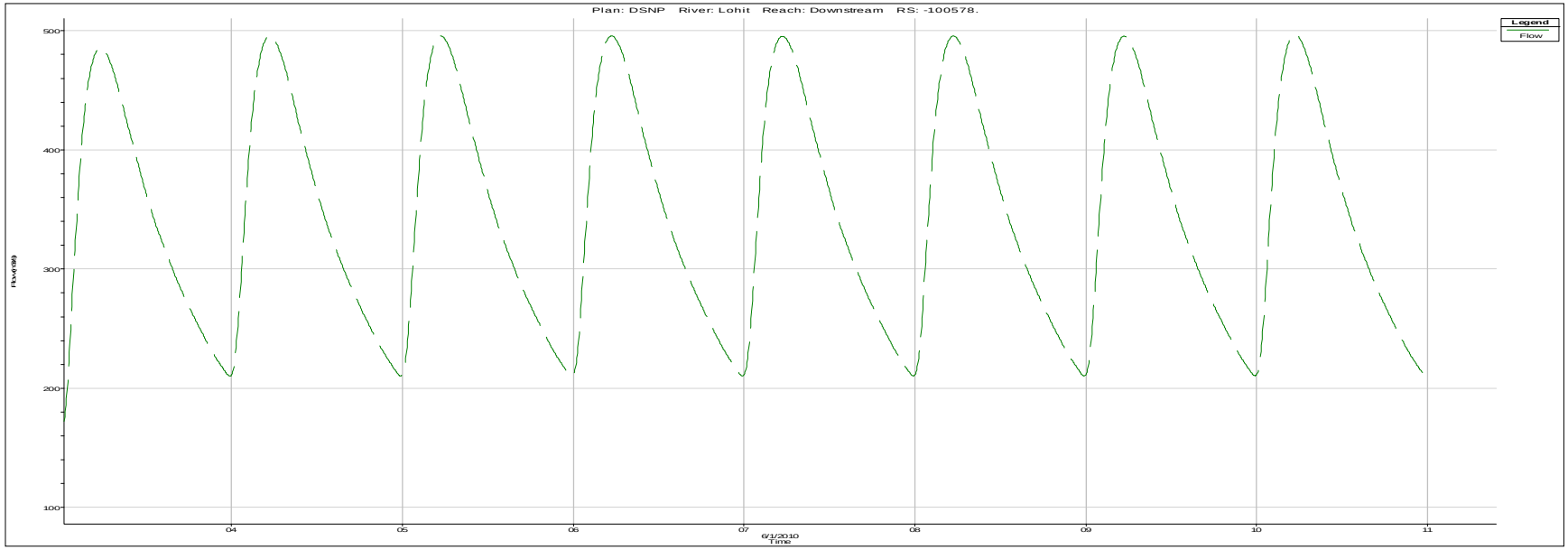
Flow hydrograph at Dibru Saikhowa National Park Cross Section - II due to 3hrs peaking and 21 hrs minimum flow at Lower Siang and Dibang Multipurpose HEP with considering downstream flow contribution of both rivers: The combined design discharge of 6892 cumec attenuated to maximum 2132.15 cumec.



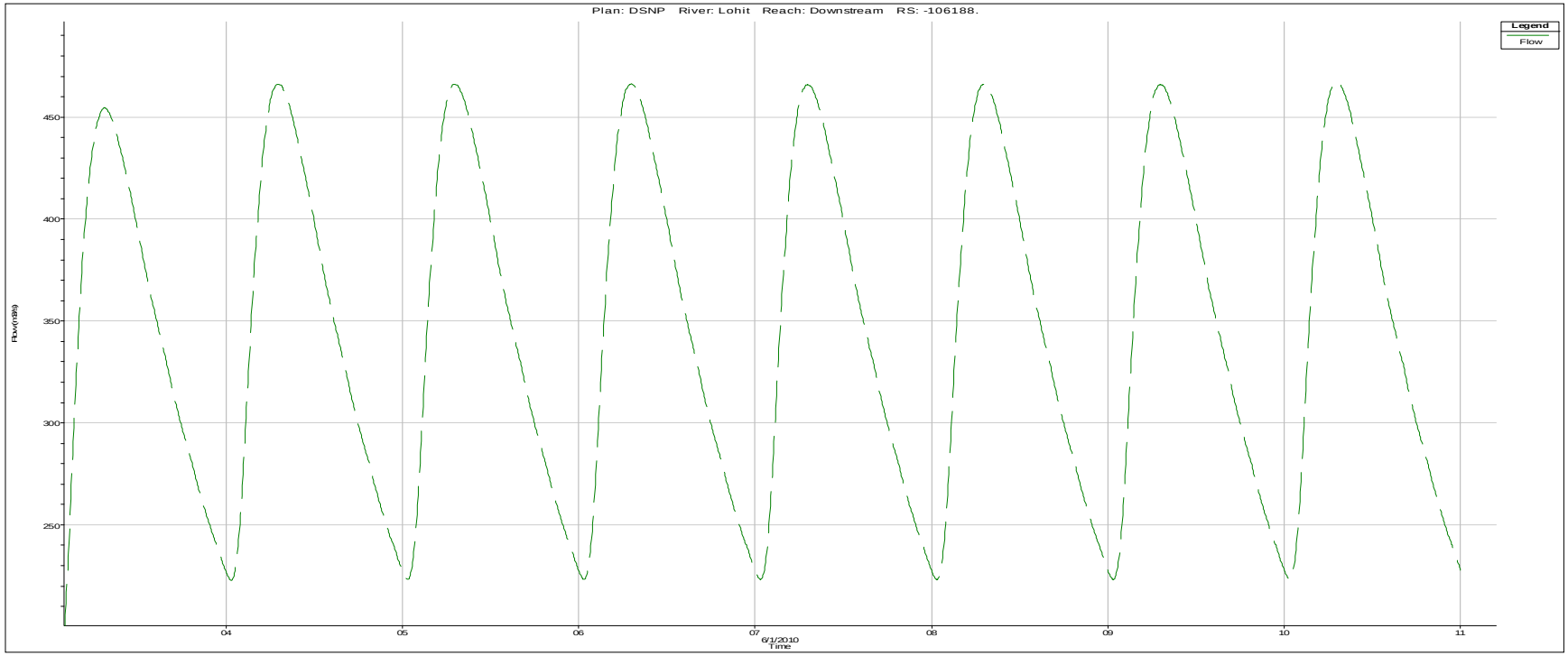
Flow hydrograph at Dibru Saikhowa National Park Cross Section - III due to 3hrs peaking and 21 hrs minimum flow at Lower Siang and Dibang Multipurpose HEP with considering downstream flow contribution of both rivers: The combined design discharge of 6892 cumec attenuated to maximum 1877.26 cumec.



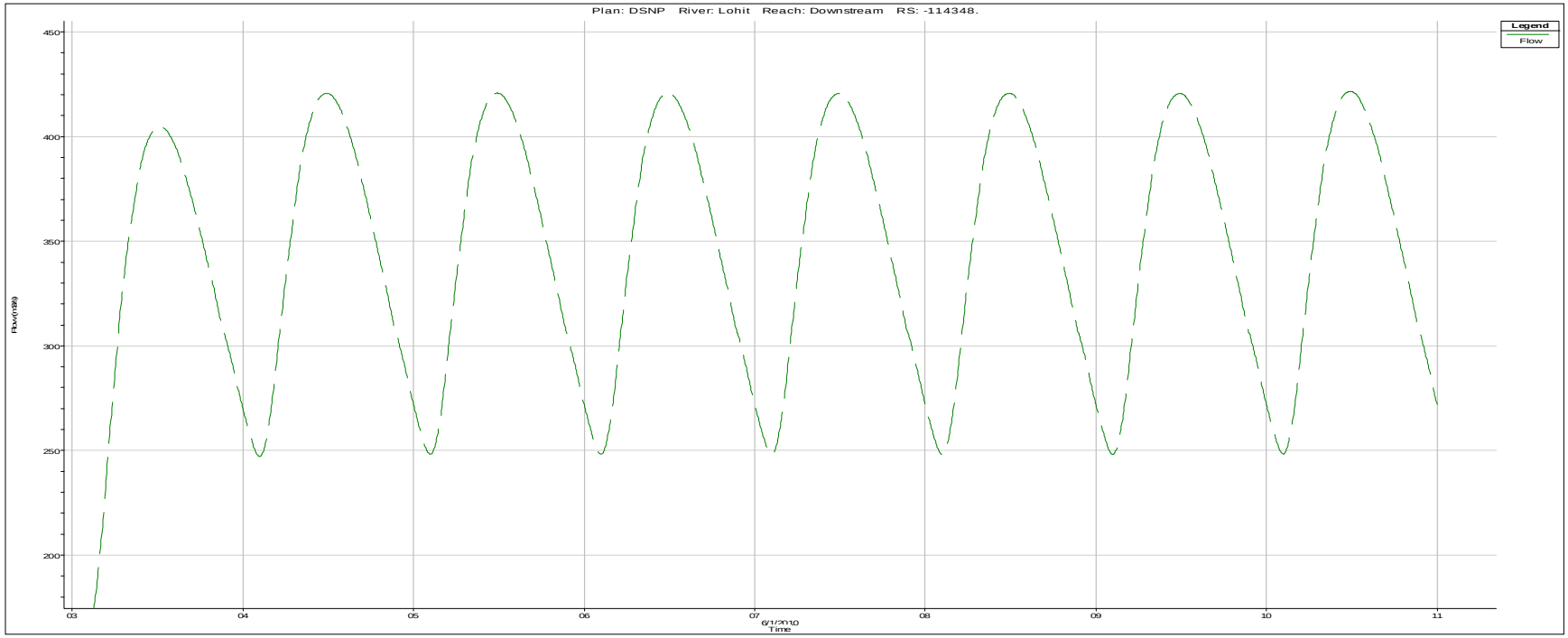
Flow hydrograph at Dibru Saikhowa National Park Cross Section - I due to 3hrs peaking and 21 hrs minimum flow at Demwe Lower HEP with considering downstream flow contribution of Lohit river: The design discharge of 1729 cumec attenuated to 496.94 cumec.



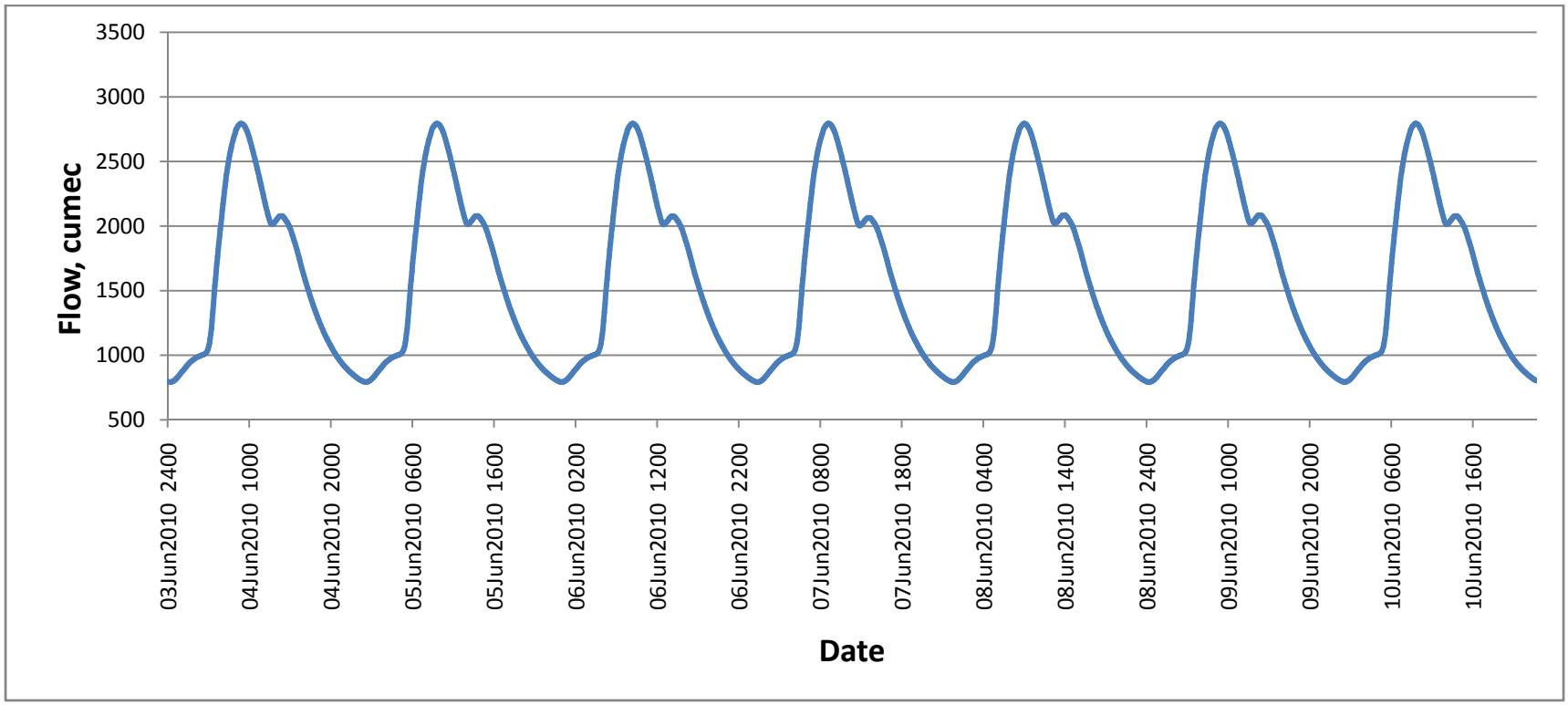
Flow hydrograph at Dibru Saikhowa National Park Cross Section - II due to 3hrs peaking and 21 hrs minimum flow at Demwe Lower HEP with considering downstream flow contribution of Lohit river: The design discharge of 1729 cumec attenuated to 467.27cumec.



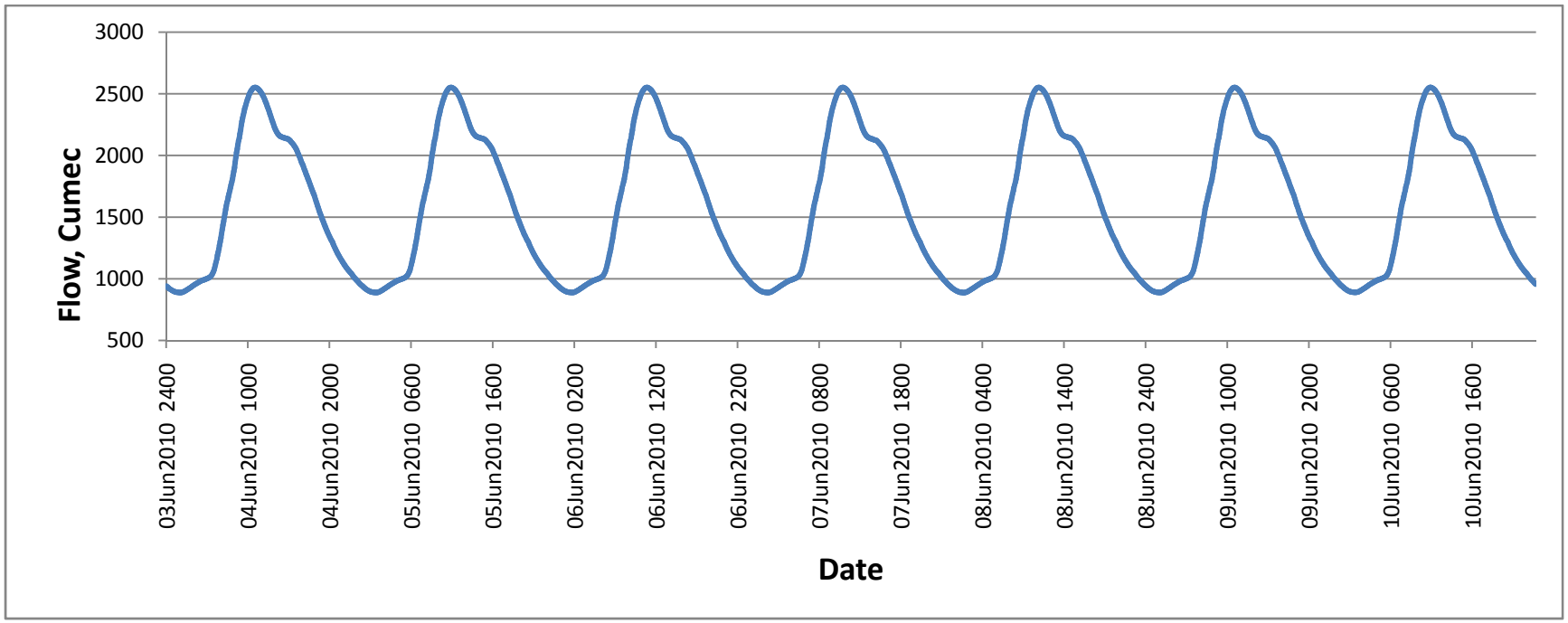
Flow hydrograph at Dibru Saikhowa National Park Cross Section - III due to 3hrs peaking and 21 hrs minimum flow at Demwe Lower HEP with considering downstream flow contribution of Lohit river: The design discharge of 1729 cumec attenuated to 421.58 cumec.



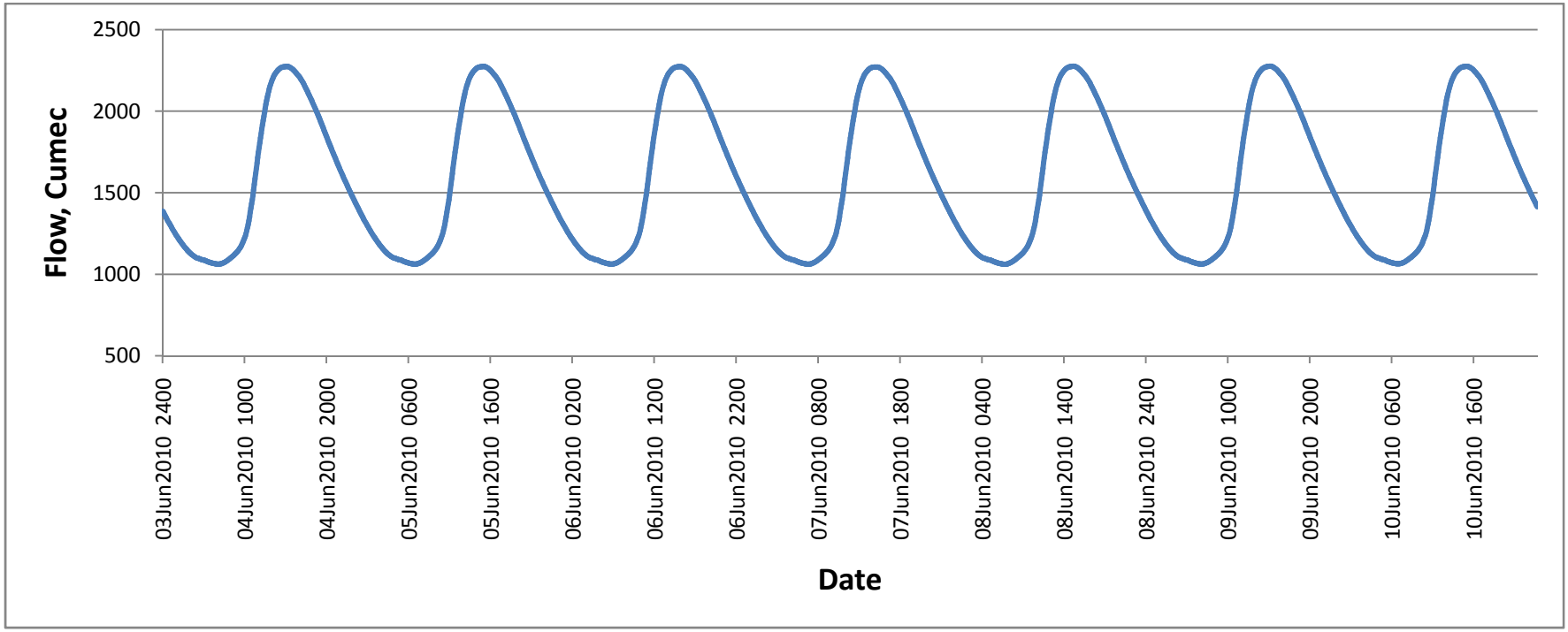
Flow hydrograph at Dibru Saikhowa National Park Cross Section - I due to 3hrs peaking and 21 hrs minimum flow at all three HEP with considering downstream flow contribution of all rivers: The combined design discharge of 8621 cumec attenuated to maximum 2794.28 cumec.



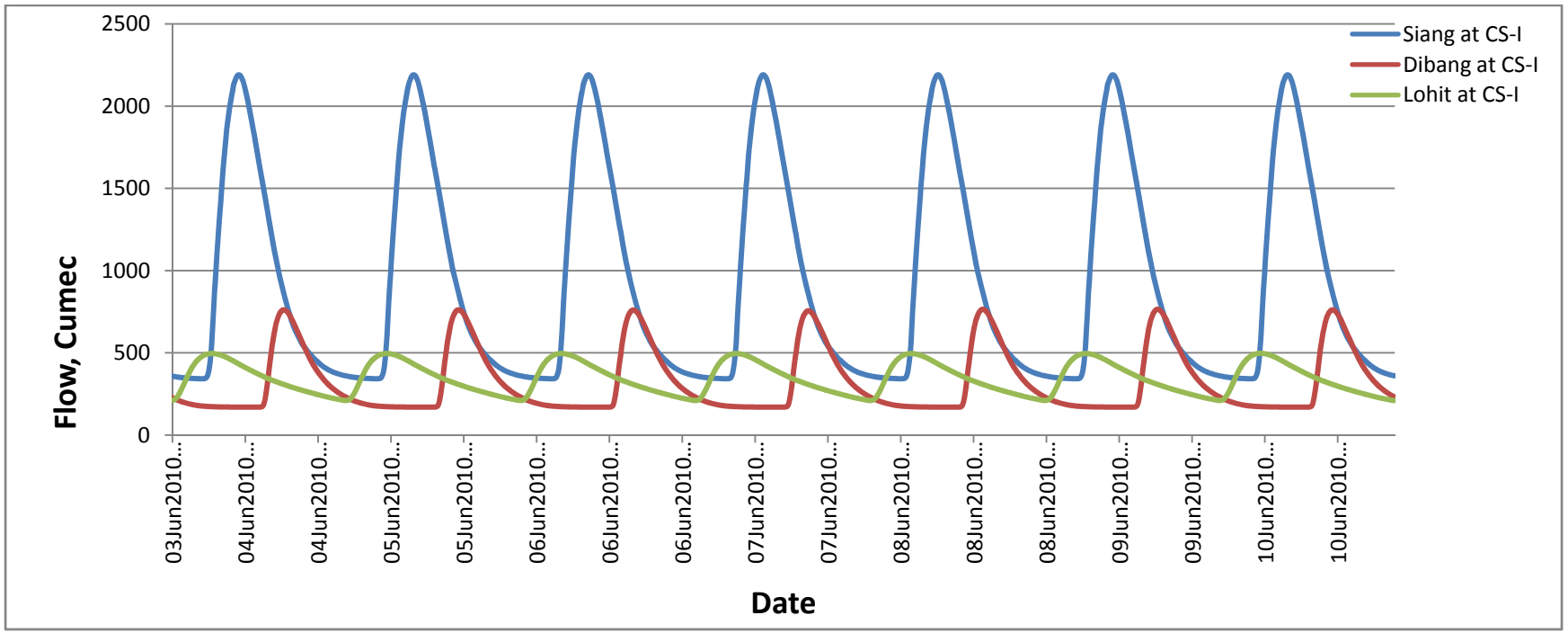
Flow hydrograph at Dibru Saikhowa National Park Cross Section - II due to 3hrs peaking and 21 hrs minimum flow at all three HEP with considering downstream flow contribution of all rivers: The combined design discharge of 8621 cumec attenuated to maximum 2551.96 cumec.



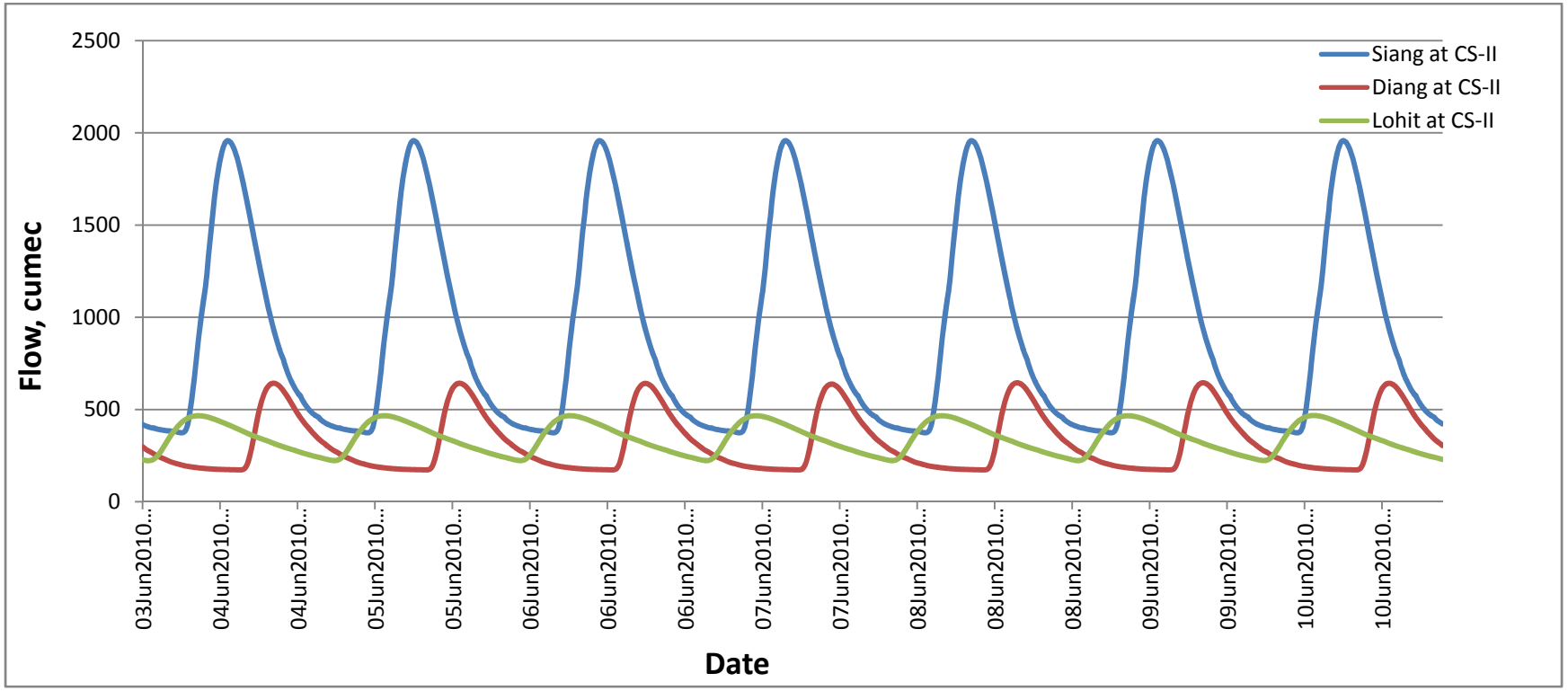
Flow hydrograph at Dibru Saikhowa National Park Cross Section - I due to 3hrs peaking and 21 hrs minimum flow at all three HEP with considering downstream flow contribution of all rivers: The combined design discharge of 8621 cumec attenuated to maximum 2275.58 cumec.



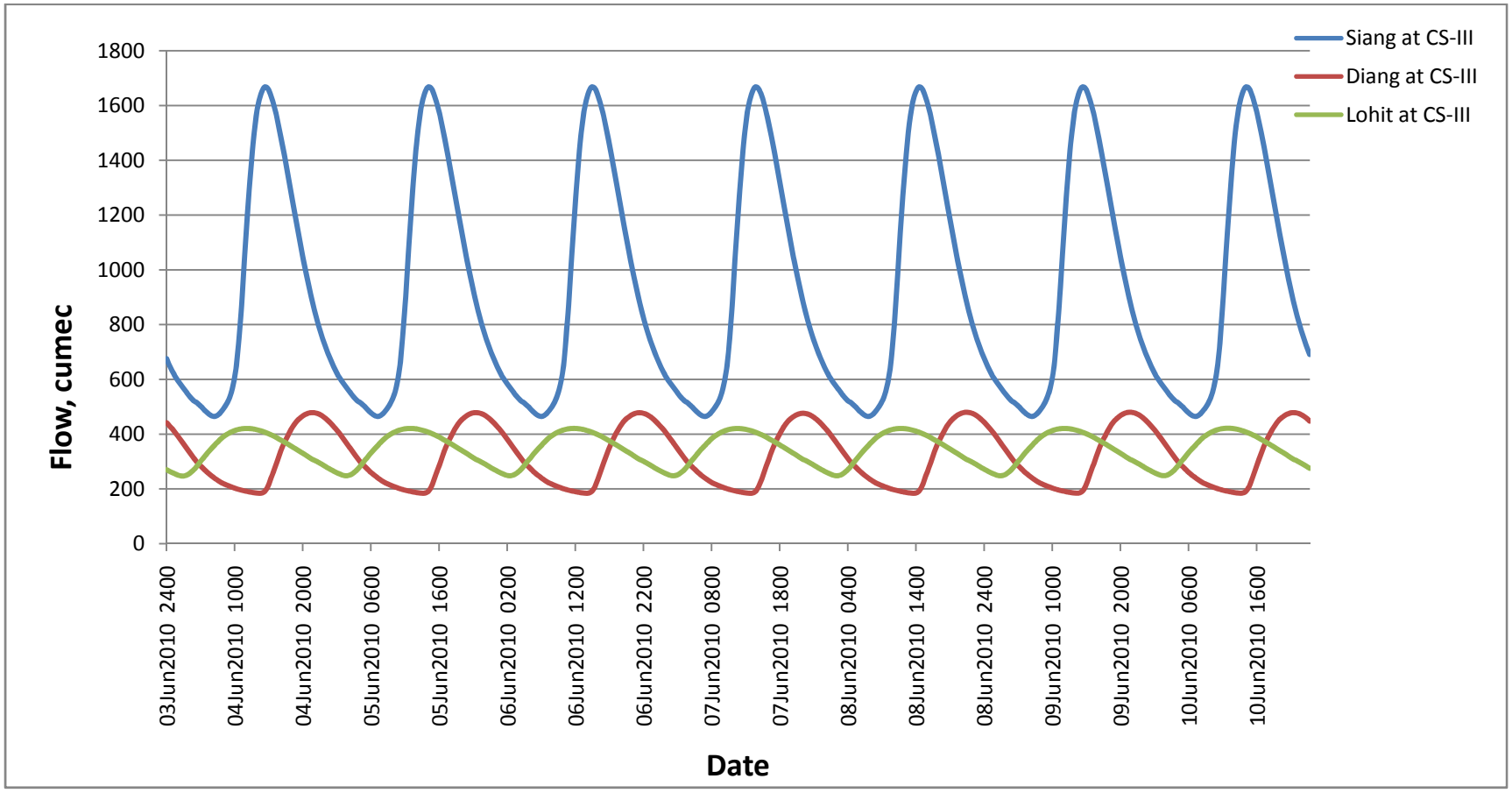
Temporal variation in arriving peak at Dibru saikhowa National Park Cross section - I when all three projects are operating at same time for peaking power generation



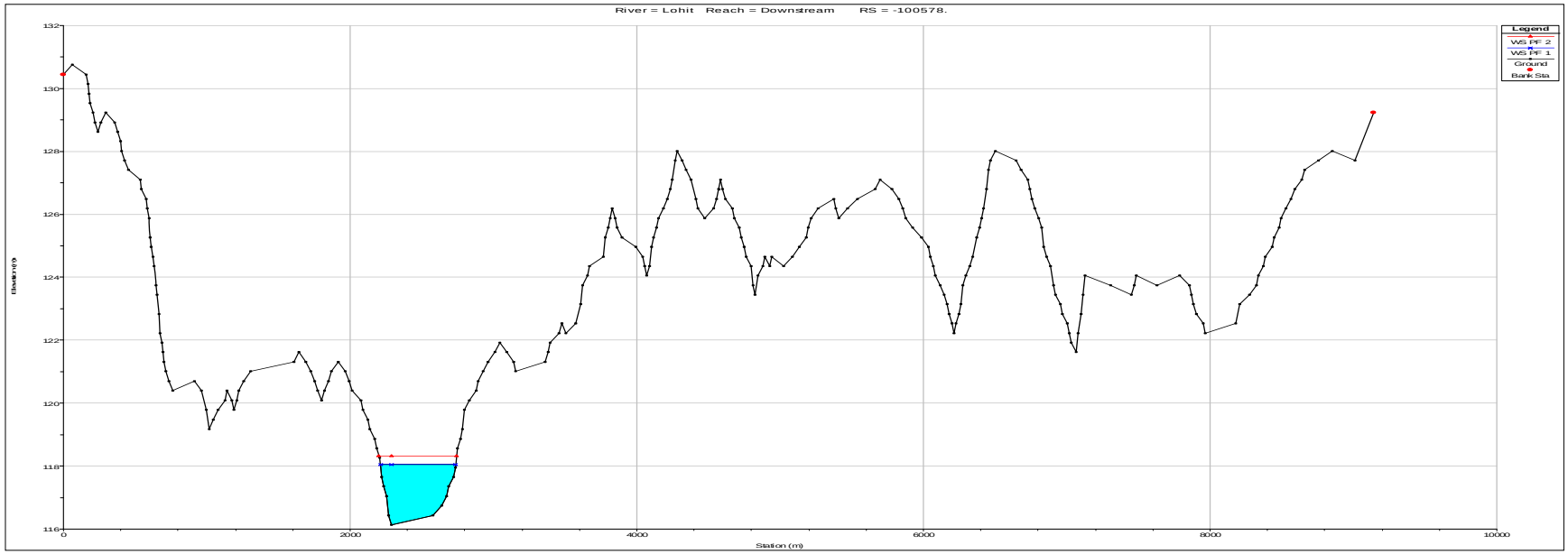
Temporal variation in arriving peak at Dibru saikhowa National Park Cross section - II when all three projects are operating at same time for peaking power generation



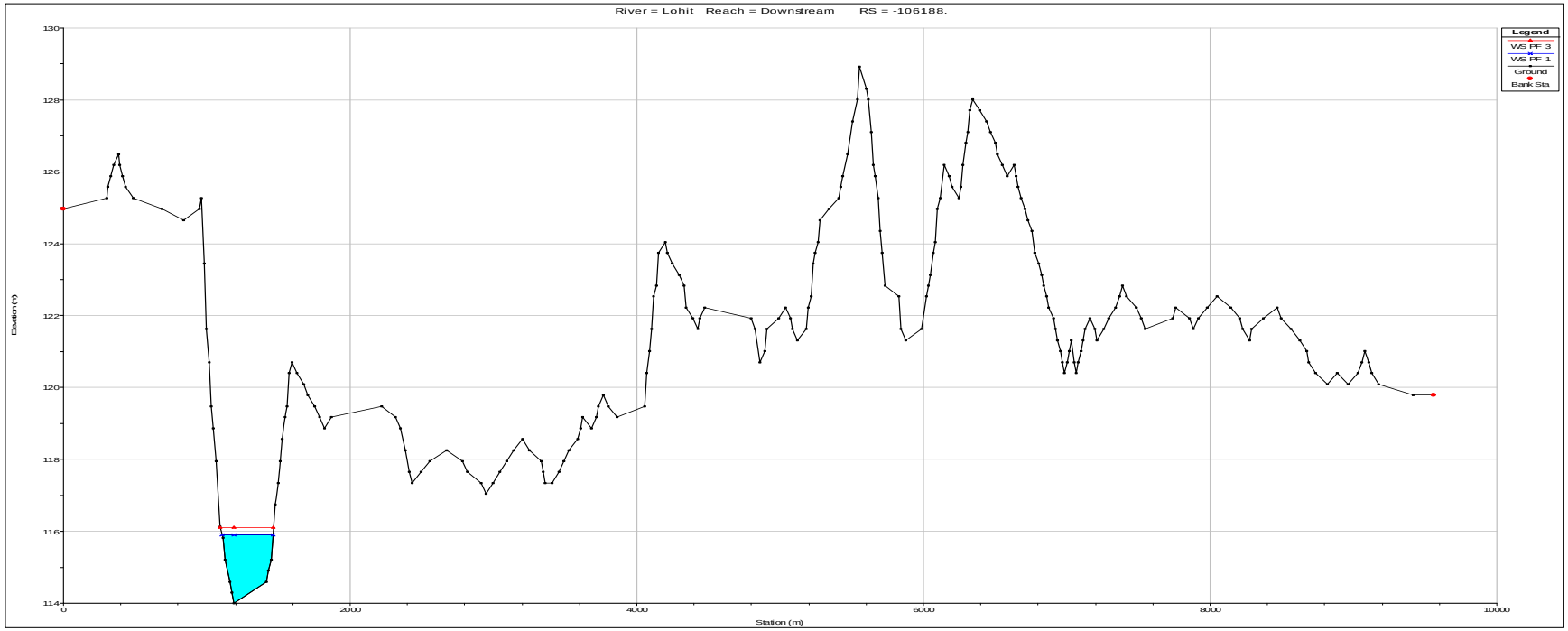
Temporal variation in arriving peak at Dibru saikhowa National Park Cross section - III when all three projects are operating at same time for peaking power generation



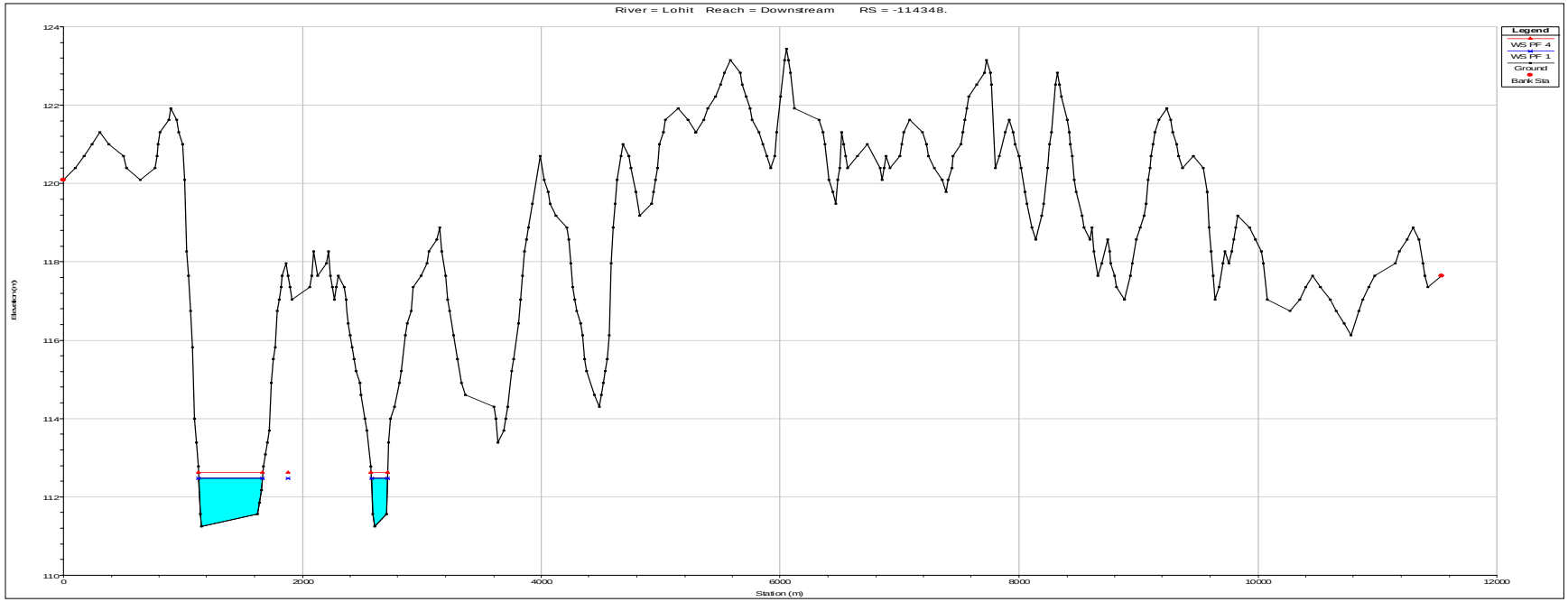
Maximum Water level due to 1. virgin Condition (WS PF 1) 2. due to operation of Demwe Lower HEP (WS PF 2) at Dibru saikhowa National Park Cross section - I on Lohit River i.e. Southern Bank of National Park



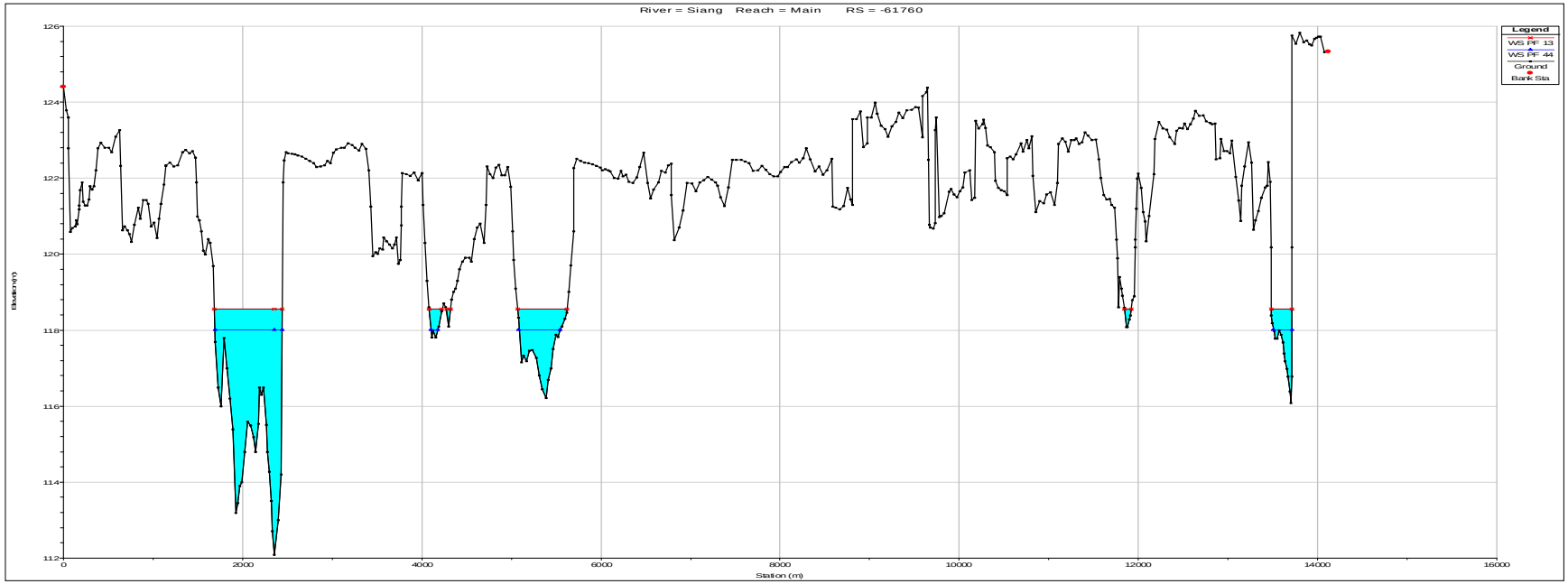
Maximum Water level due to 1. virgin Condition (WS PF 1) 2. due to operation of Demwe Lower HEP (WS PF 3) at Dibru saikhowa National Park Cross section -II on Lohit River i.e. Southern Bank of National Park



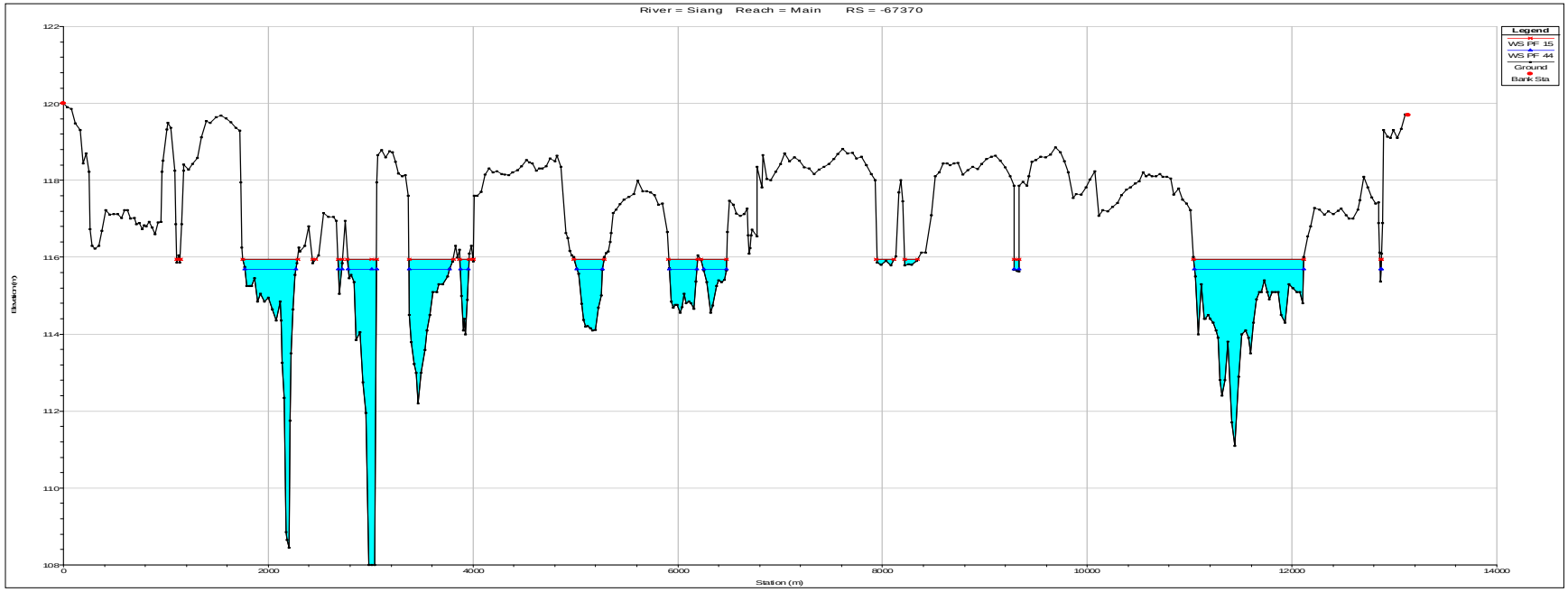
Maximum Water level due to 1. virgin Condition (WS PF 1) 2. due to operation of Demwe Lower HEP (WS PF 4) at Dibru saikhowa National Park Cross section -III on Lohit River i.e. Southern Bank of National Park



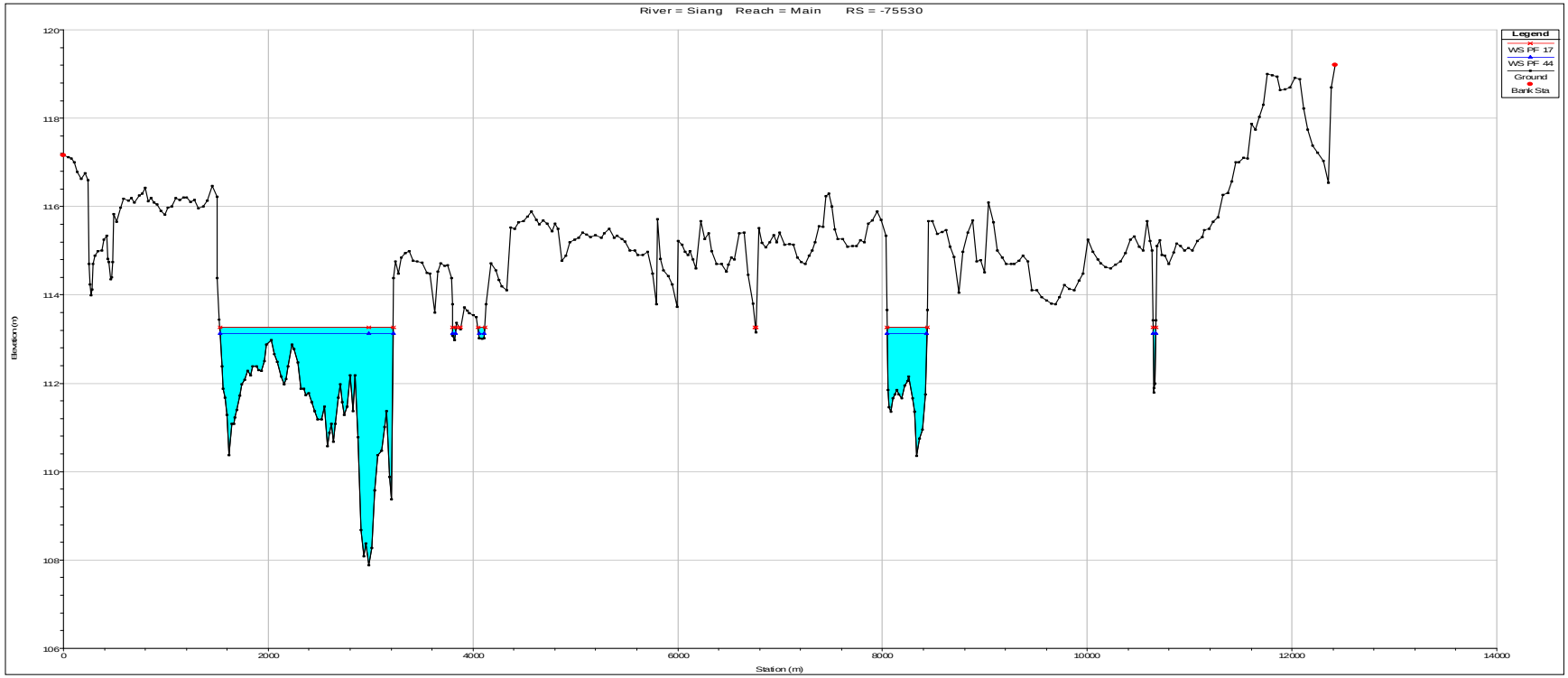
Maximum Water level due to 1. virgin Condition (WS PF 44) 2. due to operation of all three HEP's (WS PF 13) at Dibru saikhowa National Park Cross section - I on Brahmaputra River i.e. Northern Bank of National Park



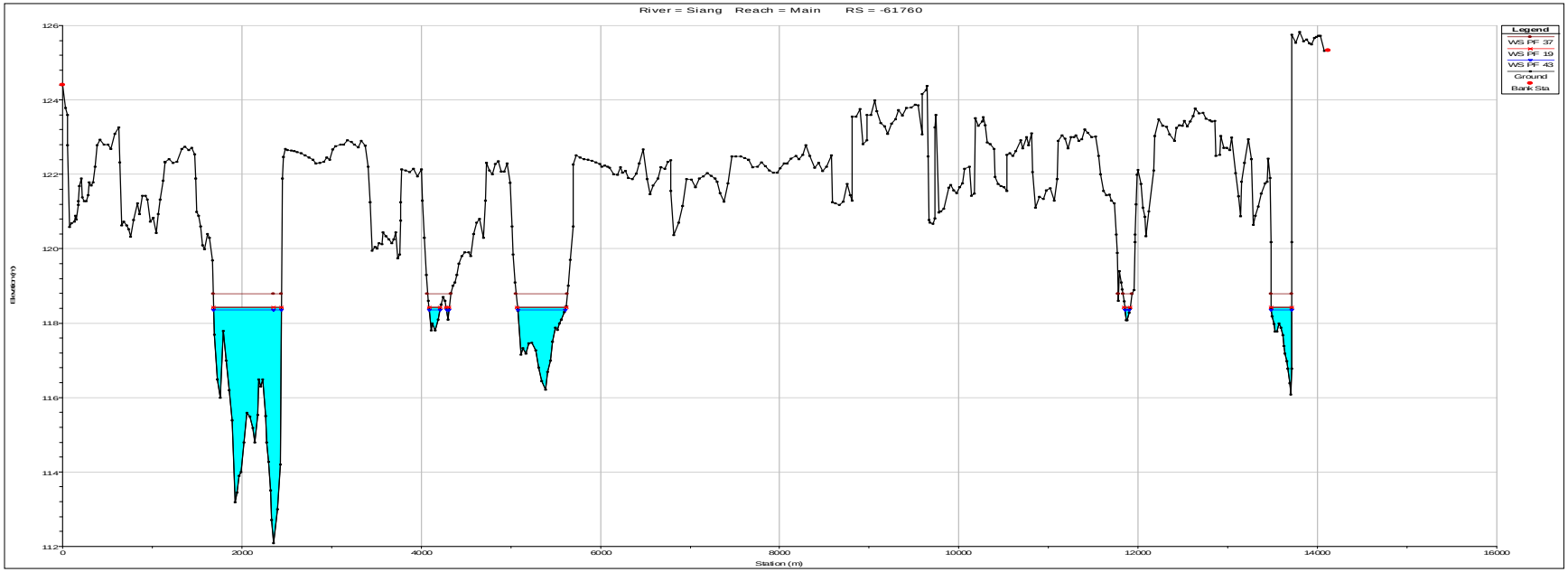
Maximum Water level due to 1. virgin Condition (WS PF 44) 2. due to operation of all three HEP's (WS PF 15) at Dibru saikhowa National Park Cross section - II on Brahmaputra River i.e. Northern Bank of National Park



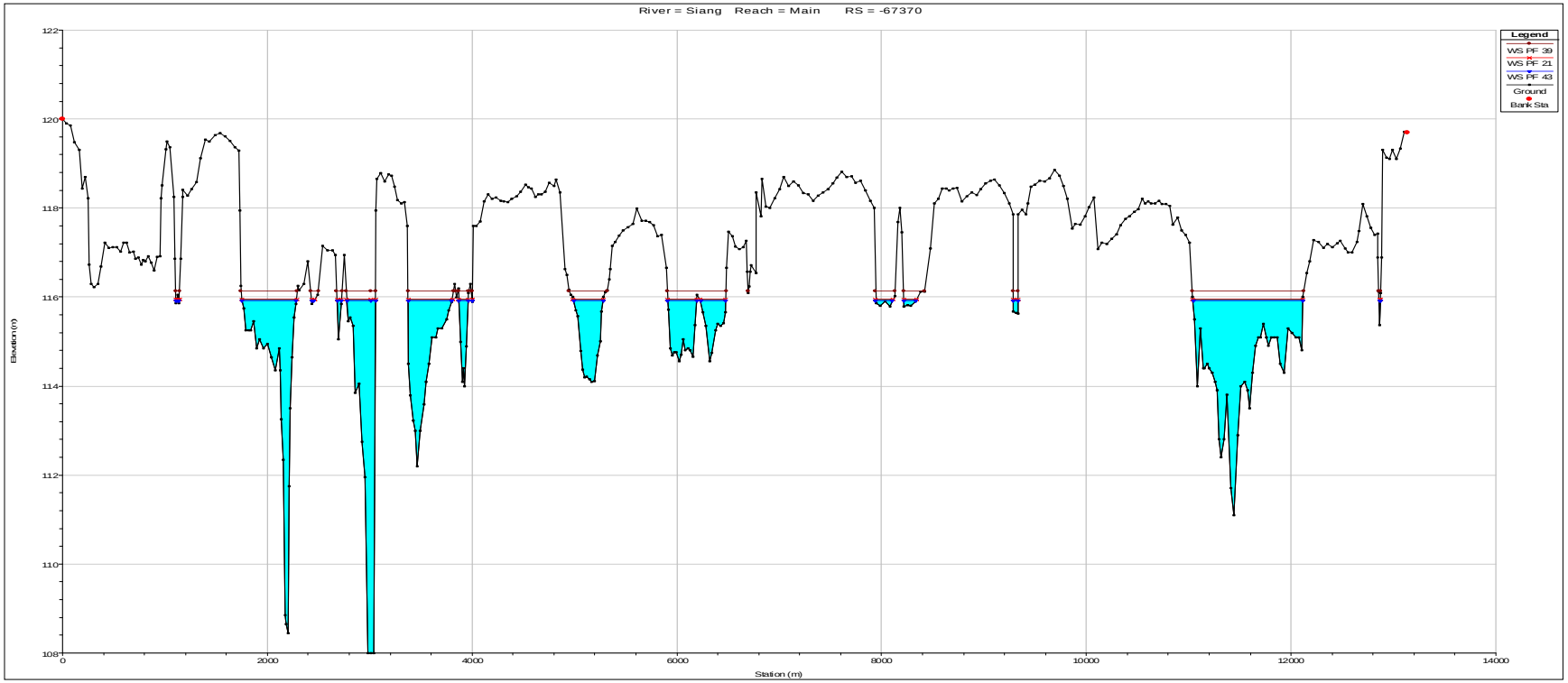
Maximum Water level due to 1. virgin Condition (WS PF 44) 2. due to operation of all three HEP's (WS PF 17) at Dibru saikhowa National Park Cross section - III on Brahmaputra River i.e. Northern Bank of National Park



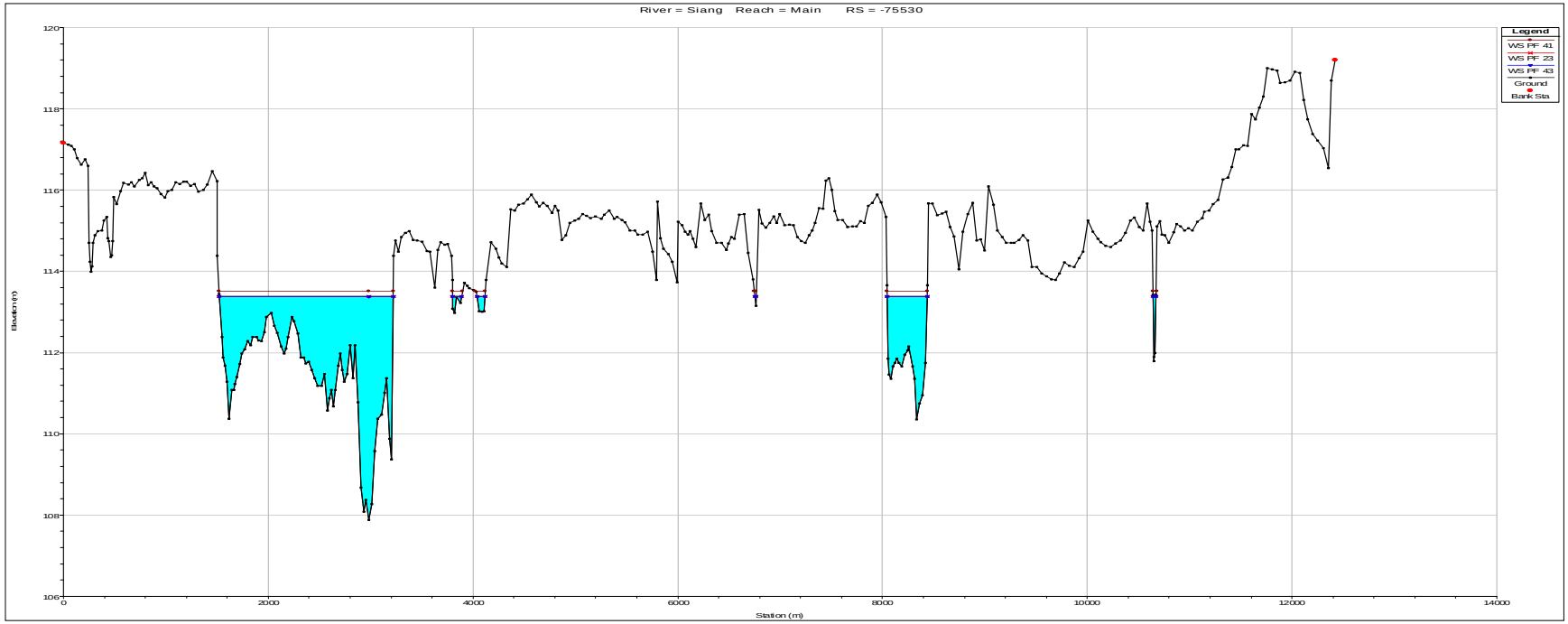
Maximum Water level due to 1. virgin Condition (WS PF 43) 2. due to operation of Demwe Lower HEP only (WS PF 19) and 3. due to operation of all three HEP's (WS PF 37) at Dibru saikhowa National Park Cross section - I on Brahmaputra River i.e. Northern Bank of National Park



Maximum Water level due to 1. virgin Condition (WS PF 43) 2. due to operation of Demwe Lower HEP only (WS PF 21) and 3. due to operation of all three HEP's (WS PF 39) at Dibru saikhowa National Park Cross section - II on Brahmaputra River i.e. Northern Bank of National Park



Maximum Water level due to 1. virgin Condition (WS PF 43) 2. due to operation of Demwe Lower HEP only (WS PF 23) and 3. due to operation of all three HEP's (WS PF 41) at Dibru saikhowa National Park Cross section - II on Brahmaputra River i.e. Northern Bank of National Park



वाप्कोस
लिमिटेड
(भारत सरकार का उपक्रम)

WAPCOS
LIMITED
(A GOVERNMENT OF INDIA UNDERTAKING)

WAP/ENVT/H-1414/2011/267

Dr. Sanchita Jindal,
Director (IA),
Ministry of Environment and Forest
Paryavaran Bhawan,
CGO Complex, Lodhi Road,
New Delhi - 110003

18.11.11

Sub.: Lohit Basin Studies – Effect on Dibru-Saikhowa National Park

Respected Madam,

This is in reference to the presentation made on 12.11.11 by M/s WAPCOS Limited on the Basin Study of Lohit River to Expert Appraisal Committee for River Valley Projects, a reference was made that the assessment pertaining to effect of peaking of Demwe Lower, Lower Siang and Dibang Projects on the Dibru-Saikhowa National Park located in Assam, as aprt of Downstream Impact Assessment Stuyd for Lower Siang HEP, needs to be modified.. Some NGO's have also made similar representations to MoEF, which also have been forwarded to us.

As discussed during the said EAC meeting on 12.11.11, a modified study entitled "Effect of Peaking Power Generation by Siang Lower HEP, Demwe Lower HEP and Dibang Multipurpose HEP on Dibru-Saikhowa National Park" is attached herewith for your kind perusal and further necessary action please.

Regards,

Yours sincerely,

18.11.11

(Dr. Aman Sharma)
Chief Engineer (Envt.)

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