Chapter -1: Tapi Basin

1.1 Introduction

Tapi Division, Surat under Hydrological Observation Circle, CWC, Gandhinagar is conducting the Hydrological observations in the catchments of Tapi River and on its tributaries at 18 stations, out of which nine (9) are under Flood Forecasting scheme, three (3), under National network scheme and six (6) are under 80 - key Hydrological observation scheme.

Basin Map of Tapi River, showing CWC sites is enclosed as Fig-1

The gauge & discharge data of five (5) stations, viz. Tapi at Burhanpur, Purna at Gopalkheda, Purna at Yerli, Tapi at Gidhade and Tapi at Sarangkheda are included in this book. From administrative consideration the basin is divided into three viz Upper Tapi Zone, Middle Tapi Zone and Lower Tapi Zone each having one sub- division viz UTSD, Bhusawal, MTSD, Dhule and LTSD,Surat respectively under the Tapi Division, Surat. Salient features of existing sites in Tapi basin are shown in Table-1.

1.2 Geographical setting of Tapi Basin

The Tapi Basin is situated in the northern part of the Deccan Plateau and extends over an area of 65.145 km which is nearly 2% of the total geographical area of the country. Nearly 80% of the basin lies in state of Maharashtra. The basin lies between east longitudes of 72^0 38′ to 78^0 17′ and north latitudes of 20^0 05′ to 22^0 03. it is bounded on the north by the Satpura range on the east by the Mahadeo hills. On the south by the Ajanta range and Satmala hills and on the west by the Arabian Sea. Bounded on the three sides by the hill ranges. The Tapi River along with its tributaries flows over the plains of vidharbha, Khandesh and Gujarat and over large areas in the state of Maharashtra and small area in Madhya Pradesh and Gujarat.

The basin has an elongated shape with a maximum length of 587 km from east to west and the maximum width of 210km from north to south. Perimeter of the basin is about 1840 km. the State wise distribution of the drainage area is given in the table -1there are two well defined physical regions, in the basin, namely, hilly region and plains the hill regions comprising satpura, Satmalas, Mahadeo, Ajanta and Gawilgarh hills are well forested. The plain covers the Khandesh areas which are broad and fertile suitable for cultivation primarily, the basin consists of black soils the coastal plains of Gujarat are composed of alluvial clays with a layer of black soil above. The culturable area of the basin is about 4.29Mha which is 2.2% of the total culturable area of the country. The forest cover is about 25% of the area in the basin.

Table-1: Existing Sites of Tapi Basin

SL. No.	Name of Site	River	Code No.	Status	Scheme	`Catchment area(Km2)	Latitude (N) D M S	Longitude (E) D M S	Date of occurrence
1	2	3	4	5	6	8	9	10	13
1.	Teska	Tapi	NA	GRF	FF	1486	21^0 49′00″	77^0 46′ 05″	08/07/2007
2.	Burhanpur	Tapi	010217002	GDSQRF	NNW	8487	21^0 17′12″	76 ^{0}13′ 18″	08/07/2007
3.	Dedtalai	Tapi	010217002	GRF	80K	6660	21^0 31′00″	76^0 45′ 24″	08/07/2007
4.	Hathnur	Tapi	010217006	GRF	FF	29430	21^0 04′35″	75^0 56′ 43″	07/10/2006
5.	Bhusawal	Tapi	010217007	GRF	FF	32478	21^0 03′54″	75^0 46′56″	07/08/2006
6.	Lakhpuri	Purna	010217003	GRF	80K	3560	20^{0}50′49′	77^0 21′ 41″	10/08/1979
7.	Gopalkheda	Purna	010217004	GDSQRF	80K	9500	20^0 52′35″	76^0 59′ 14″	10/08/1979
8.	Yerli	Purna	010217005	GDSRF	NNW	16517	20^0 56′11″	76^0 28′ 27″	1959
9.	Chikaldhara	NA	NA	RF	FF	NA	21^{0}24′04″	77^0 19′ 46″	NA
10.	Girna dam	Girna	010217008	GRF	FF	4729	20^0 28′42″	74^0 42′ 55″	25/09/1994
11.	Dahigaon weir	Girna	010217009	GRF	FF	8599	20^0 50′05″	75^0 25′ 26 ″	09/08/2006
12.	Savkheda	Tapi	010217011	GRF	NNW	48136	21^{0}08′ 53″	75^0 30′ 54″	15/09/1959
13.	Morane	Panjhra	010217013	GRF	80 K	1933	20^0 54′32″	74^0 42′ 47″	22/09/1998
14.	Gidhade	Tapi	010217014	GDRF	FF	54750	21^{0}17′ 45″	74^0 48′ 45″	07/08/2006
15.	Sarangkheda	Tapi	010217015	GDSQRF	80 K	58400	21^{0}25′55″	74 ^{0} 31′ 37″	08/08/2006
16.	Ukai	Tapi	010217016	GRF	FF	62225	21^0 14′55″	73^0 35′ 25″	08/10/1990
17.	Ghala	Tapi	010217018	GRF	80 K	63325	21^0 17′53″	73^0 01′ 43″	08/08/2006
18.	Surat	Tapi	010217019	G	FF	63973	21^0 11′49 ″	72^0 46′ 04″	09/08/2006
19.	Shegaon	Tapi	Telemetry	RF	--	--	20^0 47′46 ″	76^0 08′ 00″	2010
20.	Chiklod	Tapi/ Bokar	Telemetry	RF	--	--	21^0 20′06 ″	76^0 00′ 23″	2010
21.	Sagbara	Tapi	Telemetry	RF	--	--	21^0 32′35 ″	73^0 47′ 42″	2010
22.	Khetia	Tapi	Telemetry	RF	--	--	21^0 39′00 ″	74^0 42′ 06″	2010
23.	Nandurbar	Tapi	Telemetry	RF	--	--	21^0 21′37 ″	74^0 14′ 18″	2010
24.	Nizampur	Tapi	Telemetry	RF	--	--	21^0 06′49 ″	74^0 19′ 47″	2010

Physiographically, the area is a basaltic landscape with major physiographic units of plateau lands, escarpments, hills, piedmont plains, colluvio-alluvial plains and valley plains.

The entire Tapi basin can be divided in three sub basins: Upper Tapi Basin up to Hathnur (Confluence of Purna with the main Tapi (29,430 sq km), Middle Tapi Basin from Hathnur up to the Sarangkheda gauging site (28,970 sqkm), and the Lower Tapi Basin from sarangkheda up to Sea (6,745 sq km). the annual rainfall for the upper, middle and lower Tapi basins for an average year is 931.90mm, 713.05 mm, 1407.9 mm respectively.

1.3 The River System

1.3.1 Major Tributaries of the Tapi River System

(A) Tapi River

The Tapi River (Hindi ताप्ती , Marathi तापी, Gujarati: તાપ્તી) ancient original name Tapi River (Sanskrit: तापी), is a river in central India. It is one of the major rivers of peninsular India with a length of around 724 km. The Tapi River originates in the Betul district from a place called Multai. It is one of only three rivers in peninsular India that run from east to west - the others being the Narmada River and the Mahi River The Tapi is the second largest westward draining inter state river basin. It covers a large area in the State of Maharashtra besides areas in the states of Madhya Pradesh and Gujarat.

The Tapi River drains an area of 65145 sqkm out of which nearly 80 percent lies in Maharashtra. The State wise distribution of the drainage area is shown in Table 2.

Table-2: State wise distribution of the drainage area

S No	Name of State	Drainage area (sqkm)	Percentage of total
1	Madhya Pradesh	9,804	15.0
2	Maharashtra	51,504	79.1
3	Gujarat	3,837	5.9
	Total	65,145	100.0

For the first 282 Km., the river flows in Madhya Pradesh, out of which 54 Km. form the common boundary with Maharashtra State. It flows for 228 Km.in Maharashtra before entering Gujarat. Traversing a length of 214 Km. in Gujarat, the Tapi joins Arabian sea in Gulf of Cambay after flowing past the Surat city. The river receives tidal influence for a length of about 20 Km. upstream from mouth i.e. up to Singanapore weir.

The Tapi receives several tributaries on both banks. There are 14 major tributaries having a length more than 50 Km. On the right bank 4 tributaries namely, the Vaki, the Gomai, the Arunavati and the Aner join the Tapi. On the left bank, 10 important tributaries namely the Nesu, the Arunavati, the Buray, the Panjhra, the Bori, the Girna, the Vaghur, the Purna, the Mona and the Sipna drain into the main channel. The drainage system on the left bank of the Tapi is therefore, more extensive as compared to the right bank area.

The Purna and the Girna, the two important left bank tributaries together account for nearly 45 percent of the total catchment area of the Tapi. The Purna is one of the

principal tributaries of the Tapi, starts in Betul district in Gawilgar hills of the Satpura range and mostly drains through three districts of Vidharbha namely Amravati, Akola and Buldhana. The Girna another Major tributary rises in the Western Ghats and drains Nasik and Jalgaon districts of Maharashtra.

(B) Purna River

Purna, is one of the tributaries of Tapi, joins from the left. The Purna is the principal affluent of the Tapi. It is the main artery of a network of rivers and streams draining Akola, Amravati and Buldana districts of Maharashtra and Betul district of Madhya Pradesh. It is the only river in the upper Tapi Basin, which has a perennial flow. Rising in the Gawilgarh hills at an elevation of 900m., North latitude 21^0 38' 00" and East longitude 77^0 36' 00", the Purna flows first in a South westerly direction for about 60 km. through hills and forests before it enters the Purna plains. Flowing in a generally westerly direction for a length of 274 Km, the Purna joins the Tapi north west of Edalabad. The Man is the main left bank tributaries of Purna, and Chandrabhaga and Wan are the principal right bank tributaries. Thus Purna drains a total area of 18, 929 Sq.km.

(C) Girna River

The Girna River is a river in Maharashtra state of southern India. It originates at Kem peak in the Western Ghats range of Nashik District with a latitude of 21° 7' 60 N and a longitude of 75° 19' 0 E,, and flows east across Nashik and Jalgaon districts, swinging north in Jalgaon District to join the Tapti River.The dams on the river are Chanakapur and Girana Dam. The name Girna derives from the name of Goddess Giraja (Parvati). A 100 square km area around Girna River has an aproximate population of 979337 (0.009793 persons per square meter) and an average elevation of 246 meters above the sea. The basin of the Girna lies on the Deccan Plateau, and its valley has fertile soils which are intensively farmed,

(D) Gomai

Gomai River is tributary of Tapti River. It originates in Satpura Mountain Range and merge in Tapi River around 2 km east of Prakasha. Gomai river itself has many small tributary rivers like Susri river (passing by Sultanpur), Tipria river (passing by Mandane), Umri river, Sukhi river

(E) Panzara

The Panzara-Kan or Panjhra is a river in Khandesh region of Maharashtra state of India. It is a tributary of the Tapi River. Panjhra River originates just few kilometers

from a small town Pimpalner, tal-sakri in Dhule District. One small reserivor named Latipada dam is constructed just after its origin

(F) Pedhi.

The only important left bank tributary of the Purna is the Pedhi. It rises in the low hills near Rithpur and receives a number of small affluent both from the east and the west, the chief on the west being the Naghira river.

(G) Arna.

The first of the principal right bank affluents of the Purna is the Arna which emerges from the Satpuda hills in Betul district and flows in a south and south-easterly direction passing by Sirasgaon to join the Purna just below Deurwada.

1.3.2. Tapi Basin as per the Water Shed Atlas of India

As per the watershed atlas of India, Published by Department of Agriculture and cooperation, Ministry of agriculture, Krishi Bhavan New Delhi (1990),

The sub-catchments from 5C1A to 5C5B pertain to Tapi Basin.

1.3.2.1 Subcatchment -5C1A (5C1A1 to 5C1A4)

This catchment is situated in the Surat district of Gujarat drained by lower Tapi River near to its confluence with and some small tributary like Ver and Anjana. The catchment area of this sub catchment is 2140 sq.km.

1.3.2.2 Subcatchment 5C1B (5C1B1 to 5C1B4)

This Catchment is situated in the plain region of Surat and Bharuch District of Gujarat drained by Kim, Sena, Kini and Ghanta River. The total catchment area of this Catchment is 2580 sq.km

1.3.2.3 Subcatchment -5C2A (5C2A1 to 5C2A7)

This catchment is situated in the hilly and plane region of Gujarat, Maharashtra State and Madhyapradesh drained by small tributaries such as Godada nadi, Dadan khadi, Dudhi, khadi, Kanji nadi, Dehli nadi, Vatkaada nadi, Valhari nadi,Vaki, Gomai,Umri, Lendi-Kordi, coverd Bharuch, Surat in Gujarat Dhulia in maharashtra and Khargone in MP with the catchment area of 3890 sq.km.

1.3.2.4 Subcatchment 5C2B (5C2B1 to 5C2B7)

This catchment is situated in the hilly and plane region of Maharashtra State and Madhya Pradesh drained by small tributaries such as Arunavati, Aner, Dhudkheda, Guli Bhaurak, Mor, and Suki on the Right Bank of Tapi River. The total catchment area of this catchmen is 4890 sq.km.

1.3.2.5 Subcatchment - 5C3A (5C3A1 to 5C3A5)

this is situated in the plan region of Gujarat and Maharashtra State, drained by Main tributaries such as Rangavali, nesu, Kordi,Shivnad, Bhad and Amravti in Subcatchment on the Left Bank of Tapi River. The total catchment area of this Catchment is 3200 sq.km.

1.3.2.6 Subcatchment- 5C3B (5C3B1 to 5C3B8)

This is situated in the plan region of Maharashtra State, drained Buray ,Sur, Pan, Panjhara, Kanehr, Mokti, Hinasan, Jamkheri Kan, Bori Chikli, Sugran and Kanoli covered Dhilia Jalgaon and Nasik district in this Subcatchment on the Left Bank of Tapi River. The total catchment area of this Catchment is 6480 sq.km.

1.3.2.7 Subcatchment- 5C3C (5C3C1 to 5C3C9)

this is situated in the plan region of Maharashtra State, drained by Anjani, girna, Bahula, Tittut, Nanyad, Panjhari, Sukhi, Masam, Kanjari, Aram and Punand in subcatchment on the Left Bank of Tapi River covered most of the part of Jalgaon Nasik, Aurangabad and dhulia. The total catchment area of this Catchment is 10100 sq.km

1.3.2.8 Subcatchment-5C3D (,C3D1 to 5C3D4)

This is situated in the plan region of Maharashtra State, drained by Main tributaries such as Vaghursur, Kag, Khadki, Koka and Bhogavati in the subcatchment on the Left Bank of Tapi River. The total catchment area of this Catchment is 2800 sq.km

1.3.2.9 Sub catchment -5C4A (5C4A1 to 5C3A6)

This sub catchment is situated in the plane region of Maharashtra State, drained by the Tributaries of Purna River such as Nalganga, Biswa, Ghan nadi, Mas, Nirgana and Mun. Catchment area of this sub catchment is 5950 sq.km.

1.3.2.10 Sub catchment -5C4B (5C3B1 to 5C3B6)

This sub catchment is situated in the plane region of Maharashtra State, drained by the Tributreis of Purna river such as Ban, Shahnur and Bodli km. Catchment area of this sub catchment is 4020 sq.km

1.3.2.11 Sub catchment -5C4C (5C4C1 to 5C4C6)

This is situated in the plane region of Maharashtra State, drained by the Tributreis of Purna River such as Murna, Purna, Katapurna, Uma and Pedhi Catchment area of this sub catchment is 5950 sq.km.

1.3.2.12 Sub catchment -5C4D (5C4D1 to 5C3D4)

This Sub Catchment area is situated in the plane region of Maharashtra State, drained by the Tributaries of Purna river such as Chanrabhaga, Sapna, and Arna are

tributaries of this subcatchment. The total catchment area of this catchment is 3370 sq.km

1.3.2.13 Subcatchment -5C5A (5C5A1 to 5C5A8)

This Catchment is situated in the plan and hills region of Maharashtra and Madhya Pradesh State, drained by the Bokad river, Mona river, Utaoli, Tapi and Garg in this sub catchment area. The total catchment area of this Sub Catchment is 4650 sq.km

1.3.2.14 Subcatchment - 5C5B (5C5B1 to 5C1B8)

This Catchment is situated in the plan and hills region of Maharashtra and Madhya Pradesh State, drained by Sipna, Kharpra, Dahsana, Khandu, Baki, Betul and Ambora in Subcatchment. The total catchment area of this sub Catchment is 5980 sq.km.

Source: watershed atlas of India, Department of Agriculture and cooperation, Ministry of agriculture, Krishi Bhavan New Delhi (1990)

Table – 3: general information of main River/ tributaries of Tapi River Basin

Sl. No.	Name of River / tributary	Bank	Elevation of source above m.s.l. [m]	Length [km]	Catchment area [km.^{2}]	% of total area
1.	2.	3.	4.	5.	6.	7.
1	Tapi		752	724	22522	34.57
2	Gomai	Right	600	58	1148	1.76
3	Arunavati	Right	450	53	935	1.44
4	Buray	Left	600	64	1419	2.18
5	Panjhra	Left	600	138	3257	5.00
6	Bori	Left	600	130	2580	3.96
7	Aner	Right	600	94	1702	2.61
8	Girna	Left	900	260	10061	15.44
9	Waghur	Left	751	96	2592	3.98
10	Purna	Left	900	274	18929	29.06
				TOTAL	65145	100

1.4 The Climate

The climate of the Tapi Basin is characterised by a hot summer and general dryness throughout the year except during the south-west monsoon season in the upper and middle part of basin but in the lower part of the Tapi River Basin shows variation in Temperature, Rainfall, Humidity and all climatic parameters.

The year may be divided into four periods. The winter from December to February, the summer from March to May, the south-west monsoon season from June to September and the post-monsoon period from the October to November

1.4.1 Temperature

Temperature of Tapi basin is like any other part of central India, the temperature is maximum in the month of May and minimum in the month of December to January. In general, upper and middle part of Tapi basin record lower temperature as

compared to the lower Tapi basin, the influence of the sea is prominent, and temperature thought lower than the upper and middle basin.

The temperature profile in the basin is given in the table no. 4

Table-4: Temperature data of Tapi basin

Month	Mean Monthly Maximum Temperature (oC)										
Location / Name of Site	Bhusawal	Yerli	Hatnur	Dedtalai	Gopalkheda	Lakhapure	Burhanpur	Savkh	Morane	Gidhad	Sarsng
Jun-11	37.5	37.6	32.5	38.3	36.1	34.6	38.3	35.7	34.1	35.1	38.8
Jul-11	31.8	30.4	29.5	30.3	32.5	32.0	31.9	31.9	29.8	31.1	34
Aug-11	30.2	30.0	26.8	29.5	32.2	30.8	30.2	31.1	29	28.7	34.9
Sep-11	31.9	28.1	28.2	31.1	32.9	31.0	31.2	30.9	29.6	30.9	34.7
Oct-11	33.5	28.0	30.0	33.3	35.5	32.2	35.1	33.9	32.5	34.2	39.1
Nov-11	33.6	35.5	26.9	30.5	32.5	32.2	34.2	30.7	30.7	33.1	37.2
Dec-11	31.9	33.6	22.2	27.4	30.3	32.0	32.0	29.9	27.7	30.5	34
Jan-12	31.5	32.3	24.0	23.3	29.5	31.1	29.9	29.8	21.9	26.9	31.2
Feb-12	34.4	35.1	27.1	28.4	33.1	33.4	33.6	32.2	23.1	29.1	34.8
Mar-12	39.3	40.5	30.3	33.0	38.6	38.6	38.6	33.3	33.8	36.3	39.7
Apr-12	42.3	42.8	32.1	37.7	40.8	39.5	41.4	33.8	37.1	39.7	43.2
May-12	42.8	44.6	35.8	41.1	40.5	43.5	42.9	36.3	36.8	41.1	42.8
Annual Mean	35.1	34.9	28.8	32.0	34.5	34.2	34.9	32.5	30.5	33.1	37.0

Month	Mean Monthly Minimum Temperature (°C)										
Location / Name of Site	Bhusawal	Yerli	Hatnur	Dedtalai	Gopalkheda	Lakhapure	Burhanpur	Savkh	Morane	Gidhad	Sarsng
Jun-11	26.5	25.8	26.0	27.3	27.8	27.3	27.2	25	26.8	26.8	25.2
Jul-11	24.5	23.1	24.9	23.7	24.8	25.0	24.8	24.8	24.8	25.3	24.7
Aug-11	24.2	22.8	24.1	25.2	24.9	25.3	24.1	25.6	24.5	24.5	25.3
Sep-11	24.3	22.8	24.0	26.2	25.7	25.1	23.8	25.7	23.8	24.5	23.5
Oct-11	21.9	20.4	22.5	25.7	20.6	19.8	21.6	25	22	22	20.7
Nov-11	17.2	13.2	16.7	21.6	16.6	15.8	17.3	20.2	17.8	18.1	16.5
Dec-11	13.9	9.9	16.1	18.8	10.8	16.0	13.9	15.6	14.5	15	13.7
Jan-12	11.0	8.1	9.9	13.7	9.1	9.9	11.3	10.8	12.6	12.9	11.5
Feb-12	15.6	12.5	17.3	17.0	16.0	14.4	16.1	12.3	15.2	13.5	13.1
Mar-12	18.7	16.2	19.8	23.1	20.2	18.6	19.1	15.3	17.5	16.4	17
Apr-12	24.9	31.7	22.2	26.7	24.6	23.4	24.2	22.2	27.8	23.9	24.8
May-12	27.5	27.0	24.6	29.2	30.9	29.0	26.9	21.9	28.9	25.3	26.1
Annual Mean	20.9	19.5	20.7	23.2	21.0	20.8	20.9	20.4	21.4	20.7	20.2

1.4.2 Rainfall

The south west monsoon sets in the Tapi basin in the middle of June and withdrawal by mid October. About 90 percent of total rainfall is received during the monsoon

months , of which 50% is received during July and August. The Tapi River basin showing different climatic characteristics due to the variation of topography of Tapi basin climate is variable from upper to lower part of basin.

The average rainfall in the Tapi basin is 830 mm. but the basin wise variation are shown in table no.5

Table-5: Variation in average of monsoon rainfall

Sr. No.	Name of Sub Basin	Bank	Length in Km	Catchment Area (sqkm)	% with reference to total area.	10 years average of Monsoon rainfall (mm)
1.	Upper Tapi upto Hathnur	Main	290	10471	16.1	857
2.	Purna	Left	274	18929	29.1	650
3.	Middle Tapi, Hathnur to Ukai excluding Girna.	Main	305	22734	34.9	725
4.	Girna	Left	260	10061	15.4	642
5.	Lower Tapi-from Ukai to confluence to sea near Surat	Main	129	2920	4.5	1224

Table -6: Rainfall at sites in Tapi Narmada Basin

(Average for the period 1980-2011)							
Sl No	Name of Site	District	Seasonal Average Rainfall (mm)				Total Annual Average Rainfall
			Winter monsoon (Jan-Feb)	Pre monsoon (Mar-May)	South-West monsoon (June-Sept)	Post monsoon (Oct-Dec)	
1	Teska	Betul (MP)	0.0	0.0	967.9	0.0	967.9
2	Lakhapuri	Akola (MS)	15.7	22.0	640.1	76.9	754.7
3	Chikhaldara	Amarawati (MS)	12.6	28.0	1288.5	106.0	1435.0
4	Gopalkheda	Akola (MS)	14.2	17.7	618.6	54.3	704.7
5	Dedtalai	Burhanpur (MP)	10.5	17.3	816.3	46.3	890.3
6	Burhanpur	Burhanpur (MP)	10.6	27.4	763.0	66.2	867.2
7	Yerli	Buldana (MS)	12.4	17.1	615.8	77.3	722.6
8	Hatnur-Dam	Jalgaon (MS)	8.6	20.4	587.8	58.4	675.3
9	Bhusawal	Jalgaon (MS)	7.0	17.4	632.5	95.3	752.1
10	Girna	Nasik (MS)	5.0	44	461.8	32.4	543.2
11	Dahigaon	Jalgaon(MS)	8.4	4	425.2	25.6	463.2
12	Savkheda	Jalgaon (MS)	6.8	2.2	477.6	32.1	518.7
13	Morane	Dhule(MS)	5.6	6.8	486.6	45.3	544.3
14	Gidhade	Dhule(MS)	9.1	27.6	625	20	681.7
15	Sarangkheda	Nandurbar (MS)	8.2	18	623	29.7	678.9

1.4.3 Wind

The wind speed data of the basin is given in table no.7 the average monthly wind speed in the Tapi basin varies between about 15km/h and 1.2 km/h. in the pre and

post monsoon period , the wind speed is generally higher. The predominant wind direction is NW followed by SW and W. Table no.7 show wind data of Tapi basin.

Table-7: wind speed and direction data of Tapi Basin

Month	Average wind Speed km/h									
Location / Name of Site	Bhusawal	Yerli	Hathnur	Dedtalai	Gopalkheda	Burhanpur	Savkheda	Morane	Gidhade	Sarangkheda
January	3.60	2.80	2.90	0.90	2.20	1.7	1.2	7	0.5	1.1
February	4.10	3.80	2.00	1.30	3.30	1.6	2.1	2.8	0.5	1.3
March	3.90	4.80	2.80	3.90	3.70	1.6	2.5	3.5	1.2	1.7
April	4.60	6.10	4.50	1.90	4.80	1.8	3.7	4.8	2.1	2.5
May	7.50	12.70	9.00	25.10	8.30	3.8	8.6	8.5	7	4.9
June	8.10	15.30	11.40	12.90	9.10	6.5	8.6	6.1	5.4	4.2
July	4.60	9.30	7.20	3.50	6.40	3.5	5.3	3.7	2.9	2.3
August	3.10	6.80	4.40	3.70	5.10	3.0	5.3	2.2	1.8	1.4
September	3.10	4.50	2.70	1.90	4.30	1.7	2.8	2	1.2	1
October	2.20	3.00	2.00	1.30	2.30	1.1	1.3	1.8	0.5	0.8
November	4.30	3.30	2.50	1.90	2.20	13.5	1.2	1.7	1	0.8
December	4.60	3.10	1.80	1.80	1.80	1.2	1.1	1.2	0.7	0.9
Annual Mean	4.48	6.29	4.43	5.01	4.46	3.4	3.6	3.8	2.1	1.9

Dominant Wind Direction

Month	Dominant Direction									
Location / Name of Site	Bhusawal	Yerli	Hathnur	Dedtalai	Gopalkheda	Burhanpur	Savkheda	Morane	Gidhade	Sarangkheda
January	E	E	E	E	E	E	W	S	SE	W
February	E	E	E	W	W	E	N	E	S	N
March	E	E	E	W	W	E	E	E	S	E
April	E	W	E	S	E	SE	W	E	SE	N
May	S	W	W	E	W	SW	E	E	W	W
June	S	E	W	W	W	W	E	E	NW	S
July	S	E	W	W	W	SW	E	E	NW	E
August	S	NW	W	W	E	SW	W	W	S	W
September	S	W	W	E	W	SW	W	W	S	S
October	E	E	W	E	E	E	W	W	SE	S
November	E	E	W	W	E	E	E	E	SE	S
December	NE	E	W	W	E	E	E	E	SE	W

1.4.4 Humidity

The morning relative humidity in basin varies between 92.4% to 34.6% and the evening relative humidity, between 85.8% to 25.4% depending upon the season. The humidity is naturally maximum during the monsoon months and is around 80% to 90%. In the winter months of December and January, the relative humidity comes down to around 30%. The variation in relative humidity between upper middle and lower section of basin is not very pronounced. The relative humidity at various station of CWC representative of the Tapi basin is given in Table no. 8

Table-8: Relative Humidity Data for Tapi

Month	% Morning Humidity										
Location / Name of Site	Bhusawal	Yerli	Hatnur	Dedtalai	Gopalkheda	Lakhapure	Burhanpur	savkheda	Morane	Gidhade	Sarangkheda
Jan-11	60.8	59.1	69.1	70.3	76.6	78.6	71.6	78.7	70.5	87.4	71.4
Feb-11	60.7	54.6	63.2	75.9	75.5	69.4	68.5	75	69.2	88.3	67.8
Mar-11	49.1	57.9	66.2	61.8	65.4	53.6	54.1	70.8	60.1	80.6	55.6
Apr-11	40.6	48.6	61.8	46.5	49.2	53.7	58.6	76.2	61.3	73.1	55.1
May-11	50.5	39.0	65.7	34.6	53.1	43.4	67.0	67.4	58	74.7	64.3
Jun-11	65.3	45.7	72.7	45.9	60.0	71.7	78.3	78.8	74.4	83	74.9
Jul-11	81.7	86.7	79.5	80.1	85.1	81.4	89.7	90	84.6	90.6	88.6
Aug-11	84.0	85.5	85.2	82.5	89.2	90.0	91.1	91.2	86.6	92.6	90.8
Sep-11	84.1	87.4	78.9	80.8	87.5	92.4		91	92	92.3	89
Oct-11	75.3	78.1	75.3	78.5	75.3	84.5	78.3	87.9	76.3	85.4	76.9
Nov-11	68.0	62.5	73.9	79.0	69.1	73.7	72.0	82.3	65.6	79.9	70.9
Dec-11	60.8	60.2	70.7	71.9	74.3	74.0	76.5	73.2	66.6	84.8	66.9
Annual Mean	65.1	63.8	71.9	67.3	71.7	72.2	73.2	80.3	72.1	84.4	72.7

Month	% Evening Humidity										
Location / Name of Site	Bhusawal	Yerli	Hatnur	Dedtalai	Gopalkheda	Lakhapure	Burhanpur	savkheda	Morane	Gidhade	Sarangkheda
Jan-11	44.7	38.5	73.2	65.9	54.1	45.5	40.7	NA	NA	NA	NA
Feb-11	35.0	50.7	66.7	76.0	52.4	38.9	36.9	NA	NA	NA	NA
Mar-11	29.1	47.1	71.6	62.2	65.1	31.0	32.5	NA	NA	NA	NA
Apr-11	25.4	40.0	66.0	44.4	34.1	35.7	36.1	NA	NA	NA	NA
May-11	26.4	35.8	67.9	38.4	54.4	26.8	41.6	NA	NA	NA	NA
Jun-11	45.6	50.4	70.6	43.0	60.2	44.4	58.6	NA	NA	NA	NA
Jul-11	72.2	76.2	75.0	76.8	77.7	72.2	80.8	NA	NA	NA	NA
Aug-11	79.8	74.0	82.9	81.7	76.7	84.4	85.8	NA	NA	NA	NA
Sep-11	80.9	73.2	81.2	79.0	82.1	84.7	82.0	NA	NA	NA	NA
Oct-11	60.5	48.4	69.2	77.5	56.3	55.8	49.7	NA	NA	NA	NA
Nov-11	46.8	32.9	76.0	76.0	50.7	67.3	42.1	NA	NA	NA	NA
Dec-11	42.9	40.7	67.4	74.5	62.8	70.2	45.2	NA	NA	NA	NA
Annual Mean	49.1	50.7	72.3	66.3	60.6	54.7	52.7	NA	NA	NA	NA

1.5 Geology

Deccan traps cover maximum part of this basin, These trap rocks are the result of outpouring of enormous lava flows which spread over vast areas of Western, Central and Southern India at the end of mesozoic era. They came through long narrow fissures and cracks in the earth crust and spread out as nearly horizontal sheets. They are called 'plateau basalt', because they form a flat-topped plateau. Due to the step-like or terraced appearance on the slope of hills they are also known as 'trap'. These volcanic rocks assume a considerable thickness ranging from a few hundred feet in the south to a couple of thousand feet in the north. The individual thickness of flow varies from a few feet up to a 100 feet or more. A bore-hole at Bhusawal 1211 feet deep, revealed 29 flows, the average being 40 feet In the high hills consisting of several flows, the individual flows can easily be demarcated by their distinct flow lines along which a thin growth of grass is noticed. The lavas are generally horizontal in disposition but at places they dip at very small angles. The traps that are commonly found in the plateau or cliff faces are compact and harder, often characterised by vertical prismatic or columnar jointing. They are dark grey or dark greenish grey to brownish grey in colour. The amygdaloidal variety, which is greenish to purplish in colour and comparatively softer, generally forms the slopes and valley floors. They contain innumerable cavities which are usually filled with secondary minerals such as quartz, chalcedony, agate, jasper, rock crystal, zeolites and calcite: The ash or scoriaceous beds and red bole beds are sometimes noticed. The main minerals constituent in the trap rocks are abundant in labradorite and enstatite-augite with varying proportion of interstitial glass which on alteration gives rise to secondary minerals like palagonite, chlorophaete iddingsite, etc. Sometimes porphyritic basalt is seen showing phenocrysts of felspars and glassy matters. Magnetite occurs as minute discreet grains amidst other minerals as well as in the glassy groundmass. In a few cases, olivine is also present.

The intertrappean beds represented by clays, sandstones and limestones formed in depressions during quiescent period between the successive eruptions of lava flows have not been reported so far from the district. But they are likely to exist at places.

The other formations found in the basin are alluvium , lower gondwana, cuddapah system Bijwara series and granites gneiss. Most of the area of Tapi basin falling in the Maharashtra state is full of cuts and valleys, land on the right side of the bsin lying on southern slopes of satpura hills consist of black soils the

soil cover is deep and rock is found at greater depths . lands on the left of the basin on northern slopes of sahyadri consists mainly of dykes and red murrum soil and are rocky in most parts.

The stratigraphic sequence of Tapi basin is tabulated table no9.

Table-9: stratigraphic sequence

Formation	Age
Soil, river alluvia, calcareous Kankar and sands, etc.	Recent.
Conglomerates	Sub-recent.
Trap dykes	Cretaceous Eocene
Deccan basalt flows with inter-trappean Beds, ash beds.	
Erosional Unconformity :	
Upper Gondwana sandstones?	Lower cretaceous.

Source : Cultural.maharashtra.gov.in/english/gazetteer/lstrepr.htm

1.6 Soil

The soil in the Tapi bain up to Ukai Dam can be broadly classified in to three groups.

1. Coarse shallow soils
2. Medium black soils
3. Deep black soils.

The area covered by these three group of soils in the basin is given in table no.10

Table-10: Area covered by various soils in Tapi basin

s. no.	Type of soil	Districts covered
1	Coarse shallow soils	Betul, Khandwa, khargon, Amrawati, Akola, Buldhana, Jalgaon, dhule, Aurangabad and Nasik
2	Medium black soils	Khandwa, Amrawati, Akola, Buldhana, Jalgaon, Dhule, and Nasik
3	Deep black soils.	Amrawati, Akola, Buldhana, Jalgaon, Dhule, Nasik, surat and Bharuch

4. Coarse shallow soils

This soil have developed primarily from the basaltic Deccan trap and have been considerably affected by natural processes of weathering and eosion. Therir depth is generally between 25cm to 50 cm and swldom more, their texture from surface to sub surface varies from silty loam to clay. their organic matter content is usually poor and they are moderately drained.

5. Medium black soils

These soils have developed from deccan traps and cover the largest area of the basin. Their depth is generally between 50cm to 1m. these soils contain higher lime reserve and are alkaline in reaction. These soils are fair in their contents of phosphates and potash but low in organic matter and nitrogen.

6. Deep black soils.

These soils are found along the Purna river and in the middle and lower reaches of Tapi River . these soils have originated primarily from decomposition of trap rocks of hilly ranges. The depth of this soil varies from 1m to 6m. the soil have very high clay content montmorillonite predominating and not easily workable during monsoon . the soil reaction varies from neutral to alkaline.

Source: Hydrology and Water Resources of India, Water Science and Technology Library Volume 57, 2007, pp 561-595 **Tapi, Sabarmati and Mahi Basins,** Sharad K. Jain, Pushpendra K. Agarwal, Vijay P. Singh
(http://link.springer.com/chapter/10.1007%2F1-4020-5180-8_12)

1.7 Forest

The Tapi basin exhibits two distinct geographical regions, viz., the plain regions in the east and south-east and the hilly regions of the Satpuda ranges in north and north-west. The plain region is extensively cultivated and forests appear only in dotted, scattered patches. The hilly region is an extensive block of compact forests and contains an abundance of rich teak trees. The percentage of the forest area to total area in the Tapi basin is Aprox. 25% of the total area, and is unevenly distributed.

Tree Forests.

These include the forests of producing big-size teak and timber of other type.

Minor Forests.

These include the forests in the plain regions, which are capable of producing small-size timber poles of teak, etc. These forests also supply fire-wood, thorns and grass and serve as good pastures for grazing the cattle.

Babul Bans.

These are artificially created forests of Babul (*Acacia arabica*) in the cultivated plain tracts and lie dotted over the area.

Ramnas and Pasture Forests.

These include open forests with sparse tree growth and lie mostly in the plain regions , where an intense demand exists for grass and grazing.

Utilization.

The forests are managed under regular working plans, the object being the supply of large-size timber for commercial use. The minor forests like Babul Bans and the Ramnas and pasture lands are being maintained to supply the local demand for small-size timber, fuel, grass and grazing.

Forest Produce.

The major forest produce is timber. The minor forest produce constitutes various items, such as bamboo, fuel, rosha grass, fodder grass, minerals, horns and hides, tendu leaves and gum.

Forest Trees.

The most useful trees and plants found in these forests, are given below: -

Teak (*Tectona grandis), Tiwas* (*Ougenia dalbergioides), Shisham* (*Dalbergia latifolia*)., *Bija* (*Pterocarpus marsupium*)., *Haldu* (*Adina cordifolia*), *Saj* (*Terminalia tomenlosa), Dhawda* (*Anogeissus latifolia), Dhaman* (*Grewia tiliaefolia), Semal* (*Bombax malabaricum*; *Silk cotton tree), Siivan* (*Gmelina arborea)*, *Kusum* (*Schleichera trijuga*), *Kalam* (*Stephegyne parvifolia), Kahu* (*Terminalia arjuna), Landia* (*Lagerstroemia parviflora*), *Harra* (*Terminalia chebula), Bhormal* (*Hymenodictyon excelsum*), *Salai* (*Boswellia serrata*), *Moyen* (*Odina nodier*), *Kekda* (*Garuga pinnata*), *Maharukh* (*Ailanthus excelsa*), *Moha* (*Madhuca latifolia*), *Tendu* (*Diospyros melanoxylon*

Achar (*Buchanania lanzan), Aonla* (*Emblica officinalis*) *Beheda* (*Terminalia belerica*), *Bhilawa* (*Semecarpus anacardium*) *Amba*

(*Mangifera indica*) *Bor* (*Zizyphus jujuba*) *Palas* (*Butea frondosa*) *Babul* (*Acacia arabica*) *Khair* (*Acacia calechu*), *Anjan* (*Hardwickia binata), Jamun* (*Eugenia jambolana), Bhosa* (*Bauhiniarecemosa*), *Rohan* (*Soymida febrifuga*), *Amalatas* (*Cassia fistula*), *Bel* (*Aeglemarmelos*), *Kumbhi* (*Careya arborea*), *Gular* (*Ficus species*), *Dahi-palas* (*Cordias*), *Mokha* (*Schrebera swietenioides*), *Bhirra* (*Chlo-roxylon swietenia*), *Hiwar* (*Acacialeucophloea), Kulu* (*Sterculia urens*), *Gongal* (*Cochlospermum gossypium*) *Dudhi* (*Wrightia tinctoria*), *Arang* (*Kydia calycina*) *Pangra* (*Exythrina Indica*), *Bamboos* (*Dendrocalamus strictus*).

Source: cultural.maharashtra.gov.in/english/gazetteer/lstrepr.htm

1.8 Major/ Medium/multipurpose/irrigation projects

At present there are 28 Major and Medium Irrigation schemes completed and 2 projects are in under construction in the form of reservoirs or weirs in the Tapi catchment. List of the name of the completed, Under construction and Ongoing Projects are given in Table. 11,12 and 13 respectively

Table -11: Major/ Medium/multipurpose/irrigation projects (completed)

Sl. No	Name of project	River	Status	Capacity (MCM)	
				Gross	Live
1.	Girna Project	Girna	Medium	608.450	523.55
2.	Dahigaon	Girna			
3.	Manyad Project	Manyad	Medium	53.95	40.27
4.	Bori Project	Bori	Medium	40.31	25.15
5.	Hathnur	Tapi	Medium	388.000	255.00
6.	Suki	Suki	Medium	50.16	39.85
7.	Abhora	Boked Nalla	Medium	7.440	6.020
8.	Boker Bari	Boker Bari Nala	Medium	7.090	6.54
9.	Agnawati	Agnawati	Medium	3.740	2.76
10.	Titur	Titur	Pick up bandhara.		
11.	Tondapur	Khadki Nalla	Medium	6.304	4.636
12.	Aner Project	Aner	Medium	103.230	56.38
13.	Karwand Proj.	Arunawati	Medium	33.840	31.15
14.	Panjhra Project	Panjhra	Medium	43.410	35.63
15.	Malangaon	Kan	Medium	13.020	11.35
16.	Kanholi	Khanholi	Medium	11.79	8.450
17.	Burai	Burai	Medium	21.330	14.21
18.	Arunawati	Arunawati	Mediu	27.780	14.97
19.	Rangawali	Rangawali	Medium	15.020	12.89
20.	Nagasakya	Panzar	Medium	15.620	11.240
21.	Haran Bari	Mousam	Medium	34.780	--

22.	Ukai	Tapi	Major	8510	7092
23.	Kakrapar	Tapi	Major	51.51	36.57
24.	Lakhigav	Dhakani	Medium	38.80	37.41
25.	Ver	Ver	Medium	4.90	4.61
26.	Sulwada Barrage	Tapi	Medium	65.06	64.642
27.	Sarangkheda Barrage	Tapi	Medium	92.20	91.82
28.	Prakasha Barrage	Tapi	Medium	63.64	62.11
29.	Kate Purna	Kate Purna	Major	97.670	86.350
30.	Nal ganga	Nal ganga	Major	76.200	69.320
31.	Uma	Uma	Medium	14.000	11.680
32.	Nirguna	Nirguna	Medium	32.290	28.850
33.	Morna	Morna	Medium	44.740	41.460
34.	Gyan ganga	Gyan ganga	Medium	36.260	33.930
35.	Mos	Mos	Medium	17.504	15.140
36.	Paltag	Vishvganga	Medium	9.090	7.510
37.	Man	Man	Medium	39.760	36.830
38.	Thoran	Tributary of Purna	Medium	8.480	7.900

Table -12: Major/ Medium/multipurpose/irrigation projects (Under construction)

Under Construction projects					
Sl No	Name of Project	River	Classification	Gross Capacity (MCM)	Live storage (MCM)
1	Shelgaon Barrage	Tapi	Medium	116.37	110.35
2	Padelsa Dam	Tapi	Medium	420.56	407.59

Table -13: ongoing Major /Medium Projects

Sl No	Name of Project	River	Classification	Gross Capacity (MCM)	Live storage (MCM)
1	Ghungshi Project	Purna	Medium	17.444	17.269
2	Purna Barrage II (Ner Dhamna)	Purna	Medium	8.1743	8.1126
3	Jigaon Project	Purna	Medium	736.579	296.726

1.9 Important projects in Tapi Basin

The salient features of the important projects, namely Hathnur Dam of Upper Tapi Project, Kakrapar weir and Ukai Dam of Ukai Project, Girna Dam and Dahigaon Weir of Girna Project, are as follows:

1.9.1 Hathnur Dam (Maharashtra)

This is the first stage of Upper Tapi Project. It consists of 717 m long Ogee shaped gated overflow weir in the centre with 1863 m long earthen embankment on either side constructed across the river Tapi near Hathnur village in Jalgaon district of Maharashtra State. It is having a live storage capacity of 255 MCM to irrigate 3, 78, 384 hectares of land in Raver, Yawal and Chopda talukas of Jalgaon district by a right bank canal of 95 km length.

2. Kakrapar Weir (Gujarat): The project comprises of an Ogee shaped masonry pick up weir constructed across the Tapi River near Kakrapar in Surat district of Gujarat. The weir was constructed at a cost of Rs.20.61 crores. The weir is 621 m long and 14m high. Two canals take off from either bank to irrigate an area of 2.28 lakh ha. This project was commissioned in the year 1954 as stage -- I of the Ukai project.

3. Ukai Dam (Gujarat): This is stage - II of the multipurpose Ukai Project. It consists of 4928 m long and 68.6 m high composite earth - cum - masonry dam across the Tapi river near Ukai village in Surat district of Gujarat State. It includes a spillway with power dam constructed on the left bank. Two canals take off from either bank to irrigate an area of 1.58 lakh ha. The power house has an installed capacity of 4 units of 75 MW each.

4. Girna Dam (Maharashtra): It is constructed across river Girna, a tributary of river Tapi near Panzan village in Nandgaon taluka of Nasik district. This is a multipurpose scheme, main purpose being irrigation and subsidiary power generation (power generation yet to be started). This is a composite dam having total length of 963.17 m, masonry dam with gated spillway for a length of 426.72 m and earthen dam of length of 536.45 m respectively.

5. Dahigan Weir (Maharashtra): It is constructed across river Girna near Dahigaon village in Pachora Taluka of Jalgaon district of Maharashtra. It consists of a Ogee shaped Weir having a length of 422.76m and a maximum height of 8.82m. It irrigates an area of 57797 ha. land through left bank canal of 45.06 Km. length.

Chapter-2: Stream flow Data

2.1 Methodology

Gauge Measurement

Water level or stage of the river is measured as its elevation above the G.T.S. datum. Water level measurement is conducted by reading non - recording gauges as specified in IS: 4080-1967. Series of vertical staff gauges have been fixed at three sections at every Site. The gauge posts are generally of wood or concrete with cut at water face arrangements and fixed securely in vertical position by anchoring them in M - 150 concrete base of suitable size. Enamelled vertical gauge plates with metric markings are fixed on the gauge posts so that gauges can be read to an accuracy of 0.005 m.

Out of three gauge lines the central one is used as Station Gauge line and the readings of other two lines are used for calculation of water surface slope. During non monsoon season gauges are read thrice daily (0800, 1300 and 1800 hrs.) and during monsoon gauges are read hourly, at the station gauge line.

Discharge Observation

Discharges are observed once a day starting from 0800 hours at all the sites by area - velocity method, except on Sundays and holidays. For non observation days, the discharges are computed from the stage and discharge relation prepared, from the observed data for that water year.

The stream width is divided into 15 to 25 segments based on the degree of accuracy as outlined in IS: 1192-1981. The width of the river is measured by steel metallic tape or wire/ nylon rope stretched across the river width with markings indicated thereon when the river width and depth permitted wading. For large width and deep flow conditions segmentation is done using simple trigonometric method for which pivot point and segment blocks have been constructed at each site.

The depth is measured by using sounding rod 3 to 6 metres long adopting specifications given in IS: 3912-1966. When the river flow is very deep and swift, lead lines / echo sounders are used. Necessary Air and Wet line corrections are made to the sounding observations as provided in IS: 1192-1981. The velocity is measured as per IS: 3918 - 1966 by using a cup type current meter conforming to specifications given in IS: 3910-1966.

The current meter is lowered at the requisite depth (0.6d) in a vertical at every segment by suspension equipment as specified in IS: 6064-1971.

In high velocities, boats fitted with power engines or motor launches are used. Drift is measured and corrections for the same are made. Where observations by boat or launch are not possible, measurement of velocity is conducted from bridge or cable way. When the above procedures are not possible then velocity is measured by float observations.

The observations are recorded in a standard format for calculation of total river flow.

Equipments used for observation

Table-14: Name of equipment used in observation

Sl. No	Name of Equipment	By Wading	By Bridge	By Boat	By Float
1	Current Meter	√	√	√	X
2	Pigmy Current Meter	√	X	X	X
3	Stop Watch	√	√	√	√
4	Wading Rod	√	X	X	X
5	Nylon rope & tag	√	X	X	X
6	Measuring Tape	√	X	X	X
7	Protractor	√	√	√	X
8	Ranging Rod	√	X	√	X
9	Sounding Rod	√	X	√	X
10	Automatic Battery Counter	√	√	√	X
11	Thermometer	√	√	√	√
12	Prismatic Compass	X	X	X	√
13	Balloon	X	X	X	√
14	Sounding Cable with fish weight	X	√	√	X
15	Echo Sounder	X	X	√	X

Morphology: No significant morphological changes have been observed at sites.

Narrative description /special information on hydrological conditions is as Under

a] SRRG information for important G and D sites during flood period: - One Self recording rain gauge and one Ordinary rain gauge available at sites.

b) Flood Hydrograph details enclosed in data part.

c) Extent of flooding:- No flood experienced during 2011-12

d) Breaching of embankments and other structures, if any: - There had been no incident of major breaches during 2011-12

e) Substantial changes in river morphology: - Study of river cross sections of last few years indicates that there is no appreciable change in the river morphology at sites.

f) Drought / Water scarcity: - Water scarcity is not experienced and hence no drought in this zone.

2.2 Data availability of existing sites

Table-15: Data availability of existing sites

Sl. No	Station Name	River	Station Code No.	Type	Data available	
					From	To
1	Burhanpur	Tapi	010217002	GDSQRF		
				Gauge	16.06.1972	Contd...
				Discharge	14.09.1972	-do-
				Sediment	23.12.1972	-do-
				W Q	01.06.1977	-do-
				RF	15.06.1970	-do-
2	Gopalkheda	Purna	010217004	GDSQ RF		
				G	17.02.1977	-do-
				D	17.02.1977	-do-
				S	30.07.1979	-do-
				WQ	01.08.1979	-do-
				RF	01/01/1980	-do-
3	Yerli	Purna	010217005	GDSRF		
				G	11.11.1971	-do-
				D	01.03.1972	-do-
				S	09.04.1973	-do-
				RF	04.09.1979	-do-
				WQ	01.06.1977	31/05/05
4	Gidhade	Tapi	01 02 17014	GDRF		
				G	15.06.1969	

				D	19.06.1990	-do-
				RF	03.07.1971	-do-
				WQ	01/09/1990	31/05/05
5	Sarangkheda	Tapi	0102 17015	GDSQRF	--	
				G	29.07.1976	Contd..
				D	19.10.1977	-do-
				S	13.07.1984	-do-
				WQ.	01.01.1980	-do-
				RF	15.06.1986	-do-

2.2.1 Availability of Data of closed sites and sites with reduced Status

Table-16: Availability of data of close site

Sl. No	Station Name	River / Tributary	Station Code No.	Type	Data available	
					From	To
1	Dedtalai	Tapi	0102 17001	GDSRFQ		
				Gauge	06.01.77	Contd..
				Discharge	12.12.77	31.05.05
				Sediment	24.01.84	31.05.05
				Water Qly.	01.08.79	31.05.05
				RF	11.08.84	Contd..
2	Lakhpuri	Tapi/Purna	0102 17003	GDRFQ		
				Gauge	16.02.77	Contd..
				Discharge	18.02.77	31.05.05
				Water Qly	03.11.86	31.05.05
				Rainfall	01.09.81	Contd..
3	Savkheda	Tapi	0102 17011	GDSRFQ		
				Gauge	06.04.72	Contd..
				Discharge	10.04.72	31.05.05
				Sediment	01.11.72	31.05.05
				Water Qty.	01.06.77	31.05.05
				RF	01.01.85	Contd..
4	Morane	Tapi/ Panjhra	0102 17012	GDRFQ		
				Gauge	17.07.76	Contd…

				Discharge	02.11.77	31.05.05
				W.Quality	01.09.90	31.05.05
				RF	01.11.91	Contd
5	Dapuri	Tapi/ Girna	0102 17010	GDSRFQ		
				Gauge	21.09.71	31.05.05
				Discharge	21.01.72	31.05.05
				Silt	01.07.73	31.05.05
				WQ	01.06.77	31.05.05
				RF	01.06.85	31.05.05
6	Malkheda	Tapi/ Bori	0102 17012	GDQRF		
				Gauge	17.07.76	31.05.05
				Discharge	02.11.77	31.05.05
				W Qly.	01.09.90	31.05.05
				RF	01.06.87	31.05.05
Sl. No	Station Name	River / Tributary	Station Code No.	Type	Data available	
7	Ghala	Tapi	01 02 17 018	GDRFQ		
				Gauge	15.08.77	Contd..
				Discharge	01.06.78	31.05.05
				Water Qty.	01.08.83	31.05.05
				RF	01.06.78	Contd..
8	Kakrapar	Tapi	0102 17017	GRF		
				Gauge	01.06.69	15.10.04
				Rainfall	01.06.69	15.10.04

2.3 Explanatory notes:

The explanatory notes given here-under are designed to assist in the interpretation of hydrological parameters contained in the data presented. The notes are, therefore, applicable in so far as the data presented in this book.

i Water year covers the period from June 1st of the one calendar year to May 31st of the next calendar year and includes one complete hydrological cycle.

ii] Discharge is given in cubic metre per second.

iii] Discharges given are observed daily discharges.

iv] Discharges are expressed as 0.000 when river bed is dry and also when there is stagnation of water i.e velocity is observed as NIL.

v] Discharges indicated with asterisk (*) mark are Estimated discharges as per rating curve equation corresponding to stage at 0800 hours of that day. Discharges indicated with (**#)** marks are estimated discharges of the discarded points.

vi] The Zero of Gauge is a datum level / R. L. fixed for a given site, which is kept 1 or 2 m lower than the lowest water level recorded in a perennial stream. In a non- perennial stream, it is kept 1 or 2 m lower than the lowest bed level of the stream.

Vii] Discharges are rounded off to:

a] Nearest full integer when more than 1000.

b] Nearest first decimal figures when between 100 and 1000

c] Nearest two decimal figures when between 10 and 100

d] Nearest three decimal figures when less than 10.

Viii] Maximum and minimum discharges are taken from the observed daily flows.

Ix] Runoff in mm is the notional depth of water in millimetres over the catchment area equivalent to annual runoff calculated at the discharge measurement station. It is computed using the relation

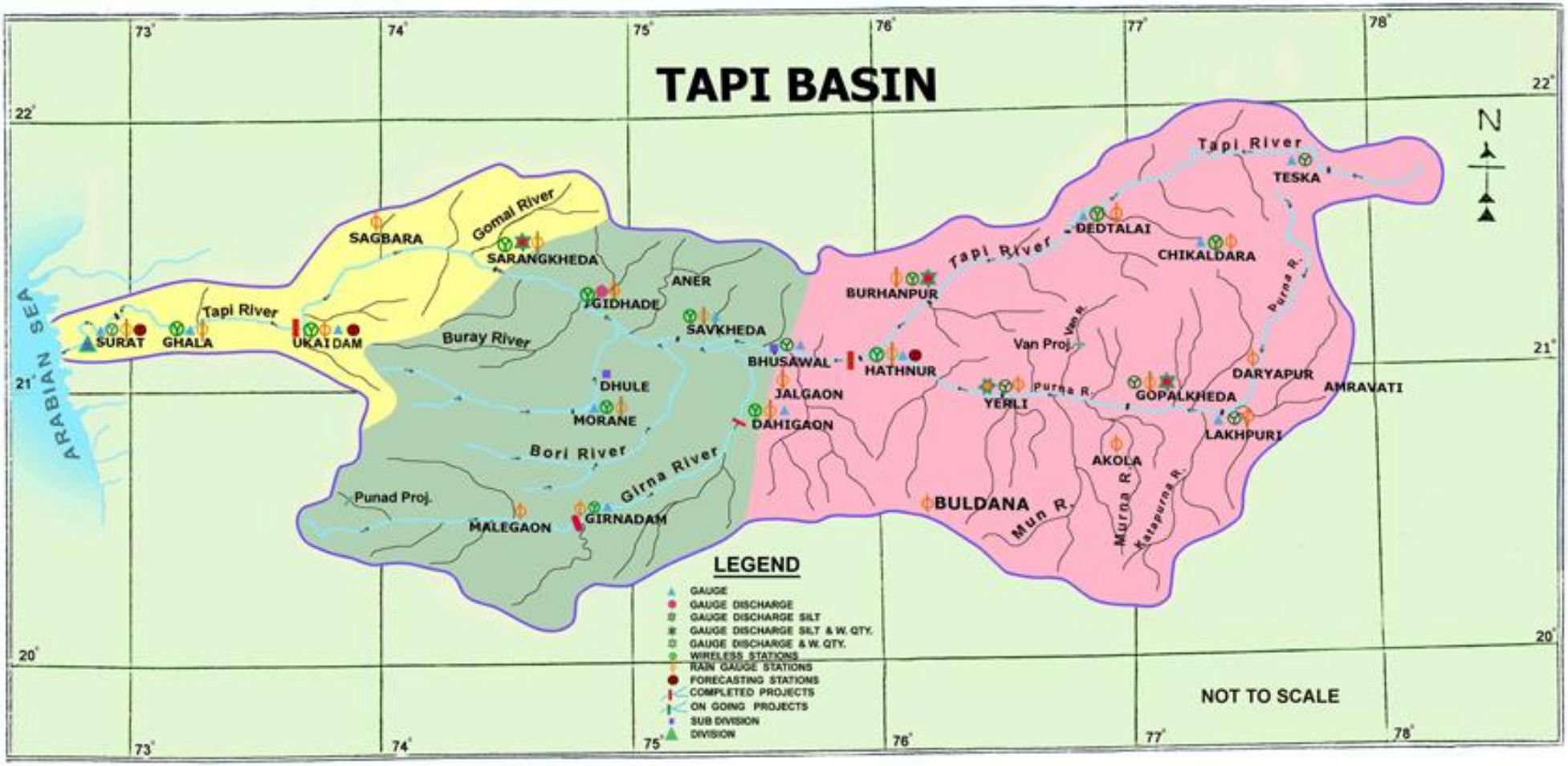
$$\text{Runoff (mm)} = \frac{\text{Annual runoff } (mm^3) \times 1000}{\text{Catchment area } (km^2)}$$

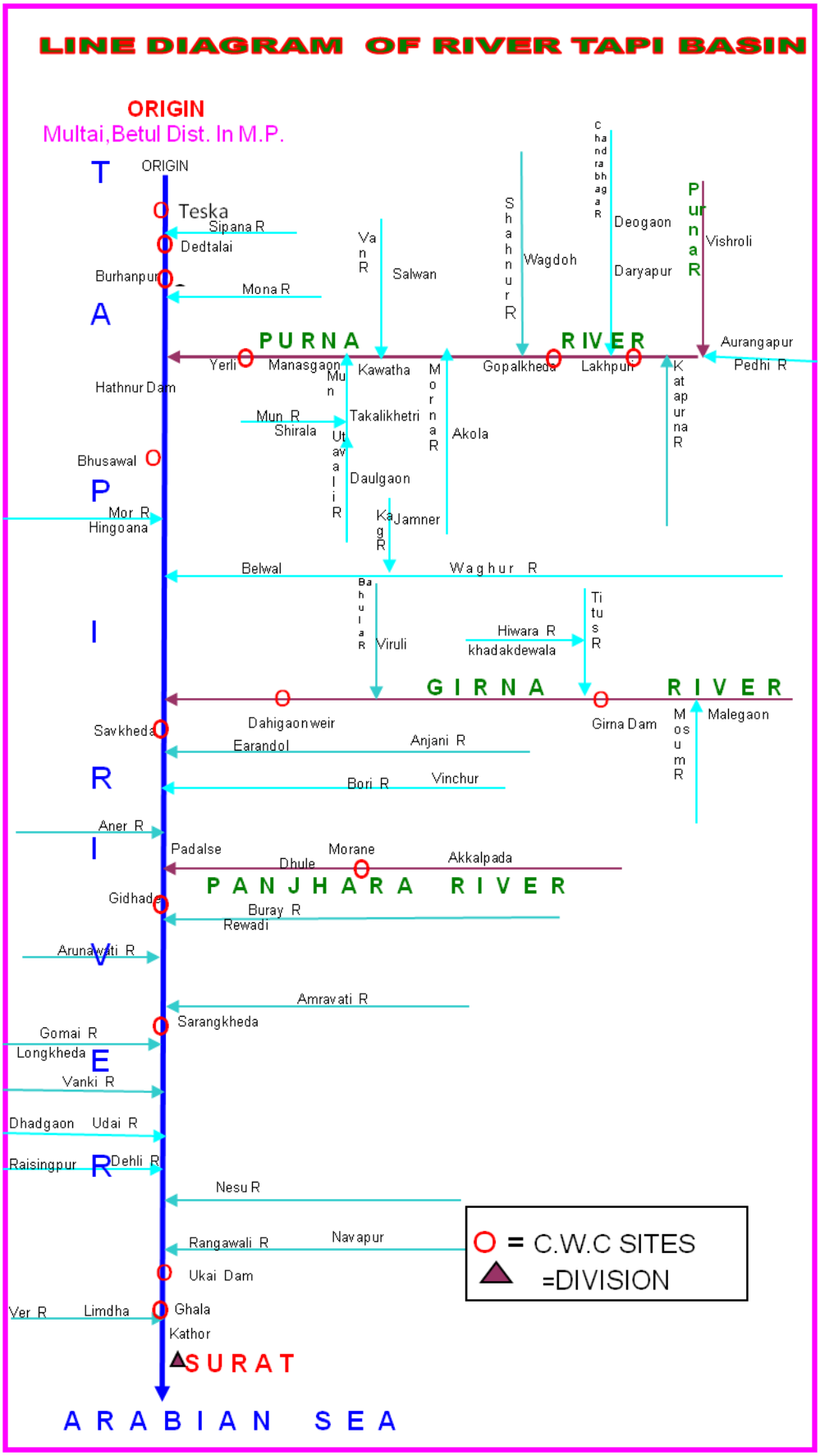
x] Peak and lowest flow correspond to the highest and lowest water levels recorded during the period of record.

xi] Measuring authority refers to the field division responsible for the operation of the gauging station.

xii] The gauging station code number is a unique NINE digit number, which facilitates storage and retrieval of flow data in data banks. The first two digits are identifier of measuring authority, third and forth digits represent Basin / Zone and fifth and sixth digit refer to independent river Basins in the zone ,seven eight and nine digits indicate site numbers.

xiii] The month and the year from which data available in the data banks is indicated against record available


TAPI BASIN
ARABIAN SEA
SURAT
GHALA
UKAI DAM
Tapi River
SAGBARA
Gomai River
SARANGKHEDA
Buray River
ANER
GIDHADE
SAVKHEDA
DHULE
MORANE
Bori River
Punad Proj.
MALEGAON
GIRNADAM
Girna River
DAHIGAON
JALGAON
BHUSAWAL
HATHNUR
BURHANPUR
Tapi River
DEDTALAI
CHIKALDARA
TESKA
Tapi River
Van R.
Van Proj.
Purna R.
YERLI
Purna R.
GOPALKHEDA
DARYAPUR
AMRAVATI
LAKHPURI
AKOLA
BULDANA
Mun R.
Murna R.
Katapurna R.
Purna R.
N
LEGEND
GAUGE
GAUGE DISCHARGE
GAUGE DISCHARGE SILT
GAUGE DISCHARGE SILT & W. QTY.
GAUGE DISCHARGE & W. QTY.
WIRELESS STATIONS
RAIN GAUGE STATIONS
FORECASTING STATIONS
COMPLETED PROJECTS
ON GOING PROJECTS
SUB DIVISION
DIVISION
NOT TO SCALE
73°
74°
75°
76°
77°
78°
22°
21°
20°


LINE DIAGRAM OF RIVER TAPI BASIN
ORIGIN
Multai,Betul Dist. In M.P.
T
A
P
I
R
I
V
E
R
ORIGIN
Teska
Sipana R
Dedtalai
Burhanpur
Mona R
Van R
Salwan
Shahnur R
Wagdoh
Chandrabhagar R
Deogaon
Daryapur
Purna R
Vishroli
PURNA RIVER
Aurangapur
Pedhi R
Yerli
Manasgaon
Mun
Kawatha
Gopalkheda
Lakhpuri
Katapurna R
Hathnur Dam
Mun R
Shirala
Takalikhetri
Utavali R
Morna R
Akola
Bhusawal
Daulgaon
Mor R
Hingoana
Kag R
Jamner
Belwal
Waghur R
Bahula R
Viruli
Hiwara R
khadakdewala
Titus R
GIRNA RIVER
Girna Dam
Mosum R
Malegaon
Dahigaonweir
Savkheda
Earandol
Anjani R
Bori R
Vinchur
Aner R
Padalse
Morane
Dhule
Akkalpada
PANJHARA RIVER
Gidhade
Buray R
Rewadi
Arunawati R
Amravati R
Sarangkheda
Gomai R
Longkheda
Vanki R
Dhadgaon
Udai R
Raisingpur
Dehli R
Nesu R
Rangawali R
Navapur
Ukai Dam
Ver R
Limdha
Ghala
Kathor
SURAT
ARABIAN SEA
= C.W.C SITES
=DIVISION

Chapter-3 Hydrological data

3.1 Burhanpur

3.1.1 History sheet

Site	**:**	**Tapi at Burhanpur**	**Code**	**:**	**01 02 17 002**
State	:	Madhya Pradesh	District		Khandwa
Basin	:	Tapi	Independent River	:	-
Tributary	:		Sub Tributary	:	
Sub-Sub Tributary	:		Local River	:	
Division	:	Tapi Division Surat	Sub-Division	:	Upper Tapi Bhusawal
Drainage Area	:	8487 sq km	Bank	:	Right
Latitude	:	21°17'12"	Longitude	:	76°30'18"
Zero of Gauge (m)	:	213 (msl)	16/06/1972		
		Opening Date	Closing Date		
Gauge	:	16/06/1972			
Discharge	:	14/09/1972			
Sediment	:	23/12/1972			
Water Quality	:	01/06/1977			

Annual Maximum / Minimum observed discharge with corresponding Water Level (m)

	Maximum			Minimum		
Year	**Q (cumec)**	**WL (m)**	**Date**	**Q (cumec)**	**WL (m)**	**Date**
1973-1974	6330	226.112	27/08/1973	1.100	215.120	04/06/1973
1974-1975	2015	220.908	13/08/1974	0.900	214.990	19/05/1975
1975-1976	6117	224.890	12/08/1975	0.800	215.085	22/05/1976
1976-1977	3745	224.435	03/09/1976	0.000	215.085	28/02/1977
1977-1978	3893	223.000	14/09/1977	0.720	214.960	28/05/1978
1978-1979	26683	239.500	29/08/1978	1.000	214.990	01/06/1978
1979-1980	12100	233.950	10/08/1979	0.400	214.970	16/05/1980
1980-1981	5379	224.780	06/08/1980	0.800	214.980	31/05/1981
1981-1982	13259	230.100	10/08/1981	0.800	214.970	16/06/1981
1982-1983	1120	219.190	12/09/1982	0.300	215.030	09/05/1983
1983-1984	3687	222.200	01/09/1983	0.300	215.030	12/06/1983
1984-1985	11305	230.975	19/08/1984	0.100	215.010	10/06/1984
1985-1986	1875	220.500	14/08/1985	0.100	214.890	31/05/1986
1986-1987	4837	223.800	15/08/1986	0.000	214.860	11/05/1987
1987-1988	1160	219.000	18/06/1987	0.200	214.920	31/01/1988
1988-1989	4707	222.825	22/07/1988	0.000	214.780	02/05/1989
1989-1990	3435	221.400	19/08/1989	0.050	214.920	08/03/1990

1990-1991	8959	226.100	23/08/1990	0.000	214.870	15/05/1991
1991-1992	8246	232.450	31/07/1991	0.000	214.700	23/04/1992
1992-1993	4694	224.600	17/08/1992	0.000	214.550	05/05/1993
1993-1994	8268	223.800	16/06/1993	0.000	214.500	12/06/1993
1994-1995	17027	233.600	06/09/1994	0.000	214.800	05/06/1994
1995-1996	6630	226.500	03/09/1995	0.000	214.730	31/05/1996
1996-1997	2742	220.800	28/07/1996	0.136	215.030	16/05/1997
1997-1998	12339	229.350	26/07/1997	0.000	214.700	29/05/1998
1998-1999	25261	238.000	15/09/1998	0.000	214.700	13/06/1998
1999-2000	8649	227.800	10/08/1999	0.111	214.750	30/05/2000
2000-2001	1403	219.000	20/07/2000	0.000	215.620	17/05/2001
2001-2002	6664	225.050	15/08/2001	0.000	215.280	31/05/2002
2002-2003	5300	225.500	06/09/2002	0.000	215.170	25/05/2003
2003-2004	5130	224.600	28/07/2003	0.000	214.950	14/06/2003
2004-2005	5197	225.130	23/08/2004	0.000	215.320	09/05/2005
2005-2006	4098	224.060	15/09/2005	0.000	214.500	13/06/2005
2006-2007	3825	224.075	08/08/2006	0.000	215.900	01/06/2006
2007-2008	32686	236.800	08/07/2007	0.000	214.920	01/06/2007
2008-2009	3797	223.050	05/08/2008	0.000	215.220	01/05/2009
2009-2010	2810	222.500	23/07/2009	0.000	215.320	01/06/2009
2010-2011	2803	223.950	09/09/2010	0.000	216.000	24/01/2011
2011-2012	5965	225.475	27/08/2011	1.439	215.620	18/01/2012

3.1.2 Annual Maximum flood peak

Year	Highest Flood Level (m)	Date	Hour
1973	227.075	15/07/1973	03:00:00
1974	221.750	13/08/1974	02:00:00
1975	225.850	11/09/1975	20:00:00
1976	224.850	03/09/1976	08:00:00
1977	223.325	14/09/1977	15:00:00
1978	239.500	29/08/1978	18:00:00
1979	233.172	10/08/1979	09:00:00
1980	227.350	06/08/1980	14:00:00
1981	229.800	10/08/1981	00:00:00
1982	218.100	12/09/1982	00:00:00
1983	222.250	02/09/1983	17:00:00
1984	230.600	19/08/1984	02:00:00
1985	219.500	14/08/1985	00:00:00
1986	225.200	15/08/1986	00:00:00
1987	219.600	21/08/1987	06:00:00
1988	223.950	03/10/1988	07:00:00
1989	222.990	23/08/1989	21:00:00
1990	232.150	23/08/1990	17:00:00
1991	233.350	31/07/1991	05:00:00
1992	225.850	16/08/1992	21:00:00
1993	230.200	16/07/1993	22:00:00
1994	236.700	06/09/1994	17:00:00
1995	226.600	03/09/1995	10:00:00
1996	223.600	26/07/1996	19:00:00
1997	229.500	26/07/1997	10:00:00
1998	238.800	15/09/1988	12:00:00
1999	229.800	10/08/1999	03:00:00
2000	223.200	19/07/2000	15:00:00
2001	229.900	15/08/2001	23:00:00
2002	227.800	06/09/2002	01:00:00
2003	228.450	28/07/2003	02:00:00
2004	226.500	23/08/2004	05:00:00
2005	224.400	02/08/2005	13:00:00
2006	225.700	06/08/2006	22:00:00
2007	239.950	08/07/2007	17:00:00
2008	227.000	05/08/2008	21:00:00
2009	225.700	23/07/2009	01:00:00
2010	225.300	30/07/2010	19:00:00
2011	226.100	27/08/2011	09:00:00
2012	238.000	05/09/2012	08:00:00

3.1.3 Summary of Data

Stage Discharge data for the period from June 2011 to May 2012

Station Name: Tapi at Burhanpur (01 02 17 002) Division : Tapi division Surat

Local River: Sub Division: Upper Tapi Bhusawal

Day	Jun		Jul		Aug		Sep		Oct		Nov	
	W.L	Q	W.L	Q	W.L	Q	W.L	Q	W.L	Q	W.L	Q
1	215.400	0.000 *	216.150	58.70	217.370	433.9	218.775	1143	216.600	157.6	216.030	17.42
2	215.370	0.000 *	216.100	52.42	217.200	369.3	220.570	1747	216.590	123.9 *	216.020	17.01
3	215.310	0.000 *	216.120	42.54 *	216.860	204.9	220.550	1683	216.550	96.40	216.010	16.63
4	215.280	0.000 *	216.075	36.50	217.450	609.9 *	219.300	1149 *	216.530	94.11	215.990	15.61
5	215.270	0.000 *	216.015	31.67	218.250	755.8	218.570	860.8	216.500	90.34	215.980	14.28
6	215.260	0.000 *	216.030	33.29	217.710	554.2	218.100	682.5	216.500	105.7 *	215.960	23.34 *
7	215.240	0.000 *	216.170	82.16	218.050	570.9 *	217.840	634.4	216.485	90.00	215.940	21.28 *
8	215.200	0.000 *	216.150	79.78	219.225	1059	217.700	531.7	216.450	84.11	215.920	12.40
9	215.190	0.000 *	216.975	356.3	218.335	795.0	217.640	548.5	216.430	92.32 *	215.920	12.30
10	215.170	0.000 *	217.000	221.8 *	218.125	724.3	217.600	532.9	216.300	53.53	215.910	18.34 *
11	215.400	0.000 *	216.435	112.2	217.840	622.4	217.420	345.3 *	216.280	47.97	215.910	10.99
12	215.790	0.000 *	216.260	96.58	217.780	582.7	217.260	295.6 *	216.260	45.91	215.900	11.24
13	215.720	7.887	216.310	97.44	217.520	452.1	217.220	377.8	216.240	43.76	215.890	16.49 *
14	215.700	7.503	219.675	1146	218.750	874.3 *	217.180	280.2	216.230	38.81	215.880	8.574
15	215.700	7.598	217.350	441.6	218.990	990.4 *	217.340	347.5	216.210	39.49	215.860	8.302
16	217.400	331.7	217.450	413.8	217.690	563.1	217.550	411.4	216.200	53.86 *	215.850	7.909
17	216.450	211.9	217.600	404.9 *	217.405	393.6	218.100	640.6	216.190	37.34	215.850	7.569
18	216.375	164.1	217.115	345.8	217.370	462.7	217.250	292.6 *	216.190	35.31	215.840	7.292
19	216.000	27.69 *	216.960	306.3	217.100	324.4	217.150	317.4	216.180	35.05	215.840	7.138
20	215.710	21.31	218.190	749.6	217.615	496.2	216.995	252.6	216.180	33.36	215.830	11.42 *
21	215.900	28.41	217.765	579.5	217.730	450.5 *	216.900	201.4	216.180	32.98	215.830	6.452
22	216.025	41.56	217.570	489.8	217.680	432.7 *	216.830	190.1	216.160	30.88	215.820	4.375
23	216.060	31.41	217.225	350.9	217.415	445.2	216.800	183.1	216.150	46.65 *	215.820	4.228
24	216.020	26.62	218.900	946.1 *	217.915	684.3	216.790	181.8	216.130	27.80	215.810	3.552
25	215.960	20.16	218.100	690.5	218.850	1034	216.900	195.8 *	216.120	27.04	215.800	3.437
26	216.000	27.69 *	217.525	507.4	220.525	1739	216.830	192.2	216.110	41.20 *	215.800	3.260
27	216.720	163.6	217.250	413.8	225.475	5965	216.740	107.5	216.100	24.89	215.790	8.476 *
28	216.370	103.3	217.365	421.8	222.175	2602	216.735	173.6	216.100	24.55	215.780	3.185
29	216.210	82.09	217.090	354.3	221.750	2397	216.655	163.3	216.090	23.95	215.770	3.023
30	216.180	72.07	216.950	295.6	218.800	1007	216.635	162.3	216.080	37.30 *	215.770	2.812
31			217.400	338.9 *	218.760	879.0 *			216.050	19.29		
Ten-Daily Mean												
I Ten-Daily	215.269	0.000	216.279	99.52	217.857	607.7	218.665	951.2	216.493	98.80	215.968	16.86
II Ten-Daily	216.025	77.97	217.335	411.5	217.806	576.2	217.347	356.1	216.216	41.09	215.865	9.691
III Ten-Daily	216.144	59.69	217.558	489.9	219.734	1603	216.781	175.1	216.115	30.59	215.799	4.280
Monthly												
Min.	215.170	0.000	216.015	31.67	216.860	204.9	216.635	107.5	216.050	19.29	215.770	2.812
Max.	217.400	331.7	219.675	1146	225.475	5965	220.570	1747	216.600	157.6	216.030	23.34
Mean	215.813	45.89	217.073	338.7	218.507	950.8	217.598	494.1	216.270	55.98	215.877	10.28

Annual Runoff in MCM = 5039 Annual Runoff in mm = 594

Peak Observed Discharge = 5965 cumec on 27/08/2011 Corres. Water Level :225.475 m

Lowest Observed Discharge = 1.439 cumec on 18/01/2012 Corres. Water Level :215.62 m

Note: No flow condition from 01/06/11 to12/06/2011 & 20/01/12 to 31/05/12 due to temporary bund at 1.00 km D/S of site.

Q: Observed/Coputed Discharge in cumec WL: corresponding Mean Water Level(msl) in m *:computed discharge #:Discarded Discharge(value changed a per rating curve)

Stage Discharge data for the period from June 2011 to May 2012

Station Name: Tapi at Burhanpur (01 02 17 002) Division : Tapi division Surat

Local River: Sub Division: Upper Tapi Bhusawal

Day	Dec		Jan		Feb		Mar		Apr		May	
	W.L	Q	WL	Q	WL	Q	WL	Q	WL	Q	WL	Q
1	215.770	3.139	215.670	1.994 *	215.540	0.000 *	215.490	0.000 *	215.750	0.000 *	215.650	0.000 *
2	215.760	3.067	215.660	2.005	215.530	0.000 *	215.490	0.000 *	215.840	0.000 *	215.630	0.000 *
3	215.760	2.863	215.650	1.891	215.520	0.000 *	215.490	0.000 *	215.840	0.000 *	215.590	0.000 *
4	215.760	6.514 *	215.650	1.877	215.520	0.000 *	215.490	0.000 *	215.840	0.000 *	215.570	0.000 *
5	215.750	2.730	215.640	1.807	215.520	0.000 *	215.530	0.000 *	215.840	0.000 *	215.540	0.000 *
6	215.750	5.908 *	215.640	1.922	215.520	0.000 *	215.550	0.000 *	215.840	0.000 *	215.530	0.000 *
7	215.730	2.517	215.640	1.858	215.520	0.000 *	215.550	0.000 *	215.830	0.000 *	215.520	0.000 *
8	215.720	2.286	215.640	0.998 *	215.520	0.000 *	215.550	0.000 *	215.830	0.000 *	215.510	0.000 *
9	215.720	2.304	215.630	1.748	215.510	0.000 *	215.550	0.000 *	215.830	0.000 *	215.500	0.000 *
10	215.710	2.137	215.630	1.680	215.510	0.000 *	215.550	0.000 *	215.810	0.000 *	215.500	0.000 *
11	215.710	3.737 *	215.630	1.658	215.510	0.000 *	215.550	0.000 *	215.810	0.000 *	215.480	0.000 *
12	215.700	1.980	215.630	1.597	215.510	0.000 *	215.550	0.000 *	215.800	0.000 *	215.460	0.000 *
13	215.700	1.933	215.630	1.547	215.510	0.000 *	215.550	0.000 *	215.800	0.000 *	215.430	0.000 *
14	215.700	1.875	215.630	1.515	215.510	0.000 *	215.550	0.000 *	215.970	0.000 *	215.410	0.000 *
15	215.690	1.771	215.630	0.731 *	215.500	0.000 *	215.550	0.000 *	215.780	0.000 *	215.400	0.000 *
16	215.690	1.664	215.630	1.587	215.500	0.000 *	215.550	0.000 *	215.770	0.000 *	215.370	0.000 *
17	215.690	1.689	215.620	1.481	215.500	0.000 *	215.550	0.000 *	215.760	0.000 *	215.360	0.000 *
18	215.680	2.387 *	215.620	1.439	215.500	0.000 *	215.550	0.000 *	215.750	0.000 *	215.330	0.000 *
19	215.760	3.934	215.620	1.453	215.500	0.000 *	215.550	0.000 *	215.750	0.000 *	215.300	0.000 *
20	215.720	2.856	215.600	0.000 *	215.500	0.000 *	215.550	0.000 *	215.750	0.000 *	215.280	0.000 *
21	215.680	2.179	215.600	0.000 *	215.500	0.000 *	215.680	0.000 *	215.750	0.000 *	215.250	0.000 *
22	215.680	2.176	215.600	0.000 *	215.500	0.000 *	215.680	0.000 *	215.750	0.000 *	215.220	0.000 *
23	215.680	2.005	215.590	0.000 *	215.490	0.000 *	215.680	0.000 *	215.750	0.000 *	215.190	0.000 *
24	215.670	1.943	215.590	0.000 *	215.490	0.000 *	215.680	0.000 *	215.750	0.000 *	215.180	0.000 *
25	215.670	1.994 *	215.590	0.000 *	215.490	0.000 *	215.680	0.000 *	215.730	0.000 *	215.170	0.000 *
26	215.660	2.079	215.580	0.000 *	215.490	0.000 *	215.680	0.000 *	215.720	0.000 *	215.130	0.000 *
27	215.660	2.016	215.570	0.000 *	215.490	0.000 *	215.680	0.000 *	215.720	0.000 *	215.120	0.000 *
28	215.530	0.000 *	215.560	0.000 *	215.490	0.000 *	215.680	0.000 *	215.720	0.000 *	215.100	0.000 *
29	215.550	0.000 *	215.550	0.000 *	215.490	0.000 *	215.680	0.000 *	215.710	0.000 *	215.100	0.000 *
30	215.570	0.000 *	215.540	0.000 *			215.680	0.000 *	215.690	0.000 *	215.090	0.000 *
31	215.650	2.841	215.540	0.000 *			215.680	0.000 *			215.080	0.000 *

Ten-Daily Mean												
I Ten-Daily	215.743	3.347	215.645	1.778	215.521	0.000	215.524	0.000	215.825	0.000	215.554	0.000
II Ten-Daily	215.704	2.383	215.624	1.301	215.504	0.000	215.550	0.000	215.794	0.000	215.382	0.000
III Ten-Daily	215.636	1.567	215.574	0.000	215.492	0.000	215.680	0.000	215.729	0.000	215.148	0.000
Monthly												
Min.	215.530	0.000	215.540	0.000	215.490	0.000	215.490	0.000	215.690	0.000	215.080	0.000
Max.	215.770	6.514	215.670	2.005	215.540	0.000	215.680	0.000	215.970	0.000	215.650	0.000
Mean	215.693	2.404	215.613	0.993	215.506	0	215.588	0	215.783	0	215.355	0

Peak Computed Discharge = 1149 cumec on 04/09/2011 Corres. Water Level :219.3 m

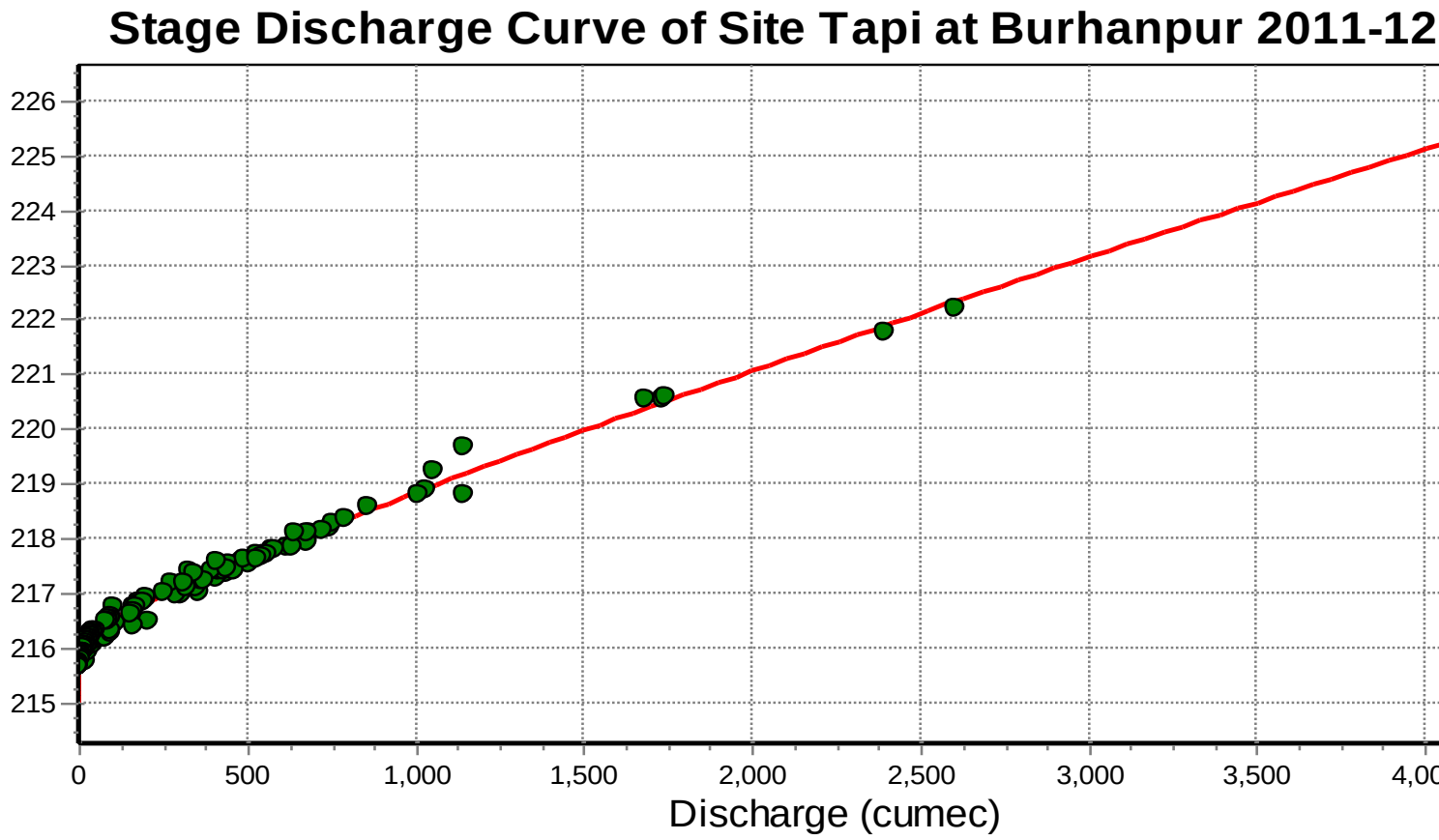
Lowest Computed Discharge = 0.000 cumec on 01/06/2011 Corres. Water Level :215.4 m

Note:No flow condition from 01/06/11 to12/06/2011 & 20/01/12 to 31/05/12 due to temporary bund at 1.00km D/S of site.Q: Observed/Coputed Discharge in cumec WL: corresponding Mean Water Level (msl) in m *: computed discharge #:Discarded Discharge(value changed a per rating curve)

3.1.4 Stage Discharge Curve

Station Name: Tapi at Burhanpur (01 02 17 002)
Division : Tapi division Local River: Surat

Sub Division: Upper Tapi Bhusawal

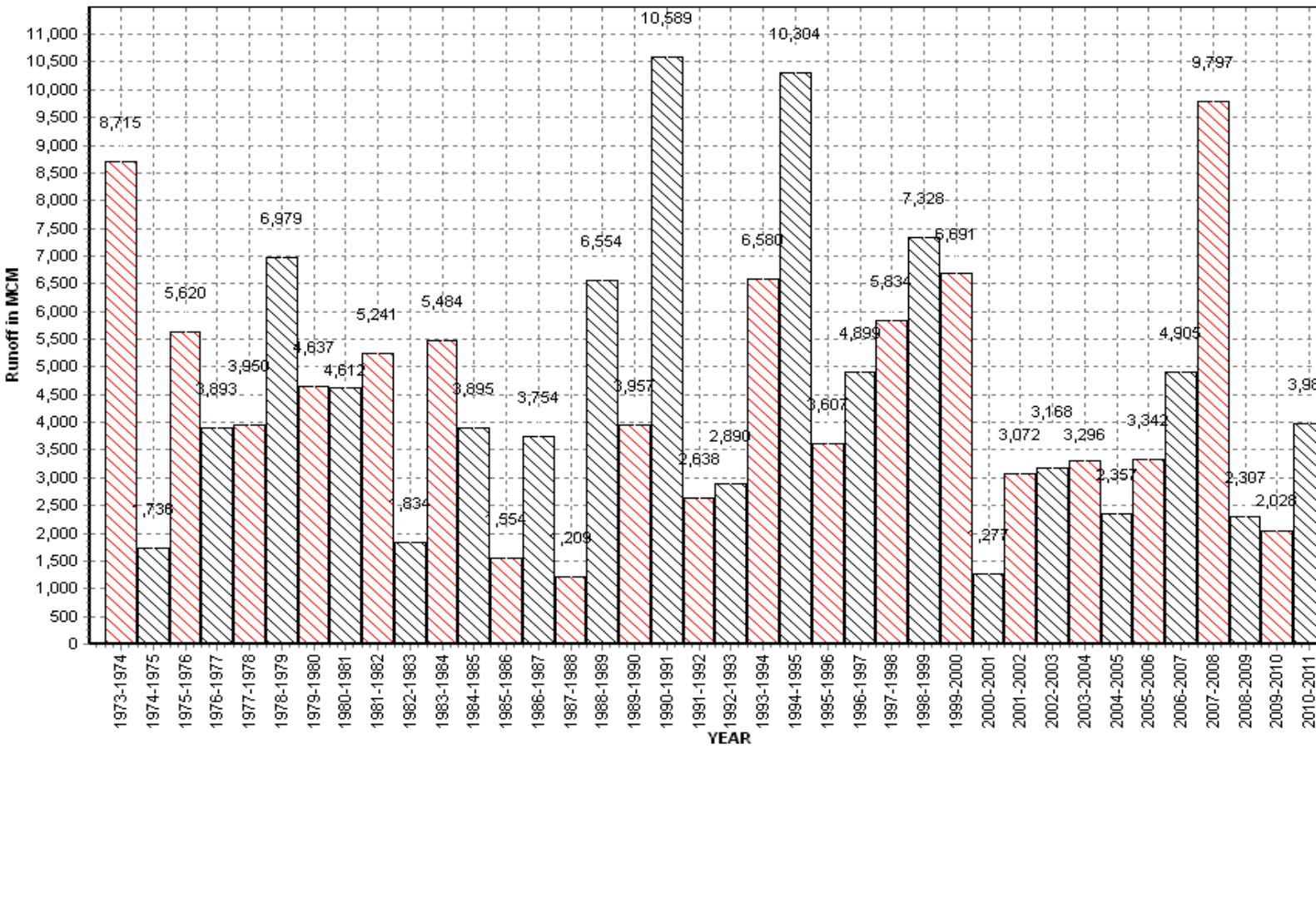


$Q=c*(h+a)^b$	WL : 215 to 217	a= (-) 215.410, b=2.723, c=82.1
	WL: 217 to 226	a= (-)216.056, b=1.191, c=295.2

3.1.5 Annual Runoff

Annual Runoff for the period 1973-2012

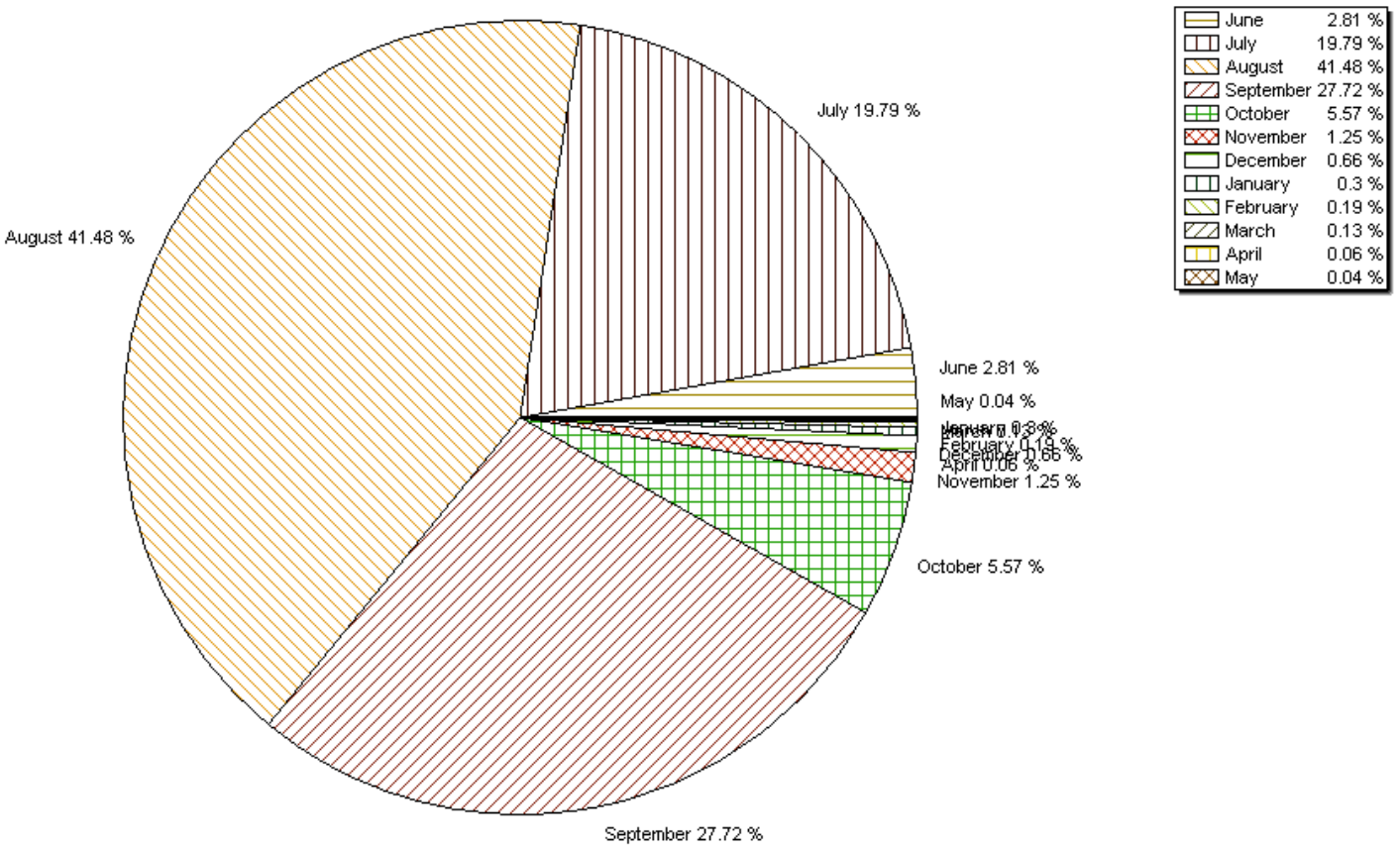
Station Name: Tapi at Burhanpur (01 02 17 002)
Division : Tapi division Surat
Local River:
Sub Division: Upper Tapi Bhusawal



3.1.6 Monthly average Runoff

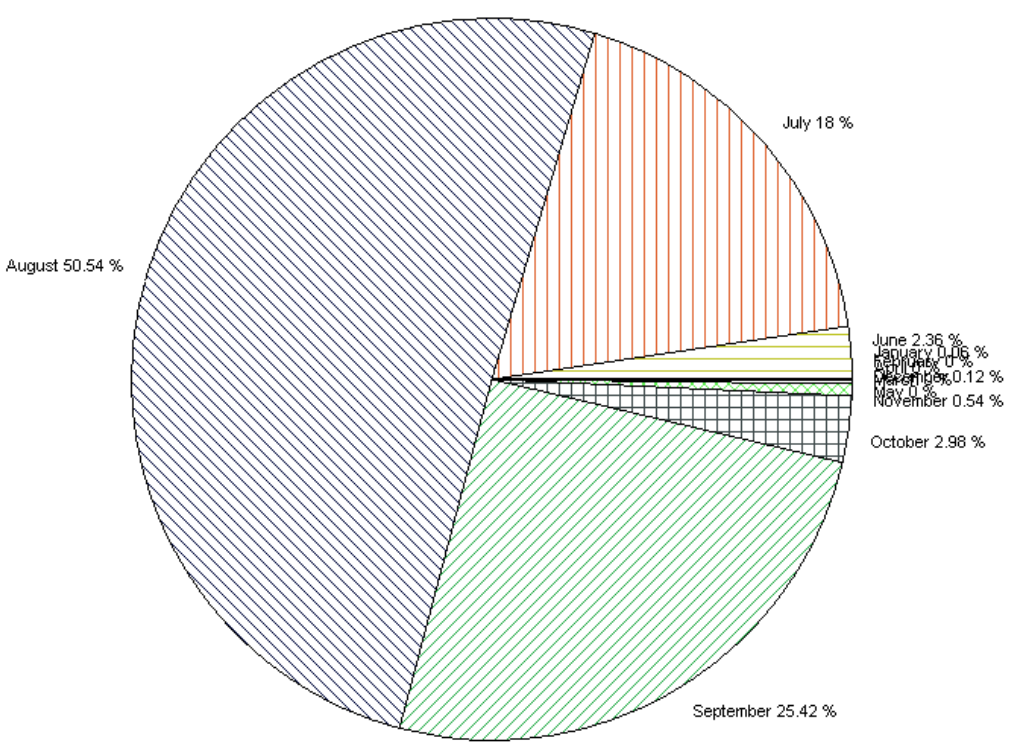
Monthly Average Runoff based on period 1973-2012

Station Name: Tapi at Burhanpur (01 02 17 002)
Division : Tapi division Surat
Local River:
Sub Division: Upper Tapi Bhusawal



Monthly Average Runoff for the year 2011-2012

Station Name: Tapi at Burhanpur (01 02 17 002)
Division : Tapi division Surat
Local River:
Sub Division: Upper Tapi Bhusawal

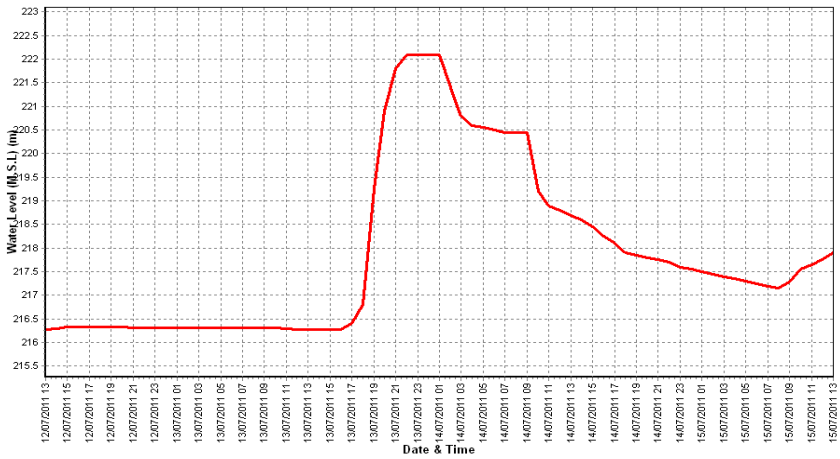


3.1.7 WL vs Time Graph of I, II, III peak

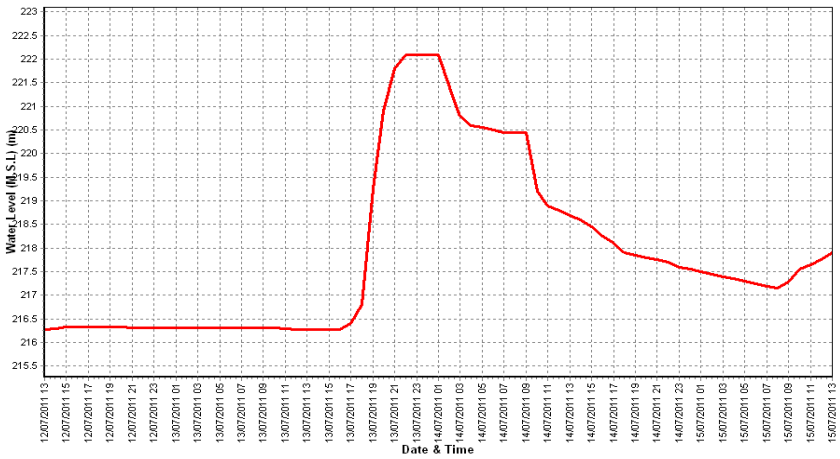
Water level vs Time Graph of Highest flood peak during the water year 2011-12

Station Name: Tapi at Burhanpur (01 02 17 002) Division: Tapi division Surat

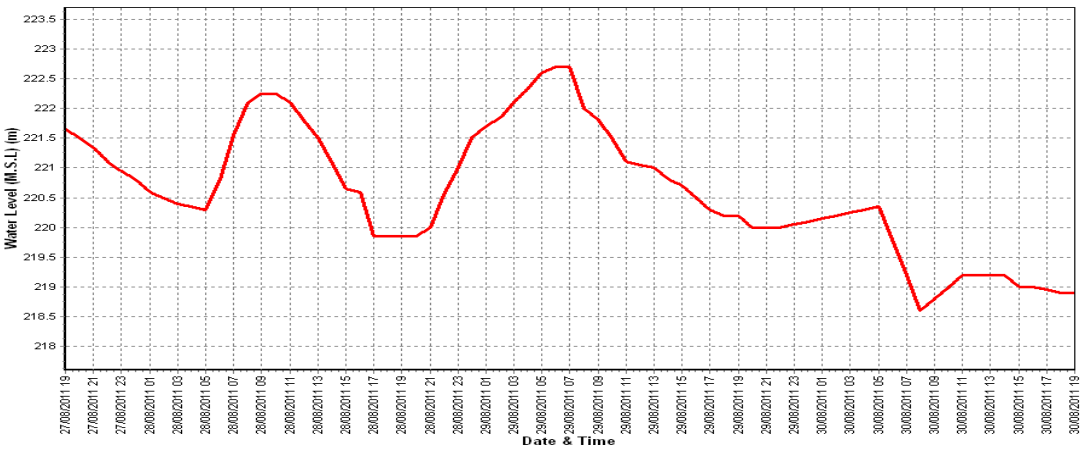
Local River: Sub Division: Upper Tapi Bhusawal



Water level vs Time Graph of Highest (I) flood peak during the water year 2011-12



Water level vs Time Graph of Highest (II) flood peak during the water year 2011-12

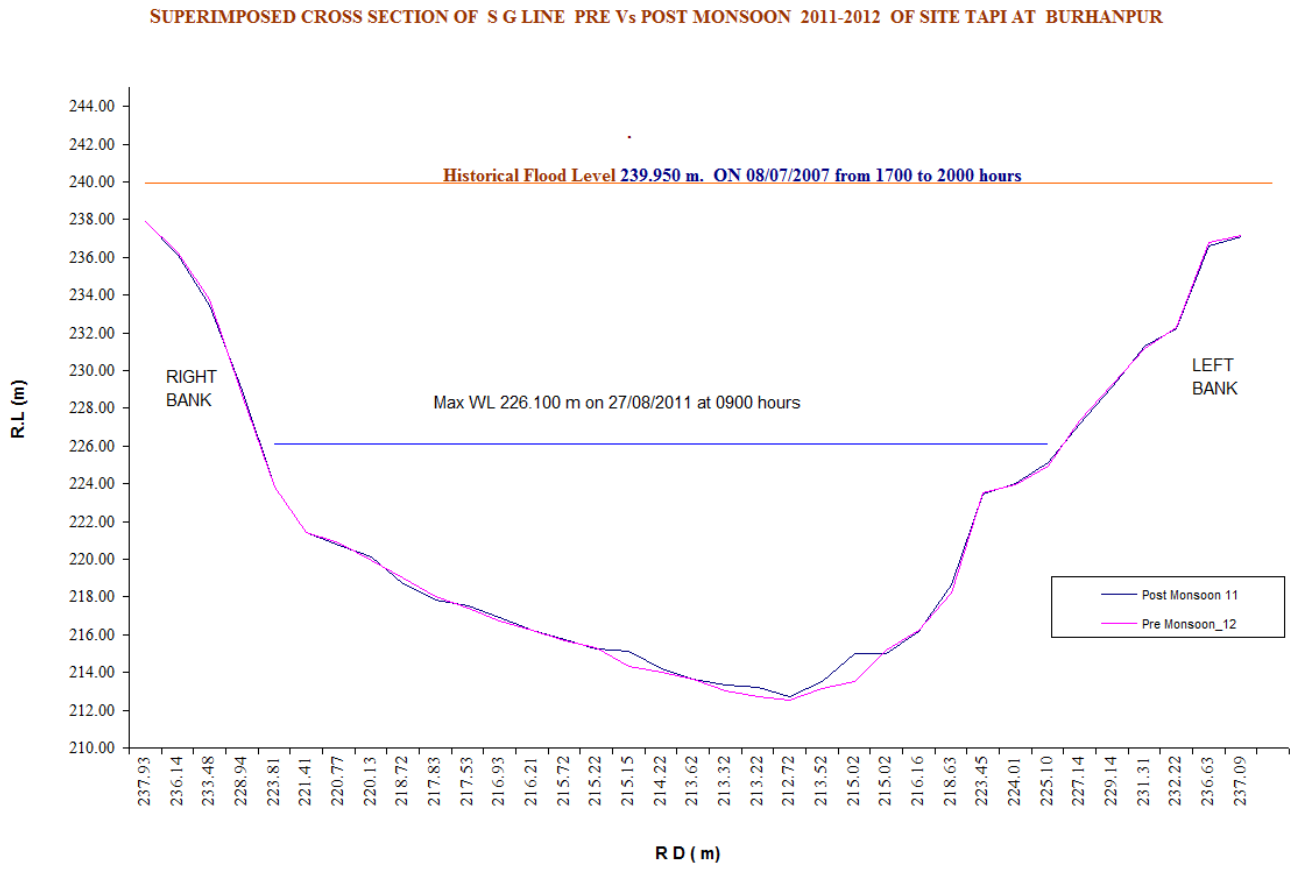


Water level vs Time Graph of Highest (III) flood peak during the water year 2011-12

3.1.8 Super imposed cross section

Station Name: Tapi at Burhanpur (01 02 17 002) Division: Tapi division Surat

Local River: Sub Division: Upper Tapi Bhusawal



3.2 Gopalkheda

3.2.1 History Sheet

Site : Purna at Gopalkheda Code : 01 02 17 004

State	:	Maharashtra			District		Akola
Basin	:	Tapi			Independent River	:	Tapi
Tributary	:	Purna			Sub Tributary	:	
Sub-Sub Tributary	:				Local River	:	
Division	:	Tapi Division Surat			Sub-Division	:	Upper Tapi Bhusawal
Drainage Area	:	9500 sq km			Bank	:	Left
Latitude	:	20°52'35"			Longitude	:	76°59'14"
Zero of Gauge (m)	:	236 (msl)			17/02/1977		
		Opening Date			Closing Date		
Gauge	:	17/02/1977					
Discharge	:	17/02/1977					
Sediment	:	30/07/1979					

Annual Maximum / Minimum discharge with corresponding Water Level (msl)

	Maximum			Minimum		
Year	**Q (cumec)**	**WL (m)**	**Date**	**Q (cumec)**	**WL (m)**	**Date**
1977-1978	133.9	81.532	26/11/1977	0.300	80.420	11/06/1977
1978-1979	2105	250.327	30/08/1978	0.196	237.120	12/05/1979
1979-1980	1872	252.100	10/08/1979	0.000	237.100	18/05/1980
1980-1981	529.3	243.920	17/08/1980	0.200	237.150	01/06/1980
1981-1982	2881	249.680	10/08/1981	0.200	237.020	02/06/1981
1982-1983	358.9	242.240	21/07/1982	0.000	236.860	15/04/1983
1983-1984	1630	248.970	12/08/1983	0.400	236.905	14/06/1983
1984-1985	712.0	245.310	19/08/1984	0.300	237.045	15/02/1985
1985-1986	437.0	242.100	27/06/1985	0.100	237.050	06/01/1986
1986-1987	2192	247.595	15/08/1986	0.200	236.920	14/06/1986
1987-1988	444.1	241.170	21/08/1987	0.000	236.960	21/07/1987
1988-1989	2700	251.450	03/10/1988	0.993	237.170	11/04/1989
1989-1990	565.3	243.800	24/08/1989	0.000	237.170	05/04/1990
1990-1991	1419	248.050	17/08/1990	0.240	236.660	05/03/1991
1991-1992	1341	246.525	31/07/1991	0.000	237.040	26/01/1992
1992-1993	1329	248.650	22/08/1992	0.213	236.470	17/03/1993
1993-1994	189.5	239.090	17/07/1993	0.000	237.300	26/05/1994
1994-1995	2976	250.690	07/09/1994	0.000	237.340	11/05/1995
1995-1996	970.8	245.188	25/07/1995	0.000	237.300	21/04/1996
1996-1997	736.8	243.000	08/09/1996	0.000	236.890	03/05/1997
1997-1998	1313	246.100	01/12/1997	0.000	236.200	24/05/1998
1998-1999	2521	249.955	16/09/1998	0.049	236.410	12/04/1999
1999-2000	1840	249.275	10/08/1999	0.047	236.450	10/04/2000
2000-2001	1020	247.325	20/07/2000	0.000	236.300	10/05/2001
2001-2002	767.7	244.085	15/06/2001	0.087	236.310	24/12/2001
2002-2003	1910	246.700	03/09/2002	0.000	236.300	20/07/2002
2003-2004	200.4	239.500	29/07/2003	0.010	237.600	04/12/2003
2004-2005	292.8	239.700	06/08/2004	0.000	236.220	21/06/2004
2005-2006	1953	247.925	02/08/2005	0.000	236.270	24/06/2005
2006-2007	4124	251.600	07/08/2006	0.430	236.260	18/07/2006
2007-2008	3608	251.100	09/07/2007	0.020	236.110	09/05/2008
2008-2009	256.5	239.740	22/09/2008	0.109	236.150	07/07/2008
2009-2010	286.4	239.675	08/07/2009	0.000	237.160	19/08/2009
2010-2011	1293	245.345	01/08/2010	0.000	237.250	13/05/2011
2011-2012	768.2	243.38	29/08/2011	0.411	236.33	05/11/2011

3.2.2 Annual Maximum flood peak

Year	Highest Flood Level (m)	Date	Hour
1977	241.200	25/11/1977	08:00:00
1978	250.405	30/08/1978	08:00:00
1979	252.100	10/08/1979	08:00:00
1980	247.010	17/08/1980	17:00:00
1981	249.770	10/08/1981	09:00:00
1982	242.940	22/07/1982	16:00:00
1983	249.130	12/08/1983	11:00:00
1984	245.980	19/08/1984	16:00:00
1985	246.000	26/06/1985	18:00:00
1986	247.730	15/08/1986	11:00:00
1987	241.990	21/08/1987	08:00:00
1988	252.000	03/10/1988	14:00:00
1989	244.700	24/08/1989	01:00:00
1990	251.000	25/07/1990	06:00:00
1991	248.350	31/07/1991	15:00:00
1992	248.650	22/08/1992	07:00:00
1993	239.780	16/07/1993	17:00:00
1994	250.750	07/09/1994	10:00:00
1995	245.350	25/07/1995	11:00:00
1996	243.240	08/09/1996	06:00:00
1997	246.250	30/11/1997	18:00:00
1998	250.150	16/09/1998	16:00:00
1999	249.590	10/08/1999	15:00:00
2000	247.400	20/07/2000	09:00:00
2001	244.300	15/06/2001	06:00:00
2002	249.550	03/09/2002	23:00:00
2003	241.900	28/07/2003	18:00:00
2004	242.050	05/08/2004	23:00:00
2005	250.800	01/08/2005	21:00:00
2006	251.600	07/08/2006	06:00:00
2007	251.270	09/07/2007	04:00:00
2008	241.150	21/09/2008	20:00:00
2009	241.880	08/07/2009	15:00:00
2010	246.580	31/07/2010	18:00:00
2011	244.550	06/09/2011	02:00:00

3.2.3 Summary of Data

Stage Discharge data for the period from June 2011 to May 2012

Station Name: Purna at Gopalkheda(01 02 17 004) Division : Tapi division Surat

Local River: Sub Division: Upper Tapi Bhusawal

Day	Jun		Jul		Aug		Sep		Oct		Nov	
	W.L	Q	W.L	Q	W.L	Q	W.L	Q	W.L	Q	W.L	Q
1	236.960	0.000 *	236.380	0.000 *	237.450	44.30	239.100	187.2	236.720	9.362	236.380	1.629
2	236.880	0.000 *	236.370	0.000 *	236.790	11.27 *	239.000	177.9	236.710	8.773 *	236.370	1.454
3	236.880	0.000 *	236.700	8.479 *	236.720	10.13	239.700	279.7	236.710	9.036	236.360	1.246
4	236.850	0.000 *	236.750	6.167	236.630	9.233	239.090	184.3	236.710	8.995	236.330	0.588
5	236.820	0.000 *	236.710	5.535	236.550	3.030	241.050	435.0	236.690	8.668	236.330	0.411
6	236.780	0.000 *	236.700	5.099	236.590	3.729	242.550	690.7	236.640	6.800 *	236.330	0.000 *
7	236.750	0.000 *	237.090	33.55	236.620	6.274 *	239.060	179.5	236.620	7.343	236.320	0.000 *
8	236.750	0.000 *	237.935	67.08	236.700	9.379	238.320	92.40	236.610	7.015	236.310	0.000 *
9	237.250	0.000 *	238.000	73.36	236.710	9.409	238.060	72.79	236.600	5.766 *	236.310	0.000 *
10	237.500	0.000 *	237.400	37.95 *	236.805	13.39	237.820	64.98	236.600	6.937	236.300	0.000 *
11	237.610	0.000 *	236.610	9.173	236.835	14.72	237.600	49.33 *	236.600	6.952	236.300	0.000 *
12	237.580	0.000 *	236.535	2.608	236.810	13.68	237.590	50.94	236.600	6.987	236.290	0.000 *
13	237.500	0.000 *	236.480	1.625	236.750	10.79	237.480	45.19	236.590	6.841	236.290	0.000 *
14	236.420	0.000 *	236.440	2.363 *	236.740	9.680 *	237.220	24.77	236.580	6.651	236.280	0.000 *
15	236.450	0.000 *	239.565	222.8	238.000	75.62 *	238.125	88.71	236.570	6.279	236.280	0.000 *
16	238.650	0.000 *	237.750	55.82	237.205	21.74	237.950	71.90	236.560	4.803 *	236.270	0.000 *
17	237.480	0.000 *	236.980	18.19 *	236.935	16.56	237.595	52.36	236.550	5.986	236.270	0.000 *
18	236.865	7.077	237.110	20.76	236.840	15.21	237.490	42.92 *	236.540	5.800	236.260	0.000 *
19	236.680	7.902 *	237.430	42.67	236.800	13.83	237.370	36.62	236.540	5.746	236.230	0.000 *
20	236.490	1.650	237.120	21.39	236.780	12.74	237.100	17.76	236.530	5.746	236.230	0.000 *
21	236.440	1.035	236.825	12.46	237.300	32.72 *	237.010	15.73	236.520	5.406	236.230	0.000 *
22	236.420	1.041	237.100	20.68	237.150	25.48 *	236.950	13.98	236.530	5.440	236.230	0.000 *
23	236.400	0.000 *	236.680	10.57	237.235	22.99	237.175	22.21	236.530	4.128 *	236.230	0.000 *
24	236.370	0.000 *	236.690	8.188 *	238.110	81.49	237.120	19.18	236.510	5.297	236.220	0.000 *
25	236.350	0.000 *	236.600	8.520	240.020	245.5	236.900	15.12 *	236.510	5.198	236.400	0.000 *
26	236.350	0.000 *	236.865	13.44	241.100	400.3	237.030	20.29	236.490	3.295 *	236.580	0.000 *
27	236.340	0.000 *	237.240	31.01	239.100	164.8	236.970	15.63	236.490	4.188	236.750	0.000 *
28	236.330	0.000 *	237.785	60.02	241.100	401.9	236.880	12.60	236.460	3.932	236.950	0.000 *
29	236.330	0.000 *	237.370	39.95	243.380	768.2	236.780	10.29	236.430	3.503	237.000	0.000 *
30	236.390	0.000 *	237.040	31.33	240.225	268.5	236.750	9.956	236.400	1.712 *	237.030	0.000 *
31			236.920	15.86 *	238.570	120.6 *			236.390	1.845		
Ten-Daily Mean												
I Ten-Daily	236.942	0.000	237.003	23.72	236.757	12.02	239.375	236.5	236.661	7.870	236.334	0.533
II Ten-Daily	237.172	1.663	237.202	39.74	236.969	20.46	237.552	48.05	236.566	6.179	236.270	0.000
III Ten-Daily	236.372	0.208	237.010	22.91	239.390	230.2	236.956	15.50	236.478	3.995	236.562	0.000
Monthly												
Min.	236.330	0.000	236.370	0.000	236.550	3.030	236.750	9.956	236.390	1.712	236.220	0.000
Max.	238.650	7.902	239.565	222.8	243.380	768.2	242.550	690.7	236.720	9.362	237.030	1.629
Mean	236.829	0.624	237.070	28.6	237.760	92.16	237.961	100	236.565	5.949	236.389	0.178

Annual Runoff in MCM = 601 Annual Runoff in mm = 63
Peak Observed Discharge = 768.2 cumec on 29/08/2011 Corres. Water Level :243.38 m
Lowest Observed Discharge = 0.411 cumec on 05/11/2011 Corres. Water Level :236.33 m

Note:No flow condition from 01/06/11 to17/06/2011 & 06/11/11 to 31/05/12 due to temporary bund at 80m D/S of S/G line

Q: Observed/Coputed Discharge in cumec WL: corresponding Mean Water Level (msl) in m *: computed discharge #: Discarded Discharge(value changed a per rating curve)

Stage Discharge data for the period from June 2011 to May 2012

Station Name: Purna at Gopalkheda(01 02 17 004) Division : Tapi division Surat

Local River: Sub Division: Upper Tapi Bhusawal

Day	Dec		Jan		Feb		Mar		Apr		May	
	W.L	Q	WL	Q	WL	Q	WL	Q	WL	Q	WL	Q
1	237.070	0.000 *	237.500	0.000 *	237.580	0.000 *	237.500	0.000 *	237.200	0.000 *	236.740	0.000 *
2	237.240	0.000 *	237.480	0.000 *	237.570	0.000 *	237.500	0.000 *	237.200	0.000 *	236.740	0.000 *
3	237.290	0.000 *	237.480	0.000 *	237.570	0.000 *	237.490	0.000 *	237.190	0.000 *	236.720	0.000 *
4	237.350	0.000 *	237.490	0.000 *	237.560	0.000 *	237.490	0.000 *	237.180	0.000 *	236.720	0.000 *
5	237.400	0.000 *	237.490	0.000 *	237.560	0.000 *	237.510	0.000 *	237.170	0.000 *	236.700	0.000 *
6	237.410	0.000 *	237.460	0.000 *	237.560	0.000 *	237.520	0.000 *	237.170	0.000 *	236.690	0.000 *
7	237.400	0.000 *	237.460	0.000 *	237.560	0.000 *	237.520	0.000 *	237.160	0.000 *	236.690	0.000 *
8	237.400	0.000 *	237.450	0.000 *	237.550	0.000 *	237.510	0.000 *	237.150	0.000 *	236.680	0.000 *
9	237.380	0.000 *	237.450	0.000 *	237.550	0.000 *	237.500	0.000 *	237.140	0.000 *	236.680	0.000 *
10	237.400	0.000 *	237.450	0.000 *	237.550	0.000 *	237.500	0.000 *	237.120	0.000 *	236.660	0.000 *
11	237.400	0.000 *	237.460	0.000 *	237.530	0.000 *	237.500	0.000 *	237.110	0.000 *	236.650	0.000 *
12	237.420	0.000 *	237.470	0.000 *	237.530	0.000 *	237.480	0.000 *	237.100	0.000 *	236.650	0.000 *
13	237.450	0.000 *	237.470	0.000 *	237.520	0.000 *	237.470	0.000 *	237.080	0.000 *	236.620	0.000 *
14	237.450	0.000 *	237.510	0.000 *	237.520	0.000 *	237.450	0.000 *	237.050	0.000 *	236.580	0.000 *
15	237.460	0.000 *	237.500	0.000 *	237.510	0.000 *	237.350	0.000 *	237.030	0.000 *	236.560	0.000 *
16	237.450	0.000 *	237.500	0.000 *	237.510	0.000 *	237.340	0.000 *	237.000	0.000 *	236.530	0.000 *
17	237.450	0.000 *	237.500	0.000 *	237.500	0.000 *	237.320	0.000 *	236.970	0.000 *	236.500	0.000 *
18	237.440	0.000 *	237.550	0.000 *	237.500	0.000 *	237.310	0.000 *	236.900	0.000 *	236.500	0.000 *
19	237.400	0.000 *	237.580	0.000 *	237.500	0.000 *	237.300	0.000 *	236.850	0.000 *	236.480	0.000 *
20	237.420	0.000 *	237.600	0.000 *	237.490	0.000 *	237.280	0.000 *	236.850	0.000 *	236.480	0.000 *
21	237.420	0.000 *	237.600	0.000 *	237.480	0.000 *	237.260	0.000 *	236.820	0.000 *	236.450	0.000 *
22	237.430	0.000 *	237.620	0.000 *	237.470	0.000 *	237.250	0.000 *	236.800	0.000 *	236.410	0.000 *
23	237.420	0.000 *	237.620	0.000 *	237.450	0.000 *	237.250	0.000 *	236.780	0.000 *	236.380	0.000 *
24	237.420	0.000 *	237.600	0.000 *	237.450	0.000 *	237.230	0.000 *	236.780	0.000 *	236.380	0.000 *
25	237.420	0.000 *	237.600	0.000 *	237.430	0.000 *	237.210	0.000 *	236.770	0.000 *	236.350	0.000 *
26	237.414	0.000 *	237.600	0.000 *	237.410	0.000 *	237.200	0.000 *	236.770	0.000 *	236.350	0.000 *
27	237.414	0.000 *	237.580	0.000 *	237.410	0.000 *	237.200	0.000 *	236.760	0.000 *	236.350	0.000 *
28	237.400	0.000 *	237.600	0.000 *	237.400	0.000 *	237.190	0.000 *	236.750	0.000 *	236.340	0.000 *
29	237.400	0.000 *	237.600	0.000 *	237.400	0.000 *	237.180	0.000 *	236.750	0.000 *	236.330	0.000 *
30	237.440	0.000 *	237.600	0.000 *			237.180	0.000 *	236.750	0.000 *	236.320	0.000 *
31	237.480	0.000 *	237.580	0.000 *			237.170	0.000 *			236.310	0.000 *
Ten-Daily Mean												
I Ten-Daily	237.334	0.000	237.471	0.000	237.561	0.000	237.504	0.000	237.168	0.000	236.702	0.000
II Ten-Daily	237.434	0.000	237.514	0.000	237.511	0.000	237.380	0.000	236.994	0.000	236.555	0.000
III Ten-Daily	237.423	0.000	237.600	0.000	237.433	0.000	237.211	0.000	236.773	0.000	236.361	0.000
Monthly												
Min.	237.070	0.000	237.450	0.000	237.400	0.000	237.170	0.000	236.750	0.000	236.310	0.000
Max.	237.480	0.000	237.620	0.000	237.580	0.000	237.520	0.000	237.200	0.000	236.740	0.000
Mean	237.398	0	237.531	0	237.504	0	237.360	0	236.978	0	236.534	0

Peak Computed Discharge = 120.6 cumec on 31/08/2011 Corres. Water Level :238.57 m

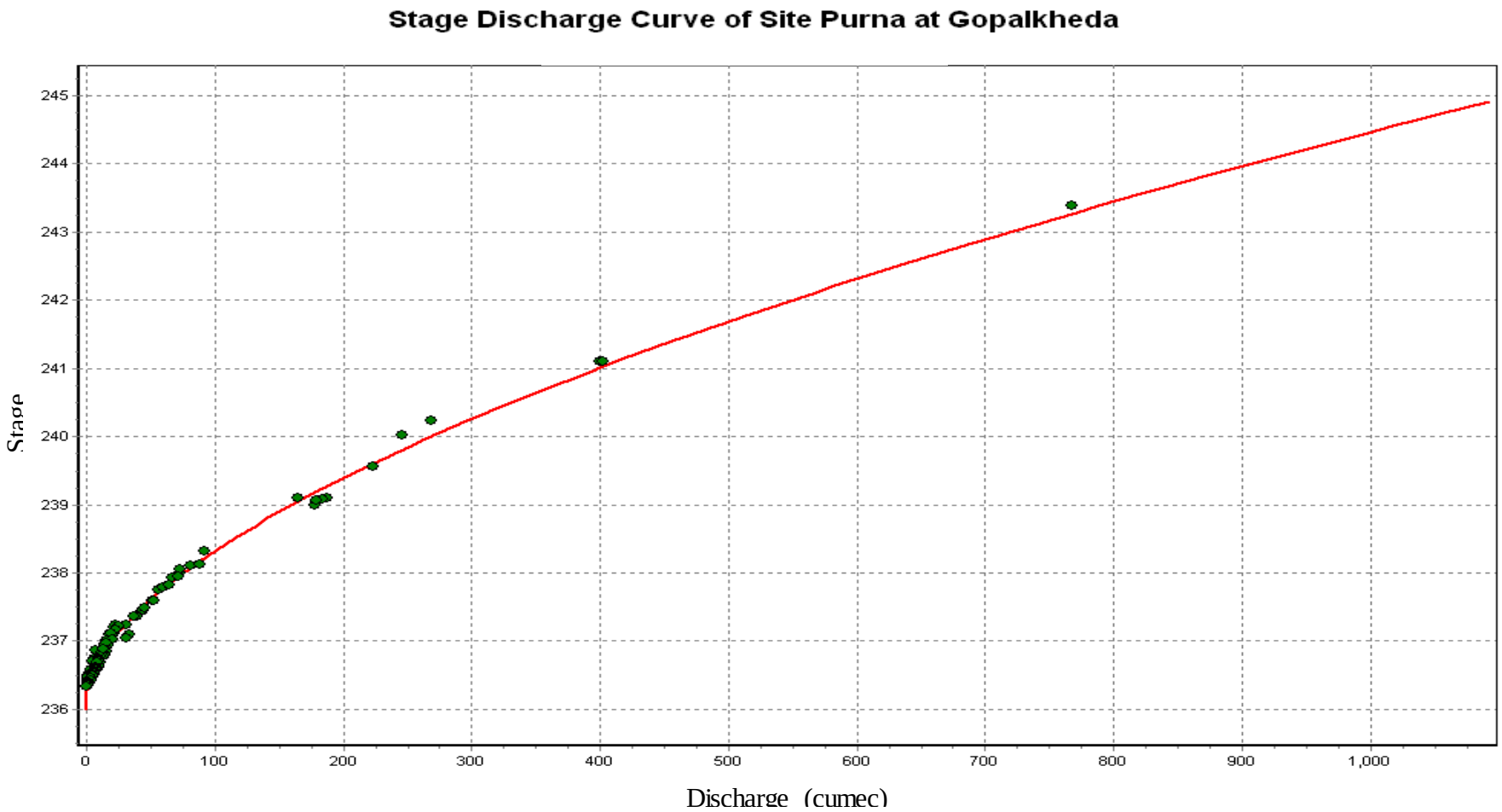
Lowest Computed Discharge = 0.000 cumec on 01/06/2011 Corres. Water Level :236.96 m

Note:No flow condition from 01/06/11 to12/06/2011 & 20/01/12 to 31/05/12 due to temporary bund at 1.00Km D/S of site.Q: Observed/Coputed Discharge in cumec WL: corresponding Mean Water Level (msl) in m *: computed discharge #:Discarded Discharge(value changed a per rating curve)

3.2.4 Stage Discharge Curve

Station Name: Purna at Gopalkheda(01 02 17 004) Division : Tapi division Surat

Local River: Sub Division: Upper Tapi Bhusawal



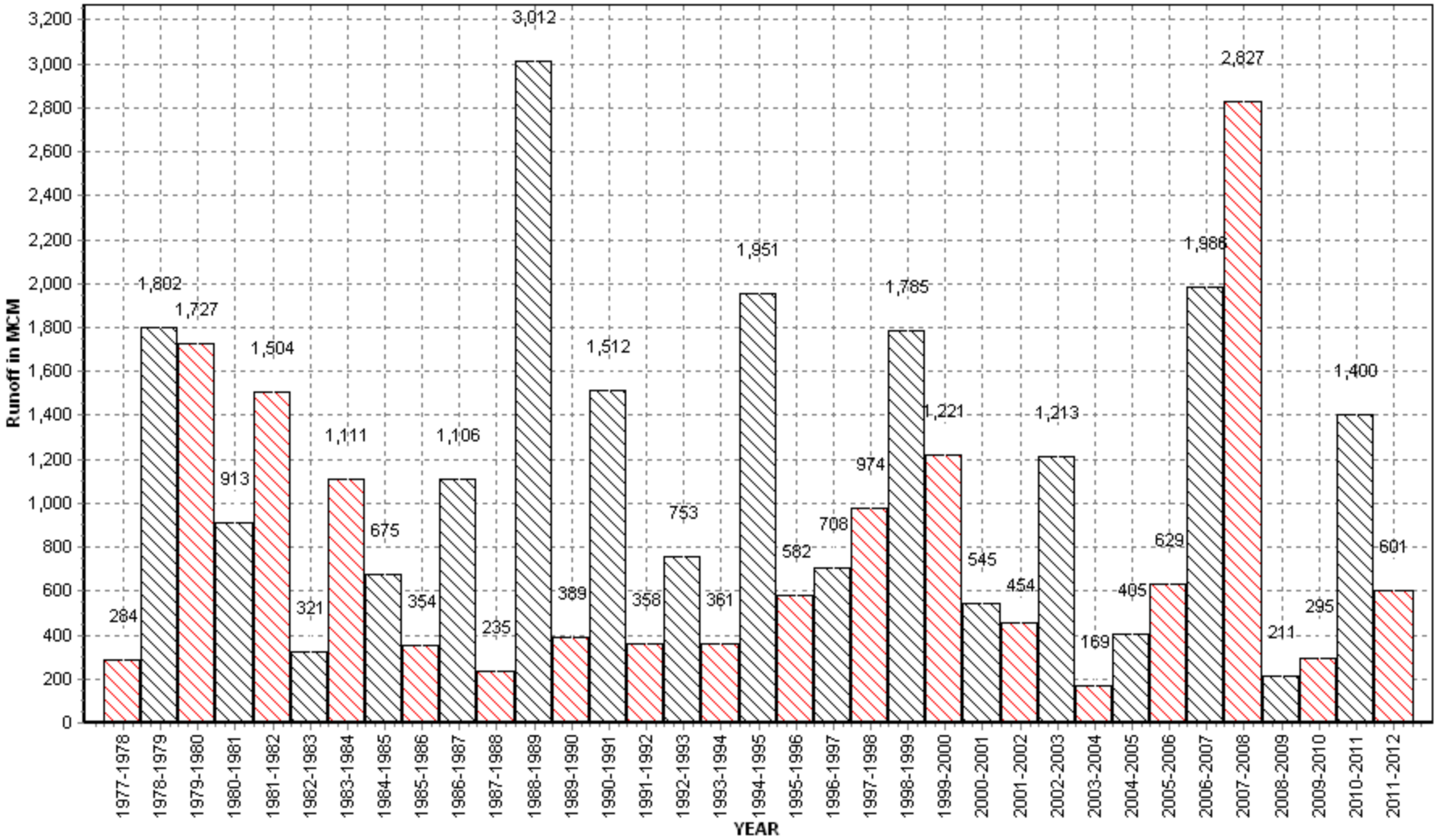
$Q=(c*(h+a)^b$	WL : 236 to 245	a= (-)236.21, b=1.689, c=28.287

3.2.5 Annual runoff

Annual Runoff for the period :1977 – 2012

Station Name: Purna at Gopalkheda(01 02 17 004) Division : Tapi division Surat

Local River: Sub Division: Upper Tapi Bhusawal

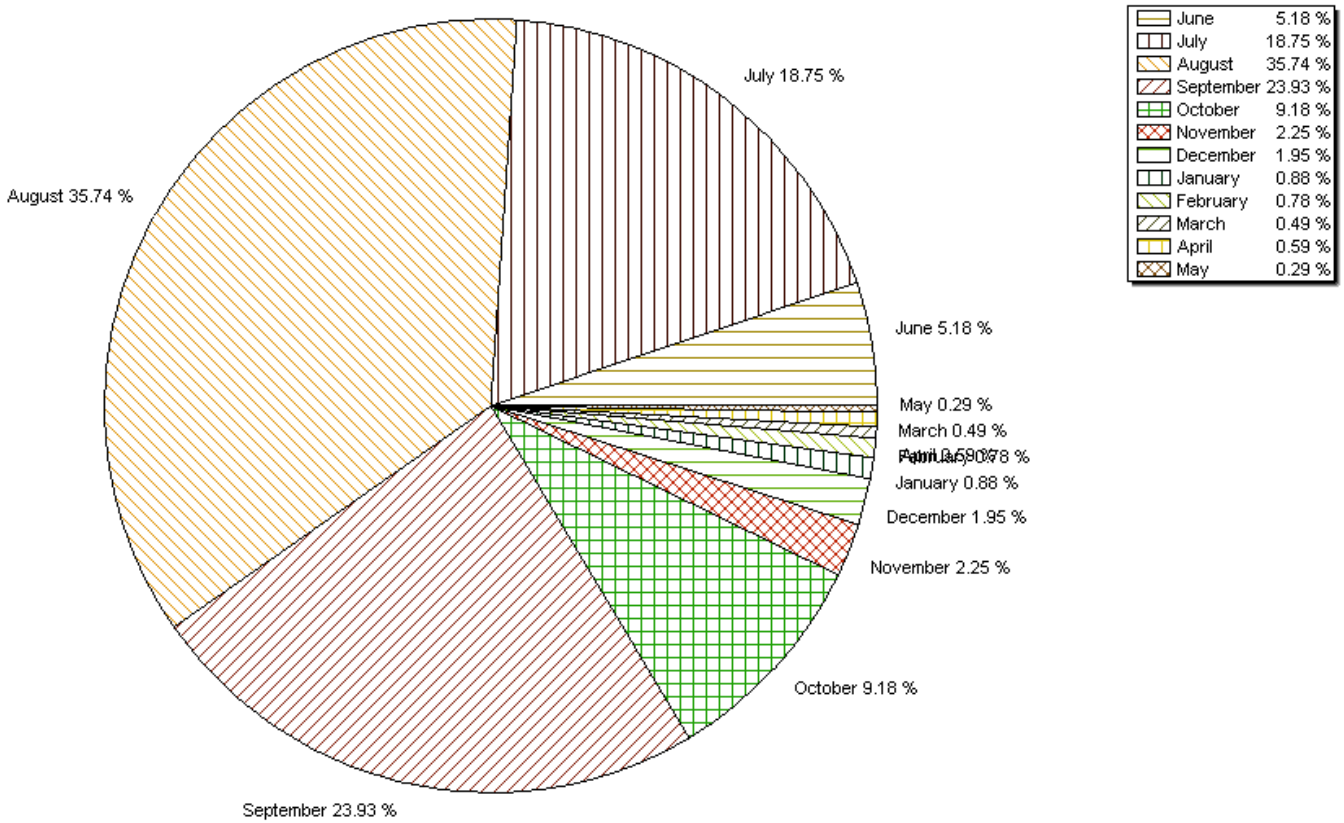


3.2.6 Monthly average Runoff

Monthly Average Runoff based on period: 1977-2012

Station Name: Purna at Gopalkheda(01 02 17 004) Division : Tapi division Surat

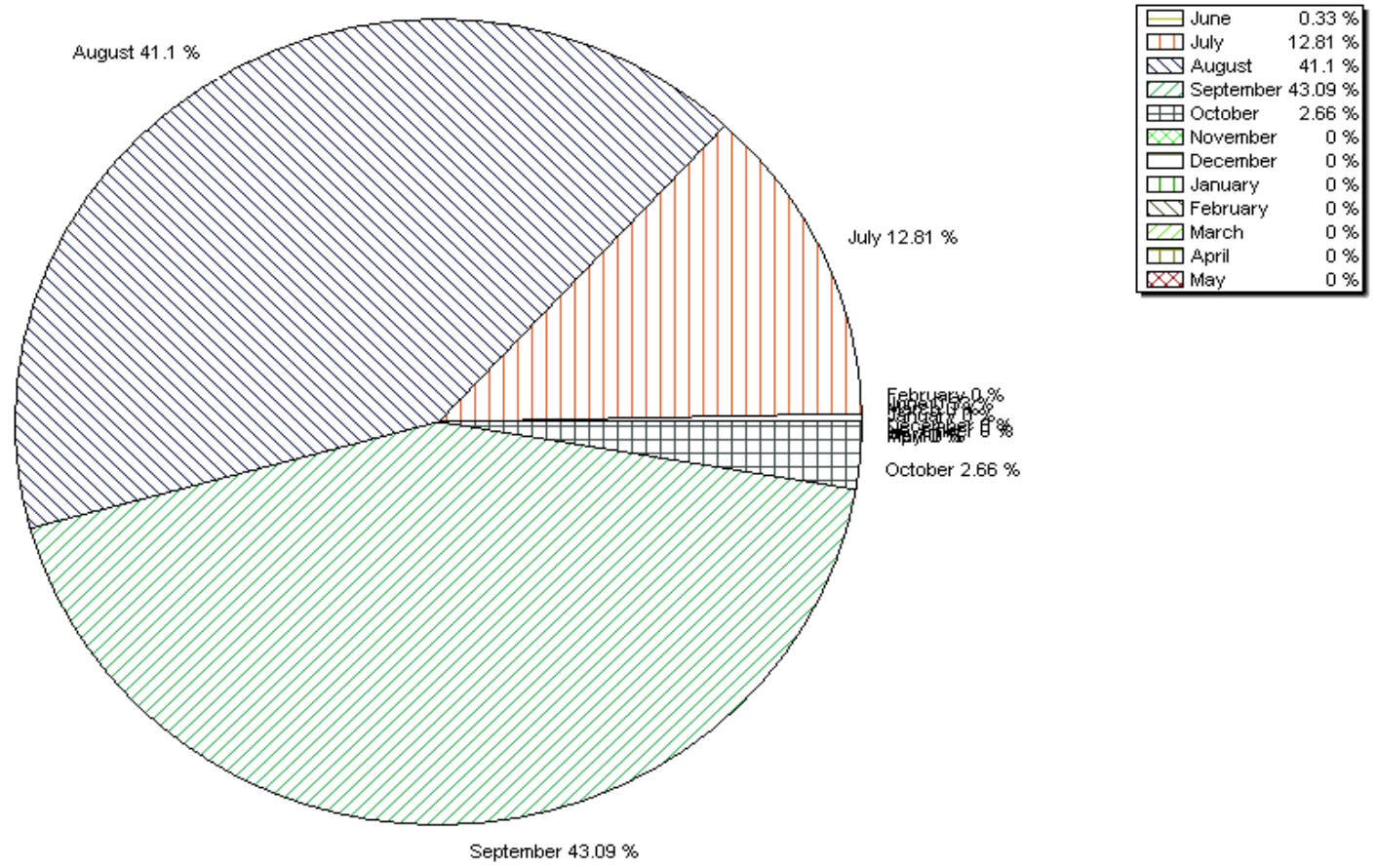
Local River: Sub Division: Upper Tapi Bhusawal



Monthly Average Runoff for the year 2011-2012

Station Name: Purna at Gopalkheda(01 02 17 004) Division : Tapi division Surat

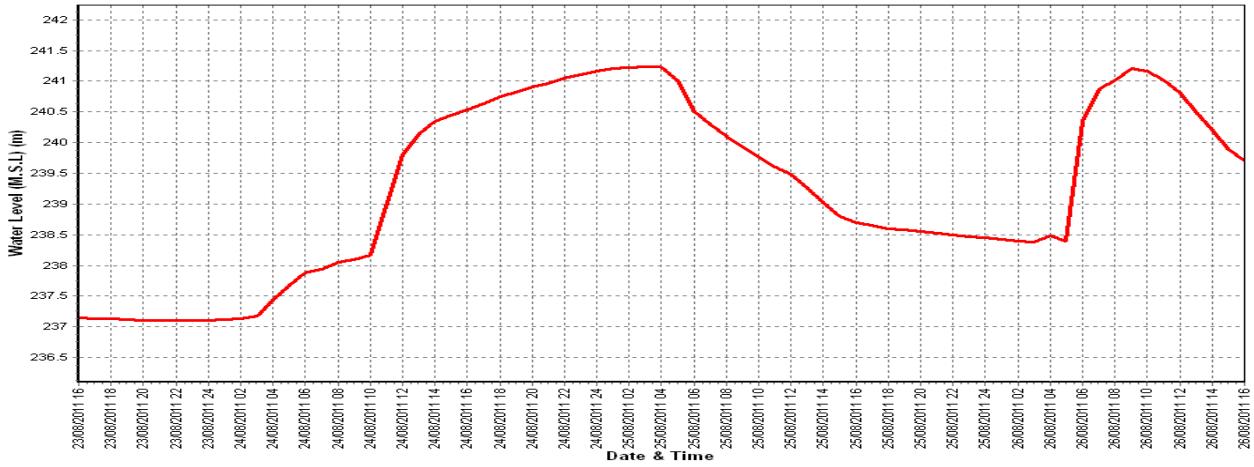
Local River: Sub Division: Upper Tapi Bhusawal



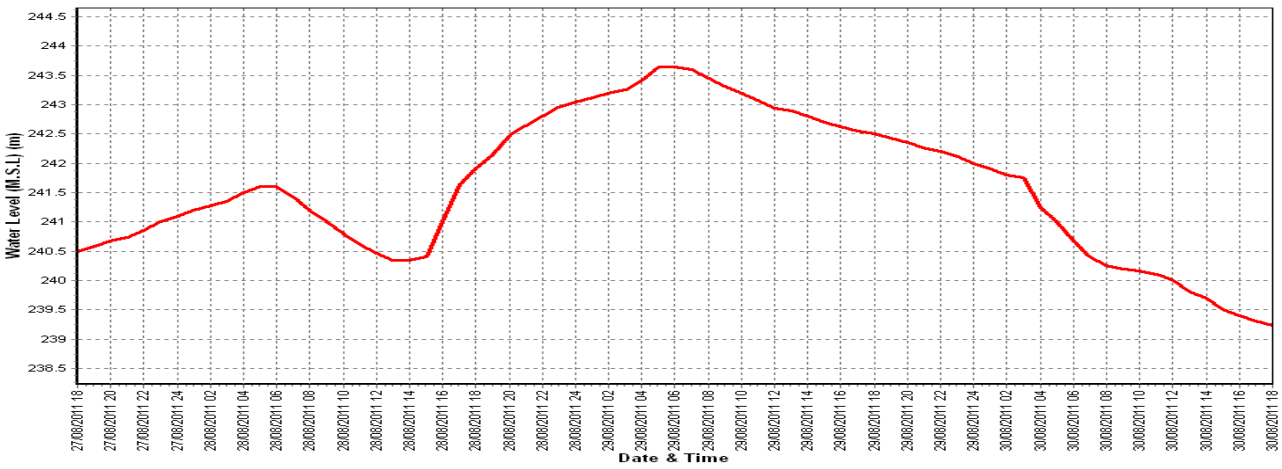
3.2.7 WL vs Time graph of highest I, II, III pead

Station Name: Purna at Gopalkheda(01 02 17 004) Division : Tapi division Surat
Local River: Sub Division: Upper Tapi Bhusawal

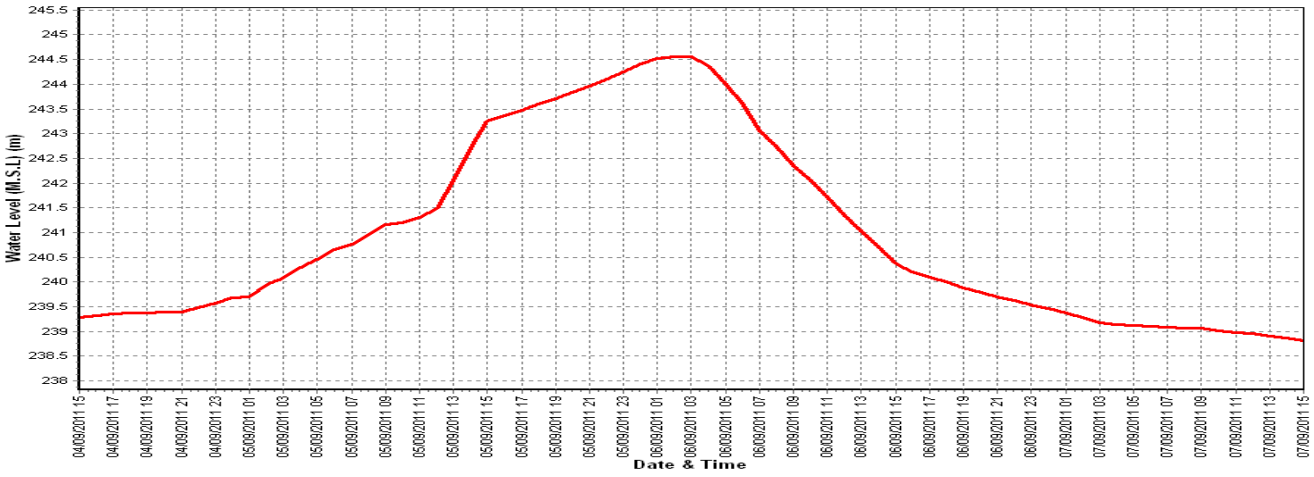
Water Level v/s Time graph of Highest (I) Flood Peak during the water year 2011-2012



Water Level v/s Time graph of Highest (II) Flood Peak during the water year 2011-2012



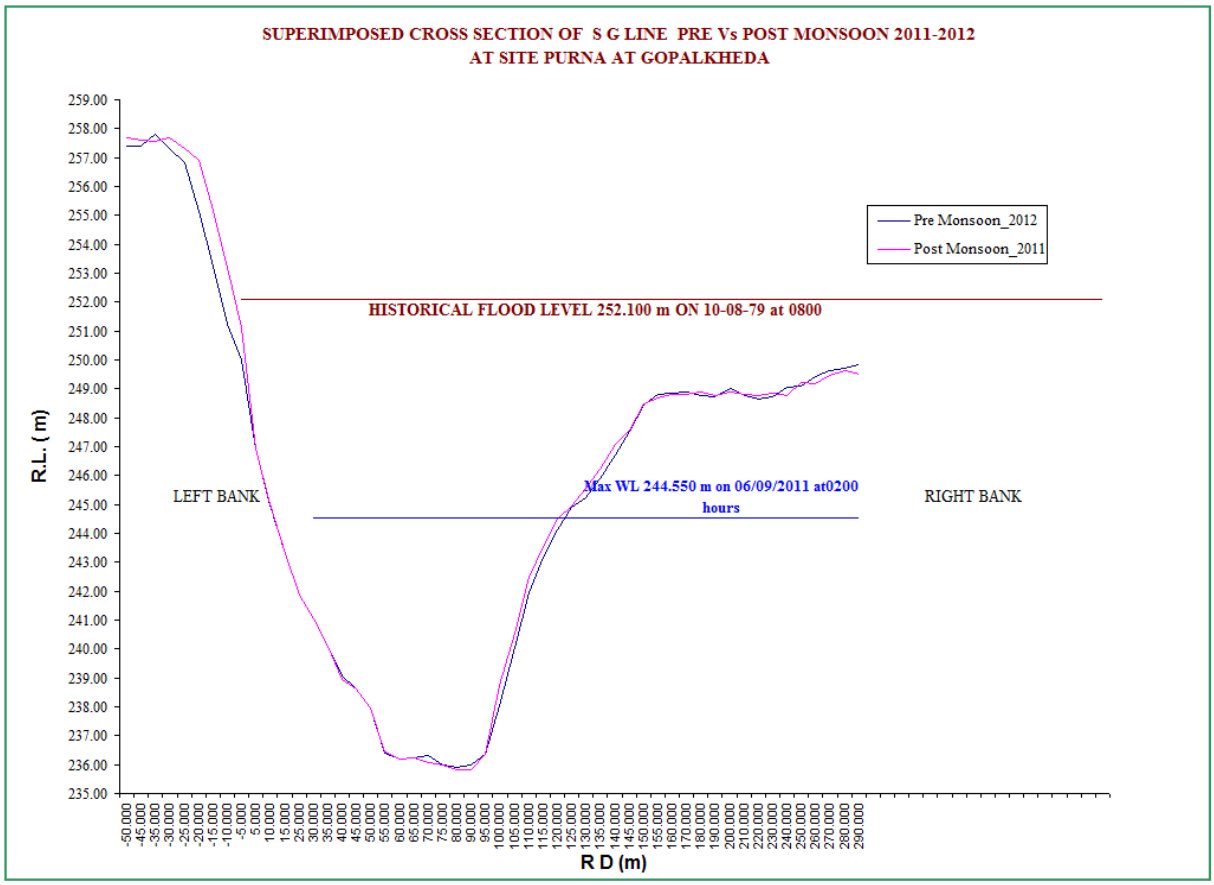
Water Level v/s Time graph of Highest (III) Flood Peak during the water year 2011-2012



3.2.8 Super imposed cross section

Station Name: Purna at Gopalkheda(01 02 17 004) Division : Tapi division Surat

Local River: Sub Division: Upper Tapi Bhusawal



3.3. Yerli

3.3.1 HISTORY SHEET

Site	**:**	**Purna at Yerli**	**Code**	**:**	**01 02 17 005**
State	:	Maharashtra	District		Buldhana
Basin	:	Tapi	Independent River	:	Tapi
Tributary	:	Purna	Sub Tributary	:	-
Sub-Sub Tributary	:		Local River	:	
Division	:	Tapi Division Surat	Sub-Division	:	Upper Tapi Bhusawal
Drainage Area	:	16517 sq km	Bank	:	Left
Latitude	:	20°56'11"	Longitude	:	76°28'27"
Zero of Gauge (m)	:	213 (msl)	11/11/1971		
		Opening Date	Closing Date		
Gauge	:	11/11/1971			
Discharge	:	01/03/1972			
Sediment	:	09/04/1973			
Water Quality	:	01/06/1977	31/05/2005		

Annual Maximum / Minimum discharge with corresponding Water Level (m.s.l)

	Maximum			Minimum		
Year	**Q (cumec)**	**WL (m)**	**Date**	**Q (cumec)**	**WL (m)**	**Date**
1973-1974	3060	226.210	28/08/1973	0.000	228.370	27/08/1973
1974-1975	2005	220.882	13/08/1974	0.200	214.400	28/05/1975
1975-1976	2493	222.883	05/09/1975	0.200	214.580	13/05/1976
1976-1977	2580	222.800	04/09/1976	0.200	214.630	02/06/1976
1977-1978	1885	220.965	14/06/1977	0.500	214.553	12/06/1977
1978-1979	4154	225.200	31/08/1978	1.200	214.805	29/05/1979
1979-1980	10380	230.510	11/08/1979	0.916	214.785	14/06/1979
1980-1981	1842	221.532	18/08/1980	1.200	214.815	31/05/1981
1981-1982	3350	224.780	11/08/1981	0.800	214.755	02/06/1981
1982-1983	651.6	219.485	21/07/1982	0.100	214.650	20/04/1983
1983-1984	6055	229.850	12/08/1983	1.243	214.695	31/05/1984
1984-1985	1611	220.595	10/10/1984	0.000	214.475	26/05/1985
1985-1986	3146	223.650	27/06/1985	0.000	214.570	30/05/1986
1986-1987	3073	224.240	07/08/1986	0.100	214.610	01/06/1986
1987-1988	1122	219.825	21/08/1987	0.000	214.620	21/04/1988
1988-1989	6700	228.500	04/10/1988	0.000	214.360	07/06/1988
1989-1990	1298	220.780	24/08/1989	0.000	214.730	17/05/1990
1990-1991	4501	227.150	25/07/1990	0.000	214.880	11/05/1991
1991-1992	1480	221.540	01/08/1991	0.000	214.730	03/03/1992
1992-1993	1974	222.445	22/08/1992	0.000	214.435	17/06/1992
1993-1994	2269	223.820	16/07/1993	0.000	214.650	07/05/1994
1994-1995	3785	225.550	08/09/1994	0.000	214.600	10/06/1994
1995-1996	1538	221.510	03/09/1995	0.000	214.600	16/04/1996
1996-1997	747.2	219.650	24/10/1996	0.000	214.655	23/04/1997
1997-1998	1294	221.350	01/12/1997	0.000	214.600	16/05/1998
1998-1999	3059	224.710	17/09/1998	0.000	214.550	22/05/1999
1999-2000	3020	224.150	11/08/1999	0.000	214.700	30/04/2000
2000-2001	680.0	220.200	20/07/2000	0.000	214.620	27/11/2000
2001-2002	1659	222.260	15/06/2001	0.000	214.600	18/05/2002
2002-2003	2750	225.870	04/09/2002	0.000	214.580	03/02/2003
2003-2004	443.4	218.095	29/09/2003	0.000	214.580	04/06/2003
2004-2005	407.8	217.425	06/08/2004	0.000	214.620	07/03/2005
2005-2006	3046	224.550	02/08/2005	0.000	214.690	07/06/2005
2006-2007	8703	233.540	07/08/2006	0.000	214.600	03/03/2007
2007-2008	3132	225.615	02/07/2007	0.000	214.620	18/05/2008
2008-2009	542.8	218.645	22/09/2008	0.000	214.410	23/04/2009
2009-2010	369.0	217.395	04/09/2009	0.000	River Dry	04/11/2009
2010-2011	1757	223.005	01/08/2010	0.257	214.760	31/12/2010
2011-2012	989.3	219.000	06/09/2012	0.000		01/06/2011

.3.2 Annual Maximum flood peak

Year	Highest Flood Level (m)	Date	Hour
1972	224.895	19/08/1972	14:00:00
1973	220.990	13/08/1973	06:00:00
1974	220.990	13/08/1974	06:00:00
1975	222.990	05/09/1975	07:00:00
1976	223.040	04/09/1976	01:00:00
1977	221.250	28/06/1977	20:00:00
1978	225.330	31/08/1978	04:00:00
1979	230.670	11/08/1979	03:00:00
1980	222.200	17/08/1980	15:00:00
1981	224.950	11/08/1981	01:00:00
1982	220.600	20/07/1982	22:00:00
1983	229.870	12/08/1983	09:00:00
1984	220.710	10/10/1984	10:00:00
1985	223.750	27/06/1985	14:00:00
1986	225.200	07/08/1986	00:00:00
1987	219.860	21/08/1987	09:00:00
1988	228.850	04/10/1988	12:00:00
1989	223.340	21/07/1989	21:00:00
1990	228.100	25/07/1990	19:00:00
1991	221.540	01/08/1991	07:00:00
1992	222.655	22/08/1992	19:00:00
1993	223.920	16/07/1993	06:00:00
1994	225.600	08/09/1994	12:00:00
1995	221.520	03/09/1995	09:00:00
1996	219.820	08/09/1996	21:00:00
1997	221.350	01/12/1997	08:00:00
1998	224.730	17/09/1998	11:00:00
1999	224.390	11/08/1999	13:00:00
2000	221.130	20/07/2000	21:00:00
2001	222.530	15/06/2001	10:00:00
2002	226.060	26/08/2002	04:00:00
2003	218.320	09/08/2003	03:00:00
2004	218.120	06/08/2004	14:00:00
2005	225.600	02/08/2005	20:00:00
2006	233.700	07/08/2006	12:00:00
2007	226.930	09/07/2007	23:00:00
2008	218.670	22/09/2008	09:00:00
2009	217.700	04/09/2009	02:00:00
2010	224.000	31/07/2010	22:00:00
2011	220.600	13/07/2011	15:00:00

3.3.3 Summary of Data

Stage Discharge data for the period from June 2011 to May 2012

Station Name: Purna at Yerli (01 02 17 005) Division: Tapi Division, Surat

Local River: Sub Division: Upper Tapi, Bhusawal

Day	Jun		Jul		Aug		Sep		Oct		Nov	
	W.L	Q	W.L	Q	W.L	Q	W.L	Q	W.L	Q	W.L	Q
1	214.970	0.000	214.690	0.000 *	215.130	25.12	216.430	254.2	214.990	22.84	214.700	3.181
2	214.970	0.000	214.690	0.000 *	215.150	27.31	216.630	287.3	214.980	18.18 *	214.700	3.056
3	214.970	0.000	214.680	0.000 *	215.050	21.46	216.200	199.7	214.970	13.05	214.700	2.985
4	214.970	0.000	214.670	0.000 *	215.010	20.06	216.940	344.5 *	214.930	11.90	214.700	2.928
5	214.970	0.000	214.670	0.000 *	214.975	10.07	216.930	400.9	214.910	11.54	214.690	2.672
6	214.970	0.000	214.680	0.000 *	214.770	7.979	219.000	989.3	214.910	13.57 *	214.680	0.000 *
7	214.970	0.000	214.700	0.000 *	214.750	5.322 *	217.095	449.1	214.900	10.82	214.670	0.000 *
8	214.970	0.000	214.870	0.000 *	214.850	8.527	215.990	182.0	214.890	10.38	214.660	0.000 *
9	214.970	0.000	215.910	100.8	214.800	8.120	215.900	178.1	214.870	11.20 *	214.650	0.000 *
10	214.970	0.000	215.700	96.49 *	214.770	7.459	215.710	104.2	214.850	9.436	214.650	0.000 *
11	214.970	0.000	215.270	22.32	214.775	8.314	215.670	92.18 *	214.820	9.131	214.640	0.000 *
12	214.970	0.000	215.170	19.67	214.830	8.227	215.850	163.7	214.810	8.883	214.640	0.000 *
13	214.970	0.000	217.005	420.2	214.820	7.695	215.525	90.68	214.795	6.413	214.630	0.000 *
14	214.970	0.000	215.950	122.9	214.810	8.025 *	215.470	85.85	214.750	5.907	214.630	0.000 *
15	214.970	0.000			214.800	7.541 *	215.535	91.41	214.730	5.629	214.630	0.000 *
16	214.970	0.000	215.875	94.57	215.200	26.49	215.870	175.6	214.720	4.154 *	214.630	0.000 *
17	214.970	0.000	215.270	43.22 *	215.080	20.93	215.800	165.7	214.720	5.446	214.630	0.000 *
18	214.970	0.000 *	216.075	174.6	215.050	20.03	215.700	96.49 *	214.720	5.439	214.630	0.000 *
19	214.870	0.000 *	215.400	34.32	215.035	17.19	215.620	114.3	214.720	5.173	214.630	0.000 *
20	214.830	0.000 *	215.200	26.38	215.000	14.66	215.320	50.53	214.710	4.993	214.620	0.000 *
21	214.800	0.000 *	215.170	22.68	215.010	20.33 *	215.205	43.66	214.710	4.902	214.620	0.000 *
22	214.780	0.000 *	215.150	22.00	215.310	47.39 *	215.140	37.27	214.710	4.736	214.620	0.000 *
23	214.770	0.000 *	215.100	27.41 *	215.300	33.84	215.070	30.47	214.710	3.793 *	214.620	0.000 *
24	214.760	0.000 *	215.080	25.76 *	215.160	30.48	215.050	27.45	214.710	4.684	214.620	0.000 *
25	214.740	0.000 *	215.060	24.15 *	216.885	402.4	215.040	22.59 *	214.710	4.566	214.620	0.000 *
26	214.730	0.000 *	215.030	10.18	216.025	184.5	215.030	28.89	214.710	3.793 *	214.620	0.000 *
27	214.720	0.000 *	215.050	19.43	216.700	313.5	215.020	27.78	214.710	4.411	214.620	0.000 *
28	214.710	0.000 *	215.770	80.71	216.950	347.0 *	215.010	27.10	214.710	4.181	214.620	0.000 *
29	214.700	0.000 *	215.525	61.72	218.430	692.3	215.000	25.63	214.710	4.208	214.610	0.000 *
30	214.700	0.000 *	215.210	26.77	218.590	707.6	215.000	24.56	214.700	3.447 *	214.610	0.000 *
31			215.040	22.59 *	216.650	274.8 *			214.700	3.680		
Ten-Daily Mean												
I Ten-Daily		0.000	214.926	19.73	214.926	14.14	216.682	338.9	214.920	13.29	214.680	1.482
II Ten-Daily	214.890	0.000	215.691	106.5	214.940	13.91	215.636	112.6	214.749	6.117	214.631	0.000
III Ten-Daily	214.741	0.000	215.199	31.22	216.455	277.7	215.056	29.54	214.708	4.218	214.618	0.000
Monthly												
Min.	214.700	0.000	214.670	0.000	214.750	5.322	215.000	22.59	214.700	3.447	214.610	0.000
Max.	214.970	0.000	217.005	420.2	218.590	707.6	219.000	989.3	214.990	22.84	214.700	3.181
Mean	214.775	0	215.255	49.96	215.473	107.6	215.792	160.4	214.790	7.757	214.643	0.494

Annual Runoff in MCM = 855 Annual Runoff in mm = 52

Peak Observed Discharge = 989.3 cumec on 06/09/2011 Corres. Water Level :219 m

Lowest Observed Discharge = 0.000 cumec on 01/06/2011

Note: No flow condition from 01/06/2011 to 08/07/2011 & 01/01/2012 to 31/05/2012. Discharge location changed and Q observation affected by construction of Bund by Jaigaon Project at 8 km D/S of S/G line

Q: Observed/Computed Discharge in cumec WL: corresponding Mean Water Level (msl) (m) *: computed discharge #: Discharge Discarded Discharge (value changed as per rating curve)

Stage Discharge data for the period from June 2011 to May 2012

Station Name: Purna at Yerli (01 02 17 005) Division: Tapi Division, Surat

Local River: Sub Division: Upper Tapi, Bhusawal

Day	Dec		Jan		Feb		Mar		Apr		May	
	W.L	Q	WL	Q	WL	Q	WL	Q	WL	Q	WL	Q
1	214.610	0.000 *		0.000		0.000		0.000		0.000		0.000
2	214.610	0.000 *		0.000		0.000		0.000		0.000		0.000
3	214.610	0.000 *		0.000		0.000		0.000		0.000		0.000
4	214.610	0.000 *		0.000		0.000		0.000		0.000		0.000
5	214.610	0.000 *		0.000		0.000		0.000		0.000		0.000
6	214.610	0.000 *		0.000		0.000		0.000		0.000		0.000
7	214.610	0.000 *		0.000		0.000		0.000		0.000		0.000
8	214.600	0.000 *		0.000		0.000		0.000		0.000		0.000
9	214.600	0.000 *		0.000		0.000		0.000		0.000		0.000
10	214.600	0.000 *		0.000		0.000		0.000		0.000		0.000
11	214.600	0.000 *		0.000		0.000		0.000		0.000		0.000
12	214.600	0.000 *		0.000		0.000		0.000		0.000		0.000
13	214.600	0.000 *		0.000		0.000		0.000		0.000		0.000
14	214.600	0.000 *		0.000		0.000		0.000		0.000		0.000
15	214.600	0.000		0.000		0.000		0.000		0.000		0.000
16	214.600	0.000		0.000		0.000		0.000		0.000		0.000
17	214.600	0.000		0.000		0.000		0.000		0.000		0.000
18	214.600	0.000		0.000		0.000		0.000		0.000		0.000
19	214.600	0.000		0.000		0.000		0.000		0.000		0.000
20	214.600	0.000		0.000		0.000		0.000		0.000		0.000
21	214.600	0.000		0.000		0.000		0.000		0.000		0.000
22	214.600	0.000		0.000		0.000		0.000		0.000		0.000
23	214.600	0.000		0.000		0.000		0.000		0.000		0.000
24	214.600	0.000		0.000		0.000		0.000		0.000		0.000
25	214.600	0.000		0.000		0.000		0.000		0.000		0.000
26	214.600	0.000		0.000		0.000		0.000		0.000		0.000
27	214.600	0.000		0.000		0.000		0.000		0.000		0.000
28	214.600	0.000		0.000		0.000		0.000		0.000		0.000
29	214.600	0.000		0.000		0.000		0.000		0.000		0.000
30	214.600	0.000		0.000				0.000		0.000		0.000
31	214.600	0.000		0.000				0.000				0.000
Ten-Daily Mean												
I Ten-Daily	214.607	0.000		0.000		0.000		0.000		0.000		0.000
II Ten-Daily	214.600	0.000		0.000		0.000		0.000		0.000		0.000
III Ten-Daily		0.000		0.000		0.000		0.000		0.000		0.000
Monthly												
Min.	214.600	0.000		0.000		0.000		0.000		0.000		0.000
Max.	214.610	0.000		0.000		0.000		0.000		0.000		0.000
Mean	214.605	0		0		0		0		0		0

Peak Computed Discharge = 347.0 cumec on 28/08/2011 Corres. Water Level :216.95 m

Lowest Computed Discharge = 0.000 cumec on 18/06/2011 Corres. Water Level :214.97 m

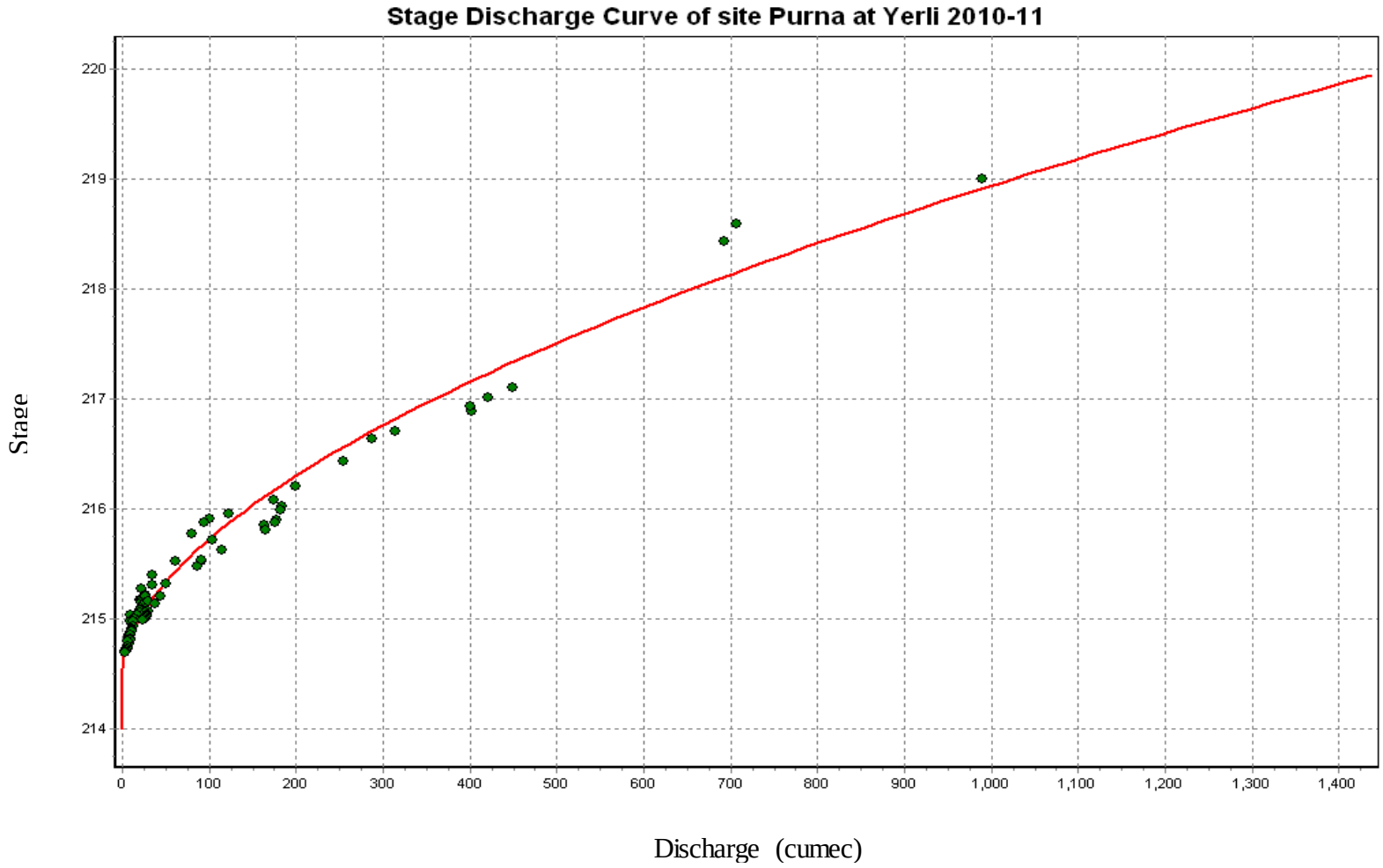
Note: No flow condition from 01/06/2011 to 08/07/2011 & 01/01/2012 to 31/05/2012. Discharge location changed and Q observation affected by construction of Bund by Jaigaon Project at 8 km D/S of S/G line

Q: Observed/Computed Discharge in cumec WL: corresponding Mean Water Level (msl) (m) *: computed discharge #: Discharge Discarded Discharge (value changed as per rating curve)

3.3.4 Stage Discharge Curve

Station Name: Purna at Yerli
Local River:

Division: Tapi division Surat
Sub Division: Middle Tapi Sub Division Dhule



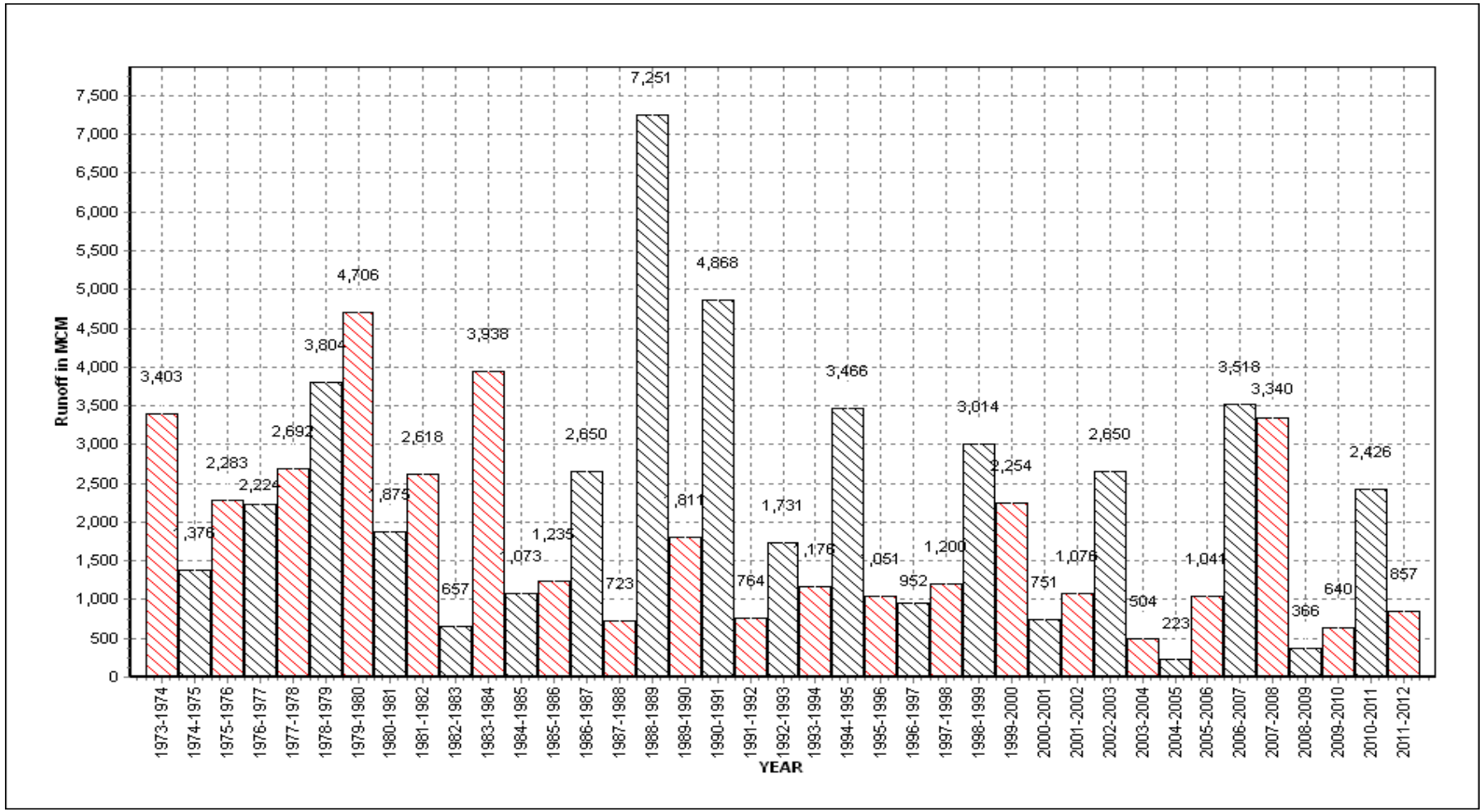
$Q=c*(h+a)^b$	WL : 214 to 220	a= (-)214.520, b=1.772, c=71.959

3.3.5 Annual runoff

Annual runoff for the period of 1973-2012

Station Name: Purna at Yerli (01 02 17 005)
Local River:

Division: Tapi Division, Surat
Sub Division: Upper Tapi, Bhusawal

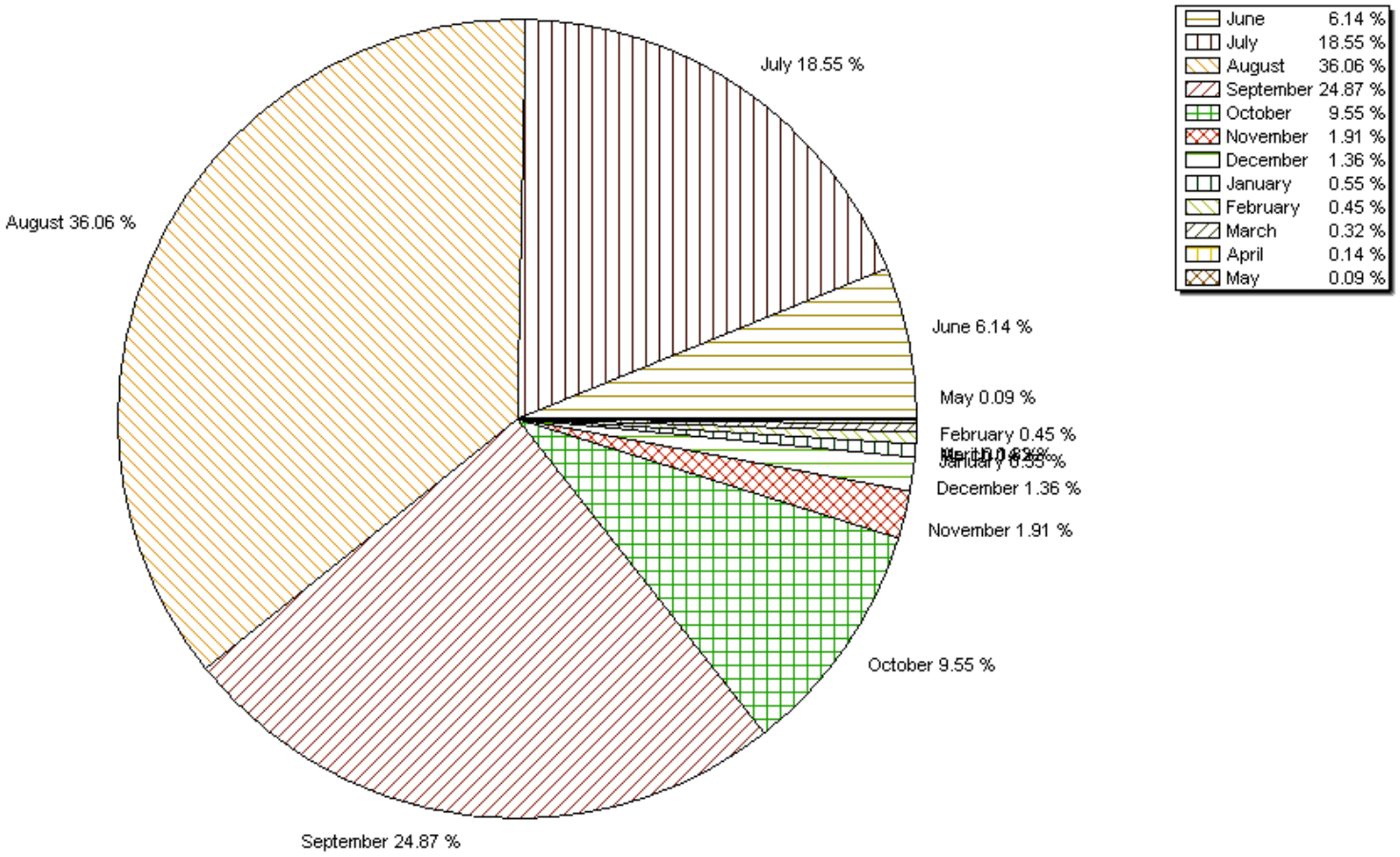


3.3.6 Monthly average Runoff

Monthly average runoff Based on period 1973-2012

Station Name: Purna at Yerli (01 02 17 005) Division: Tapi Division, Surat

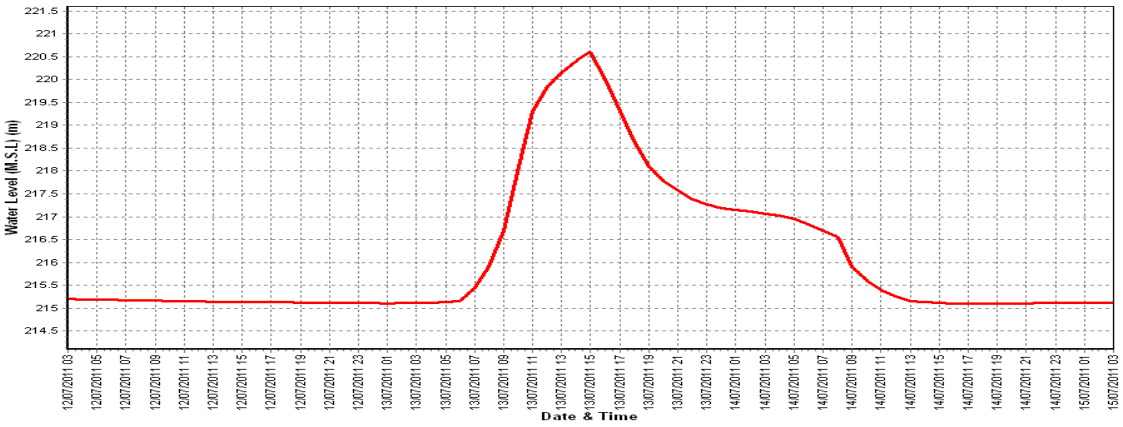
Local River: Sub Division: Upper Tapi, Bhusawal



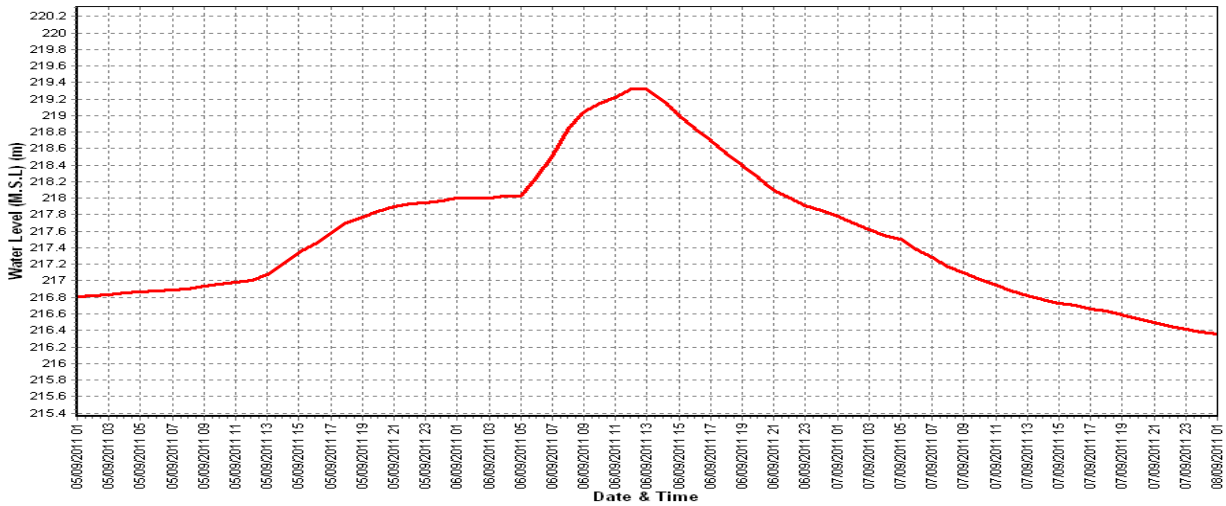
3.3.7 WL vs Time graph of highest I, II, III pead

Station Name: Purna at Yerli (01 02 17 005) Division: Tapi Division, Surat
Local River: Sub Division: Upper Tapi, Bhusawal

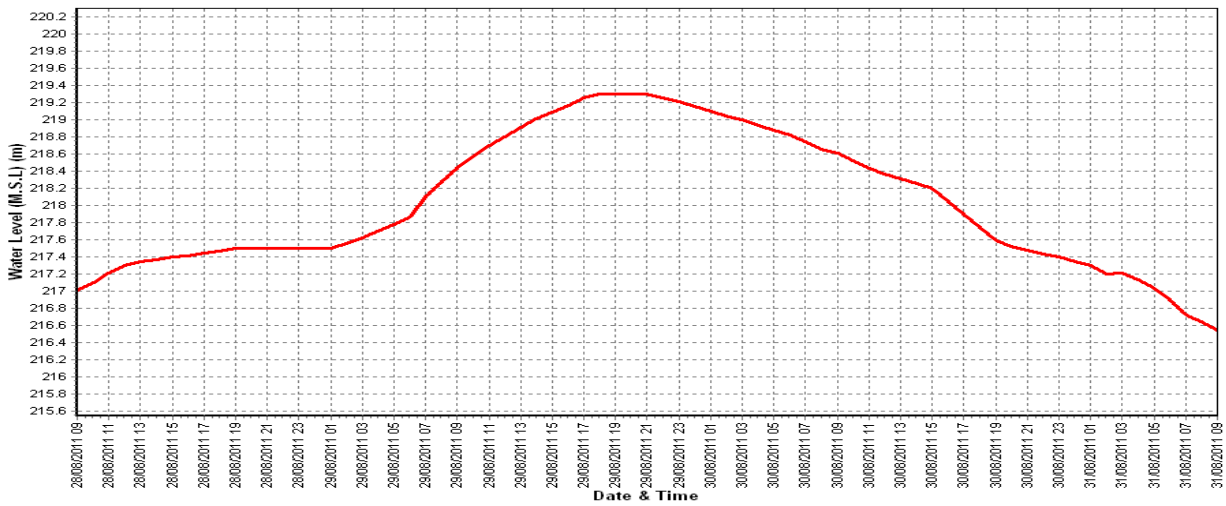
Water Level v/s Time graph of Highest (I) Flood Peak during the water year 2011-2012



Water Level v/s Time graph of Highest (II) Flood Peak during the water year 2011-2012



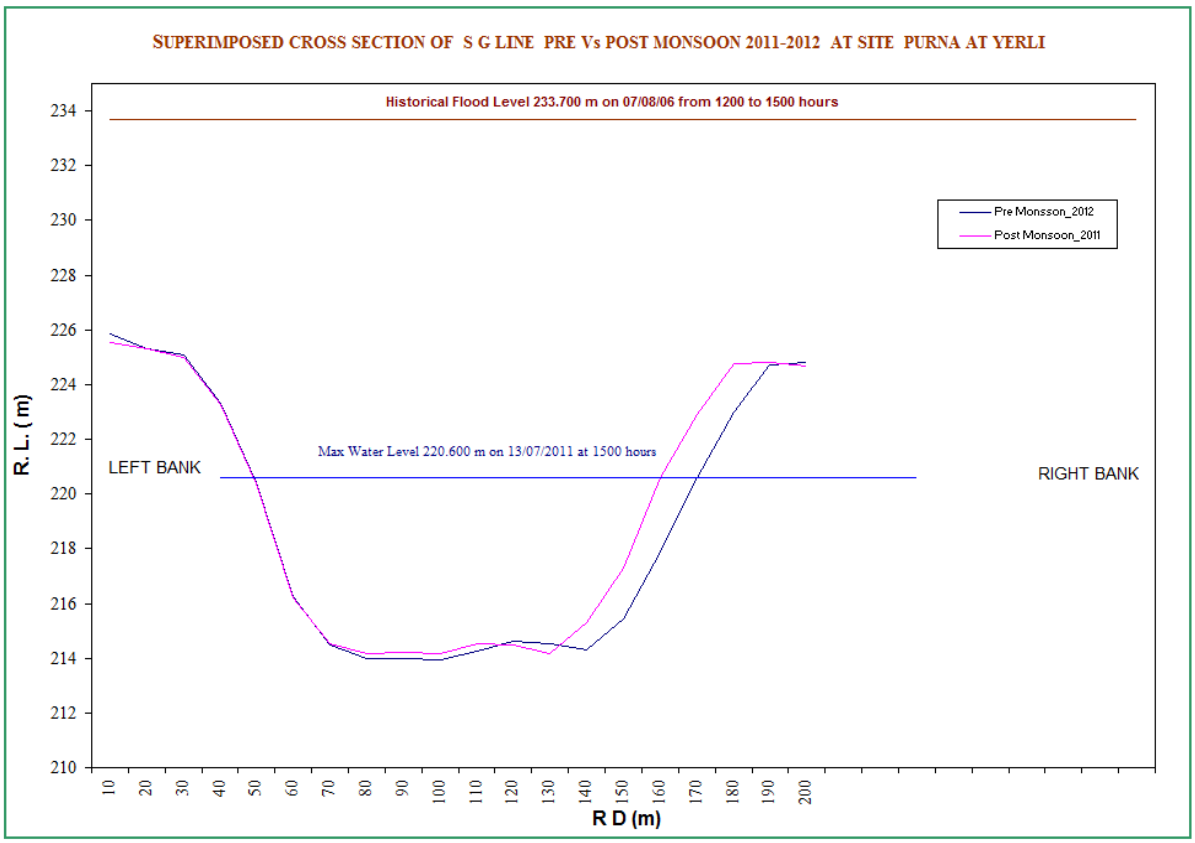
Water Level v/s Time graph of Highest (III) Flood Peak during the water year 2011-2012



3.3.8 Super imposed cross section

Station Name: Purna at Yerli (01 02 17 005) Division: Tapi Division, Surat

Local River: Sub Division: Upper Tapi, Bhusawal



3.4 Gidhade

3.4.1 History Sheet

Site	**:**	**GIDHADE**	**Code**	**:**	**01 02 17 014**
State	:	Maharashtra	District		Dhule
Basin	:	Tapi	Independent River	:	Tapi
Tributary	:	-	Sub Tributary	:	
Sub-Sub Tributary	:		Local River	:	Tapi
Division	:	Tapi Division Surat	Sub-Division	:	Middle Tapi Dhule
Drainage Area	:	54750 sq km	Bank	:	Right
Latitude	:	21°17'45"	Longitude	:	74°48'45"
Zero of Gauge (m)	:	119 (msl)	15/06/1969		
		Opening Date	Closing Date		
Gauge	:	15/06/1969			
Discharge	:	19/06/1990			
Sediment	:				
Water Quality	:	01/09/1990	31/05/2005		

Annual Maximum / Minimum discharge with corresponding Water Level (msl)

	Maximum			Minimum		
Year	**Q (cumec)**	**WL (m)**	**Date**	**Q (cumec)**	**WL (m)**	**Date**
1991-1992	7680	131.300	01/08/1991	0.000	122.100	01/04/1992
1992-1993	4224	129.175	18/08/1992	0.000	River Dry	15/03/1993
1993-1994	8018	132.250	17/07/1993	0.000	River Dry	26/03/1994
1994-1995	15068	136.775	07/09/1994	0.000	River Dry	12/06/1994
1995-1996	4981	130.705	04/09/1995	0.000	River Dry	06/02/1996
1996-1997	2681	127.880	28/07/1996	0.000	River Dry	08/8/1997
1997-1998	4516	130.825	27/07/1997	0.000	River Dry	24/03/1998
1998-1999	17578	137.805	16/09/1998	0.000	River Dry	15/04/1999
1999-2000	6267	131.050	11/08/1999	0.000	River Dry	02/04/2000
2000-2001	2541	126.925	20/07/2000	0.000	River Dry	30/04/2001
2001-2002	5063	130.250	16/08/2001	0.000	River Dry	29/01/2002
2002-2003	7361	132.900	03/09/2002	0.000	River Dry	27/12/2002
2003-2004	4180	129.150	25/08/2003	0.000	River Dry	26/03/2004
2004-2005	3218	129.225	06/08/2004	0.000	River Dry	14/12/2004
2005-2006	3697	128.700	03/08/2005	0.000	River Dry	02/12/2005
2006-2007	20898	141.650	08/08/2006	0.000	River Dry	03/01/2007
2007-2008	10684	135.690	09/07/2007	0.000	121.560	25/06/2007
2008-2009	3670	128.900	06/08/2008	33.270	122.340	26/08/2008
2009-2010	5735	131.190	04/09/2009	0.000	123.350	13/08/2009
2010-2011	4134	129.200	10/09/2010	32.16	122.335	22/07/2010
2011-2012	3639	128.475	30/08/2011	39.62	122.600	14/07/2011

3.4.2 Annual Maximum flood peak

Station Name: Tapi at Gidhade (01 02 17 014) Division: Tapi division Surat
Local River: Sub Division: Middle Tapi Sub Division Dhule

Year	Highest Flood Level (m)	Date	Hour
1970	134.650	20/08/1970	11:00:00
1971	128.200	24/07/1971	22:00:00
1972	135.650	19/08/1972	10:00:00
1973	134.300	28/08/1973	02:00:00
1974	128.750	13/08/1974	21:00:00
1975	130.950	05/09/1975	23:00:00
1976	130.300	04/09/1976	23:00:00
1977	129.275	03/09/1977	21:00:00
1978	138.075	30/08/1978	17:00:00
1979	137.650	11/08/1979	07:00:00
1980	130.860	07/08/1980	09:00:00
1981	134.000	11/08/1981	04:00:00
1982	127.140	20/06/1982	19:00:00
1983	131.020	13/08/1983	13:00:00
1984	133.000	19/08/1984	22:00:00
1985	126.650	03/08/1985	16:00:00
1986	130.450	16/08/1986	09:00:00
1987	126.300	22/08/1987	06:00:00
1988	131.740	04/10/1988	05:00:00
1989	131.640	20/08/1989	03:00:00
1990	135.240	17/08/1990	14:00:00
1991	133.500	01/08/1991	01:00:00
1992	129.580	03/09/1992	19:00:00
1993	132.550	17/07/1993	16:00:00
1994	138.820	07/09/1994	23:00:00
1995	131.150	03/09/1995	23:00:00
1996	128.450	28/07/1996	03:00:00
1997	131.850	27/07/1997	04:00:00
1998	137.890	16/09/1998	12:00:00
1999	132.060	11/08/1999	02:00:00
2000	128.620	13/07/2000	18:00:00
2001	131.510	16/08/2001	16:00:00
2002	133.550	26/08/2002	00:00:00
2003	131.900	24/08/2003	21:00:00
2004	129.450	24/08/2004	03:00:00
2005	129.250	02/08/2005	19:00:00
2006	142.950	07/08/2006	15:00:00
2007	136.240	09/07/2007	16:00:00
2008	131.590	16/10/2008	00:00:00
2009	132.760	03/10/2009	09:00:00
2010	130.000	10/09/2010	10:00:00
2011	132.680	08/10/2011	18:00:00

3.4.3 Summary of Data

Stage Discharge data for the period from June 2011 to May 2012

Station Name: Tapi at Gidhade (01 02 17 014) Division: Tapi division Surat

Local River: Sub Division: Middle Tapi Sub Division Dhule

Day	Jun	Jul	Aug	Sep	Oct	Nov

	W.L	Q		W.L	Q		W.L	Q		W.L	Q		W.L	Q	
1	129.450	0.000	*				123.220	221.8		125.100	1164		129.300	0.000	*	132.840	0.000	*
2	129.430	0.000	*	128.140	0.000	*	123.180	186.7		126.275	1745		130.900	0.000	*	132.820	0.000	*
3	129.400	0.000	*	128.150	0.000	*	123.340	268.9		128.300	3307		131.900	0.000	*	132.820	0.000	*
4	129.380	0.000	*	128.440	0.000	*	123.250	226.4		127.200	2311		131.600	0.000	*	132.820	0.000	*
5	129.360	0.000	*	128.500	0.000	*	123.100	173.6		126.200	1837		131.860	0.000	*	132.820	0.000	*
6	129.340	0.000	*	128.520	0.000	*	123.920	519.1		125.500	1317		132.040	0.000	*	132.800	0.000	*
7	129.320	0.000	*	128.720	0.000	*	123.860	487.3	*	125.430	1274		132.220	0.000	*	132.780	0.000	*
8	129.320	0.000	*	128.450	0.000	*	123.255	226.4		125.200	1136		132.500	0.000	*	132.780	0.000	*
9	129.300	0.000	*	127.800	97.36		124.070	560.3		124.200	675.2		132.500	0.000	*	132.780	0.000	*
10	129.280	0.000	*	127.550	0.000	*	124.260	660.7		124.180	655.0		132.700	0.000	*	132.780	0.000	*
11	129.280	0.000	*	127.000	158.0		123.660	401.5		123.700	417.1	*	132.700	0.000	*	132.760	0.000	*
12	129.260	0.000	*	127.440	192.0		123.660	407.3		123.780	444.2		132.800	0.000	*	132.740	0.000	*
13	129.250	0.000	*	127.000	0.000	*	123.660	396.1		123.280	256.4		132.880	0.000	*	132.700	0.000	*
14	129.240	0.000	*	122.600	39.62		123.000	151.2	*	123.600	368.0		132.860	0.000	*	132.680	0.000	*
15	129.250	0.000	*	124.750	948.6		123.340	271.2	*	123.550	363.5		132.760	0.000	*	132.660	0.000	*
16	129.240	0.000	*	123.275	228.3		124.050	575.5		123.470	340.1		132.760	0.000	*	132.640	0.000	*
17	129.240	0.000	*	122.900	119.9	*	123.500	364.3		123.760	422.8		132.750	0.000	*	132.620	0.000	*
18	129.000	0.000	*	123.200	207.2		123.200	207.8		124.100	598.0	*	132.720	0.000	*	132.600	0.000	*
19	127.250	0.000	*	123.100	172.6		123.200	205.9		124.100	598.9		132.720	0.000	*	132.580	0.000	*
20	126.700	0.000	*	123.520	400.4		123.200	220.5		123.540	368.1		132.760	0.000	*	132.560	0.000	*
21	126.900	0.000	*	123.700	468.2		123.200	219.5	*	123.000	184.9		132.780	0.000	*	132.540	0.000	*
22	127.780	0.000	*	123.750	475.1		123.200	219.5	*	123.200	206.9		132.800	0.000	*	132.520	0.000	*
23	128.050	0.000	*	123.530	346.2		123.800	501.2		123.140	192.6		132.800	0.000	*	132.520	0.000	*
24	128.150	0.000	*	123.400	294.3	*	123.550	375.7		123.080	187.4		132.800	0.000	*	132.500	0.000	*
25	128.360	0.000	*	124.280	745.0		125.200	1252		123.000	151.2	*	132.800	0.000	*	132.500	0.000	*
26	128.480	0.000	*	123.890	510.6		126.350	1859		123.000	183.2		132.860	0.000	*	132.480	0.000	*
27	128.600	0.000	*	123.280	233.4		126.800	2019		122.990	182.6		132.900	0.000	*	132.460	0.000	*
28	128.720	0.000	*	123.240	228.0		128.425	3396		123.100	152.6		132.920	0.000	*	132.440	0.000	*
29	128.460	0.000	*	124.415	785.1		127.400	2389		123.200	155.9		132.940	0.000	*	132.420	0.000	*
30	127.600	0.000	*	123.920	513.5		128.475	3639		126.950	0.000	*	132.940	0.000	*	132.400	0.000	*
31				123.280	248.7	*	125.900	1596	*				132.860	0.000	*			
Ten-Daily Mean																		
I Ten-Daily	129.358	0.000		128.252	10.82		123.545	353.1		125.759	1542		131.752	0.000		132.804	0.000	
II Ten-Daily	128.771	0.000		124.479	246.7		123.447	320.1		123.688	417.7		132.771	0.000		132.654	0.000	
III Ten-Daily	128.110	0.000		123.699	440.7		125.664	1588		123.466	159.7		132.855	0.000		132.478	0.000	
Monthly																		
Min.	126.700	0.000		122.600	0.000		123.000	151.2		122.990	0.000		129.300	0.000		132.400	0.000	
Max.	129.450	0.000		128.720	948.6		128.475	3639		128.300	3307		132.940	0.000		132.840	0.000	
Mean	128.746	0		125.325	247.1		124.265	780.6		124.304	706.5		132.472	0		132.645	0	

Annual Runoff in MCM = 4562 Annual Runoff in mm = 83
Peak Observed Discharge = 3639 cumec on 30/08/2011 Corres. Water Level :128.475 m
Lowest Observed Discharge = 39.62 cumec on 14/07/2011 Corres. Water Level :122.6 m

Note: Stagnation of Water/No flow due to closure of gates of Sulwade Barrage from 01/06/2011 to 08/07/2011 & 30/09/2011 to 31/05/2012. Hence discharge shown as zero on these days.
Q: Observed/Computed Discharge in cumec WL: corresponding Mean Water Level (msl) (m) *: computed discharge #: Discharge Discarded Discharge (value changed as per rating curve)

Stage Discharge data for the period from June 2011 to May 2012

Station Name: Tapi at Gidhade (01 02 17 014) Division: Tapi division Surat
Local River: Sub Division: Middle Tapi Sub Division
Dhule

Day	Dec		Jan		Feb		Mar		Apr		May	
	W.L	Q	WL	Q	WL	Q	WL	Q	WL	Q	WL	Q
1	132.400	0.000 *	131.880	0.000 *	131.620	0.000 *	130.860	0.000 *	130.300	0.000 *	129.760	0.000 *
2	132.380	0.000 *	131.880	0.000 *	131.620	0.000 *	130.850	0.000 *	130.260	0.000 *	129.740	0.000 *
3	132.380	0.000 *	131.860	0.000 *	131.600	0.000 *	130.840	0.000 *	130.240	0.000 *	129.720	0.000 *
4	132.360	0.000 *	131.860	0.000 *	131.580	0.000 *	130.830	0.000 *	130.220	0.000 *	129.700	0.000 *
5	132.340	0.000 *	131.840	0.000 *	131.540	0.000 *	130.820	0.000 *	130.200	0.000 *	129.680	0.000 *
6	132.320	0.000 *	131.840	0.000 *	131.480	0.000 *	130.810	0.000 *	130.180	0.000 *	129.680	0.000 *
7	132.300	0.000 *	131.820	0.000 *	131.420	0.000 *	130.800	0.000 *	130.170	0.000 *	129.660	0.000 *
8	132.280	0.000 *	131.820	0.000 *	131.400	0.000 *	130.780	0.000 *	130.160	0.000 *	129.640	0.000 *
9	132.260	0.000 *	131.820	0.000 *	131.360	0.000 *	130.760	0.000 *	130.150	0.000 *	129.620	0.000 *
10	132.260	0.000 *	131.810	0.000 *	131.340	0.000 *	130.740	0.000 *	130.140	0.000 *	129.600	0.000 *
11	132.240	0.000 *	131.810	0.000 *	131.280	0.000 *	130.720	0.000 *	130.120	0.000 *	129.580	0.000 *
12	132.220	0.000 *	131.800	0.000 *	131.240	0.000 *	130.680	0.000 *	130.100	0.000 *	129.560	0.000 *
13	132.200	0.000 *	131.800	0.000 *	131.180	0.000 *	130.660	0.000 *	130.080	0.000 *	129.550	0.000 *
14	132.180	0.000 *	131.800	0.000 *	131.140	0.000 *	130.640	0.000 *	130.060	0.000 *	129.540	0.000 *
15	132.180	0.000 *	131.800	0.000 *	131.120	0.000 *	130.620	0.000 *	130.040	0.000 *	129.540	0.000 *
16	132.180	0.000 *	131.800	0.000 *	131.100	0.000 *	130.600	0.000 *	130.020	0.000 *	129.520	0.000 *
17	132.160	0.000 *	131.780	0.000 *	131.080	0.000 *	130.580	0.000 *	130.000	0.000 *	129.500	0.000 *
18	132.160	0.000 *	131.780	0.000 *	131.060	0.000 *	130.580	0.000 *	130.000	0.000 *	129.480	0.000 *
19	132.140	0.000 *	131.760	0.000 *	131.040	0.000 *	130.560	0.000 *	129.990	0.000 *	129.460	0.000 *
20	132.140	0.000 *	131.760	0.000 *	131.020	0.000 *	130.520	0.000 *	129.980	0.000 *	129.420	0.000 *
21	131.980	0.000 *	131.750	0.000 *	131.000	0.000 *	130.480	0.000 *	129.960	0.000 *	129.380	0.000 *
22	131.960	0.000 *	131.740	0.000 *	131.000	0.000 *	130.460	0.000 *	129.940	0.000 *	129.360	0.000 *
23	131.960	0.000 *	131.720	0.000 *	130.980	0.000 *	130.440	0.000 *	129.920	0.000 *	129.340	0.000 *
24	131.960	0.000 *	131.720	0.000 *	130.960	0.000 *	130.420	0.000 *	129.900	0.000 *	129.320	0.000 *
25	131.960	0.000 *	131.700	0.000 *	130.940	0.000 *	130.410	0.000 *	129.880	0.000 *	129.300	0.000 *
26	131.940	0.000 *	131.700	0.000 *	130.920	0.000 *	130.400	0.000 *	129.870	0.000 *	129.280	0.000 *
27	131.940	0.000 *	131.680	0.000 *	130.900	0.000 *	130.400	0.000 *	129.860	0.000 *	129.260	0.000 *
28	131.920	0.000 *	131.680	0.000 *	130.900	0.000 *	130.380	0.000 *	129.840	0.000 *	129.200	0.000 *
29	131.900	0.000 *	131.660	0.000 *	130.880	0.000 *	130.360	0.000 *	129.820	0.000 *	129.200	0.000 *
30	131.900	0.000 *	131.640	0.000 *			130.340	0.000 *	129.800	0.000 *	129.160	0.000 *
31	131.880	0.000 *	131.640	0.000 *			130.320	0.000 *			129.120	0.000 *
Ten-Daily Mean												
I Ten-Daily	132.328	0.000	131.843	0.000	131.496	0.000	130.809	0.000	130.202	0.000	129.680	0.000
II Ten-Daily	132.180	0.000	131.789	0.000	131.126	0.000	130.616	0.000	130.039	0.000	129.515	0.000
III Ten-Daily	131.936	0.000	131.694	0.000	130.942	0.000	130.401	0.000	129.879	0.000	129.265	0.000
Monthly												
Min.	131.880	0.000	131.640	0.000	130.880	0.000	130.320	0.000	129.800	0.000	129.120	0.000
Max.	132.400	0.000	131.880	0.000	131.620	0.000	130.860	0.000	130.300	0.000	129.760	0.000
Mean	132.141	0	131.773	0	131.197	0	130.602	0	130.040	0	129.480	0

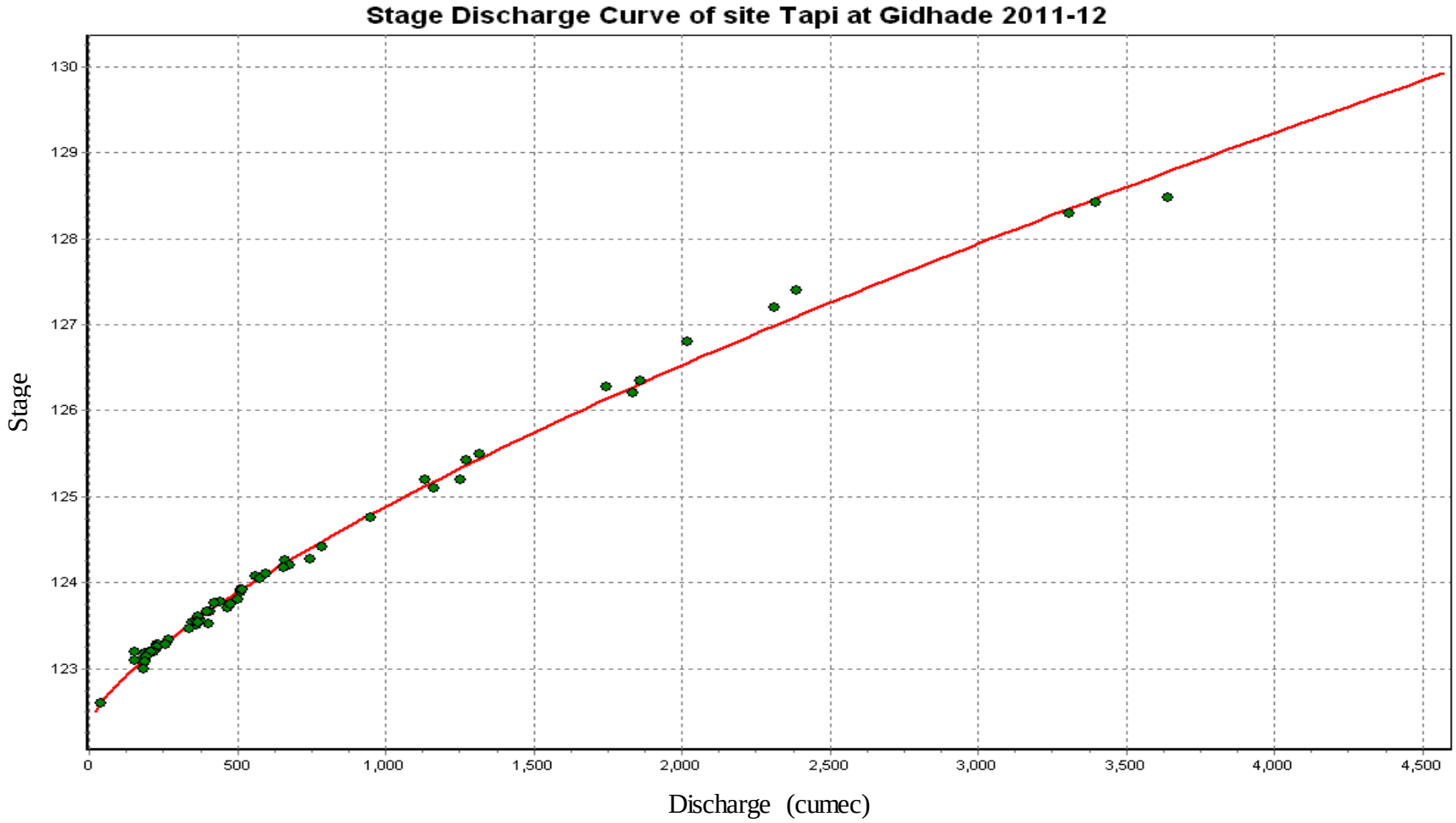
Peak Computed Discharge = 1596 cumec on 31/08/2011 Corres. Water Level :125.9 m
Lowest Computed Discharge = 0.000 cumec on 01/06/2011 Corres. Water Level :129.45 m

Note: Stagnation of Water/No flow due to closure of gates of Sulwade Barrage from 01/06/2011 to 08/07/2011 & 30/09/2011 to 31/05/2012. Hence discharge shown as zero on these days.
Q: Observed/Computed Discharge in cumec WL: corresponding Mean Water Level (msl) (m) *: computed discharge #: Discharge Discarded Discharge (value changed as per rating curve)

3.4.4 Stage discharge curve

Station Name: Tapi at Gidhade (01 02 17 014)
Local River:

Division: Tapi division Surat
Sub Division: Middle Tapi Sub Division Dhule



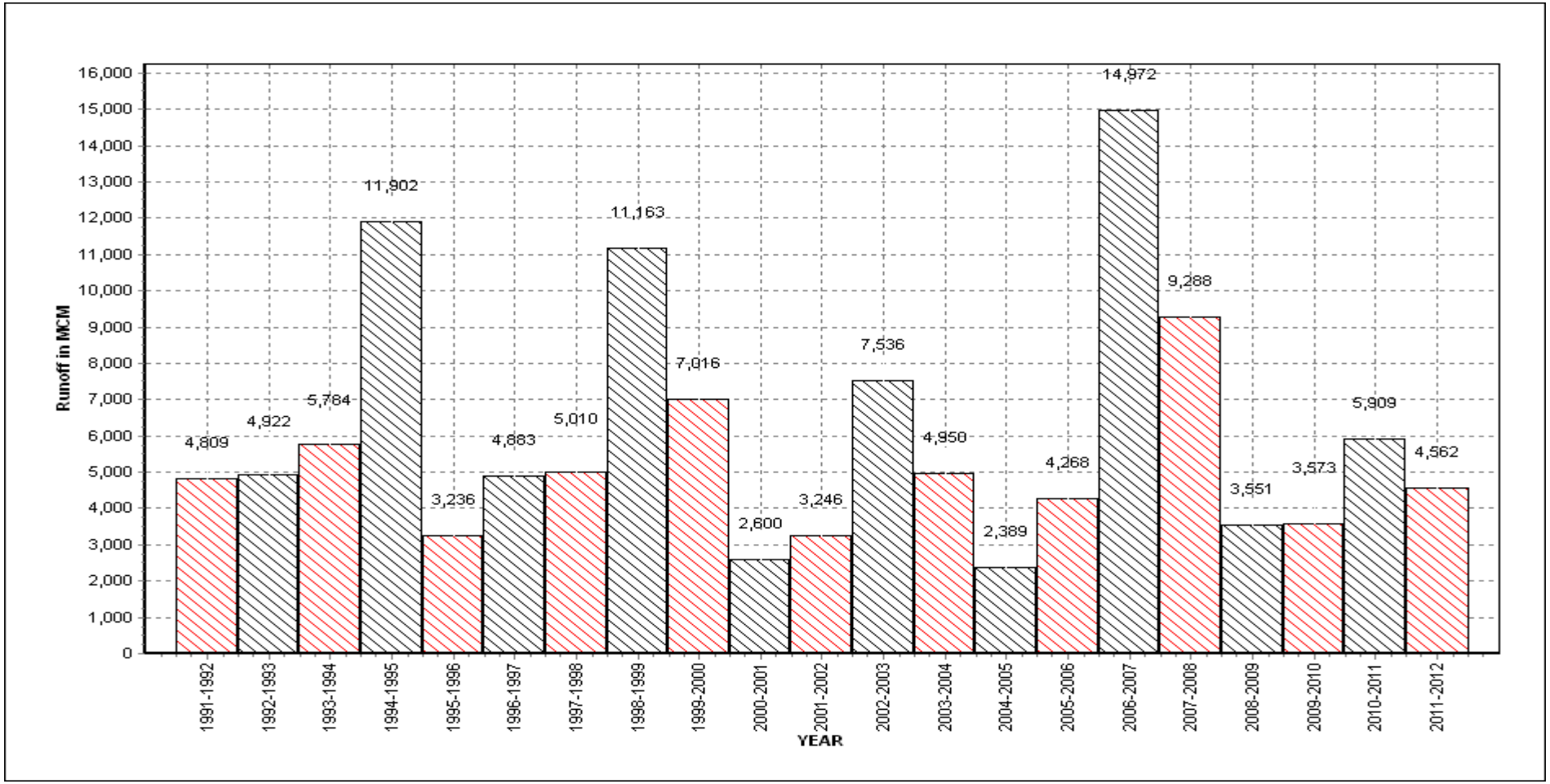
$Q=c*(h+a)^b$	WL : 122 to 130	a= (-)122.350, b=1.388, c=275.019

3.4.5 Annual Runoff

Annual Runoff for the period 1991 to 2012

Station Name: Tapi at Gidhade (01 02 17 014) Division: Tapi Division, Surat

Local River: Sub Division: Middle Tapi, Dhule

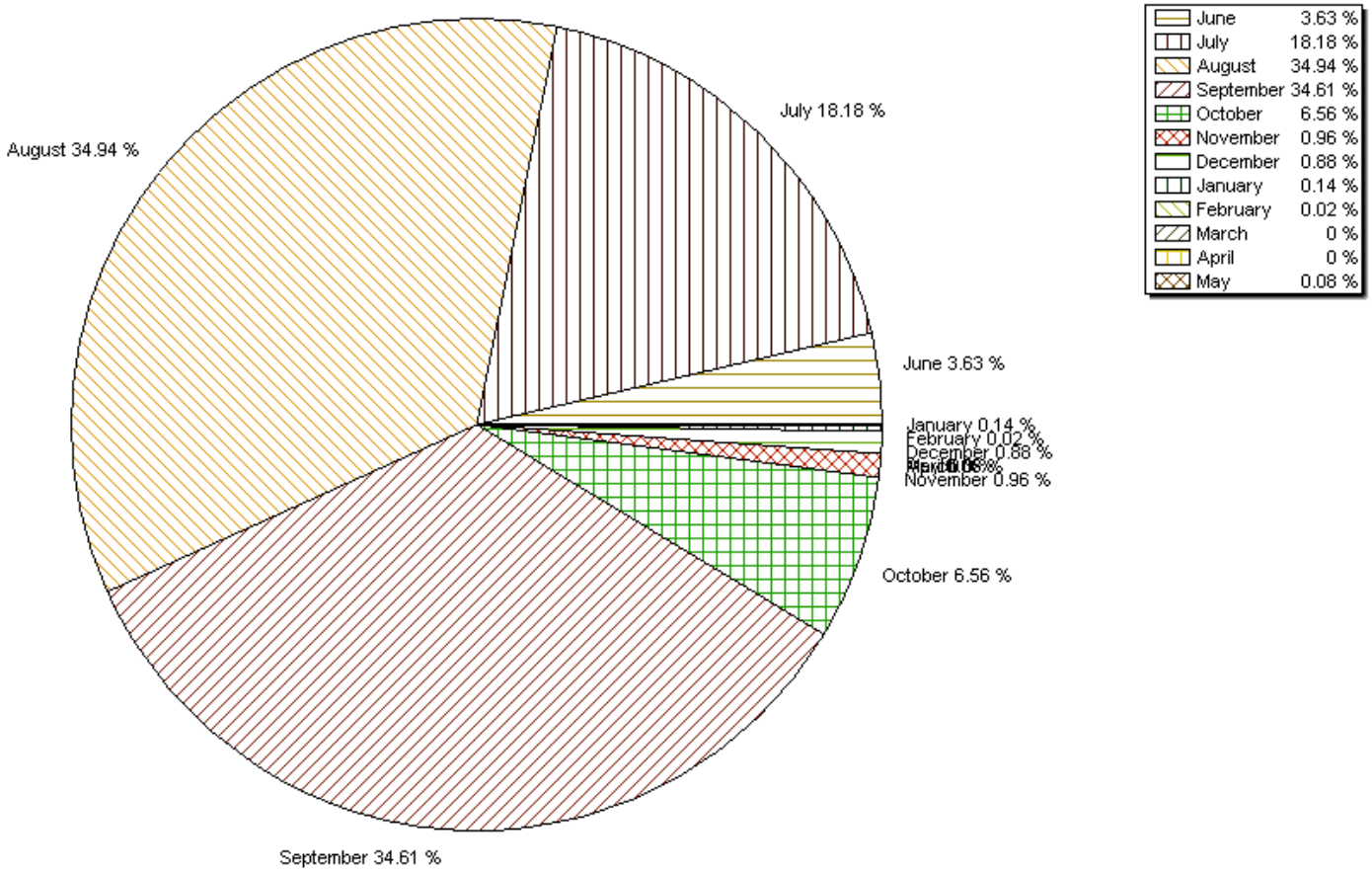


3.4.6 Monthly average Runoff

Monthly average runoff for the year 2011-2012

Station Name: Tapi at Gidhade (01 02 17 014) Division: Tapi Division, Surat

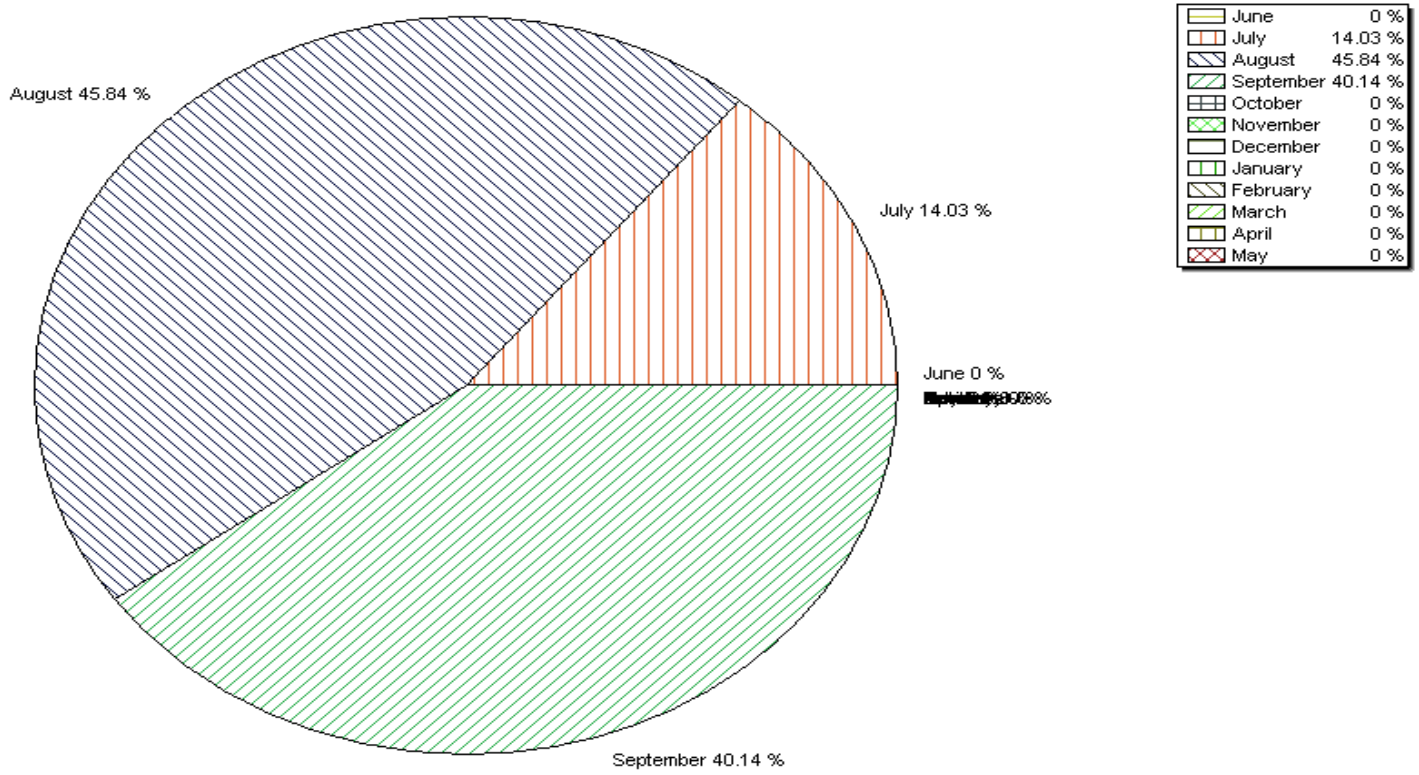
Local River: Sub Division: Middle Tapi, Dhule



Monthly average runoff for the year 2011-2012

Station Name: Tapi at Gidhade (01 02 17 014) Division: Tapi Division, Surat

Local River: Sub Division: Middle Tapi, Dhule

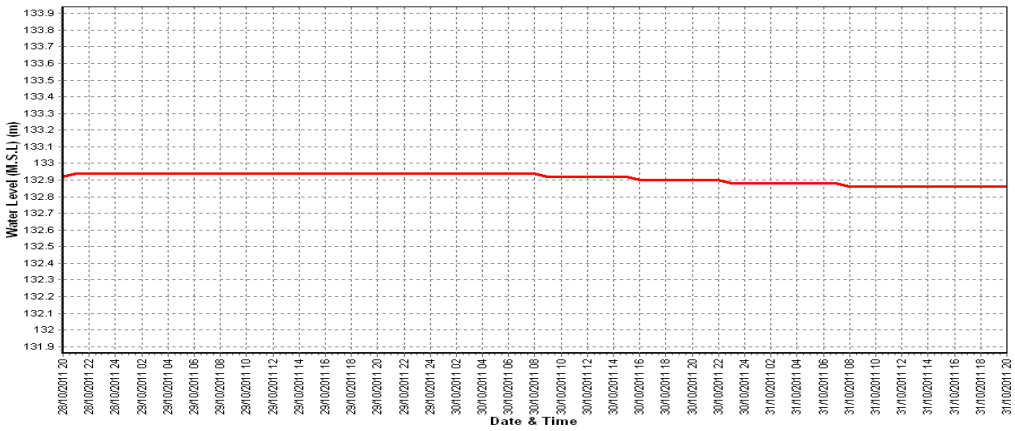


3.4.7 WL vs Time Graph of I,II,III peak

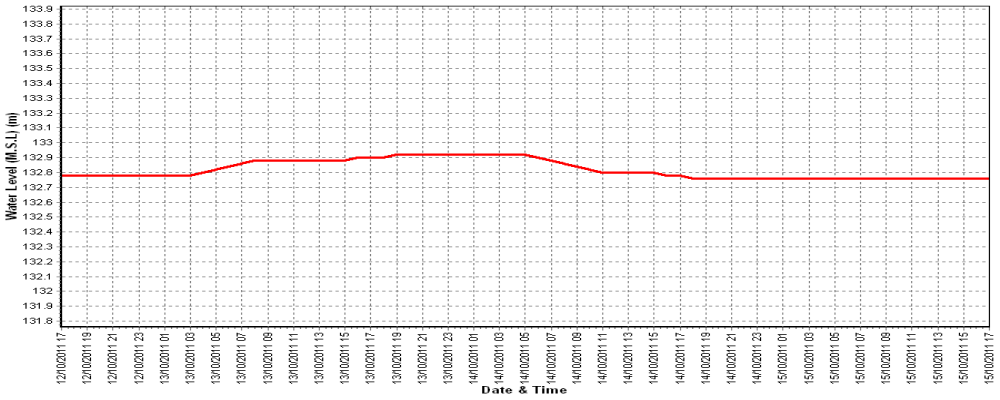
Station Name: Tapi at Gidhade (01 02 17 014) Division: Tapi Division, Surat

Local River: Sub Division: Middle Tapi, Dhule

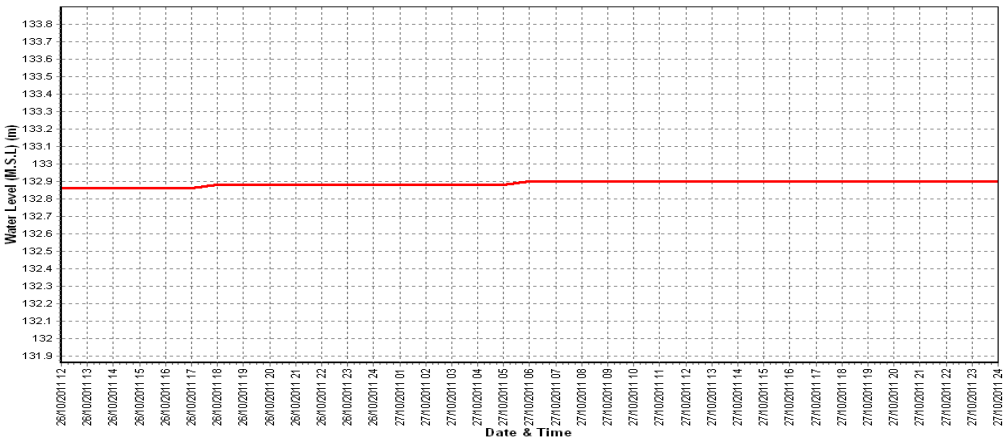
Water Level v/s Time graph of Highest (I) Flood Peak during the water year 2011-2012



Water Level v/s Time graph of Highest (II) Flood Peak during the water year 2011-2012



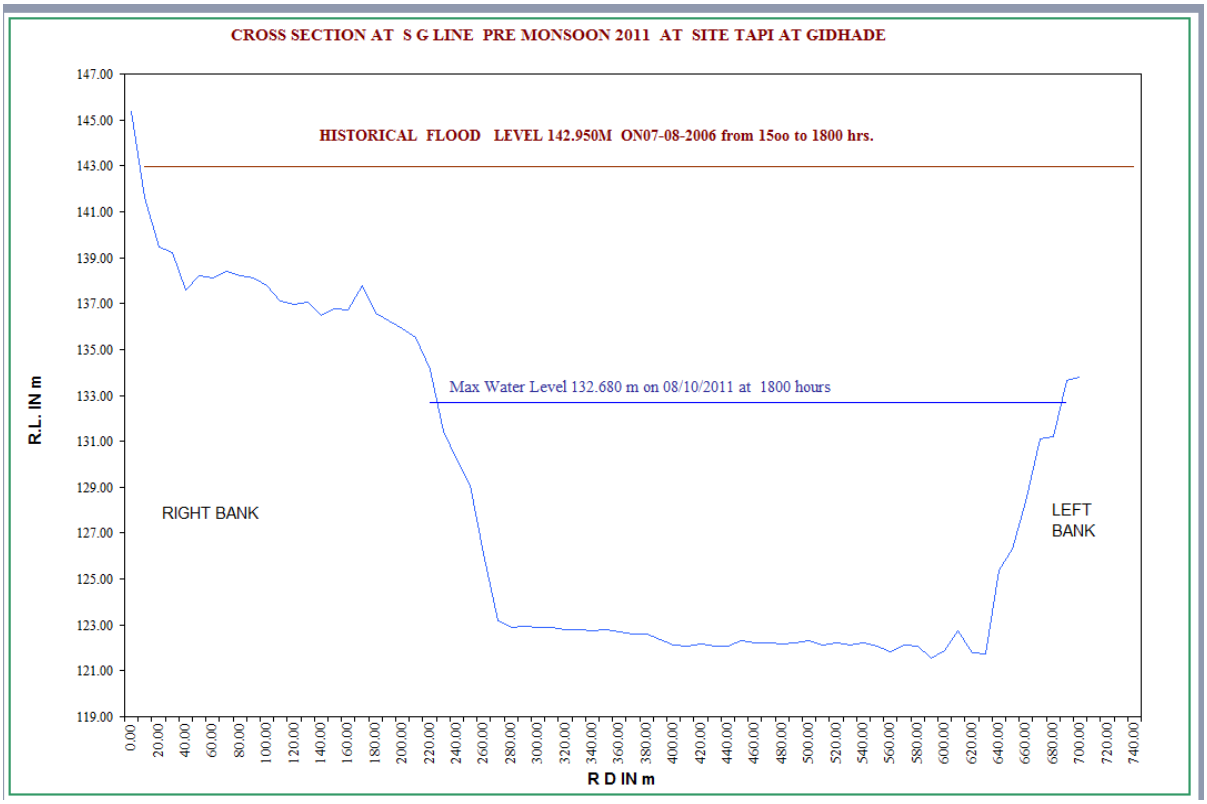
Water Level v/s Time graph of Highest (III) Flood Peak during the water year 2011-2012



3.4.7 Super imposed cross section

Station Name: Tapi at Gidhade (01 02 17 014) Division: Tapi Division, Surat

Local River: Sub Division: Middle Tapi, Dhule



3.5 Sarangkheda

3.5.1 History Sheet

Site	**:**	**SARANGKHEDA**	**Code**	**:**	**01 02 17 015**
State	:	Maharashtra	District		Nandurbar
Basin	:	Tapi	Independent River	:	Tapi
Tributary	:	-	Sub Tributary	:	
Sub-Sub Tributary	:		Local River	:	Tapi
Division	:	Tapi Division Surat	Sub-Division	:	Middle Tapi Dhule
Drainage Area	:	58400 sq km	Bank	:	Right
Latitude	:	21°25'55"	Longitude	:	74°31'37"
Zero of Gauge (m)	:	108 (msl)	21/09/1971		
		Opening Date	Closing Date		
Gauge	:	29/07/1976			
Discharge	:	19/10/1977			
Sediment	:	13/07/1984			
Water Quality	:	01/01/1980			

Annual Maximum / Minimum discharge with corresponding Water Level (msl)

	Maximum			Minimum		
Year	**Q (cumec)**	**WL (m)**	**Date**	**Q (cumec)**	**WL (m)**	**Date**
1977-1978	600.0	111.610	27/11/1977	0.000	109.400	08/07/1977
1978-1979	13819	121.500	30/08/1978	6.400	109.450	01/06/1978
1979-1980	15000	122.725	11/08/1979	5.000	109.795	03/06/1979
1980-1981	5403	117.010	07/08/1980	5.500	109.730	19/05/1981
1981-1982	11375	119.985	11/08/1981	5.400	109.760	16/06/1981
1982-1983	1714	113.498	21/06/1982	2.500	109.570	22/05/1983
1983-1984	9493	117.135	13/08/1983	2.700	109.570	04/06/1983
1984-1985	13750	118.600	20/08/1984	0.700	109.530	07/10/1984
1985-1986	1820	113.570	04/08/1985	1.400	109.615	24/02/1986
1986-1987	7026	117.395	16/08/1986	0.300	109.480	31/05/1987
1987-1988	1604	113.270	22/08/1987	0.000	109.280	03/05/1988
1988-1989	10521	118.145	04/10/1988	0.000	109.280	11/06/1988
1989-1990	9300	118.055	20/08/1989	0.000	River Dry	24/03/1990
1990-1991	11838	120.060	17/08/1990	0.000	River Dry	23/03/1991
1991-1992	7986	118.485	01/08/1991	0.000	River Dry	29/10/1991
1992-1993	5244	116.000	18/08/1992	0.000	River Dry	10/02/1993
1993-1994	8462	118.060	17/07/1993	0.000	River Dry	05/03/1994
1994-1995	15626	122.575	07/09/1994	0.000	River Dry	01/04/1995

1995-1996	6156	117.530	04/09/1995	0.000	River Dry	26/01/1996
1996-1997	3510	114.810	28/07/1996	0.000	River Dry	29/06/1996
1997-1998	7174	117.970	27/07/1997	0.000	River Dry	24/02/1998
1998-1999	21292	123.030	16/09/1998	0.000	River Dry	22/04/1999
1999-2000	6300	118.100	11/08/1999	0.000	River Dry	05/03/2000
2000-2001	3435	114.900	14/07/2000	0.000	River Dry	01/01/2001
2001-2002	4076	115.800	17/08/2001	0.000	River Dry	23/02/2002
2002-2003	9000	119.000	26/08/2002	0.000	River Dry	13/02/2003
2003-2004	7564	117.400	25/08/2003	0.000	River Dry	30/04/2004
2004-2005	5909	115.970	24/08/2004	0.000	River Dry	24/02/2005
2005-2006	4458	116.050	03/08/2005	0.000	River Dry	30/11/2005
2006-2007	23044	126.000	08/08/2006	0.160	109.330	30/01/2007
2007-2008	11827	121.000	09/07/2007	0.000	109.680	03/01/2008
2008-2009	3406	114.900	06/08/2008	0.000	River Dry	05/09/2008
2009-2010	3942	114.850	24/07/2009	0.000	River Dry	01/06/2009
2010-2011	4876	116.450	10/09/2010	7.400	109.900	22/07/2010
2011-2012	4404	116.100	20/06/2011	123.9	110.650	20/06/2011

Q: Observed/computed discharge WL: corresponding discharge

3.5.2 Annual Maximum flood peak

Station Name: Tapi at Sarangkheda (01 02 17 015) Division: Tapi division Surat
Local River: Sub Division: Middle Tapi Dhule

Year	Highest Flood Level (m)	Date	Hour
1977	111.910	27/11/1977	18:00:00
1978	123.340	30/08/1978	22:00:00
1979	122.800	11/08/1979	10:00:00
1980	117.420	07/08/1980	16:00:00
1981	120.000	11/08/1981	09:00:00
1982	114.370	21/06/1982	01:00:00
1983	117.370	13/08/1983	17:00:00
1984	119.120	20/08/1984	03:00:00
1985	114.115	28/06/1985	21:00:00
1986	117.830	16/08/1986	13:00:00
1987	113.510	22/08/1987	11:00:00
1988	118.160	04/10/1988	09:00:00
1989	118.340	20/08/1989	06:00:00
1990	120.700	17/08/1990	17:00:00
1991	119.440	01/08/1991	05:00:00
1992	116.200	03/09/1992	22:00:00
1993	118.730	17/07/1993	18:00:00
1994	123.640	08/09/1994	03:00:00
1995	117.800	03/09/1995	23:00:00
1996	115.070	28/07/1996	17:00:00
1997	118.050	27/07/1997	07:00:00
1998	123.640	16/09/1998	18:00:00
1999	118.280	11/08/1999	00:00:00
2000	115.550	13/07/2000	23:00:00
2001	117.700	16/08/2001	22:00:00
2002	119.900	26/08/2002	04:00:00
2003	118.300	25/08/2003	00:00:00
2004	116.350	06/08/2004	15:00:00
2005	116.300	03/08/2005	03:00:00
2006	127.080	08/08/2006	02:00:00
2007	121.800	09/07/2007	19:00:00
2008	115.650	06/08/2008	14:00:00
2009	117.000	06/09/2009	03:00:00
2010	116.800	10/09/2010	05:00:00
2011	116.400	28/08/2011	08:00:00

3.5.3 Summary of Data

Stage Discharge data for the period from June 2011 to May 2012

Station Name: Tapi at Sarangkheda (01 02 17 015) Division: Tapi division Surat

Local River: Sub Division: Middle Tapi Dhule

Day	Jun			Jul			Aug			Sep			Oct			Nov		
	W.L	Q		W.L	Q		W.L	Q		W.L	Q		W.L	Q		W.L	Q	
1	110.150	0.000	*	110.300	16.60	*	110.950	319.5		112.850	1766		112.100	0.000	*	111.800	0.000	*
2	110.150	0.000	*	110.300	16.60	*	111.050	322.9		113.350	2355		112.100	0.000	*	111.800	0.000	*
3	110.150	0.000	*	110.150	0.000	*	111.000	318.2		115.100	3342		112.100	0.000	*	111.750	0.000	*
4	110.150	0.000	*	110.150	0.000	*	111.100	338.6		114.750	3164	*	112.200	0.000	*	111.750	0.000	*
5	110.150	0.000	*	110.150	0.000	*	110.850	282.3		113.900	2734		112.050	0.000	*	111.700	0.000	*
6	110.150	0.000	*	110.150	0.000	*	111.400	556.2		113.200	2028		112.050	0.000	*	111.700	0.000	*
7	110.150	0.000	*	110.500	79.55	*	111.650	680.0	*	113.150	1875		112.050	0.000	*	111.650	0.000	*
8	110.150	0.000	*	111.050	349.1		111.100	362.7		112.975	1792		112.050	0.000	*	111.650	0.000	*
9	110.150	0.000	*	111.050	305.9		111.800	754.3		112.000	917.6		112.000	0.000	*	111.650	0.000	*
10	110.150	0.000	*	111.350	497.4	*	112.150	987.6		111.900	807.0		112.000	0.000	*	111.600	0.000	*
11	110.150	0.000	*	111.200	387.7		111.400	535.2		111.500	586.9	*	111.950	0.000	*	111.600	0.000	*
12	110.150	0.000	*	110.600	131.9		111.350	534.8		111.500	599.1		111.950	0.000	*	111.600	0.000	*
13	110.150	0.000	*	110.750	202.8		111.350	535.3		111.300	505.1		111.950	0.000	*	111.550	0.000	*
14	110.150	0.000	*	110.800	176.9		111.350	497.4	*	111.300	502.4		111.900	0.000	*	111.550	0.000	*
15	110.150	0.000	*	113.100	1409		110.950	278.9	*	111.200	408.6		111.950	0.000	*	111.550	0.000	*
16	110.150	0.000	*	111.400	474.1		112.150	969.5		111.200	399.3		112.100	0.000	*	111.500	0.000	*
17	110.150	0.000	*	111.300	468.4	*	111.350	532.0		111.400	511.0		112.100	0.000	*	111.500	0.000	*
18	110.775	183.7		111.250	428.4		111.000	319.8		111.850	809.4	*	112.100	0.000	*	111.500	0.000	*
19	111.000	304.4	*	111.000	320.6		111.000	327.0		111.850	800.3		112.100	0.000	*	111.450	0.000	*
20	110.650	123.9		111.300	432.9		111.000	330.1		111.450	557.2		112.100	0.000	*	111.450	0.000	*
21	110.200	0.000	*	111.300	433.8		111.100	357.0	*	110.950	322.0		112.050	0.000	*	111.450	0.000	*
22	110.200	0.000	*	111.700	696.1		111.000	304.4	*	111.500	545.0		112.000	0.000	*	111.450	0.000	*
23	110.200	0.000	*	111.300	429.2		111.400	545.3		111.950	326.5		112.000	0.000	*	111.400	0.000	*
24	110.200	0.000	*	111.200	411.8	*	111.150	392.6		111.750	241.7		111.950	0.000	*	111.400	0.000	*
25	110.200	0.000	*	111.800	687.9		112.300	1292		112.100	0.000	*	111.950	0.000	*	111.400	0.000	*
26	110.200	0.000	*	111.900	788.3		113.050	1907		112.100	0.000	*	111.900	0.000	*	111.350	0.000	*
27	110.200	0.000	*	111.100	358.8		113.900	2757		112.100	0.000	*	111.900	0.000	*	111.350	0.000	*
28	110.200	0.000	*	111.000	322.8		116.100	4404		112.100	0.000	*	111.850	0.000	*	111.350	0.000	*
29	110.300	16.60	*	111.600	667.4		115.650	3736		112.100	0.000	*	111.850	0.000	*	111.300	0.000	*
30	110.300	16.60	*	111.950	874.0		115.100	3416		112.100	0.000	*	111.800	0.000	*	111.300	0.000	*
31				111.200	411.8	*	114.100	2573	*				111.800	0.000	*			
Ten-Daily Mean																		
I Ten-Daily	110.150	0.000		110.515	126.5		111.305	492.2		113.318	2078		112.070	0.000		111.705	0.000	
II Ten-Daily	110.348	61.19		111.270	443.3		111.290	486.0		111.455	567.9		112.020	0.000		111.525	0.000	
III Ten-Daily	110.220	3.321		111.459	552.9		113.168	1971		111.875	143.5		111.914	0.000		111.375	0.000	
Monthly																		
Min.	110.150	0.000		110.150	0.000		110.850	278.9		110.950	0.000		111.800	0.000		111.300	0.000	
Max.	111.000	304.4		113.100	1409		116.100	4404		115.100	3342		112.200	0.000		111.800	0.000	
Mean	110.239	21.5		111.094	380		111.961	1015		112.216	929.9		111.998	0		111.535	0	

Annual Runoff in MCM = 6202 **Annual Runoff in mm = 106**

Peak Observed Discharge = 4404 cumec on 28/08/2011 **Corres. Water Level :116.1 m**

Lowest Observed Discharge = 123.9 cumec on 20/06/2011 **Corres. Water Level :110.65 m**

Note: Stagnation of Water/No flow due to closure of gates of Sarangkheda Barrage from 01/06/2011 to 06/07/2011 & 25/09/2011 to 31/05/2012. Hence discharge shown as zero on these days.

Q: Observed/Computed Discharge in cumec WL: corresponding Mean Water Level (msl) (m) *: computed discharge #: Discharge Discarded Discharge (value changed as per rating curve)

Stage Discharge data for the period from June 2011 to May 2012

Station Name: Tapi at Sarangkheda (01 02 17 015) Division: Tapi division Surat

Local River: Sub Division: Middle Tapi Dhule

Day	Dec			Jan			Feb			Mar			Apr			May		
	W.L	Q		WL	Q		WL	Q		WL	Q		WL	Q		WL	Q	
1	113.300	0.000	*	110.800	0.000	*	110.300	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
2	113.250	0.000	*	110.800	0.000	*	110.300	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
3	113.250	0.000	*	110.750	0.000	*	110.300	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
4	113.250	0.000	*	110.750	0.000	*	110.250	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
5	113.250	0.000	*	110.750	0.000	*	110.250	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
6	113.250	0.000	*	110.750	0.000	*	110.250	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
7	112.200	0.000	*	110.700	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
8	112.200	0.000	*	110.700	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
9	112.200	0.000	*	110.700	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
10	112.200	0.000	*	110.650	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
11	111.150	0.000	*	110.650	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
12	111.150	0.000	*	110.650	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
13	111.100	0.000	*	110.600	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
14	111.100	0.000	*	110.600	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
15	111.050	0.000	*	110.600	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
16	111.050	0.000	*	110.600	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
17	111.050	0.000	*	110.550	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
18	111.000	0.000	*	110.550	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
19	111.000	0.000	*	110.500	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
20	111.000	0.000	*	110.450	0.000	*	110.200	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
21	111.000	0.000	*	110.450	0.000	*	110.150	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
22	110.950	0.000	*	110.450	0.000	*	110.150	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
23	110.950	0.000	*	110.450	0.000	*	110.100	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
24	110.950	0.000	*	110.450	0.000	*	110.100	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
25	110.900	0.000	*	110.400	0.000	*	110.050	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
26	110.900	0.000	*	110.400	0.000	*	110.050	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
27	110.900	0.000	*	110.400	0.000	*	110.050	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
28	110.850	0.000	*	110.350	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
29	110.850	0.000	*	110.350	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
30	110.800	0.000	*	110.350	0.000	*				110.000	0.000	*	110.000	0.000	*	110.000	0.000	*
31	110.800	0.000	*	110.350	0.000	*				110.000	0.000	*				110.000	0.000	*
Ten-Daily Mean																		
I Ten-Daily	112.835	0.000		110.735	0.000		110.245	0.000		110.000	0.000		110.000	0.000		110.000	0.000	
II Ten-Daily	111.065	0.000		110.575	0.000		110.200	0.000		110.000	0.000		110.000	0.000		110.000	0.000	
III Ten-Daily	110.895	0.000		110.400	0.000		110.072	0.000		110.000	0.000		110.000	0.000		110.000	0.000	
Monthly																		
Min.	110.800	0.000		110.350	0.000		110.000	0.000		110.000	0.000		110.000	0.000		110.000	0.000	
Max.	113.300	0.000		110.800	0.000		110.300	0.000		110.000	0.000		110.000	0.000		110.000	0.000	
Mean	111.576	0		110.565	0		110.176	0		110.000	0		110.000	0		110.000	0	

Peak Computed Discharge = 3164 cumec on 04/09/2011 **Corres. Water Level :114.75 m**

Lowest Computed Discharge = 0.000 cumec on 01/06/2011 **Corres. Water Level :110.15 m**

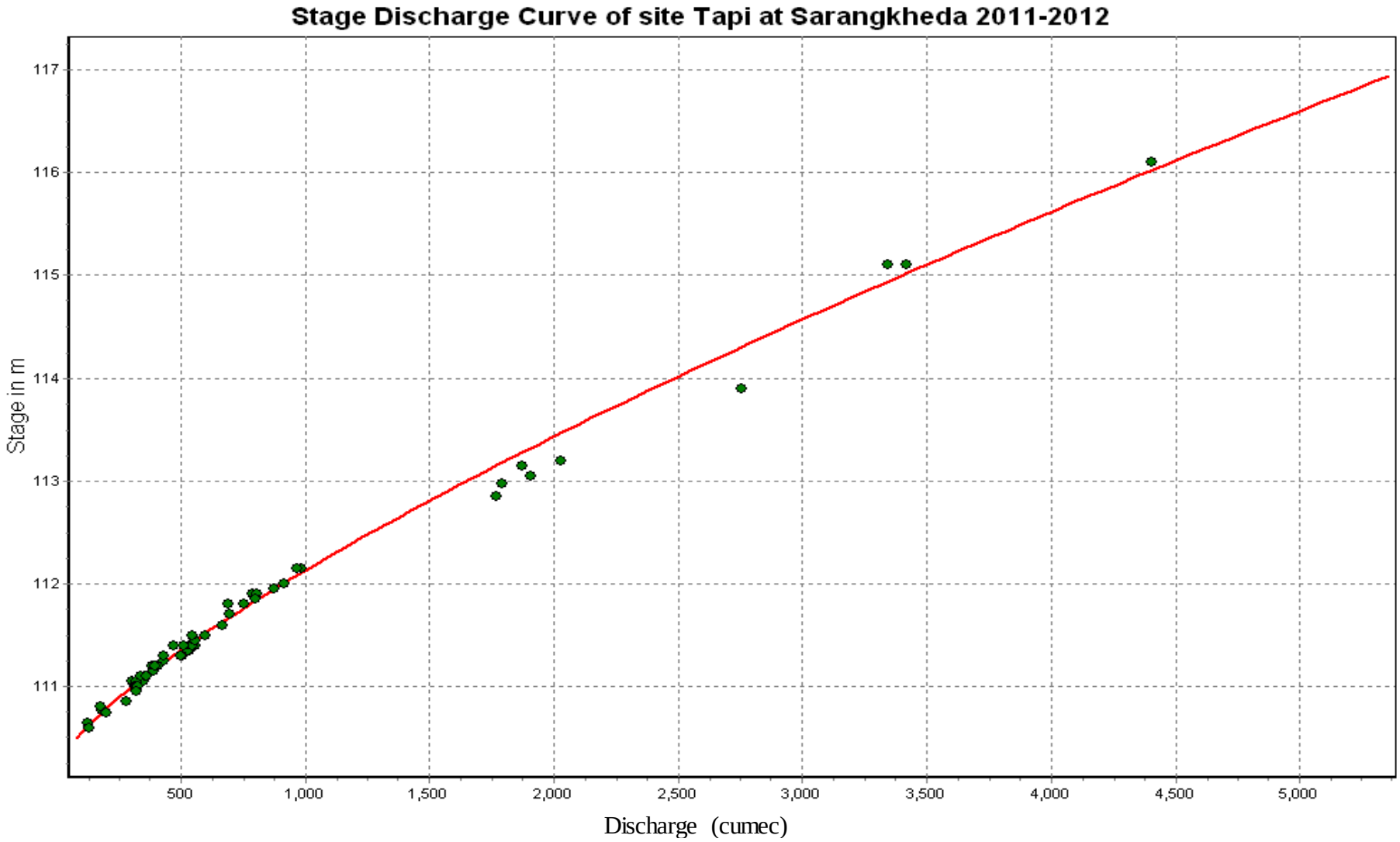
Note: Stagnation of Water/No flow due to closure of gates of Sarangkheda Barrage from 01/06/2011 to 06/07/2011 & 25/09/2011 to 31/05/2012. Hence discharge shown as zero on these days.

Q: Observed/Computed Discharge in cumec WL: corresponding Mean Water Level (msl) (m) *: computed discharge #: Discharge Discarded Discharge (value changed as per rating curve)

3.5.4 Stage Discharge Curve

Station Name: Tapi at Sarangkheda(01 02 17 015) Division: Tapi Division, Surat

Local River: Sub Division: Middle Tapi, Dhule



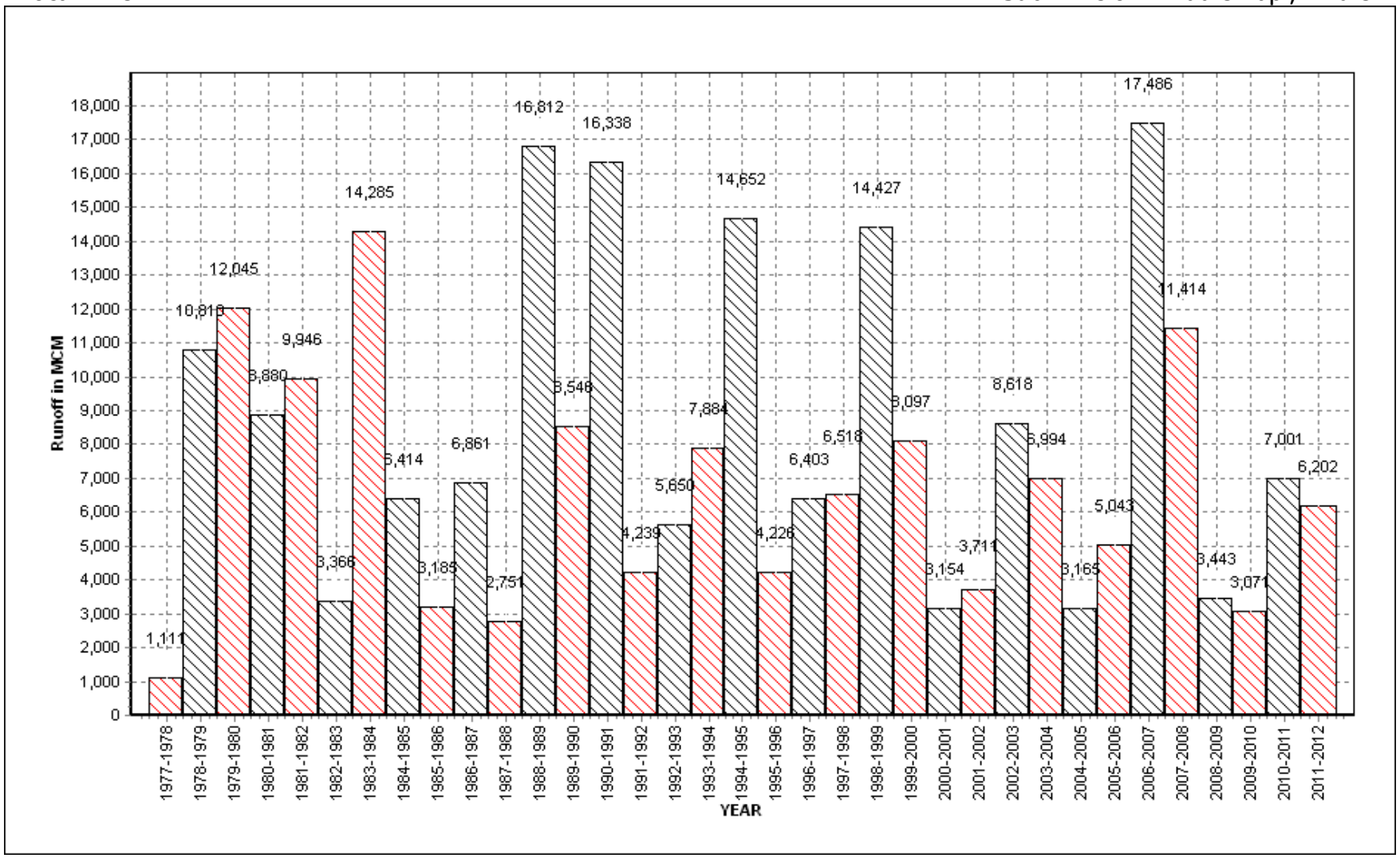
$Q=c*(h+a)^b$	WL : 110 to 1117	a= (-)110.210, b=1.339, c=417.329

3.5.5 Annual runoff

Annual Runoff for the period 1977-2012

Station Name: Tapi at Sarangkheda(01 02 17 015) Division: Tapi Division, Surat

Local River: Sub Division: Middle Tapi, Dhule

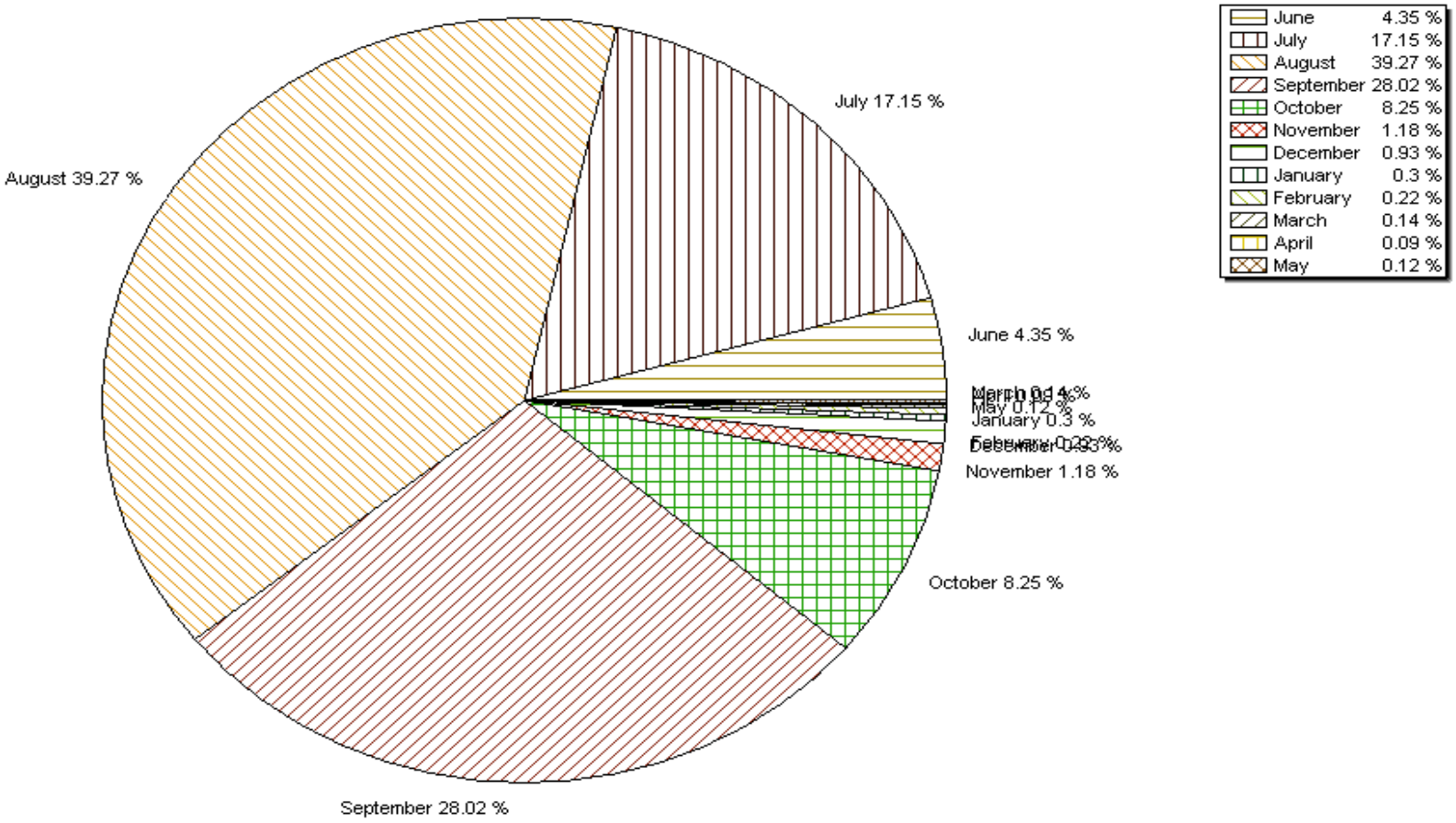


3.5.6 Monthly Average Runoff

Monthly average runoff Based on period 1977-2012

Station Name: Tapi at Sarangkheda(01 02 17 015) Division: Tapi Division, Surat

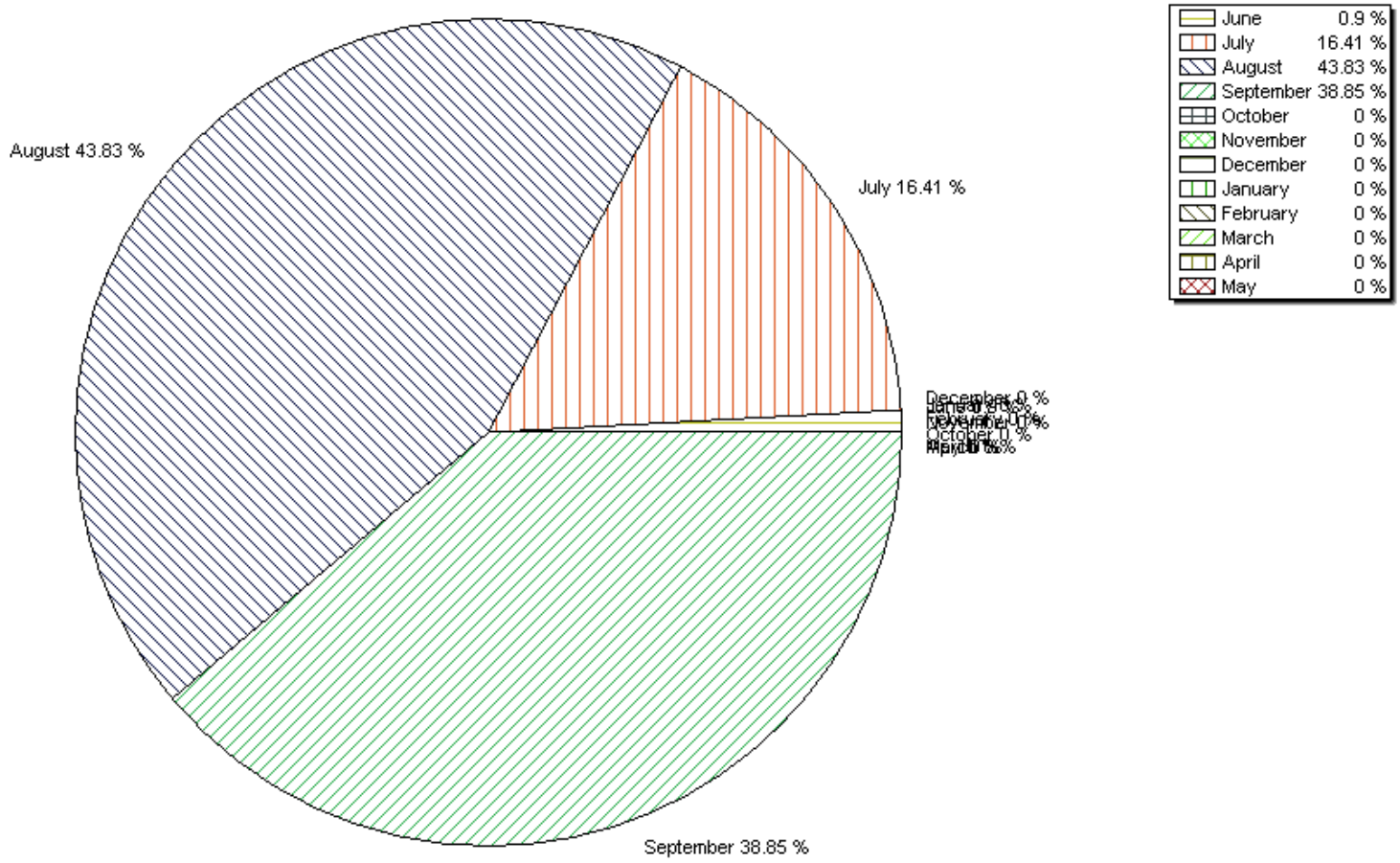
Local River: Sub Division: Middle Tapi, Dhule



Monthly average runoff Based on period 1977-2012

Station Name: Tapi at Sarangkheda(01 02 17 015) Division: Tapi Division, Surat

Local River: Sub Division: Middle Tapi, Dhule

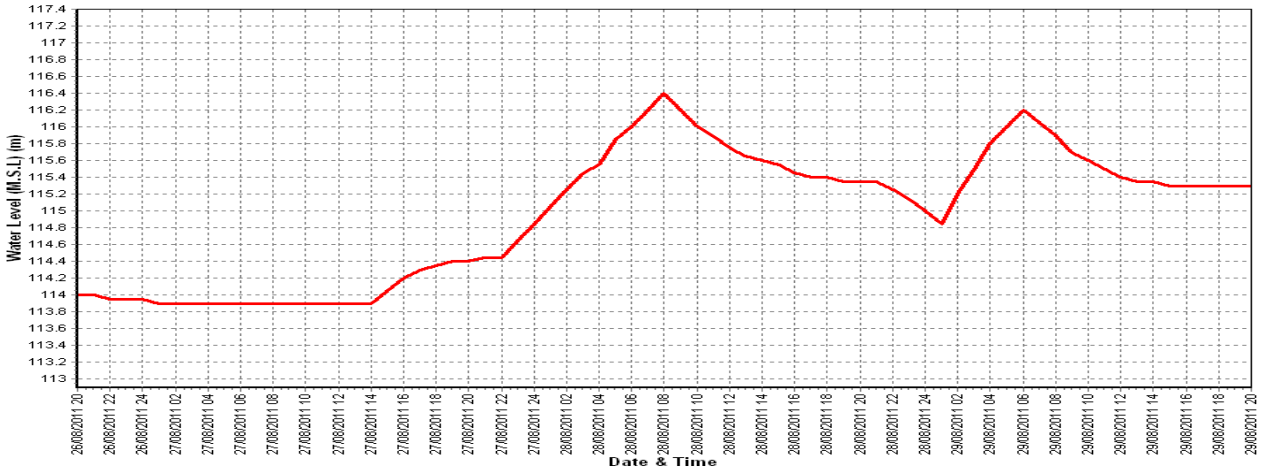


3.5.7 WL vs Time Graph of I,II,III peak

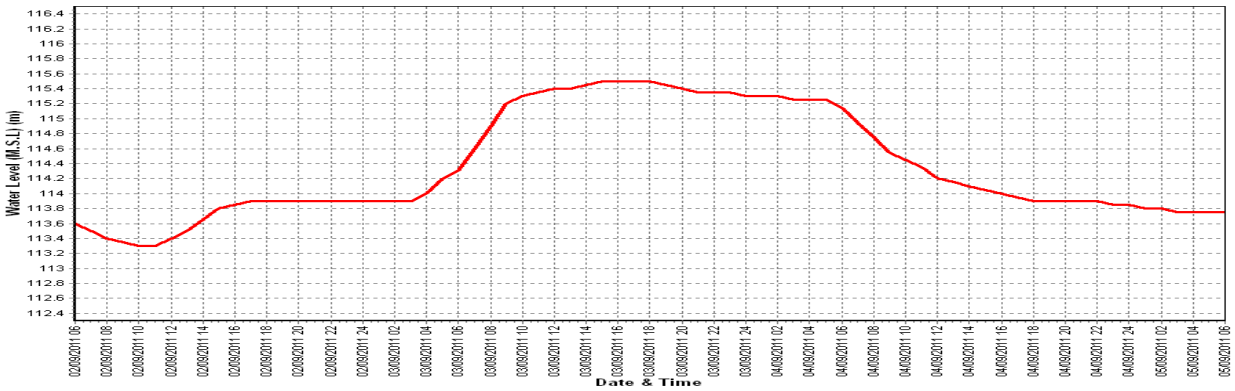
Station Name: Tapi at Sarangkheda(01 02 17 015) Division: Tapi Division, Surat

Local River: Sub Division: Middle Tapi, Dhule

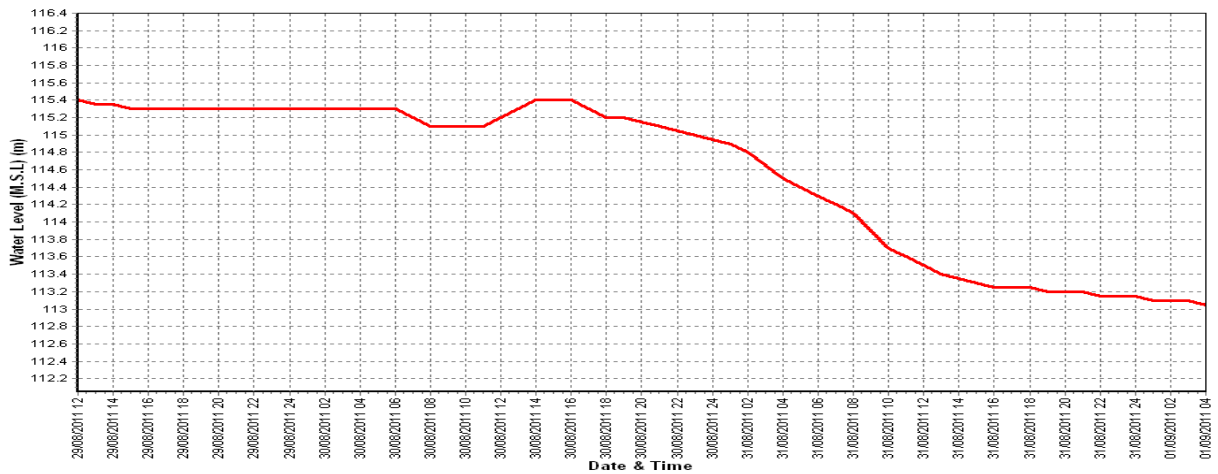
Water Level v/s Time graph of Highest (I) Flood Peak during the water year 2011-2012



Water Level v/s Time graph of Highest (II) Flood Peak during the water year 2011-2012



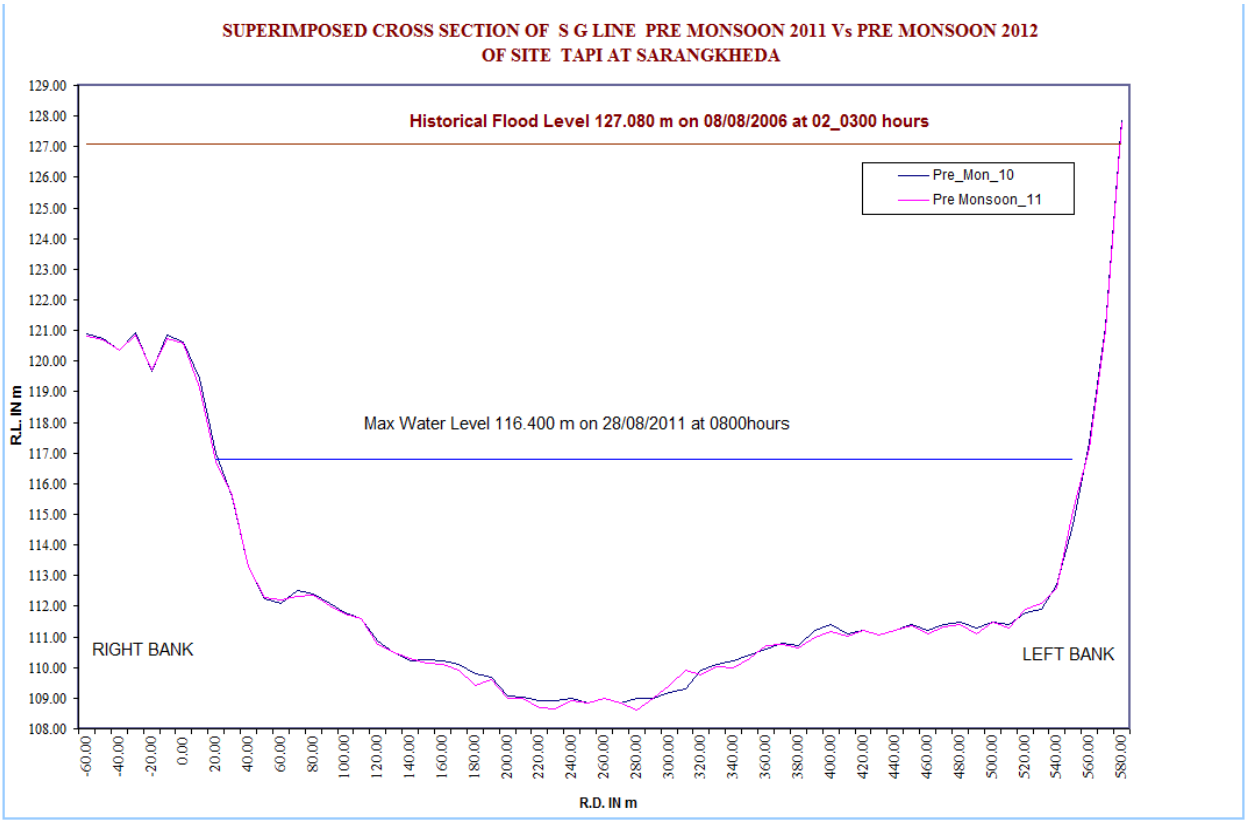
Water Level v/s Time graph of Highest (III) Flood Peak during the water year 2011-2012



3.5.8 Super imposed cross section

Station Name: Tapi at Sarangkheda(01 02 17 015) Division: Tapi Division, Surat

Local River: Sub Division: Middle Tapi, Dhule



Chapter-4

Trend Analysis

4.1 Introduction

Trends are important indicators of the temporal variability of runoff as computed from observed discharge at site. By analyzing the time sequence of the runoff, we assess the magnitude and significance of the temporal variability. The present surface runoff trend study involves analysis of the temporal variability of data sets on the observed discharges in Tapi basin using available data of existing river gauging stations.

4.2 Methodology

In the analysis of the trends of runoff on Tapi River and its major tributary Purna, average annual runoff is computed and analysed. The analysis is carried out for five (5) river gauging stations with sufficiently long and continuous data sets that are fairly representatively distributed across Tapi river Basin.

Overall five stations have been considered in this study. The length of the data sets of river gauging station varies from 21 to 39 years. Subsequently, time series are analysed on various statistical parameters, fitting of mathematical equations, observing moving means for various period so as to find out if there are any trends in the average annual runoff data.

4.2.1 Time series analysis

Time series is defined as a sequence of values arrayed in order of their occurrence which can be characterized by statistical properties. Time series analysis may be used to test the variability, homogeneity and trend of a stream flow series or simply to give an upright list the characteristics of the series as graphically displayed. Significant movements of time series are the secular, periodic, cyclic and irregular trends. A time series may display a tendency to increase or decrease, over a specified period. Such a series provides an interesting illustration because if the trend is usually predominant, virtually no other movements are discernible.

Various methods exist for analysis of time series such moving averages, residual series, residual mass curves and balance. Trends may also be revealed by determining if observed stream flow follows some mathematical equation as a function of time.

In this chapter, first statistical parameters have been computed for time series data of annual runoff at different sites in Tapi basin. It is also ascertained if any mathematical equation can be fitted to the time series to assess predictability. Finally, the data is analysed by the method of moving means for various periods.

4.3 Availability of Data

There are 5 G&D sites in Tapi Basin. Availability of annual runoff data for these sites is summarized in **Table -1**

Table-1: Availability of Data

S. no.	Site	Period of Availability	Years
1.	Burhanpur on Tapi River	1972-73 to 2011-12	39
2.	Yerli on Purna River	1972-73 to 2011-12	39
3.	Gopalkheda On Purna River	1976-77 to 2011-12	35
4.	Gidhade On Tapi River	1990-91 to 2011-12	21
5.	Sarangkheda on Tapi River	1976-77 to 2011-12	35
The data is placed at Annexure-1 and shown in line diagram in **Fig- 1.**			

4.4 Analysis

4.4.1 Statistical Analysis

Various statistical parameters of the time series of available data are given below in **Table-2**.

Table-2: Statistical parameters of Average Annual Runoff series at various sites in Tapi Basin

River Gauging Station	Data length (years)	Mean (MCM)	Median (MCM)	standard deviation (MCM)	Co-efficient of variation
Burhanpur	39	4576.744	3957	2432.161	0.531
Yerli	39	2107.385	1812	1502.666	0.713
Gopalkheda	35	1010.714	753	722.608	0.715
Gidhaade	21	5979.476	4922	3308.516	0.553
Sarangkheda	35	7792.086	6861	4498.252	0.577

4.4.2 Fit characteristics

In order to find out if any mathematical equation represents the time series as a function of time, fitting of various types of equations viz. linear, logarithmic, exponential and polynomial have been attempted. Results of such fits are given in the **Table- 3** and shown in **Fig 2 through 6**.

Table-3: Fit Characteristics

S. No.	Station name	Standard Deviation σ (MCM)	Coefficient of variance C_v	Mathematical Fit		R^2
1.	Burhanpur	2432.161	0.531	Linear	y = -19.361x + 48144	0.0082
				Logarithmic	y = -38494Ln(x) + 297010	0.0082
				Exponential	$y = 2E+07e^{-0.0044x}$	0.0080
				Polynomial	$= -1.4443x^2 + 5734.6x - 6E+06$	0.0129
2.	Yerli	1502.666	0.713	Linear	y = -40.233x + 82252	0.0932
				Logarithmic	y = -80120Ln(x) + 610766	0.0931
				Exponential	$y = 1E+26e^{-0.0265x}$	0.1508
				Polynomial	$Y= -0.4415x^2 + 1718.8x - 2E+06$	0.0943
3.	Gopal-kheda	722.608	0.715	Linear	y = 0.2793x +1567.6	2E-05
				Logarithmic	y =-566.84Ln(x)+5317.5	2E-05
				Exponential	$y = 7366.8e^{-0.0011x}$	0.0002
				Polynomial	$y= 0.2437 x^2-972.24x +970588$	0.001
4.	Gidhade	3308.516	0.553	Linear	y =-14.884x +35763	0.00008
				Logarithmic	y = -29681Ln(x) +231596	0.00008
				Exponential	$y = 3E+08e^{-0.0054x}$	0.0046
				Polynomial	$y= -7.0471x^2 +28188 x - 3E+07$	0.0059

5.	Sarang-kheda	4498.252	0.577	Linear	y = -45.539x +98415	0.0108
				Logarithmic	y = -90410 Ln(x) +694535	0.0107
				Exponential	$y = 384931e^{-0.002x}$	0.0011
				Polynomial	$Y= -5.1828x^2 + 20582x - 2E+07$	0.0221

4.4.3 Moving Mean Analysis

In statistics, a moving mean (average), also called rolling average, rolling mean or running average, is a type of finite impulse response filter used to analyze a set of data points by creating a series of averages of different subsets of the full data set.

The first element of the moving average is obtained by taking the average of the initial fixed subset of the number series. Then the subset is modified by "shifting forward", that is excluding the first number of the series and including the next number following the original subset in the series. This creates a new subset of numbers, which is averaged. This process is repeated over the entire data series. The plot line connecting all the (fixed) averages is the moving average. A moving average is a set of numbers, each of which is the average of the corresponding subset of a larger set of data points. A moving average may also use unequal weights for each data value in the subset to emphasize particular values in the subset.

A moving average is commonly used with time series data to smooth out short-term fluctuations and highlight longer-term trends or cycles.

In the present analysis, moving means have been computed for 3, 5 and 7 year periods for various sites of Tapi River Basin and shown in **Fig-7 through 11**.

4.5 Interpretation

4.5.1 Fitting of various statistical/mathematical models viz linear, logarithmic, exponential and polynomial reveals that values of R^2 range from 0.0080 to 0.0129 for Burhanpur, from 0.0931to 0.1508 for Yerli, from 0.00027 to 0.001 for Gopalkheda, from 0.00008 to 0.0046 for Gidhade, and 0.0011 to 0.0221 for Sarangkheda. The values of R^2 are quite close to 0 indicating absence of any significant trend.

4.5.2 As regards the Purna, tributary of river Tapi, a decreasing trend is seen at site Yerli from the plot of moving mean averages from about mid-nineties, which

again shows signs of rising by 2010, though no trend is visualized on the upstream site Goplakheda on Purna. On the main stream Tapi, it may be seen from the moving mean analysis that there does not appear any significant trend as observed from 3 year moving mean. But as we prolong the period of mean, cyclicalness or periodicity begins to appear. However, in view of the limited length of data series, it may be premature to conclude that there exists a definite cyclic trend in the average annual runoff data.

4.6 Conclusion

Statistically speaking, the average annual runoff of river Tapi and its tributary Purna, in general, appears to be a random variable; however elements of cyclicalness cannot be ruled out on the strength of moving mean analysis. A longer set of time series data may help identify trends in average annual runoff, if any.

Annexure-I: Average Annual Runoff data at Various Sites in Tapi Basin

(MCM)

Site / Year	Burhanpur on Tapi	Yerli on Purna	Gopalkheda on Purna	Gidhade on Tapi	Sarangkheda on Tapi
1973	8714	3404			
1974	1736	1376			
1975	5620	2282			
1976	3892	2224			
1977	3951	2693	284		1111
1978	6979	3804	1802		10810
1979	4637	4706	1727		12045
1980	4612	1875	913		8880
1981	5241	2618	1504		9946
1982	1834	657	321		3368
1983	5484	3938	1111		14258
1984	3895	1074	675		6414
1985	1555	1235	354		3185
1986	3753	2650	1106		6861
1987	1209	723	235		2751
1988	6553	7250	3012		16812
1989	3957	1812	389		8546
1990	10589	4869	1512		16338
1991	2638	763	358	4809	4239
1992	2889	1731	753	4922	5650
1993	6580	1176	361	5784	7884
1994	10304	3466	1951	11902	14652
1995	3607	1051	582	3236	4226
1996	4900	952	708	4883	6403
1997	5834	1201	974	5010	6518
1998	7328	3014	1785	11163	14427
1999	6691	2254	1221	7016	8097
2000	1277	751	545	2600	3154
2001	3071	1076	454	3246	3711
2002	3168	2649	1213	7536	8618
2003	3296	504	1169	4950	6994
2004	2357	223	405	2389	3165
2005	3342	1040	629	4268	5043
2006	4905	3518	1988	14972	17486
2007	9797	3340	2827	9288	11414
2008	2307	365	211	3551	3443
2009	2028	640	295	3573	3071
2010	3983	2427	1400	5909	7001
2011	3980	857	601	4562	6202

Fig.1: Average Annual Run-Off at Various Sites

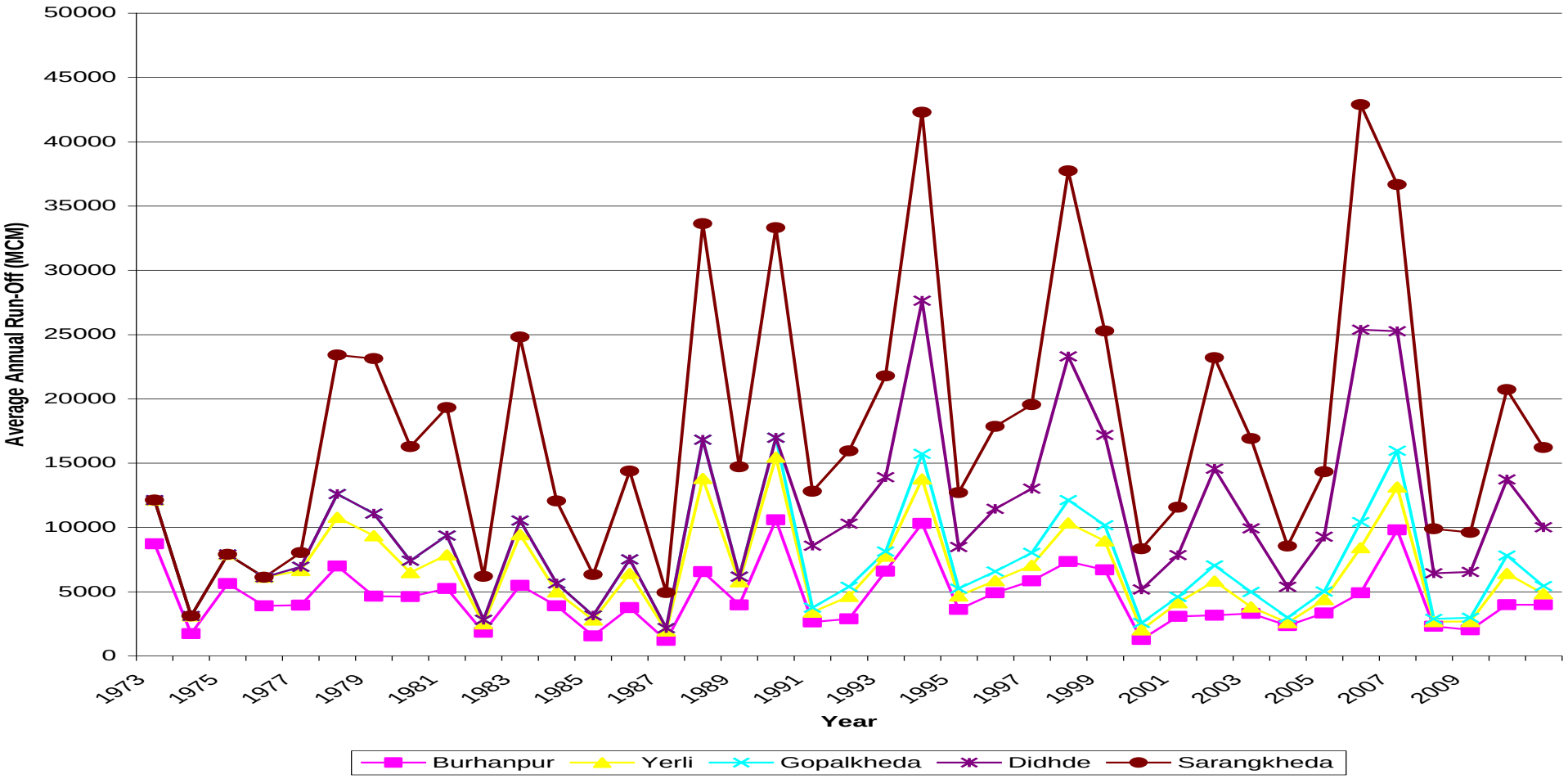


Fig.2: Fit Characteistics at Burhanpur

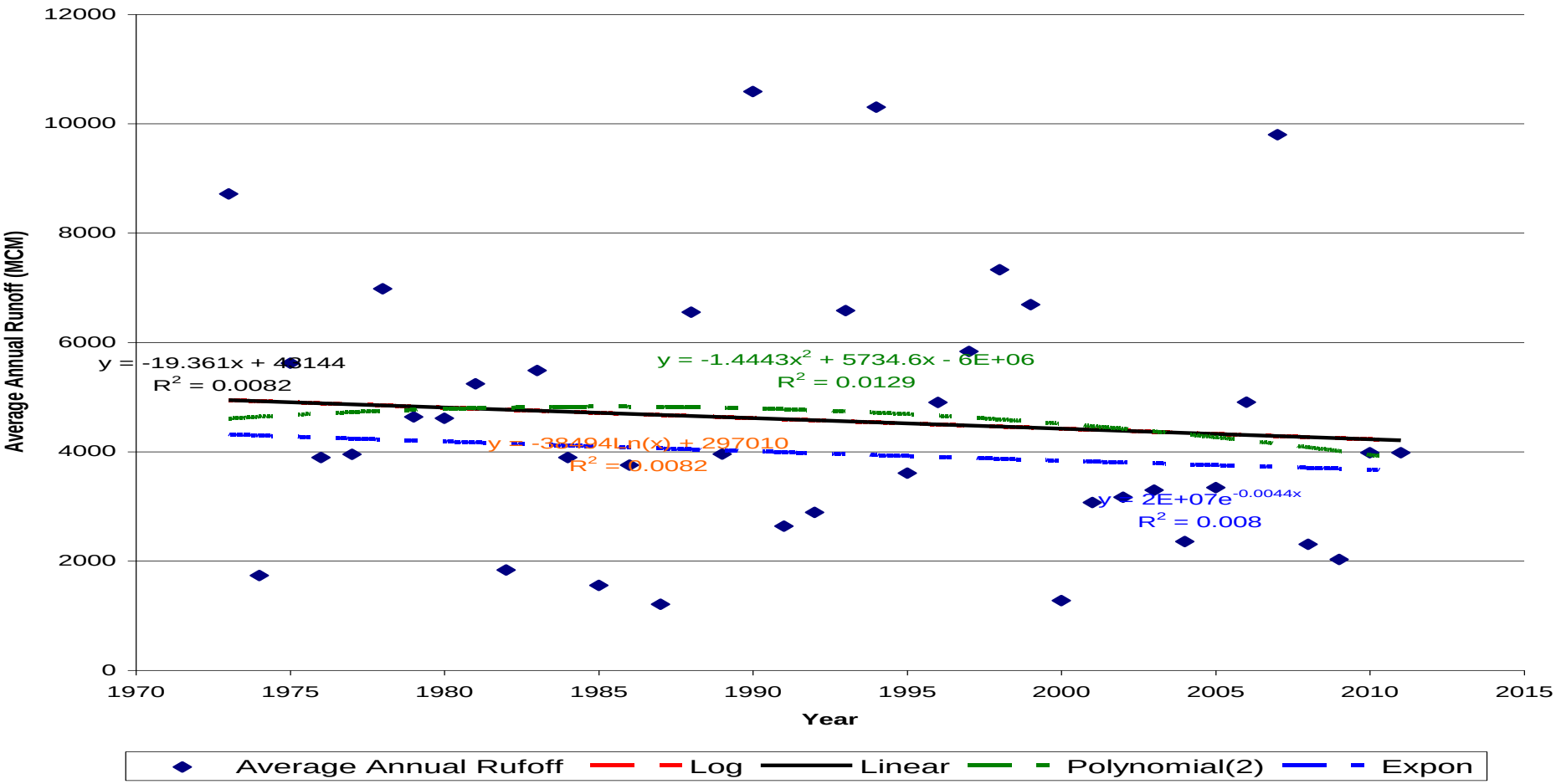


Fig.3: Fit Characteistics at Yerli

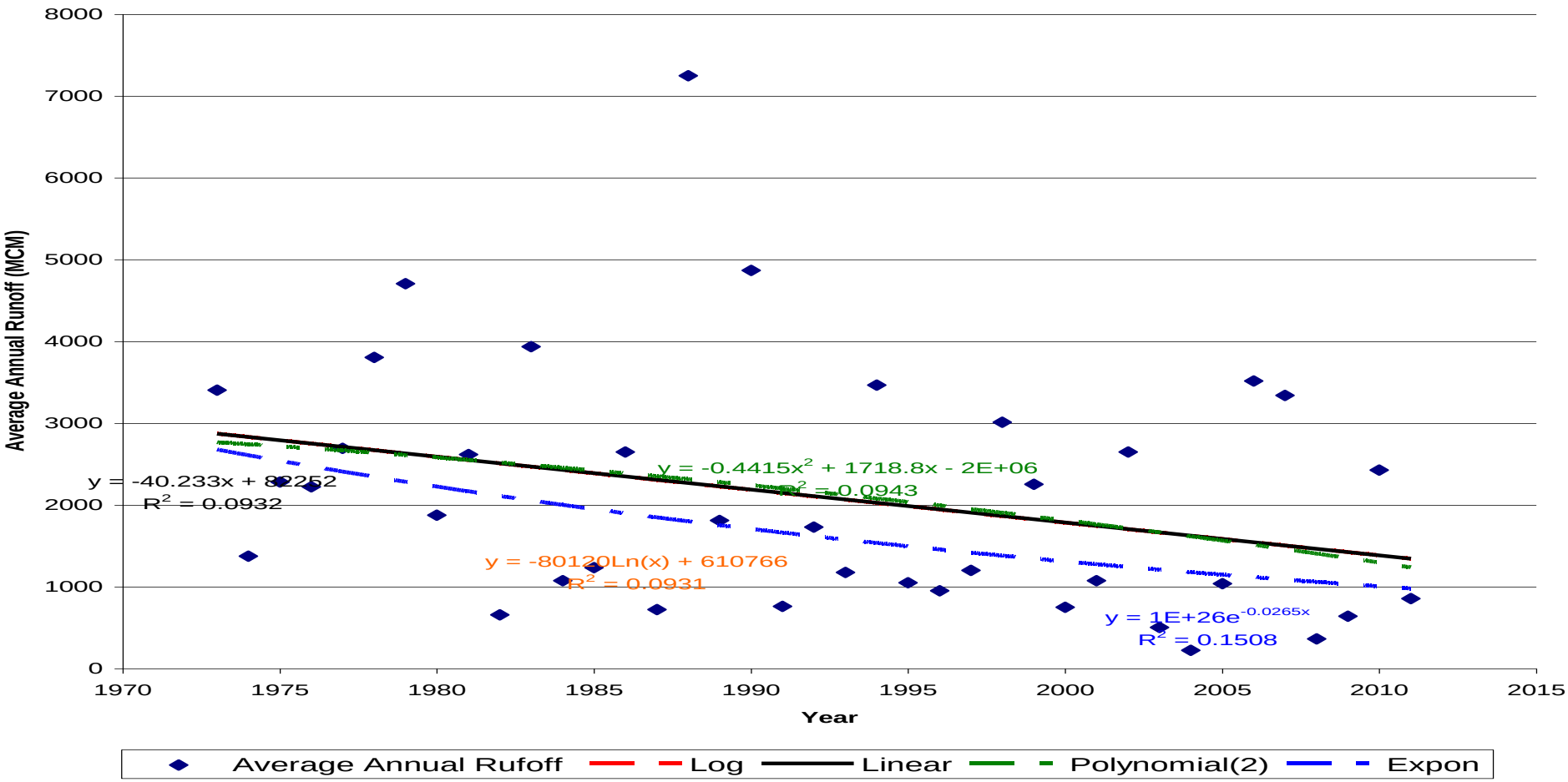


Fig.4: Fit Characteistics at Gopalkheda

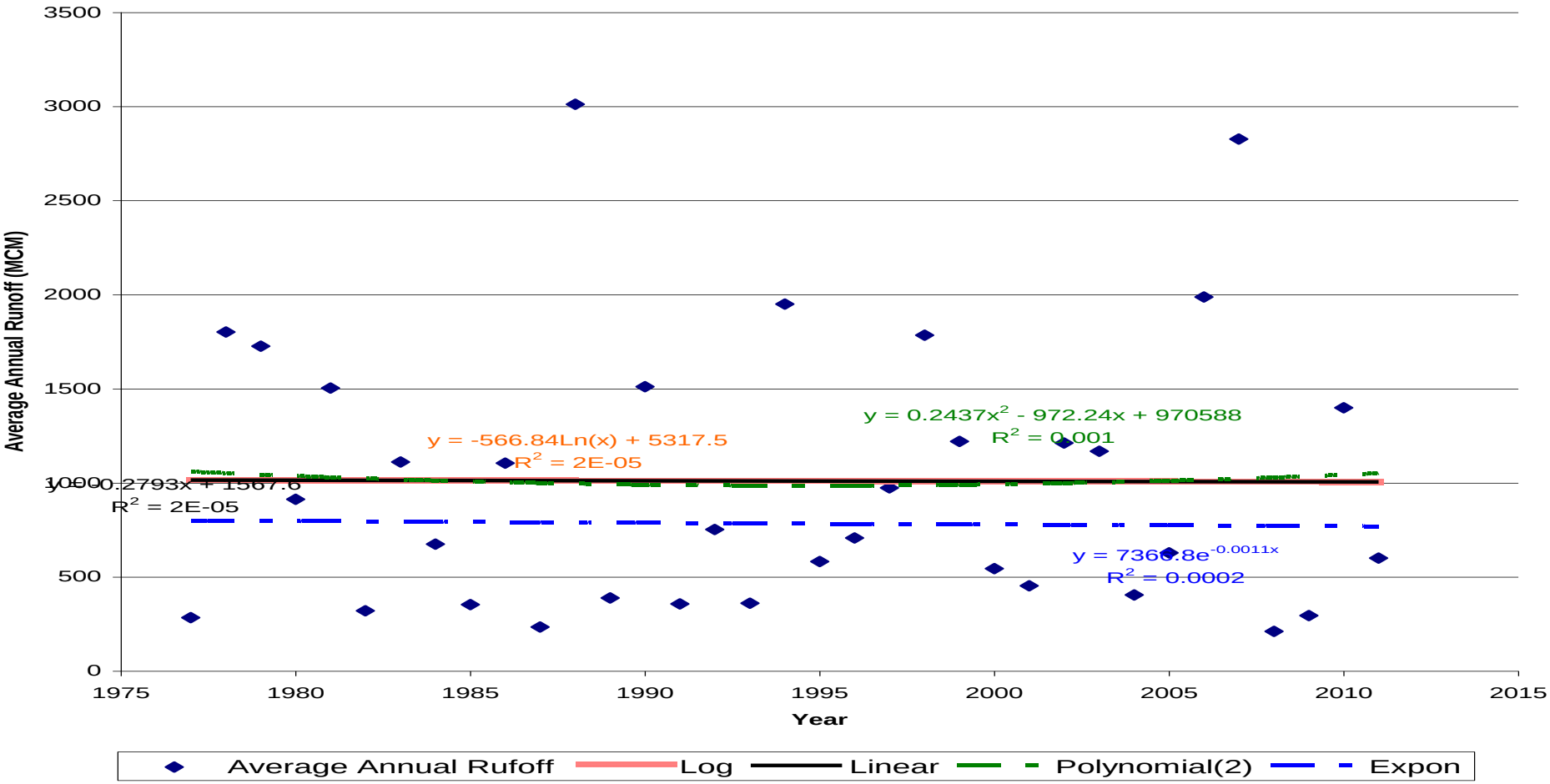


Fig.5: Fit Characteistics at Gidhade

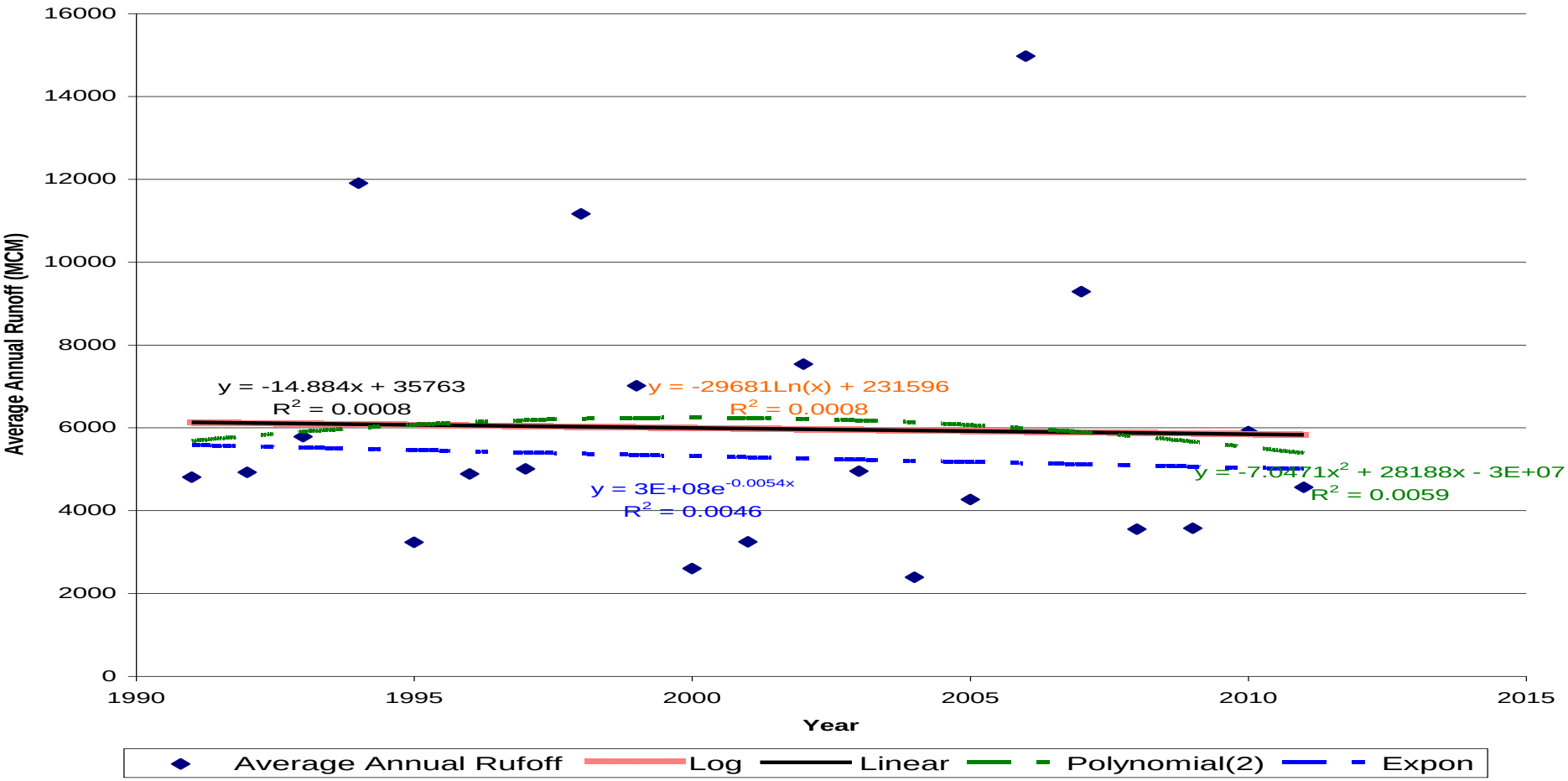


Fig.6: Fit Characteistics at Sarangkheda

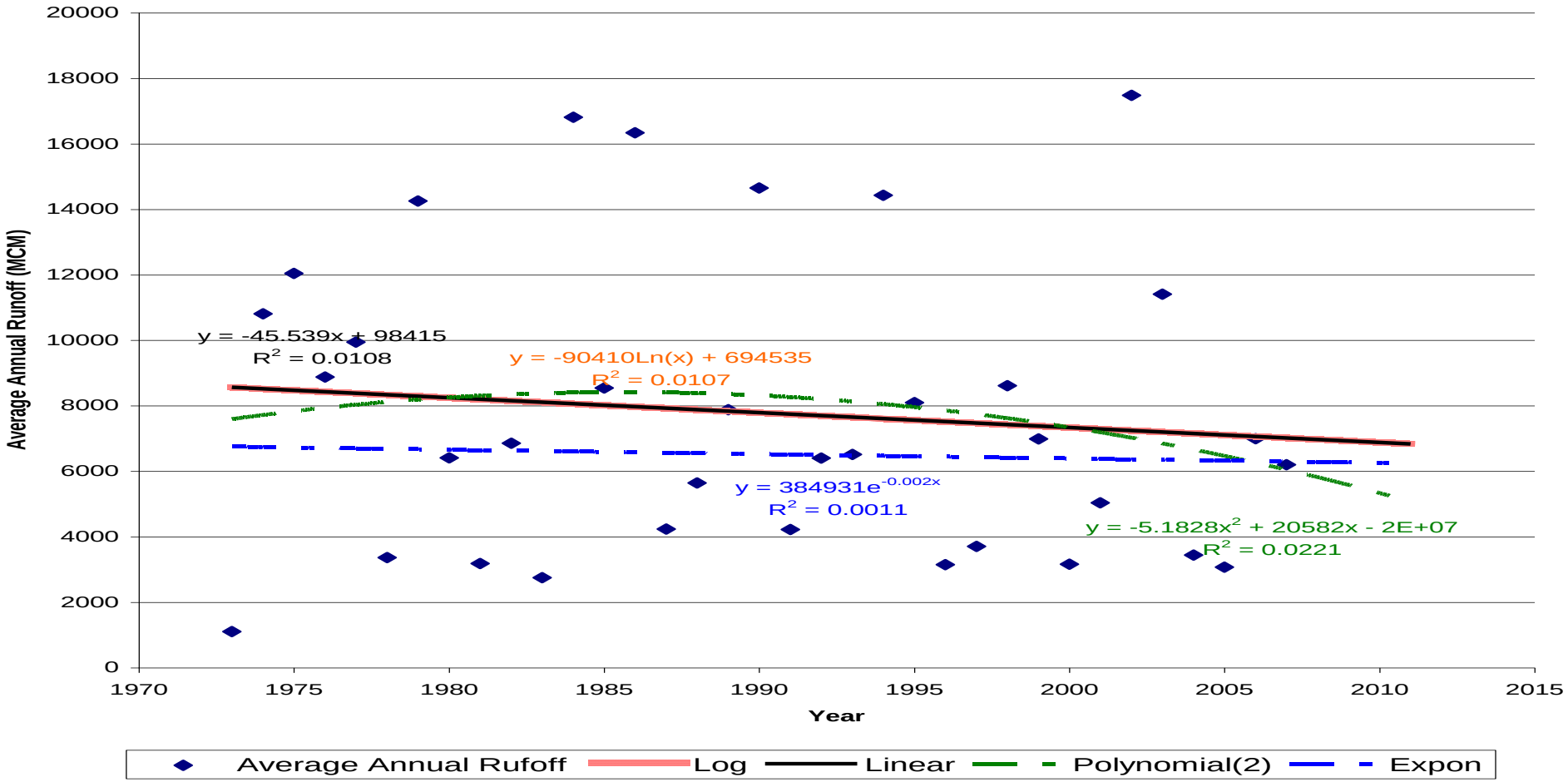


Fig.7: Moving Mean Analysis for Burhanpur

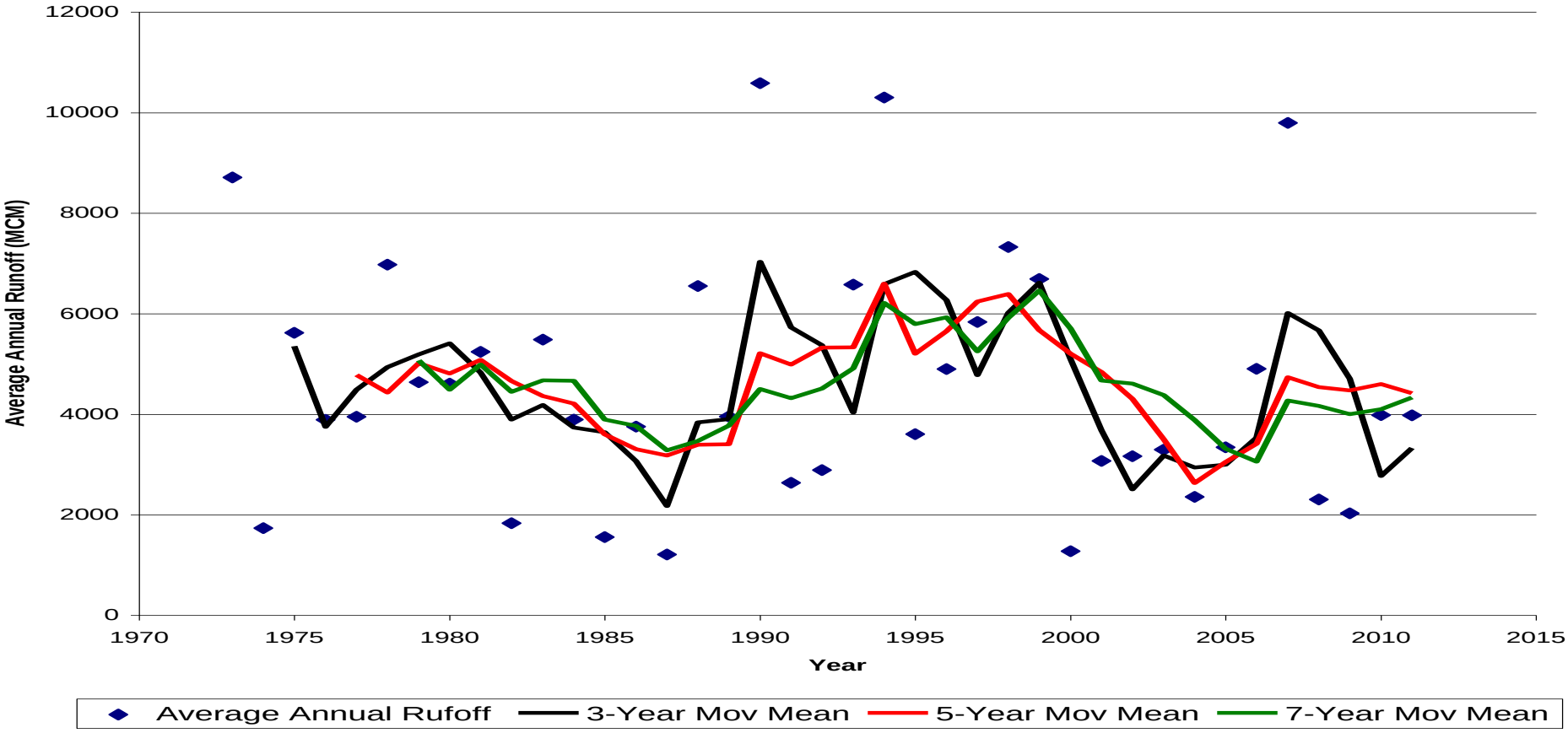


Fig.8: Moving Mean Analysis for Yerli

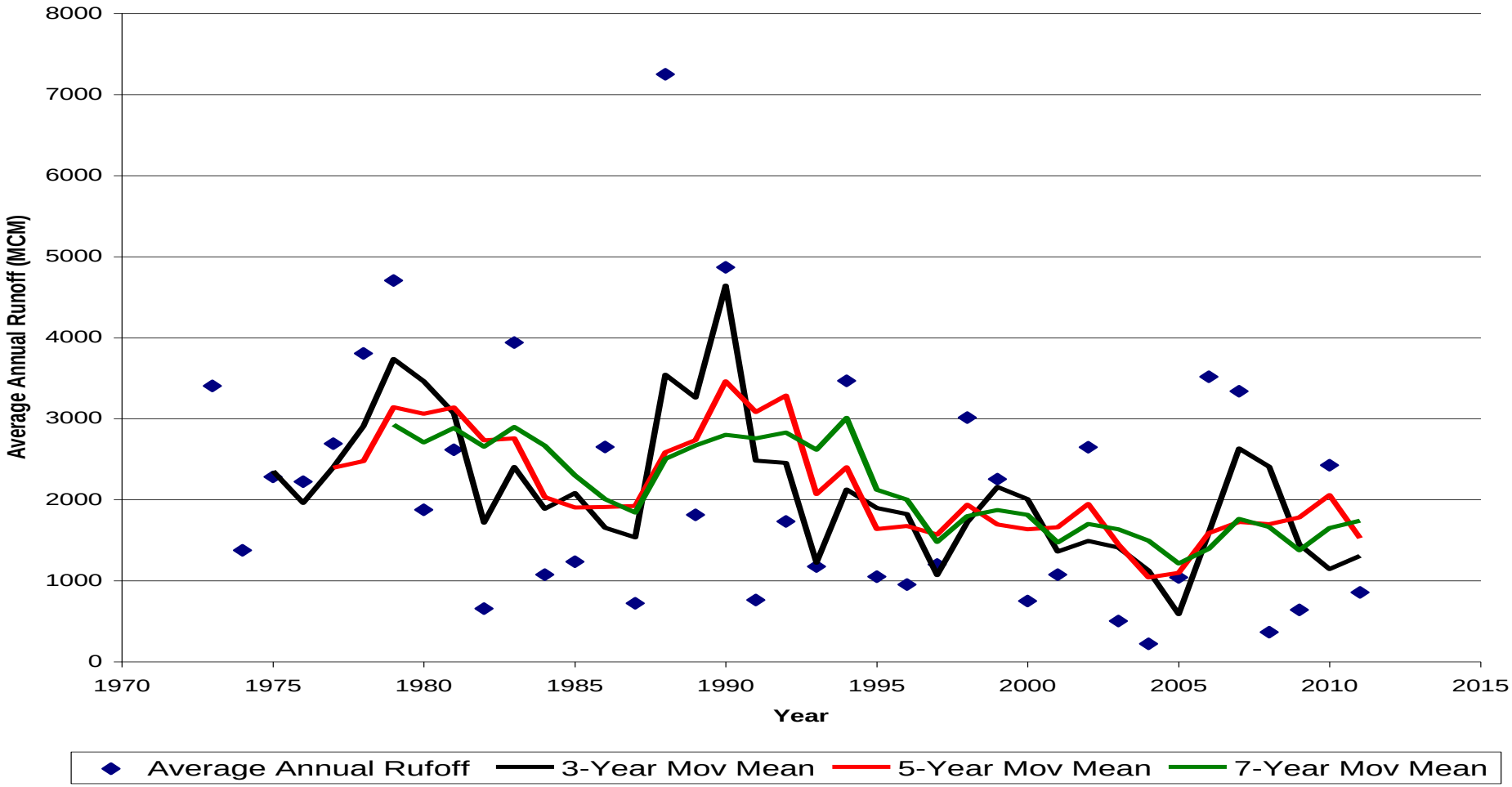


Fig.9: Moving Mean Analysis for Gopalkheda

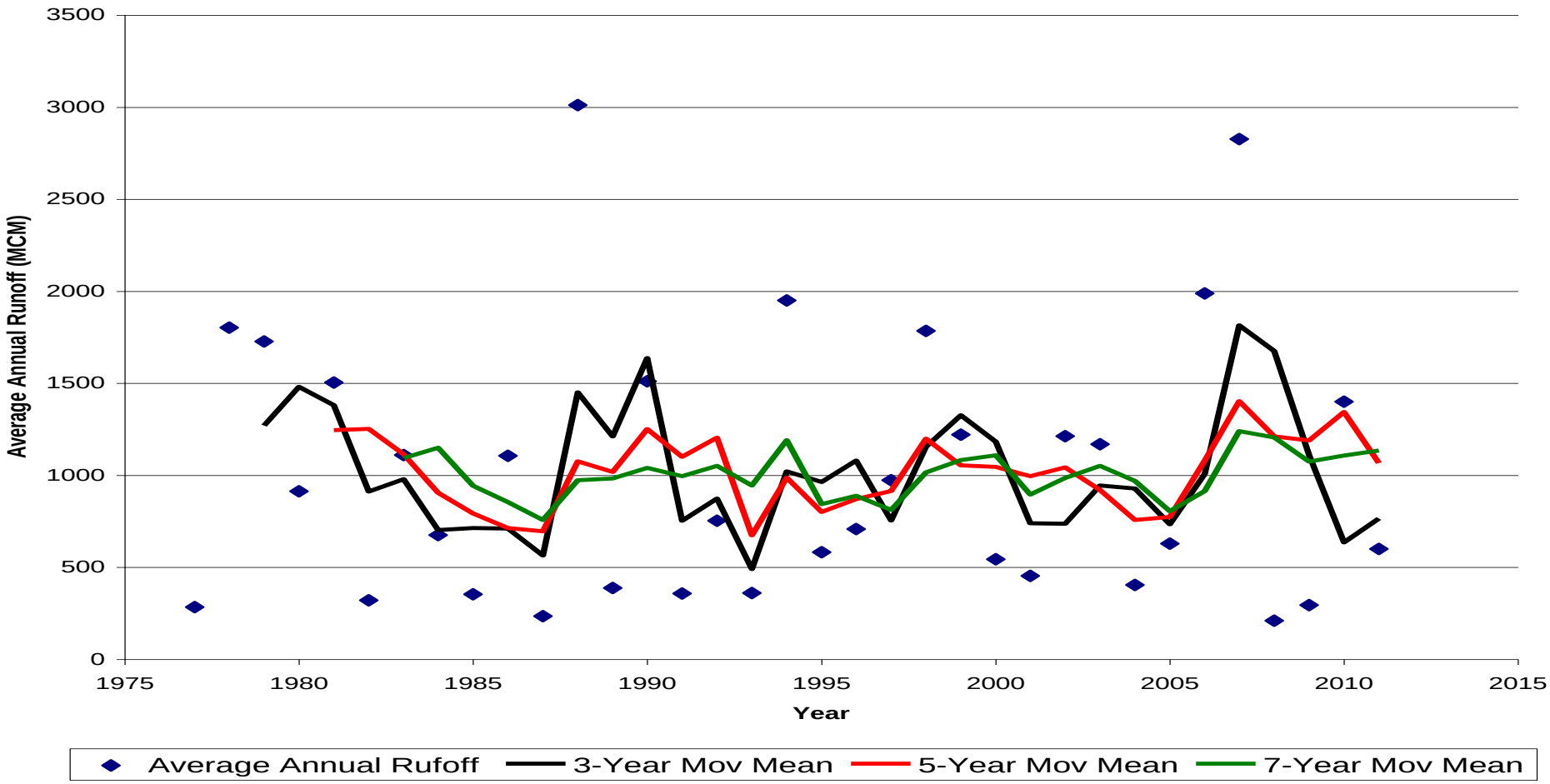


Fig.10: Moving Mean Analysis for Gidhade

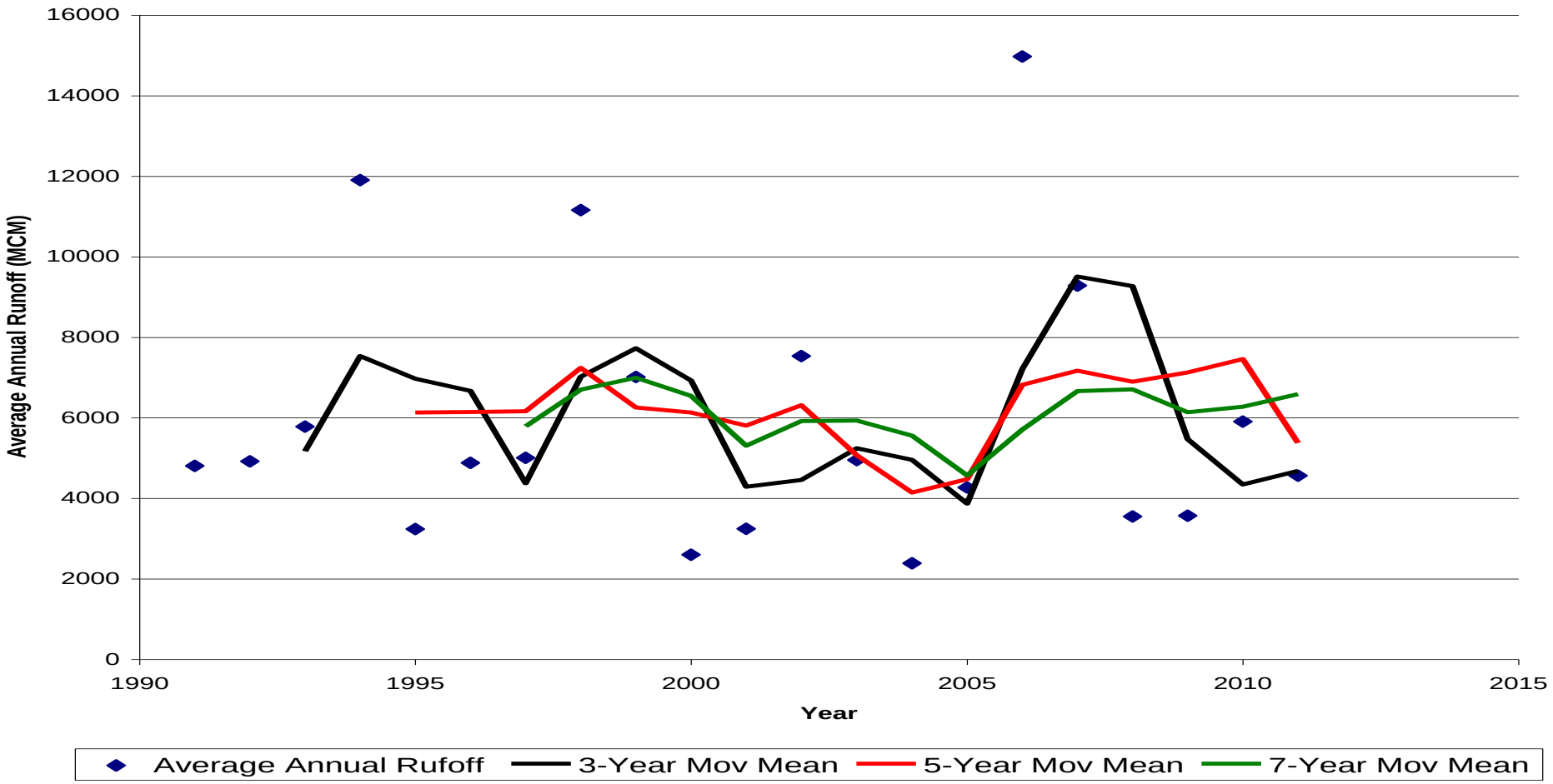


Fig.11: Moving Mean Analysis for Sarangkheda