Chapter I
INTRODUCTION

1.1 GENERAL

Floods are deliberated as one of the world's supreme grim environmental hazards. Recorded history of 4000 years tells repeated failure of man to evade the destructions caused by floods. Floods are even now playing havoc in almost every portion of the planet, even after the development of scientific techniques and an experience of many years. Destruction of crop in terms of million acres, movement of hundred thousand people and monetary losses in terms of billion rupees are the damages of floods.

Floods are Natural events ,can be defined as a temporary covering of land by water outside its normal confines due to rainfalls, snow melting, dam break, tsunamis, sea surge, water overtopping from water bodies or Levees Break events. Each flood event is characterized by Flow Velocity, temporal &spatial dynamics, water depth and matter fluxes. .this can happen in large or small river basins.

Generally it has been recognized that protection against flood is possible and is also a vigorous necessity but complete preclusion from floods is humanly impossible. Shape and size of river drainage basin dictates the precipitation received by river and Lag time. Large drain basin means Large Catchment area which indicates receiving of more water by river. For Circular shaped basin, discharge will reach roughly at same time in river because of equidistant points, this will generate peak discharge which will leads finally into flashflood. Permeability of rock and soil present in the drainage basins is another big factor which helps in flooding, for impermeable soil which may be either due to Saturated condition by previous precipitation or baking by persistent heating the falling precipitation will never infiltrates and meet with the river straightly which results excess discharge in river .If the rock present in drainage basin is impermeable /Non porous (Clay or Granite) then water will never infiltrates in rock and will meet directly to river which results excess discharge. Basin's Vegetative cover also affects flooding. Very dense vegetative cover will intercept rainfall and then store it, which reduces water volume entering in the river and vice versa phenomenon for sparsely vegetative cover. Vegetative cover also helps in binding the soil. If there is no vegetation soil will be highly prone to mass wasting, which allows large soil volume to enter in a river which will reduces capacity of river. Basin's Steepness also affects flooding. For steep valley sides water entering a river will quickly increases its discharge. River tributaries also affect flooding more will be number of tributaries more will be discharge which will cause more damage.

1.2 FLOOD GROUNDS

Floods occurs because of the quantity of water which river brings with it either due to heavy rainfall or snow melting in mountainous regions exceeds the capacity of channel's, due to which the rivers overflows onto the surrounding areas. Flashfloods which are caused by thunderstorms, small rivers swells quickly and carries up to ten times more discharge than the normal discharge is another cause of floods. Slowly flowing rivers carry water, silt and sand buildup their beds and rises the bed levels causes more damages.

Prolonged rainfall is the basic cause of floods. If the duration of rainfall is long then ground becomes saturated and soil becomes unable to absorb water which leads to increase in surface runoff, which in result increases the river discharge at much faster rate and causes flooding.

Floods are also caused by humans. Trees and plants normally help absorb too much water. When forests are cut or burned down, water from rainfall flows down barren land and produces mudslides. Too much water pressure on dams can lead to cracks in the concrete or even cause a dam to break completely.

In spring season Snow Melts, melt water enters in rivers increasing their discharges and results flooding but such type of floods are annual. Such floods only occur when snow melts.

1.3 FLOODS CHRONOLOGY AND PAKISTAN

In Pakistan Indus river is responsible of flood disasters, major Trans Boundary River considered in Asia. Indus river has nine tributaries ,five on left bank are Sutlej, Jhelum, Beas, Ravi, Chenab rivers and four on right bank are Kurram, Swat, Gomel and Kabul rivers. The alluvial plain area of Indus river is 207,200 km and its length is 2800 kilometers out of which 2682 kilometers is in between southern & Northern restrains of Pakistan, deltaic area of Indus river is 20000 kilometers which originates in Tibetan tableland on mountain named Kailas parbat from spring named Singi Khahd nearby mansarwar lake, then it passes through Himalayan range and also collects of Suleiman and Hindu Kush ranges. Indus was mightier during warm period about 6000 years ago than 4000 years ago, as climate cooled the large portion of indus river dried up and the deserts replaced waterways. Processor points toward localized phenomenon of warming are responsible for this disaster. The intensity of monsoon is somewhat sensitive to Indian oceans surface temperature, at the time of cooler climate monsoon weakens because of less moisture picking up from Indian Ocean which in result reduces flow of Indus River. In 2010 climate change is considered as major factor in back of devasting and severe monsoon. This time unique monsoon was experienced by Khyber Pakhtunkhwa due to non-reliable historic data.

Pakistan has faced various flood disasters during last 66 years ,21 major flood disasters in between 1950 to 2011 almost 1 flood after every 3 years (ADB .2008).

Being located in Temperate region Pakistan is facing severe floods since its creation during 1950,1956,1957,1973,1976,1978,1988,1992,2010,2011.Foods of various magnitude which occurred in between 1922 to 2010, affected the river Basins of Punjab and Sindh. Heavy concentrated rainfall during monsoon season and snowmelt flows cause floods in Pakistan. Monsoon currents which originate in Bay of Bengal and the resultant depressions results heavy downpour on Himalayan foothills cause destructive floods in either or all of the main rivers of indus system. However sometimes formation of temporary dams due to land sliding or glacial movement and its collapse also causes high floods. Moreover large seasonal variations almost in all river discharges further aggravate river course and its morphology.

Inundation of areas along the bank of rivers cause flood losses by damaging communication facilities (either adjacent or across the rivers), damaging irrigation and land erosion along river banks. Discussing about upper part of indus basin system usually floodwater returns back to river which spills over the banks of rivers ,while in lower part of indus basin system spilling water don't returns back to river. This largely extends period of inundation, which results greater damages. However embankments have also been provided at many locations in upper areas and also along the entire length in Sindh province, bund breaches still occurs and often causes greater damage than would have occurred without the bunds .Inadequate discharging capacity of some important structures such as Bridges and Barrages on Rivers Ravi, indus ,Swat and Chenab is another reason of flooding. The high floods results an afflux on upstream side, sometimes which results breaching of flood Embankments and sometimes the embankments at any preselected location have to be intentionally breached to save barrage structures. Encroachments of villages in riverine areas are one of another reason of more flood damages and losses to humans & live stocks. Many poor people construct their shelters very close to river banks and they become targeted by devastating floods and this is because of no regular frame work regarding settlement near river areas in our country.

1.3.1 Flood Control Objectives & Need

In Pakistan Flood management planning is being carried out to essentially cover the following three specific objectives:

- To reduce or eliminate damages to existing properties
- To prevent future increase in damages
- To mitigate the residual hazards

1.4 RAINFALL PATTERN AND FLOODING IN 2010

Rain fall of July 2010 was five times more than usual rainfall during July in Pakistan. Flash floods resulted in Kabul River and swat rivers due to this unprecedented rainfall. Heavy rainfall on Karakorum and hindukush ranges accelerated glacial melt and snow melt which caused extraordinary floodwater in river Indus at terbela. Second rainfall spawned another flood wave during same year, these 2 flood events instigated the longest persistent floods in the history of Pakistan.

The Patterns of global weather were under the effect of EI Nino a year before which intimidated monsoon rainfall in Pakistan. Transition of EI Nino to opposite phenomenon of La Nino contributed a lot to rain in Northwestern part of Pakistan. 24 hour rainfall ranging from 21-280mm occurred at 18 stations in indus basin on 29th July 2010, average rainfall recorded 128mm and 290mm on 30th July 2010.Recorded rainfall for month of July and august was double against historical recorded rainfalls for these months. This widespread rainfall generated very high runoff in Indus, Kabul, Swat Chenab and Jhelum rivers. The damages due to this rainfall were too much than the damages of 2005 earthquake.

1.5 PROBLEM STATEMENT

Floods mostly occur in summer season. Inundation of areas along the bank of rivers cause flood losses by damaging communication facilities either adjacent or across the rivers, damaging irrigation and land erosion along riverbanks. During the flood 2010 communication networks b/w various areas were disconnected by bridge damages. Heavy rainfall of this season caused physical destruction of Sixty Five Communication networks. A report published by FFC dictates that 2010 flood bettered the previous records and destroyed Munda and Amandara Headworks both on Swat River. An encroachment of villages in riverine areas is reason of more flood damages and losses to humans & live stocks. Many poor people construct their shelters very close to river banks and become targeted by devastating floods, even some of the infrastructures are within the river area, people have supported them from the river area and this is because of no regular frame work regarding settlement near river areas in our country. Destructive magnitudes of flood 2010 are revealing assessment of flood risk in Valley Swat so that vulnerability by flood of this region to higher magnitude be well signified in spatial format. This study will describe the infrastructures which are built within the river area and areas that can be affected.

1.6 OBJECTIVES

1. Assessment of Design Flood for various Return Periods.
2. Computation of water surface profile in river system analysis model.
3. Flood Inundation of River Swat from Utror Valley Kalam to Bazkhela**.**

1.7 UTILIZATION OF RESEARCH

Floods frequently occur in Pakistan and are a stochastic progression. Flood Hazard maps will help in appropriate land use development with in flood prone areas, which will facilitate in the identification of risk areas during flooding and in prioritize mitigation and response effort.it will also increase awareness of flooding among local authorities, Public and organizations ,and will differentiate flood risk zones from high to moderate and moderate to low.it will also help in emergency planning, evacuation planning, flood proofing measures and flood shelters provisions. Study will help in designing with suitable remedial measures to minimize damage extent.

Chapter II
REVIEW OF LITERATURE

This chapters includes the followings

1. Review of Floods and their Damages in Pakistan.
2. Review of Various Distributions for Frequency Analysis.
3. Review of Significance test for Best fit Distribution.
4. Review of Flood inundation and Modeling using HECRAS.

2.1 HISTORICAL BACKGROUND OF FLOODS

Floods are not very new to man; these have been known by man since the beginning of history. Floods play prodigious hovac and untold miseries such as life loss, human activities disruptions, property damage, agriculture crop damage and health hazards are caused in affected areas.

Gigantic flood when visited the Kanan land in 2957 B.C, it drowned all living creatures except Hazarat Noah (A.S), his followers and few animals who provoked to safety in Hazarat Noah's Boat. Continuous Heavy rainfall for 40 days & nights resulted this gigantic flood and land remained inundated for a period of 150 days. Again a flood targeted Egypt in 147 B.C, which resulted submergence of entire Nile Valley.

Pakistan is one of the south Asian countries which have faced several catastrophic disasters during the period of last 66 years, caused by rain fed floods. During the period of 1950 to 2011 about 21 Twenty one major flood events have been experienced by Pakistan (ADB, 2010) almost one flood event after every three years.

These catastrophic disasters claimed an economic loss of about $19 billion by imposing damage to 109822 villages and 8887 human lives. Averagely flood damage was 1% of mean annual GDP during 1960 to 2011.the economic loss of $10 billion was caused by worst ever flood of 2010. 1950 flood,1955 flood,1956 flood,1957 flood,1959 flood,1973 flood,1975 flood,1976 flood,1977 flood, 1978 flood,1981 flood,1983 flood,1984 flood,1988 flood,1992 flood,1994 flood,1995 flood,2010 flood,2011 flood and 2012 flood are considered as major flood events for Pakistan.

1955 Flood

The flood event of 1955 was considered as highest for River Ravi and Balloki Headwork's records. This flood occurred due to rain fell of an amount of 200mm in Sialkot city and Dalhousie town and 500 mm in Basntar river and UJh Catchments, thus covering approximately whole catchment of river Ravi. Embankments of Bambanwala, Ravi, Bedian, Dipalpur link canal and Shahdara Bridge were breached by this flood.

1973 Flood

The flood event of 1973 was considered as highest for Punjnad Barrage and Khanki Headwork's records which are on river Chenab. Flood peaks were generated by rainfall of about 324 millimeters, land area of 3.6 million hectares was inundated up to 6m water height, Wheat crop and cotton crop was completely devasted and about 474 people, 255000 houses, 70000cattle were lost by Province Punjab. The estimated damage of this event was $2.39 billion.

1976 Flood

Monsoon Rainfall during month of July and month of September of about 579 millimeters on catchment of Indus was responsible of flooding at Jinnah and Guddu Barrage, which are on river Indus. This flood event slaughtered 425 people, affected 1.7 million people and 18390 villages, inundated land area of 8 million hectares and damage to 11000 houses. The estimated economic loss was $1.62 billion during this event.

1988 Flood

An average rainfall on 23 to 26 September of 400 millimeters occurred on River Sutlej, Chenab and Ravi catchments were liable to this event. This event killed 500 people and deluged about 1 million hectares of irrigated crops and agricultural land. About $400 million was the economic loss during this flood.

1992 Flood

Monsoon of 1992 caused prevalent rainfall on River Chenab, Indus and Jhelum Catchments. Rain fell continuously 5 days from 7th September to 11th September, which was highest rainfall during same period in its history. This rainfall flooded River Jhelum, Chenab and Indus.13000 villages were inundated, 960000 houses were damaged, 4.8 million people were affected and more than 1000 people were killed by the Flood protection levees breaching (World bank 1996).

The estimated damage was $1.4 billion by Pakistan’s Government. This flood event badly targeted the communication and agriculture sectors, a damage of about $396 million.

1994 Flood

Rain fell during July and September flooded River Sutlej and Indus. About 386 people were killed, 557000 houses were damaged, 14000 cattle loss and 700000 hectares of crop loss was caused by this flood event.

2005 & 2006 Floods

Very high flooding was experienced by River Chenab and Kabul in 2005 & 2006.About 591 people were slaughtered and within 117 districts 1 million Hectares of land was badly affected by these continuous floods.

2010 Flood

Flood of 2010 was the second worst ever flood in sense of devastation. Heavy monsoon rain fell in KPK, lower Punjab, Baluchistan and Sindh regions in July 2010, thus affected all provinces. Riverine flooding was observed in Southern Pakistan areas (Webster et al.,2011) while flash floods were observed in Northern Pakistan area and Northwestern area of India(Chi-Cherng et al.,2011).the rainfall during this season was 5 times more than the normal rain fall during this period in its history, which resulted submergence of fifth of total Pakistan’s area. These rains caused the rivers to surge and overflow. Rain fell within the indus catchment area and tributary rivers of indus river caused heavy floods in the river Indus in a very short period of about 3-4 days, Rainfall ranging from 21-280 millimeter was observed on 29th July at Eighteen (18) stations within indus basin, 240millimeter in Kamra city in Punjab on 30th July. Unprecedented monsoon rainfall from 27th July to 30th July 2010 resulted flash floods in River Kabul and Swat. About 200 millimeter rain fell in 24 hours at many places of Khyber Pakhtunkhwa, 274 millimeters record breaking rain fell within 24 hours in Peshawar. River Kabul and Swat crossed the previous recorded historic flow of 250000 cusecs in 1929 by 400000 cusecs.

Damage of this flood event was more than the damage taken place in the Earthquake of 2005.Sindh Province suffered highest damage of about 43% of total being sited at termination of indus basin,26% by Punjab and 12% by Khyber Pakhtunkhwa. The estimated damage was US$311 million. Losses in flood 2010 in every province of Pakistan are described in Table 2.1.

Table 2.1 Country wide Damages/Losses due to Flood 2010

Province	Affected Districts	Affected Population (Million)	Injuries	Deaths	Cropped Affected (Ha)	Road Millage (km)	Affected Villages	House Damaged
Khyber Pakhtunkhwa	24	3.8	1198	1156	121500	6511	544	257294
Sindh	17	7.185	1235	411	1043500	8467	11988	879978
Baluchistan	12	0.7	104	54	132500	2077	2896	79720
Punjab	11	8.2	262	110	746900	2819	1778	375773
Gilgit Baltistan	7	0.1	60	183	7900	382	347	3157
AJK	7	0.2	87	71	33100	3575	0	6843
FATA	-	-	-	-	7220	1257	-	5419
Total	78	20185	2946	1985	2082600	25088	17553	1744471
Source	NDMA 24Feb 2011	NDMA 24-Feb-11	NDMA 24Feb 2011	NDMA 24Feb 2011	DNA Report pg.153	DNA Report pg.153	NDMA 24Feb 2011	NDMA 24-Feb-11

2011 Flood

During Monsoon 2011 none of main rivers reached up to danger level of flood, because the catchments of main rivers didn’t receive very heavy precipitation. That was the reason that no severe riverine flooding in the areas were seen during 2011.But torrential monsoon precipitation of 2011 badly hit southern eastern portions of Sindh province and this was historical event of 150 yrs return period. Rain started from August (Second week) to mid-September with dumpy interims .First spell was from 10th August to 17th August with short interims. About 300mm precipitation occurred in Districts Mirpurkhas, Tando Muhammad Khan, Hyderabad, Nawabshah, Badin and Sanghar which generated the surface runoff in excess of 14000 cusecs. Recorded rainfall was 8 to 10 times in excess of Kotri Barrage and LBOD drainage capacity. Second spell was from 29th August and 200 to 400 millimeter rainfall was recorded during this spell. Losses in flood 2011 in every province of Pakistan are described in Table 2.2.

Table 2.2 Country wide Damages/Losses due to Flood 2011

Province	Affected Population	Injuries	Deaths	Cropped Affected (Ha)	Affected Villages	House Damaged
Khyber Pakhtunkhwa	-	-	-	-	-	-
Sindh	9275568	753	497	6674859	38347	1596807
Baluchistan	-	-	-	-	-	-
Punjab	26393	17	4	136758	335	1284
Gilgit Baltistan	-	-	-	-	-	-
AJK	170	-	12	-	3	4
FATA	671	-	3	310	15	534
Total	9302802	770	516	2310774	38700	1598629
Source	FFC 2011	FFC 2011	FFC 2011	FFC 2011	FFC 2011	FFC 2011

2012 Flood

Extremely low-pressure Monsoon system, established over Bay of Bengal entered in country on 3 September 2012 and lashed Southern Khyber Pakhtunkhwa, Southern Punjab, Sindh and eastern Baluchistan with heavy falls, causing widespread damages described in Table 2.3.

Table 2.3 Country wide Damages/Losses due to Flood 2012

Province	Inundated Area (sq Km)	Persons Killed	Injuries	Damaged Road (Km)			No. of Settlements
				Provincial	Kacha Pakka	National	
Punjab	1872	455	2884	128.1	231	56.4	325
Sindh	2963.6	451	2916	622.5	1779	39.7	145
Baluchistan	2596	16	12	369	2129	30.8	711
Total	126.9	922	5812	1119.6	4139	126.9	1181

2013 Flood

Heavy rainfall was noted over catchments of Northern Punjab, KPK, Kashmir and River Chenab due to Monsoon low development over Rajasthan, India and adjoining area of Bahawalpur Division. The countrywide destructions are described in Table 2.4.

Table 2.4 Country wide Damages/Losses due to Flood 2013

Province	Persons Affected	Death	Injured	House Damaged		Crop Affected (Acres)	Villages Affected
				Partially	Fully		
Punjab	887345	60	272	16440	473998	9116	1512
Sindh	3174716	283	2421	188935	245459	232723	11894
KP	-	38	36	4293	-	105	-
Baluchistan	787,780	156	146	183513	452588	753	-
GB	-	-	-	70	-	-	-
Islamabad	-	3	-	-	-	-	-
AJK	-	31	32	1017	-	226	-
Total	636438	571	2902	636438		1172045	14159
Source	FFC 2013	FFC 2013	FFC 2013	FFC 2013		FFC 2013	FFC 2013

2014 Flood

Torrential rainfall in September's First week affected Public and Private infrastructures because of riverine & flash floods in country's Northeastern parts and Indian flood flows ,the damage during this season is described in Table 2.5.

Tavke 2.5 Country wide Damages/Losses due to Flood 2014

Province/ Region	Persons Affected	Persons Died	Persons Injured	Cropped Area Affected (Acres)	House Damaged	Villages Affected	Cattle Heads Perished
Punjab	2474727	286	512	2413797	100000	3484	1733
Gilgit-Baltistan	132666	13	35	1513	1292	127	5369
Sindh	65583	-	-	-	-	267	-
AJ & K	46976	56	111	-	5768	187	2620
Khyber Pakhtunkhwa	-	12	15	-	42	-	-
G. Total	2719952	367	673	2415310	107102	4065	9722
FFC 2014	FFC 2014	FFC 2014	FFC 2014	FFC 2014	FFC 2014	FFC 2014	FFC 2014

2015 Flood

Flash flood triggered by downpour by rainfall of monsoon season 2015, inundated various areas of Pakistan. Especially Chitral Valley, KPK and areas adjoining Gilgit Baltistan were affected badly by flashfloods generated by glacier melts and torrential rains during night b/w 15th July and 16th July and on 19th July badly destructed roads, village abadies, bridges, agricultural crops. The country wide destructions are described in Table 2.6.

Table 2.6 Country wide Damages/Losses due to Flood 2015

Province/ Federal Agency	Persons Affected	Persons Died	Persons injured	Villages Affected	House Damaged
Sindh	1001696	-	-	3203	-
Punjab	463902	58	11	586	3096
Baluchistan	69976	16	34	NR	1176
KP	361244	109	148	523	4799
G-B	35717	10	21	286	812
FATA	900	19	13	19	425
AJ & K	NR	26	5	17	408
G.TOTAL	1933435	238	232	4634	10716

Historical Records of Floods in Pakistan from 1950 to 2015

Table 2.7 Summary of Damages by Flood from 1950 to 2015

Year	Flooded area (Sq-Km)	Direct Losses (USS million)		Lost lives (No)	Affected village (No)
		@IUSS=PKR 40	@IUSS=PKR 86		
1950	17928	227	488.05	2190	10000
1955	20480	176	378.4	679	6945
1956	74406	148	318.2	160	11609
1957	16003	140	301	83	4498
1959	10424	109	234.35	88	3902
1973	41472	2388	5134.2	474	9719
1975	34931	318	683.7	126	8628
1976	81920	1621	3485.15	425	18390
1977	4657	157	337.55	848	2185
1978	30597	1036	2227.4	393	9199
1981	4191	139	298.85	82	2071
1983	1882	63	135.45	39	643
1984	1093	35	75.25	42	251
1988	6144	399	857.85	508	100
1992	38758	1400	3010	1008	13208
1994	5568	392	842.8	431	1622
1995	16686	175	376.25	591	6852
2010	160000	-	10000	1985	17553
2011	27581	-	3730	516	38700
2012	4746	-	2640	571	14159
2013	4483	-	2000 1US$=PKR94	333	8297
2014	9779	-	440 1US$=PKR100.89	367	4065
2015	2877	-	170 1US$=PKR105	238	4634
Total	**616598**	**8923**	**38165**	**12177**	**197230**

2.2 FLOOD FREQUENCY ANALYSIS

Flood frequency analysis is to estimate the occurrence of specified which often occurs, probability of this flood event occurrence a best fit frequency distribution selected which describe the previous characteristics on magnitude and secondly the probability occurrence of floods. This requires the best flood fit frequency model on the availability of historical record. (Opere.A.O, et.al.2006.). Analysis of Stream flow data is more important to acquire flood's probability distribution before any estimation.(Ahmad, B., Muhammad, S. K., Butt, M.J., Dahri, Z.H., 2010).Results validity in FFA application relates to a hypothesis which is independent and identical distribution of series .(Khaliq.M,et.al. 2006; J. R. Stedinger and R. M. Vogel. 1993).

Different studies employed many statistical distributions in order to quantify most likelihood and flood intensity but no one gained any worldwide acceptance & is particular to any country (G. S. Law, and G. D Tasker. 2003).

Planning, Management and Design of any water resource system requires complete knowledge of very important characteristics of flood such as Volume, Peak and duration. Probability distribution of annual peak discharge is very important in determination of statistics of flows of different magnitudes for design problems. Which are then applied for design, planning and management of water resource project.log normal, weibull, normal, log Pearson type 3,Pearson type 3,gamma and extreme value distributions are most common probability distributions among other probability distributions in the stochastic hydrology (Robert. M. H. 1987; Moughamian. M. S, et.al. 1987; Hromadka. T. V. and Whitley. R. J. 1989; Opere.A.O et.al. 2006.). Pearson and Log Normal distributions are considered fit for peak stream flow and rainfall, while extreme value distribution and Weibull distributions are best for extremes hydrological variables (Burn.D.H. and Goel.N.K. 2001.; Aksoy.H. 2000).

The best fit distribution among others is always remained challenging. (Cunnane. C.1989) worked in selection of most suitable distribution for a country or region.(Vogel. R.M, et al. 1993; Wallis. J. R. 1988 and Benson, M.A. 1968) described flood flows by using several distributions in USA. Various flood distributions were investigated by (McMahon. T.A. and Srikanthan. R. 1981), "Log-Pearson Type 3 Distribution – Is It Applicable to Flood Frequency Analysis.

of Australian Streams?", J. Hydrology, 52, 139-147, 1981.) for Australia. (Ahmad.M.I, Sinclair.C.D. and Werrity.A. 1988) and (Rossi.F, et.al. 1984) estimated various distributions of flood for Scotland and Italy. (Haktanir.T, Horlacher.H.B. 1993) investigated distributions for Turkey. (Mutua.F.M. 1994) made a comparison for various distributions for flood in Kenya. (Vogel.R. M and Wilson.I 1996)., performed a very extensive study related to PDF (Probability Density Function) of Mean, Maximum and Minimum annual stream flows in USA. They analyzed 1455 stations flow observations. (Khan Mujiburrehman. 2013) investigated various frequency distributions for Narmada River in India using monthly peak flood data. GEV type 1, lognormal, Normal and Log Pearson (type 3) were the tested distributions, Normal Distribution was found best fit for Garudeshwar Station with monthly maximum stream data.

(Wisam.A, et.al. 2013) Conducted analysis on River ZAB using Gamble ,log-Normal [type 3], log –Pearson [type 3] and Pearson type 3 statistical models and concluded log-Normal [type 3] as best fit for this river. (B.K. Sathe, M.V. Khire, and R.N. Sankhua. 2012) applied Log Pearson Type 3 on the catchment area of upper Karishna river basin and found this distribution best fit for flood prediction at any site of river. (Jyothi.P, Saurabh.S. 2015) applied Log Gamble's Distribution, log Pearson type 3,log normal, normal and Pearson type 3 and found Log Gamble's distribution as a best fit for River Kosi. (Manas.K.M. 2013.) analyzed River Subernarekha using Gamble Extreme Distribution(GEV) for frequency analysis.(Masum.A.A, et.al. 2014) compared Powell, Gamble, Stochastic methods and Vente Chow and recommended Gumbel as a best fit for Hydraulic Structures using data of 13 years(2000-2012). (Abdullah. A, et.al. 2013) used Powell and Gamble distribution for River DudhKumar with 14 years data. It was assumed that Powell and Gamble distributions are best fit for River Dudhkumar.

(Luna.M.D, Zahid.H.Q. 2014) determined the frequency analysis for River Jiya Dhol and resulted that Gamble Extreme Value and log Pearson Type 3 are the best fit distributions for this River on the basis of 40years discharge data.

(Todorovic.P, Rousselle.J. 1971) concluded Gamble distribution as a best fit approach for the estimation of maximum type event. If we have data in form of instant annual flows then log normal distribution (3 Parameters) is considered as best fit for modeling.Log Pearson 3 and GEV(gumble extreme value distribution) both are considered good for the estimation of high discharge if bulk of flood data is available.

(Ishfaq.A, Abbas. A. 2015) applied generalized logistic, Generalized Extreme value and Generalized Pareto distributions on the data of 44 metrological stations of Pakistan and concluded Generalized Pareto the best one distribution for extreme rainfall. (Zakaullah, Mazhar.M.S. 2012) concluded Gamble distribution best fit approach for the frequency analysis of flood with Chi Square test base after the application of Log-Pearson[type3], Gamble, log-Normal and Pearson [type 3]. (Jacob.O.E, Osadolor.C.I. 2013) functioned Extreme value(EVI) [type 1].Log-Normal (LN) and log-Pearson (LP3)[type 3] distributions on Oshun River, Nigeria and concluded Log-Normal (LN) distribution as a best fit for return period (>50 years) and Extreme Value (EVI) distribution for (<50 years) return periods. (Ghorbani.A, et.al. 2010) functioned 18 distributions to analyze discharge related flood frequency for Iran.

2.2.1 Theoretical Background

Frequency analysis is the computation of interrelation between relative frequency (RF), Probability of Excedence (POE) and average reoccurrence interval (ARI) .

Where POE is probability of flow equal or greater than a specific value and ARI is the return period, which can be described as:

Probability of Excedence(POE) = P(Z)

Relative Frequency(RF) = F(Z)

Average Reoccurrence Interval(ARI) = T(Z)

Where

$$\mathrm{P(Z)} = 1 - \mathrm{F(Z)} \quad \text{.......................... Eq 2-1}$$

$$\mathrm{T(Z)} = \frac{1}{\mathrm{P(Z)}} = \frac{1}{1-\mathrm{F(Z)}} \quad \text{.......................... Eq 2-2}$$

Several methods have been suggested by scholars for calculation of these parameters. Weibull's method was earliest method which was first applied in 1939 for the analysis of frequency of flood. Peak Annual discharge data is ranked either from lowest to highest peak value or vice versa and calculations are made for F (Z) by

$$F(Z) = \frac{n+1}{R} \qquad \text{……………………. Eq 2-3}$$

R is rank of a single flood event Z from the selected data series and n is size of series.

For the comparison with other distributions this simple one distribution is plotted on log paper. Following are few methods which are adopted for present researches nowadays.

Gamble Extreme Value(GEV) Distribution

In 1941 E.J.Gumbel introduced a distribution which was relying on unlimited distribution of extreme events and hence double exponential is most reliable distribution for extreme value fitting. Probability of Excedence and occurrence for any event $z_{\circ}$ is given by

$$P(z \geq z_{\circ}) = 1 - e^{-e^{-x}} \qquad \text{……………………. Eq 2-4}$$

Where

e = Natural logarithm base

x = Reduced Variate, which is given below

$$\mathrm{x = m(z - n)} \qquad \text{……………………. Eq 2-5}$$

Where

$$n = Z - 0.45005\sigma$$

$$m = \frac{1.2858}{`\sigma}$$

$$x = \frac{(z - Z + 0.45\sigma)}{0.78\sigma} \qquad \text{……………………. Eq 2-6}$$

Here

z = Peak Discharge /Magnitude of flood with probability P of occurrence.

Z = Mean (Arithmetic) of all peak discharges in Series

σ =Series Standard Deviation

$$Z_T = Z - k\sigma \qquad \text{……………………. Eq 2-7}$$

This equation is to estimate the Peak Discharge. Where k is frequency factor for Gamble's distribution, is determined by

$$k = \frac{y_T - y_n}{\sigma_n} \qquad \text{……………………. Eq 2-8}$$

Here

y_T = Peak discharge against given reoccurrence interval(R)

y_n = Gumble reduced mean(GRM)

σ_n=Gumble reduced St.devation

Reduce Variate for given return-period Tr is calculated by

$$z = -\ln[ln\frac{T_r}{T_r - 1}] \qquad \text{……………………. Eq 2-9}$$

$$z = \frac{-(0.834 + 2.303loglogT_r)}{T_r - 1}$$

Reoccurrence interval of event have magnitude z is computed by

$$\mathrm{T} = \frac{1}{\mathrm{P}} = \frac{1}{1 - \mathrm{e}^{-\mathrm{e}^{-\mathrm{x}}}} \qquad \text{……………………. Eq 2-10}$$

Log Pearson LP[Type 3] Distribution

This is a distribution which is considered as standard for frequency analysis of flood and is referred as Gamma Distribution. This is most preferable method by several scholars for frequency analysis and is gaining popularity even in India. This distribution has also been acclaimed by United State Water Resource Council(USRC)

Considering its flexibility. Annual peak discharges are first converted to base 10 logarithm form and then Arithmetic mean(AM),Coefficient of Skewness(Cs) and Standard Deviation(SD) are computed for the estimation of Peak Discharge against Reoccurrence interval(RI) or Excedence Probability for an event. Peak discharge computation involves

$$Z = Z_{avg} + k\sigma_z \qquad \text{……………………. Eq 2-11}$$

Z_{avg}=Mean of Logarithm Series

σ_z=Standard Deviation(SD)

k =Frequency Factor is a function of Coefficient of Skewness(Cs) and reoccurrence interval.

Skewness Coefficient is evaluated by

$$C_s = \frac{n\sum_{i=1}^{n}(z-\bar{z})^3}{(n-1)(n-2)\sigma^3}$$

Then evaluate for k

$$P = \frac{1}{T}$$

$$v = \sqrt{\left[\ln(\frac{1}{P^2})\right]}$$

$$J = v - \frac{2.515517 + 0.802853v + 0.010328v^2}{1 + 1.432788v + 0.189269v^2 + 0.001308v^3}$$

$$k = J + (J^2-1)d + \frac{1}{3}(J^3-6J)d^2 - (J^2-1)d^3 + Jd^4 + \frac{1}{3}d^5$$

Where

$$d = \frac{1}{6}C_s$$

Log Normal (LN)Distribution

Annual peak discharges are first converted to base 10 logarithm form and then Arithmetic mean(AM),Coefficient of Skewness(Cs) Which is to take Zero for this distribution and Standard Deviation(SD) are computed for the estimation of Peak Discharge against Reoccurrence interval(RI) or Excedence Probability for an event. Peak discharge computation involves

$$Z = Z_{avg} + k_0 \sigma_z \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{Eq 2-12}$$

Z_{avg}=Mean of Logarithm Series

σ_z=Standard Deviation(SD)

k_0=Frequency Factor, is a function of Coefficient of Skewness(Cs) and reoccurrence interval.

Then evaluate for k

$$P = \frac{1}{T}$$

$$v = \sqrt{\left[\ln\left(\frac{1}{P^2}\right)\right]}$$

$$J = v - \frac{2.515517 + 0.802853v + 0.010328v^2}{1 + 1.432788v + 0.189269v^2 + 0.001308v^3}$$

$$k_0 = J + (J^2 - 1)d + \frac{1}{3}(J^3 - 6J)d^2 - (J^2 - 1)d^3 + Jd^4 + \frac{1}{3}d^5$$

Where

$$d = \frac{1}{6}C_s$$

As for this Distribution Cs=0, thus d=0 and final result for k_0 = J

2.3 SIGNIFICANCE TESTS

Standard deviation and mean describes set of observations or data, which are projected from samples. In some cases sample may become unrepresented and thus leads to too low or too high estimates. This estimate has no any importance if it differs from the expected values more than prescribed limits. Thus statistic's test becomes necessary to analyze either the difference is within limits or not.

To measure compatibility of a random sample from data with theoretical probability distribution function(PDF) tests are performed called goodness of fit(GOF).these tests indicates the fitness of data with distributions. Defining test statistic,(function of data) by measuring distance between data and hypothesis and calculation of probability of the obtained data have larger value than observed value is general procedure behind these tests and we call this probability as Confidence level. Small probabilities (<1%) indicates poor fit, while High probabilities (≈1%) corresponds to best fit which happens often.

2.3.1 Kolmogrov Smirnov Test

This test rely on function of cumulative distribution(ECDF)and decides whether a sample is from hypothesized continuous distribution(HCD) or not. Empirically CDF is given as

$$F_n(z) = \frac{1}{n} X\{No\ of\ Observations \leq z\}$$

Statistics (K_n) of this test bases on highest vertical difference b/w $F_n(z)$ and$F(z)$, is given as

$$K_n = {}^{Sup}{}_{z}|F_n(z) - F(z)| \qquad \text{……………………. Eq 2-13}$$

In case if test statistic (K_n) comes larger than Critical Value which is obtained from table then the hypothetical distribution is rejected at chosen level of significance.

2.3.2 Anderson Darling

In this test we make a comparison is made in between Observed Cumulative distribution function (OCDF) and Expected Cumulative distribution function (ECDF).but in comparison to Kolmogorov Smirnov it gives larger weight to tails.

Statistic (A^2) will be given by

$$A^2 = -m - \frac{1}{m}\sum_{i=1}^{m}[2i-1]X[\ln F(Z_i) + \ln(1 - F(Z_{m-i+1}))]$$ ……………. Eq 2-14

In case if test statistic (A^2) comes larger than Critical Value which is obtained from table then the hypothetical distribution is rejected at chosen level of significance.

2.3.3 Chi Squared

This test is for binned data and test statistic value depends on binness of data and is utilized to know if sample from population comes with certain distribution. Although for number of bins(b),we have no optimal choice. But we have different formulas for the calculation of number based on sample size (N).

$$b = 1 + log_2 N$$

Statistic (C^2) is given by

$$C^2 = \sum_{i=1}^{b}\frac{(O_i - E_i)^2}{E_i}$$ ……………………. Eq 2-15

O_i&E_i= Observed and Expected Frequency for a bin i. The Expected Frequency can be estimated by

$$E_i = F(z_2) - F(z_1)$$

z_2&z_1 are limits for bin i

Hypothesis regarding distributional form will be rejected at selected significance level(α),incase if C^2 is higher than Critical value, is given by

$$C^2{}_{1-\propto, b-1}$$

2.4 FLOOD HAZARD MAPPING OR FLOOD INUNDATION

Flood is excessive water flow causes first Overflow and then Inundation.Floods occurrence is purely natural but the posed risks are wide ranging especially to property and to people. It is that natural phenomenon in which elimination of l flood risks are not conceivable either economically or practically. Settlements are always put on floodplains. The environmental, social and economic assistances at riverside location have outweighed risks, which are found historically. (Alkema.D. 2003) defined probability occurrence of flood event at a specific severity as flood Hazard. Flood severity is represented in term of flow velocity, Duration and Water levels while Probability in term of frequency.(Campana.N.A,Tucci.C.E.M. 2001).Some authors also considers impulse, rise rate and warning time for flood. However depth and Flood extents are important parameters in mapping of flood hazards, other parameters are considered important according to the purpose and situation of Map.

Different Authors have defined flood hazard in different views (Merz.B, Thicken.A. 2006) defines that flood hazards is probability Excedence of damaging flood condition in given area under a specific time period.

To date a technical approach is applied for protection designing; the basic focus of this approach is giving confidence on certainty in defensing flood. Several Methods are available for accurate flood prediction, all the places where flooding will take place. Flooding duration, Velocities, flow depths, flooding extent and rise rate can also all be predicted.

Urban flooding which is significant challenge now a days, increasingly provokes residents of expanding towns and cities of under developing countries (Jha, Abhas. K, et. al. 2012). Presence of impervious surface plus hydrologic structures (manmade) contributes flash flooding in urban areas. Over the few last decades Flooding has significantly increased due to continued infrastructure development and urban centers without considering drainage aspects (Tennakoon. 2004).

Rapid urbanization is responsible that floodplains became attractive areas for development and human settlements(Alkema.D.2007)which causes interference with floods (WMO/GWP. 2008). For its avoid complete knowledge on how management and development activities have a significant impact on flood risks is more important. Both urbanization process and flood behavior's aspects are all considered in various approaches for flood management. (Menzel, Kundzewicz. Z. W. 2003) and (Sliuzas. R. 2012) emphasized on the existence of nonstructural and structural approaches for flood management. Structural methods concentrate more on the physical protections such as levees, reservoirs, floodway, channel improvements, dikes and dams, while nonstructural on evacuation, flood warning, insurance mechanism and watershed management.(Parodi. G. 2009) but none of above methods guarantees safety against the flooding (Menzel, Kundzewicz. Z. W. 2003.)use of these approaches into integrated flood management (IFM) proved only way to reduce risks of flood (Kundzewicz.Z. W., Takeuchi K.1999; Jha, Abhas.K, et. al.2012; WMO. 2006) IFM takes universal outlook of flood management than outdated engineering perspective (Sliuzas. R. 2012).

A prominent tool for the mitigation of flood consequences is Flood Hazard maps. They are considered as very important for mitigation of natural hazard impacts. (Alkema.D. 2004.),these maps are easily interpretable and every non-technical and technical individual can easily understand it.(FEMA. 2000)But fails in the communication of potential to users in fulfilling needs, for awareness raise and in provision of understandable and clear information it is the best source for planning. The flood magnitude How often floods occurred in its historic period is the first task to be determined for the assessment of flood hazards.(Alphen. V. et al. 2009; EXCIMAP. 2007 and Zeil. P, et.al. 2009) resulted that vulnerability reduction is not too much effective in public encouraging because user groups and public responds disputatious to map contents.

(Pender. G, Neelz. S. 2007) appraised existing one dimensional(1D) and two dimensional (2D) models. Principle of momentum, energy and mass conservation of these models are same(Bates.PD, Horritt.MS. 2002).for confined water in channel unsteady 1D model is best for simulation (Verwey. S. A. 2006) and simulation is by one dimensional (1D) Saint Venant Eq, (Bates.PD, Horritt. MS. 2002) one dimensional (1D) models defines flood in term of water level and discharge as function of time and space with limitations of flood simulation inoverland, which causes shifting of 1D model into 2D flow model.(Bates.PD, Horritt.MS. 2002).Two dimensional (2D) flood model prophesies flood inundation on the basis of Two dimensional (2D) shallow water Eq. (Mignot. E, et. al. 2006), which consists of three equations 2 equations for momentum conservation and 1 equation for Continuity (Mignot. E, et.al. 2006.)

As both One dimensional(1D) and two Dimensional(2D)flow model have some disadvantages and some advantages but integration of these flood models is an extensive approach for floodplainning which extends model capability for simulation of more accurate flood (Shaviraachin.T. 2005)1D-2DSOBEK (Alkema. D. 2007), SW12D (Wesselling. C. G, et.al. 1996) are various models which offers capability.

For the hazardous evaluation, United State and other sources have developed different models to assess the historic floods in order to predict a future flood event. Various models are there to possess different functions for flood assessments. Modelling approach is considered as an operative tool for the management of water resources. Hydrologic & Hydraulic models are two types of water resources related models. Hydrologic models are to deal with simulation of stream flows which contributes from watershed to river and various water properties, while hydraulic models are to deal with simulation of flows that can overflow and inundates the area and Channel properties. PRMS (Precipitation runoff modelling system), SWAT (Soil & Water assessment tool), (HSPF)FORTRAN, WEPP (Water erosion prediction project) SHE (System Hydrologic European), HEC-HMS/HEC-1(Modelling system of Hydrologic Engineering Center and GSSHA (Gridded surface Hydrologic analysis) are known as Hydrologic Models while HEC RAS, Quick2 and Storm CAD as Hydraulic Models.

Model Calibration and then its Validation is more important for the estimation of Scenarios. Calibration is the process of supporting model to imitate real world with simulation as close as possible. While validation of model is process of confirming ability of model which is calibrated without change of any parameter. HSPF model was calibrated and then validated by (Ninova.P, Ribarovab.I, Kalinkovb.P, Dimovab.G. 2008) for River Lesnovska using Geographical, Hydrological, GIS and meteorological data of 2003-2004 period and model was validated for 2005 year. Water balance was estimated from the estimation of water volume crossing a hydrometric station and results were then compared with simulated volume of HSPF Model. (Al-Abed.N.A, Whiteley.H.R. 2002) calibrated HSPF model with GIS. He found that automatic calibration with GIS gives more accurate and realistic calibration for model HSPF with less effort than unassisted calibration.the results produced by this calibration was very satisfactory. (Singh.V.P, Woolhiser.D.A. 2002;Borah DK, Bera M. 2003)worked on different hydrologic models. (Chung.E.S, Park.K, Lee.K.S. 2011) studied Watershed of south Korea for determination of urbanization and climate change effects on water quantity and quality with HSPF.

(Ahmad, B., Muhammad, S. K., Butt, M.J., Dahri, Z.H., 2010) researched on Hydrologic Modelling &Flood mapping of Nallah Lai ,they used First HECRAS and then Hec–GeoRAS for delineation of vulnerable area. (Karki.S, et.al. 2011) used first HECRAS model and then Hec GeoRAS extension for hazardous mapping of flood for Kankai Watershed. (Maidment, D.R, et.al. 1998) used HECRAS model for floodplainning for Waller Creek located in Austtin, Texas. He in his research highlighted that for modelling of Floodplain GIS is very effective source and secondly HECRAS provides better representation by improving visualization. There is no any limit which is seen in any paper .to determine impact of flooding by urbanization (Mudgal.B.V, Suriya.S. 2012) applied HECRAS model for flood mapping for Thirusoolam subwatershed, Chennai.

So during few years continuously Hec-Ras is the only software which is used by different authors for flood hazardous mapping, which can be described as:

2.4.1 Profile Computation

Energy equation is used for the computation of water-surface profiles from a cross-section to other with an iterative method which is also known as Standard step method, is given by

$$Y_2 + \frac{1}{2g} \propto_2 V_2^{\,2} + Z_2 = Y_1 + \frac{1}{2g} \propto_1 V_1^{\,2} + Z_1 + h_e \quad \text{........................} \quad \text{Eq 2-16}$$

Z_1&$Z_2$are elevations of main channel upturns

Y_1&Y_2 are water depths at cross-sections

V_1&$V_2$are average velocities

$\propto_1$ &$\propto_2$ are velocity coefficients

h_e is head loss in terms of energy

$$h_e = S_f L + C \left| \frac{\propto_2 V_2^{\,2}}{2g} + \frac{\propto_1 V_1^{\,2}}{2g} \right| \quad \text{........................} \quad \text{Eq 2-17}$$

L= Reach Length

S_f=Friction slope in between sections

C=Coefficient of Expansion or Contraction loss

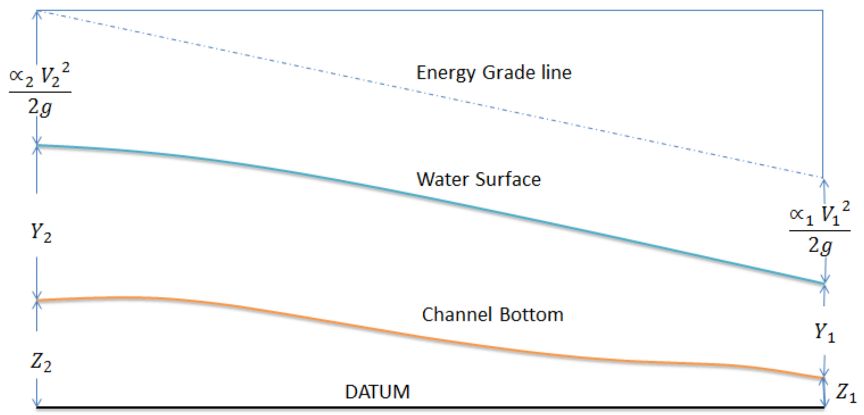


Figure 2.1: Water Surface Profile distribution for Gradually Varied flow

Chapter III
METHODOLOGY AND APPLICATION PROCEDURE

3.1 DESCRIPTION OF STUDY AREA

Swat Valley is located In between of foothills of Hindukush mountain range and is known for its snowcapped peaks, glaciers and countless waterfalls, Pastures and water springs, rivulets and streams, glens and glade, thick wood and scenic beauty.

High mountains have surrounded by this valley and is bounded by Ghizer and Chitral districts in North Shangla and Kohistan districts in East, Malakand and Buner districts in South, Upper&lower Dir districts in west. Altitude of this area differs from 2500-7500 ft. and area of about 50337km². The historic and lush green Swat valley deceits in between Latitude of 34˚40′-35˚N and longitude of 74˚6′ E.it is a part of PATA (Provincially administrated Tribal Area) of Pakistan's North-West Frontier Province. Swat valley is a central part of Significant and strategic region where (3)Three Major parts of Asian continent Central Asia, China and south Asia meets. Suvastu and Udyana are the names which are found in the ancient sources for Swat, because of its scenic beauty and river name respectively. Swat valley is spread-eagled over an area of about 5737 km² with 2800feet average elevation above Mean Sea level. The Valley physiology changes from South to North with an increase of elevation. River Swat flows in the valley axis. Malakand is southern boundary of Valley Swat, which is situated at a distance of about 91 kilometers from Peshawar and 211 Kilometers from Islamabad. Swat is well-known for its Scenic and historical tourist terminus in all over the world. Swat valley is most fertile beautiful and green valley than further north valleys. In Upper swat valley, River passes through Narrow valley and Swat-Kohistan is Northern mountainous slice of Valley where forests(alpine) in snow-capped mountains are in abundance. MT Mankial and Mt Falaksir are the chief peaks in these mountains. Lower swat valley is widespread and fields are there on either river side, have prosperous villages and are surrounded by Fruit-laden orchards. The location of Swat District in Project Boundary is shown in Figure 3.1.

Kalam is one of the villages along upper reaches of River Swat and is famous for its lakes, lush-green hills and Water falls. Kalam Valley is located upstream 25 miles from Bahrain, 100 kilometers from Mingora and 200 meters above sea level, is a spot from where Swat river cuts Broader-banks among high mountains on the both sides. Highest mountain is Mt.Mankial. The 2 peaks Falakser 21000ft and Mankial 18500ft are shielded by Snow. Saidi and Daral are Swats most important lakes. River Daral passes through Bahrain is located high among hills near this town. River Swat, which basically is Perennial River and is fettered by tall mountains has diverted its water to thriving monster to release from shackling but at some places it is very salient and calm and does not shows any rebellion signs. River instigates from Swat-Kohistan region in Kalam and goes downstream in a constricted ravine up to Baghdheri and has 2 main tributaries Gabral and Ushu. Hindukush Mountains are the basic source from where glacial water fed it entire year and then passes through Kalam Valley with rushing speed in a constricted gorge up-to Madyan and the lower plain zones of Valley Swat up-to Chakdara for 160kms.River meets with Panjkora river by entering through narrow gorge in extreme south of Valley and finally drains in to River Kabul near Charsada.

The rustic swat valley has number of precious natural resorts where respite and solace can be found from never ending life struggles. Kandol lake is one of them and is located in North of valley Utror. Utror valley is located in between 35˚20′-35˚48′ N latitudes & 72˚12′-72˚32′E longitudes and is16 kilometers from Valley Kalam, the Epicenter of Swat-Kohistan and 120 kilometers from Saidu-Sharif. The Valley population is 6888 and Valley area is 47400 hectares. The Valley is fenced by Bhan and Gabral valleys on East, Valley Kalam on South, Valley Gabral on North and District Upper Dir on West. At Upper proper the Valley altitude is about 2300 m, which reaches to 2900 m at the Kandol Lake.

3.1.1 Natural Topographical & Drainage Features

Surface land of the Swat valley consists of following forms**:**

a) Very rugged terrain

b) Steep Valley slope mainly of V-Shaped

c) residual hills & Acute Ridges

d) Ravines & small rivers

e) Depressions &Troughs

f) Dendritic drainage

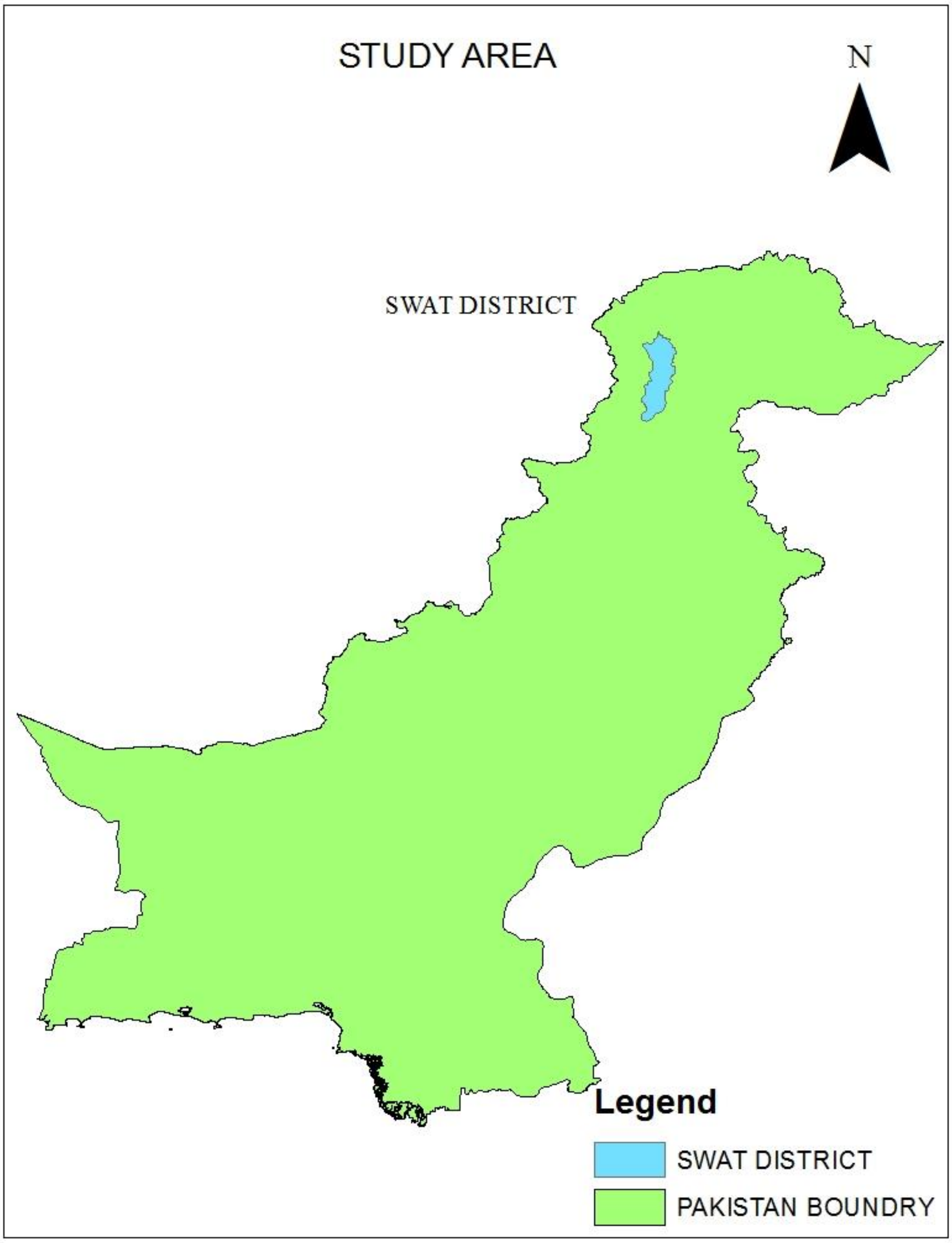


Figure 3.1: Location of Swat in Pakistan Map

a) Very rugged terrain

The Terrain of the valley is generally very rugged and secondly has high relief .Forests and Mountains have surrounded this valley completely and the elevation varieties from 500-6000 meters m.a.s.l.

b) Steep Valley Slope mainly of V-Shaped

The valley base is fewer than 2200 feets which is Kayal village in south and the nearby peaks ranges from 10000 to 12000 feets. Thus valley has very steep slopes, in which major slope type is of V-Shaped.

c) Residual Hills & Acute Ridges

They rise up to the 1200 meters. Due to constant erosion and deposition, residual hills made up of resistant rock are found. Residual hills are hard which left behind after erosion.

d) Ravines and small Rivers

Small rivers erode the land and take away the alluvium during the rainy season. A feature common in most of the landscapes.

e) Troughs and Depression

A soft rock eroded by water and wind creates troughs and depression.

f) Dendritic Drainage

Generally the drainage pattern of the valley is dendritic, Some small streams also meets with major consequents perpendicularly and locally produces trellised pattern.

3.2 PHYSICAL FEATURES OF VALLEY SWAT

Swat valley consists of 2 physical regions. Swat proper and swat Kohistan. Swat Kohistan basically is mountainous region on upper reaches of river swat up to South Ain. While Swat proper is the entire South ain .Ain is further divided into Kuz(lower Swat) and Bar (Upper Swat). Valley elevation at southern boundary of district is about 600m ,which rises towards North. Valley consists of various mountain peaks covered with perpetual snow, which ranges from (4500-6000)m above the Sea level.

3.3 CLIMATE OF VALLEY SWAT

Basically swat is located in temperate zone, in lower portion of swat valley summer is moderate and short, while cool in Upper Northern portion. June is the hottest month for this area with recorded Mean Minimum & Maximum temperature is 16˚C &33˚C respectively and January is the coldest month with recorded mean minimum & maximum temperature -2 ˚C and 11˚C.Rainfall amount during summer season is less than winter season. Snowfall and rain generally occurs during winter season, which ranges in between November and March, 242mm in March is the Recorded maximum Rainfall for this area.

3.4 TOPOGRAPHY OF VALLEY SWAT

Swat valley is located in North b/w 34˚40 -35˚N latitudes & 72-74˚6 E longitude with an altitude of about 2000 meters above sea-level. The region amid mountainous territory with number of intersecting streams rolling in between Swat and Kalam. The area is Humid with trivial summer season and annually mean rainfall surpasses 1000 millimeters. Annual mean temperature ranges in between 18˚C & up-to 30˚C in summer. Rivers subject to various natural hazards. Seasonal floods recurrently occurs in July-August and water level due to the glacier melts and torrential rainfall in Pakistan's higher portions rises .Rainfall pattern for July & August varies from 120 to 134 millimeters. With the passage of time swat valley is subjected to more erosion and land-sliding due to deforestation.

3.5 DRAINAGE PATTERN

The drainage pattern of the Basin is dendritic due to V shaped Valley, in which there exist numerous contributing streams, which then join together into tributaries of River. The system is like branches and trunk of tree respectively, usually such type of pattern develops when channel of river follows slope of terrain. Rock type is non-porous and impervious.

3.6 GEOLOGY OF VALLEY SWAT

Principal rocks in south and southeast belong to Lower Swat Buner schistose-group, which is generally represented by quartz-mica schists, marbles, phullitic-schists, greenschists, graphitic schists, calcareous schists, amphibolite and low-grade quartzite. These were imposed by ultramafic-rocks during earlier phase of Himalayans orogency. Granite Gneisses, Pegmatites, Granite were also intruded during later phase of orogency.

3.7 COLLECTION OF ESSENTIAL DATA FOR ANALYSIS

Collection of needed data is one of the very important processes for analysis. This data is essential in the application of different empirical approaches and Hydraulic analysis model, HEC-RAS. Data is collected from various Government Departments and Non- Government bodies such as WAPDA; Irrigation Department KPK and NESPAK are various Government Departments and Non- Government body from which following data is collected

1. Stream Flow/ Discharge data recorded at WAPDA gauge Stations.
2. Elevation Data.
3. Areal Coefficients considering topography.

1. **Stream Flow/ Discharge Data**

Recorded Stream Flow/ Discharge data of Swat river at Kalam &Chakdara stations was collected from Surface water and hydrology reports. About 47 years discharge data was collected for the above mentioned two stations located at upstream and downstream of the study area ranging from 1963-2010.The peak stream flow record is also taken from Irrigation Department KPK of flood 2010 at Khwazakhela site because of the failure of WAPDA gauges in flood 2010.

2. **Elevation Data**

Elevation data is essential for Flood Hazard Mapping and River pattern in terms of its centerline and bank-lines. Digital Elevation model(DEM) was utilized as an elevation source. DEM is taken from freeware websource www.cigar.org.

3. **Areal Coefficients Considering Topography**

Areal Coefficients such as Manning n for the River Swat is taken from NESPAK a Non-Government Body.

3.8 OPEN-CHANNEL FLOW

Open-channel flow is the free surface flow of a fluid with in a demarcated channel. Natural stream flow, Storm sewer and Drainage canals are the typical examples of such flows. Flood-plain management plan require the knowledge about hydraulics of such flows, which depends upon classification of flows, flow & Conveyance and energy equation.

3.8.1 Flow classification

Space, Time and Regime of flow are the parameters by which open-Channel flows are classified.

Space

Uniform flows are those fluid flows in which Velocity and depth remains constant w.r.t space, but this requires straight channel without any change in cross-sectional geometry and water-surface remains parallel to bed of channel. While in Non-Uniform flows velocity and depth varies with space along channel.

Time

Steady flows are those fluid flows in which velocity and depth remains constant with time while in unsteady flows these properties varies w.r.t time.

Flow Regime

Froude Number (Fr), a dimensionless parameter classifies the flow types.

$$\mathbf{Fr = V/\sqrt{gy}} \qquad \text{……………………. Eq 3-1}$$

Where

V = Average fluid Velocity

Y = Flow depth

g = Gravitational acceleration

- Flow will be sub-critical when $Fr < 1$
- Flow will be critical when $Fr = 1$
- Flow will be super critical when $Fr > 1$

Velocity and Flow rate are calculated or should be known for the determination of Water-Surface elevation at various X-sections. in Steady-gradually varied flow velocity &flow depth gradually varies over channel length and this assumption is used for super and subcritical type flows for Hydraulic analysis of river(Prasuhn,1992)

3.8.2 Flow & Conveyance

According to Continuity Equation flow must remain constricted in between the adjacent X-Sections.

$$\mathbf{Q = \ A_1V_1 = A_2V_2} \quad \text{……………………. Eq 3-2}$$

Q=Discharge/Stream Flow

A_n=Cross-Sectional area at section n

V_n= Cross-Sectional area at section n

Momentum Equation in the term of Manning equation is utilized for Open-Channel flow, which is given by

$$\mathbf{Q = \frac{A}{n} R^{0.67} \sqrt{S_f}} \quad \text{……………………. Eq 3-3}$$

n= Manning’s Co-efficient for roughness

R=hydraulic radius

S_f=Frictional-slope b/w adjacent cross-sections

Subdivision of Cross-section is made for the conveyance determination on the basis of manning Co-efficient into ROB(Right Over-Bank),MC (Main Channel) and LOB(Left Over-Bank).Total Conveyance will be the sum of individual sub-division conveyances (HEC, 1997).

3.8.3 Energy Equation

For the Open-Channel flow, the energy head (Energy per Unit Weight) will be due to Elevation-Head, Pressure-Head and Velocity-Head.

$$\boldsymbol{H_T = z + y + \frac{\propto V^2}{2g}} \quad \text{……………………. Eq 1-4}$$

H_T = Energy Head

z = Elevation-Head

y = Water Depth/Pressure-Head

$\propto$ = Energy Co-efficient

This data is essential in the application of different empirical approaches and Hydraulic analysis model, HEC-RAS. Data is collected from various Government Departments and Non- Government bodies. The details about data collection for described work are explained in previous chapter. The related information about study area is also explained in Third chapter.

3.9 FREQUENCY ANALYSIS OF HISTORIC DATA

In the research a best fit frequency distribution Gen Extreme Value [Type I] distribution is used for the estimation of occurrence of specified which often occurs, probability of this flood event occurrence .The selected frequency distribution describes the previous characteristics on magnitude and secondly the probability occurrence of floods. Easy fit is selected as a best flood fit frequency model on the availability of historical record.

3.9.1 Gamble Extreme Value(GEV) Distribution

In 1941 E.J.Gumbel introduced a distribution which was relying on unlimited distribution of extreme events and hence double exponential is most reliable distribution for extreme value fitting. Probability of Excedence and occurrence for any event $z_{\circ}$ is given by

$$\boldsymbol{P(z \geq z_{\circ}) = 1 - e^{-e^{-x}}}$$

Where

e = Natural logarithm base

x=Reduced Variate, which is given below

$$\mathbf{x = m(z - n)}$$

where

$$n = Z - 0.45005\sigma$$

$$m = \frac{1.2858}{\sigma}$$

$$\boldsymbol{x = \frac{(z - Z + 0.45\sigma)}{0.78\sigma}}$$

Here

z =Peak Discharge /Magnitude of flood with probability P of occurrence.

Z=Mean (Arithmetic) of all peak discharges in Series

σ =Series Standard Deviation

$$\boldsymbol{Z_T = Z - k\sigma} \qquad \text{……………………. Eq 3-5}$$

This equation is to estimate the Peak Discharge. Where k is frequency factor for Gamble's distribution, is determined by

$$\boldsymbol{k = \frac{y_T - y_n}{\sigma_n}}$$

Here

y_T = Peak discharge against given reoccurrence interval(R)

y_n = Gumble reduced mean(GRM)

σ_n=Gumble reduced St.devation

Reduce Variate for given return-period Tr is calculated by

$$\boldsymbol{z = -\ln[ln\frac{T_r}{T_r - 1}]}$$

$$z = \frac{-(0.834 + 2.303 loglogT_r)}{T_r - 1}$$

Reoccurrence interval of event have magnitude z is computed by

$$\boldsymbol{T = \frac{1}{P} = \frac{1}{1 - e^{-e^{-x}}}}$$

3.10 PROBABILITY DISTRIBUTION FUNCTION(PDF) TESTS

In the research EASYFIT is used to measure compatibility of a random sample from data. Kolmogrov smirnov, Anderson Darling and Chi-Square tests were used, a brief description is stated below.

3.10.1 Kolmogrov Smirnov Test

This test rely on function of cumulative distribution(ECDF)and decides whether a sample is from hypothesized continuous distribution(HCD) or not. Empirically CDF is given as

$$F_n(z) = \frac{1}{n} X\{No\ of\ Observations \leq z\}$$

Statistics (K_n) of this test bases on highest vertical difference b/w $F_n(z)$ and$F(z)$, is given as

$$\boldsymbol{K_n = {}^{Sup}_{z}|F_n(z) - F(z)|} \qquad \text{……………………. Eq 3-6}$$

In case if test statistic (K_n) comes larger than Critical Value which is obtained from table then the hypothetical distribution is rejected at chosen level of significance.

3.10.2 Anderson Darling

In this test we make a comparison is made in between Observed Cumulative distribution function (OCDF) and Expected Cumulative distribution function (ECDF) but in comparison to Kolmogorov Smirnov it gives larger weight to tails.

Statistic (A^2) will be given by

$$A^2 = -m - \frac{1}{m}\sum_{i=1}^{m}[2i-1]X[\ln F(Z_i) + \ln(1 - F(Z_{m-i+1}))] \ldots\ldots\ldots\ldots\ldots \quad \text{Eq 3-7}$$

In case if test statistic (A^2) comes larger than Critical Value which is obtained from table then the hypothetical distribution is rejected at chosen level of significance.

3.10.3 Chi Squared

This test is for binned data and test statistic value depends on binness of data and is utilized to know if sample from population comes with certain distribution. Although for number of bins(b),we have no optimal choice. But we have different formulas for the calculation of number based on sample size (N).

$$b = 1 + log_2 N$$

Statistic (C^2) is given by

$$\boldsymbol{C^2} = \sum_{\boldsymbol{i=1}}^{\boldsymbol{b}} \frac{(\boldsymbol{O_i - E_i})^2}{\boldsymbol{E_i}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad \text{Eq 3-8}$$

O_i&E_i= Observed and Expected Frequency for a bin i. The Expected Frequency can be estimated by

$$E_i = F(z_2) - F(z_1)$$

z_2&z_1 are limits for bin i

Hypothesis regarding distributional form will be rejected at selected significance level(α),incase if C^2 is higher than Critical value, is given by ${C^2}_{1-\propto,b-1}$

3.11 EASYFIT SIMULATION

Easy Fit is an application for data analysis and simulation, allowing fitting the probability distributions into sample data. It is the combination of classical-Statistical analysis methods & advanced data-analysis techniques which helps in taking decision about probability data.

3.11.1 Input Files

Stream flow/Discharge data or rainfall data etc. and selection of best models serve as an input for the model. Discharge data taken from SWHP are given in Annexure A.

3.11.2 Functioning with Data

The analysis is performed by entering data in Easyfit; Following are the methods by which data can be entered.

- Manual Data Entry
- Importing data in the format of CSV or text file from Excel-workbook.
- Pasting data from Clipboard

In this research work Discharge data recorded at Chakdara Station in SI system is copied from Excel workbook and is pasted, which is taken from SWHP.

Data Analysis

Easyfit provides necessary features for the specification of input data, performs analysis and finally interprets results.

Input data

After selecting data analysis command, Data domain is selected as continuous and Discharge values in Sample data in the appearing window, which is represented in Figure 3.2.

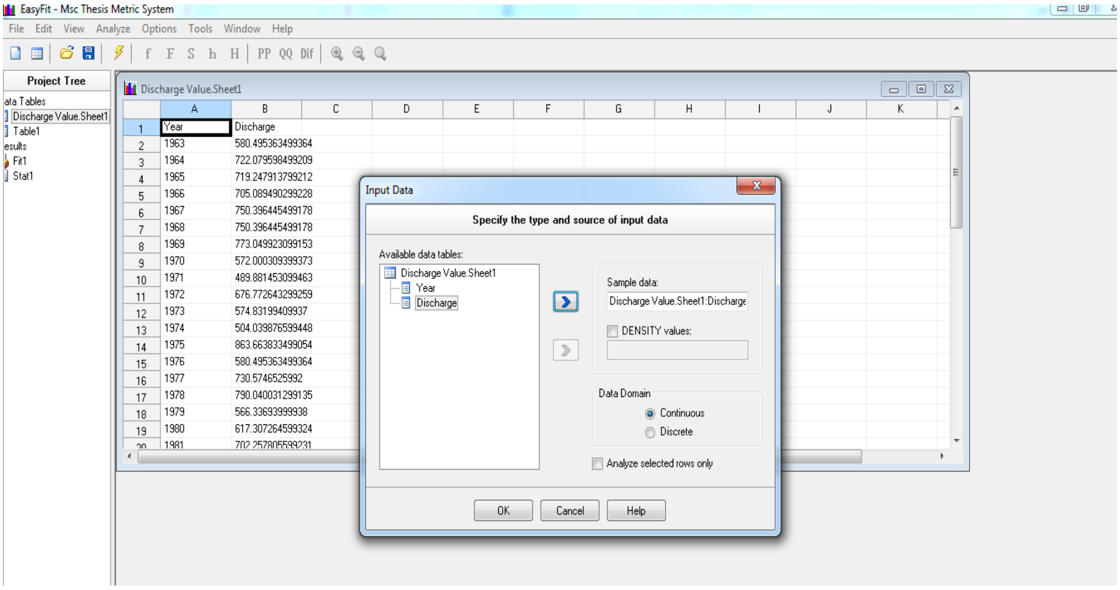


Figure 3.2: Input Data and Selections in Easyfit Simulations

Continuous Sample data format is selected because we have just 1 data field which is discharge values.

Distribution Fitting

This step involves selection of distributions to be inevitably fitted to data. Following are the distributions selected.

Unbounded

- Gamble Max
- Gamble min
- Normal

Non-Negative

- Lognormal

Advanced

- Log Pearson
- Lognormal 3P

Bounds

The process of distribution is affected by both Upper and lower Bound settings, Both Upper and lower bounds are not known and we have no information about it so the Unknown selection is made.

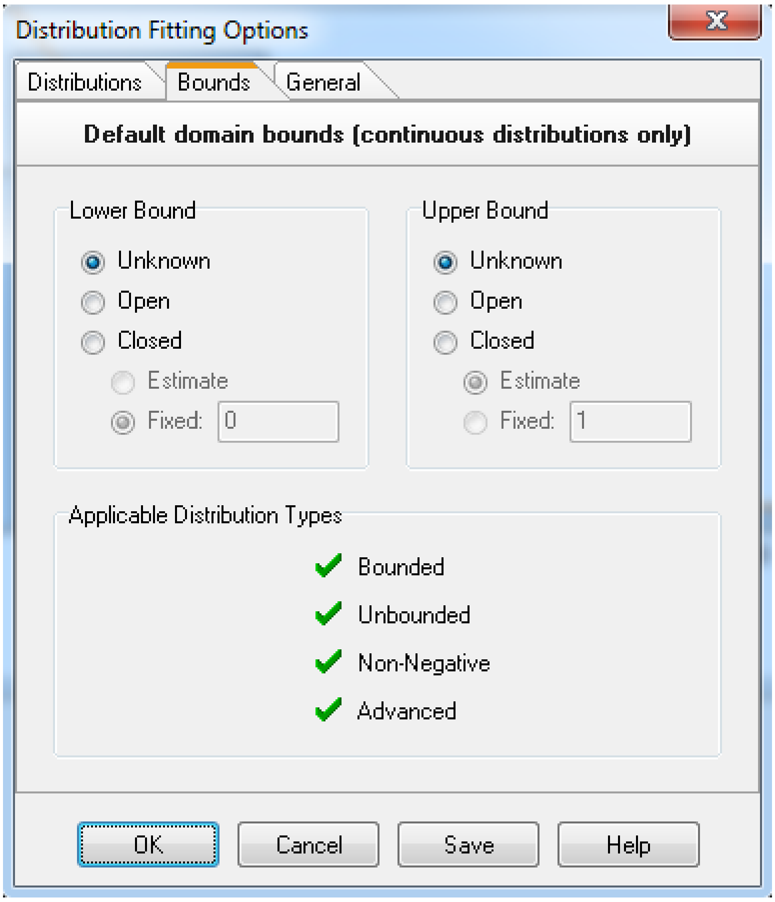


Figure 3.3: Bounds Distribution Fitting Options for Easyfit Simulation

General option

Maximum-likelihood Estimates(MLE) is a method for fitting many supported distributions of Easyfit, iterative-parameter-estimation-algorithm is used for mostly distributions, Easyfit offers way for the selection of maximum number-of-iterations and accuracy of estimation. For this research number-of-iterations are kept upto 100 while accuracy up to 1×10^{-5}.

Easyfit also provides way to state which goodness-of-fit tests are to be performed, for this research Kolmogorov smirnov, Anderson Darling and Chi-Square with equal probability are selected.

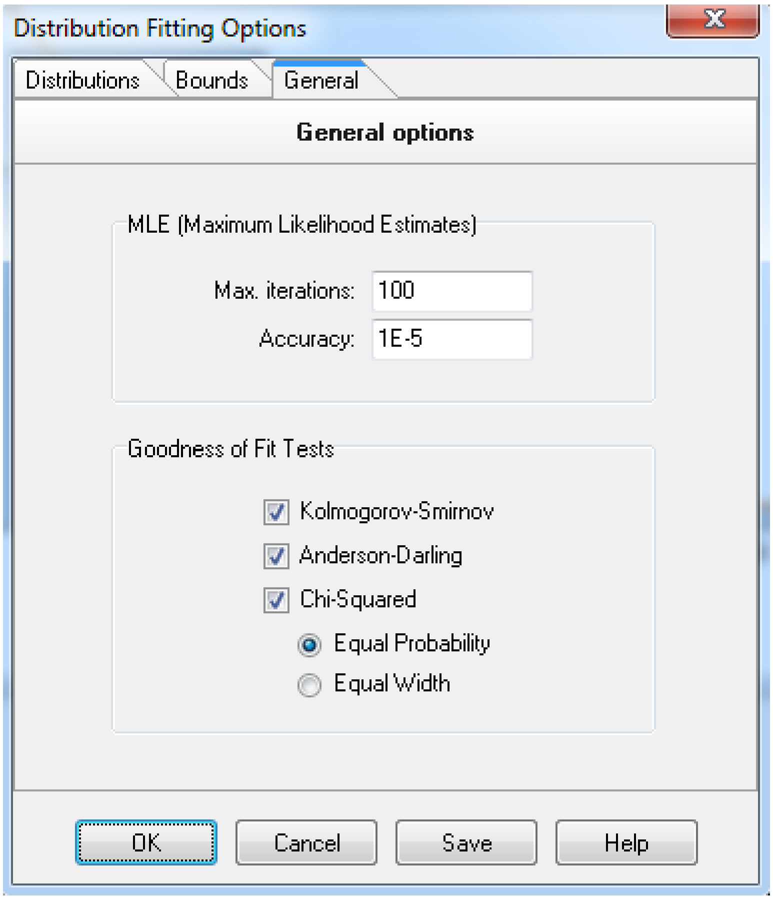


Figure 3.4: Bounds Distribution Fitting Options for Easyfit Simulation

3.12 HEC-RAS

The Hydraulic Model HEC-RAS is the development of(HEC)Hydrologic-Engineering Center U.S army corps of Engineers. For the Floodplain determination and analysis of stream-channel Computer model HEC-2 was released by HEC in 1964.Hec-2 hurriedly became standard hydraulic program for stream analysis and capabilities were protracted in succeeding years by the provision of weir, culvert and bridge analysis. In early 1990s HEC introduced window compatible in replace of HEC-2, which was DOS supportive and termed RAS River-Analysis system. Hec-Ras has graphical user-interface programmed in Visual-Basic, to which Flow Computation algorithms-Programs in FORTRAN are attached, numerous were imitative from HEC-2 Model. HEC-RAS is one dimensional steady-flow model, projected for water-surface profile computation. Computations of Unsteady-flow and movable boundary-sediment transport are also included in module. Supercritical, Subcritical and mixedflow-regimes conditions can be controlled in system for single river-reach, dendritic system & full channel network. The results are then applied in flood-insurance study and managing floodplain for the evaluation of effects caused by floodway encroachments (HEC,1997).

3.12.1 HEC-RAS Parameters

Number of parameters is used in HEC-RAS for the hydraulic analysis of water flow and channel geometry of stream, by these parameters series of X-sections can be established along stream. In each X-section location of stream-banks are identified, which separates left-floodway, Right-floodway and Main Channel. Subdivision of cross-sections in HEC-RAS is due to different hydraulic-parameters. The influence of friction forces b/w channel bed and water will be greater if floodway's wetted perimeter is more than main channel, which will lead to lower Manning n value and higher flow velocity and conveyance in main channel than floodway.

Several parameters are used as an input by HEC-RAS at every single X-section for the description of Elevation, Relative location and shape

- River-Station(X-Section) number
- Elevation and Lateral co-ordinates for every single (Unflooded, dry) terrain point

- Locations of Right and Left bank-stations
- Reach length b/w left-floodway, stream-Centerline and Right-floodway of the adjacent X-sections. These reach-lengths represent average flow-path through every slice of X-section pair, these reach lengths may differ due to the presence of stream bends in magnitude.
- Co-efficient of roughness Manning n
- Channel expansion and contraction coefficients
- Description of geometry of hydraulic structures, like culverts, weirs and bridges

HEC-RAS based on an assumption that energy head across the X-section is constant and velocity vector to the X-section is perpendicular (i.e. Quasi-One dimensional flow).Flow should meet this criterion for each selected X-section. After defining geometry of stream, the discharge values are entered for every single reach present in river system. Descriptions of channel geometry and flow rate are primary inputs of model for hydraulic computations.

3.12.2 Water Surface Profile Computation

Water-surface profile for steady-gradually varied flow is primary computed by Direct-Step Method but it supports the WSPRO bridge, Yarnell Method and momentum too. The computational procedure is Iterative-solution of Energy equation. Water-surface elevation and flow are given at a X-section. Computation of Water-surface elevation at adjacent X-sections is goal of Standard-step method. For subcritical type flows computation starts from downstream boundary, which proceed upstream; for supercritical flow computation starts from upstream boundary, which proceeds downstream. Water-surface elevation and flow must be known at boundary

Following is the procedure for subcritical flow

1. First Assume water-surface elevation at X-section 1.
2. Determine the area(A), hydraulic radius(R), and velocity(V) (Eq. 3-1) of X-section 1 on the basis of X-section profile.
3. Compute the attendant conveyance (Eq. 3-2) and values of velocity head.
2. Calculate the friction slope, friction loss and Expansion/contraction loss.
3. Solve energy equation (Eq. 3-4) for water-surface elevation at adjacent X-section.
4. Make a comparison between computed water-surface elevations with assumed value in step No 1.
5. Repeat the steps from 1 to 6 until computed and assumed water-surface elevations reach within predetermined tolerance.

Then for the automation of floodplain mapping GIS is essential to allocate map coordinates, following are Some GIS concepts.

3.13 GEOGRAPHIC-INFORMATION SYSTEMS

GIS is a developed tool specially for cartographers, it assembles, stores, manipulates and displays information related to geography(USGS,1998).Recently GIS has gained prevalent practice in Engineering Analysis and Design, especially in Hydrology, Hydraulics and water quality fields.

GIS offers a setting to overlay data-layers in order to perform the spatial quaries to create a new spatial-data. The Results then can be either digitally mapped or tabulated which facilitates in Decision making and effective analysis.

GIS joins the graphical elements such as Lines, Points and polygons with relevant tabular attributes description. Structurally it consists of computer environment which sets it apart from databases(Tabular-Descriptive data) and computer aided software (Geo-graphic representation).

For example, in GIS-View of river network graphical elements epitomize the shape and location of rivers while attribute describes stream-name, length and discharge/flow rate. The one to one relationship between feature and feature relevant attribute makes a unique GIS environment. Some basic constructs are necessary to be first defined for the provision of conceptual framework.

3.13.1 Data Model

In GIS graphical elements can be described by 3 data models including Vector, raster or TIN Triangular irregular-network, are described below.

Vector

Vector type data models include 3 element types lines, points and polygons. Line is the series of points in which intermediate points are termed as vertices and node to beginning & end points. Straight line contains no vertices but just 2 nodes while curved line contains Number of vertices and 2 nodes (Smith.P, et.al. 1995).Point is single-set of Cartesian-coordinates((x)Easting.(y)northing).At least 3 or more lines are connected to create an enclosed area, known as polygon.

Modelling of Linear features such as (Lakes, roads etc.), Modelling of time-varying process and cartographic base-maps are represented by Vector data model. In

Figure 3.5, points represent flow gages, lines represent streams, and polygons represent watershed boundaries.

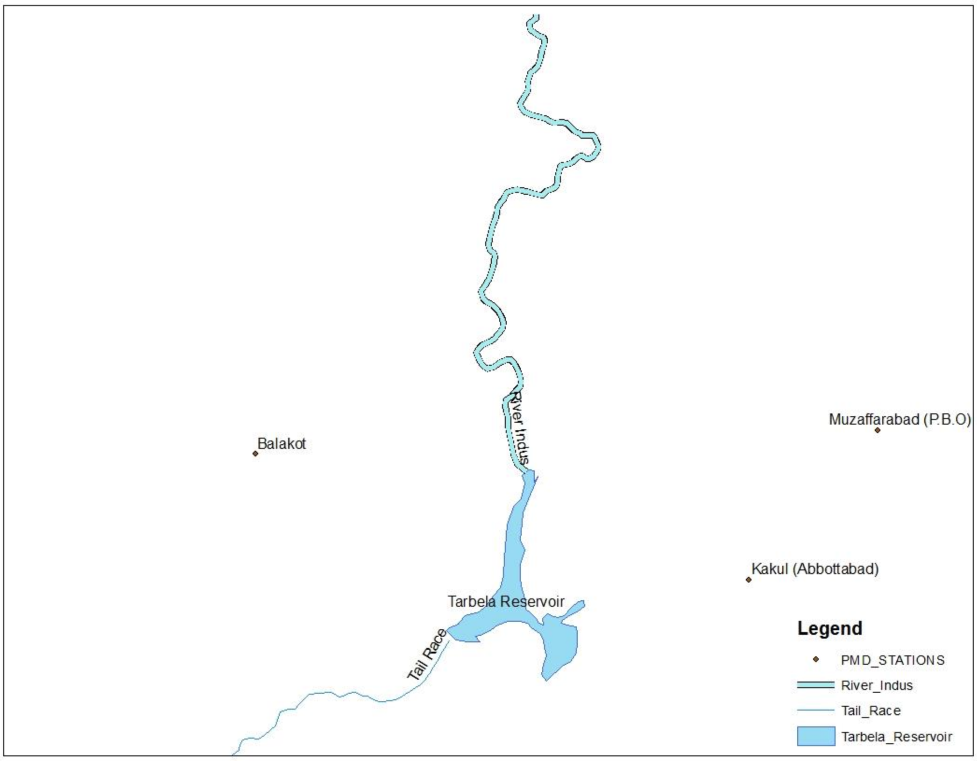


Figure 3.5: Vector data modelling

Raster

Raster data model contains rectangular mesh created by joining points by lines, creating mesh/Grid of square cells of uniform size as shown in Figure 3.6.

OID	VALUE	COUNT	TYPE	AREA	CODE
0	1	12	Forest Land	8100	FL010
1	2	4	Barren Land	4500	BL001
2	3	16	Crop Land	8100	CL301
3	4	15	Water Body	9900	WB040

Figure 3.6: Raster data modelling

A numerical value is assigned to each cell which defines condition of desired spatially-varied quantity (Smith.P, et.al. 1995.).In raster GIS Grids/mesh are source of analysis and are used for representation of 2-dimensional surface and spatial modelling of steady state. The representation of Land surface in raster-domain is known as (DEM) Digital-elevation Model.

Triangular-Irregular Network (TIN)

TIN basically is triangular mesh created on location(X, Y) of data point set. For the formation of TIN perimeter around data points called convex hull is established first. Triangles with equiangular internal angles are then created for the connection of interior points, which is known as Delaunay triangulation, then for the formation of Plane Triangles are raised &tilted by adding height for every triangle vertex. Land surface terrain is obtained by combining all triangular planes. The triangles of TIN will be small for complex & detailed land surface For Example: River channels but larger for gently sloppy or flat areas. Supplementary elevation data like spot-elevation at depression, break-lines and summit can be included. The terrain features such as roads or streams can be represented by break-lines, which are an indicative of slope change; triangles of TIN don't cross break-lines. TIN is the favorite data model for GIS in 3-dimensional representation of surface and modelling. Following are few reasons preferring a TIN model.

Requires less points in number than grid for the representation of surface terrain of equal accuracy

- Can be eagerly adapted to inconstant complexity of terrain.
- Supports polygon, line and point features.
- In model Input data in original format can be maintained and privileged in analysis.

3.14 APPLICATION PROCEDURE

The procedure for floodplain delineation and terrain modelling by exporting ArcView output in HEC-RAS and after processing HEC-RAS output in ArcView GIS. Application of this methodology reduces time required for analysis and improvement in accuracy by the integration of spatial-stream geometry with the hydraulic analysis. Approach bases on allocating map co-ordinates to stream X-sections and stored data of computed water-surface profile In co-ordinates of HEC-RAS model. The procedure contains 7 primary steps

1. Digitizing River Features
2. RAS Processing
3. Exporting Data to HEC RAS
4. Importing Data from HEC-RAS
5. Stream center-line definition
6. Geo-referencing the X-sections
7. Terrain Modelling
8. Floodplain Mapping

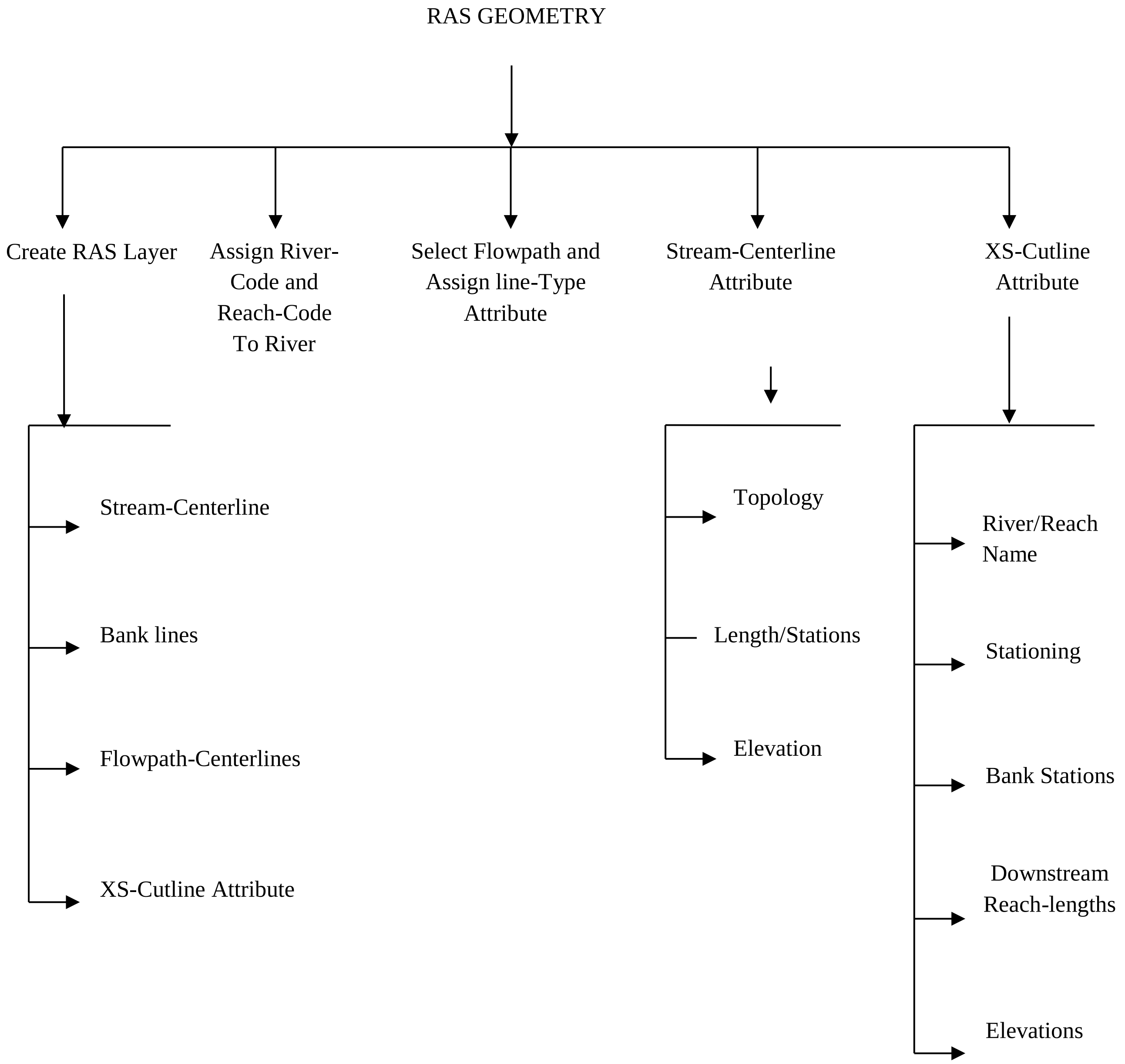
The detailed descriptions of these steps are explained in following sub-sections. GIS and HEC-RAS data for Swat river study area are to explain the procedure.

1. Digitizing River Features

Stream center-line, Left Stream bank-line, Right Stream bank-line, Left flow path line and Right Flowpath lines are digitized from Google earth. This kmz files are then transferred to layers in Arc-GIS after assigning Co-ordinate system of data frame as WGS_1984_UTM_Zone_42N acquisited on 17-Oct-2011.

2. RAS Processing

The following Flowchart summarizes the entire RAS Processing



I. Create RAS Layers

Series of layers including Stream-Centerline, Bank-lines, X-section Cutlines and Flowpath lines are created and edited, which collectively known as RAS layers, stored in geo-database. These RAS layers are core for geometric data which are extracted in GIS and helps in hydraulic analysis by HEC-RAS.

Stream-Centerline

Stream-Centerline is to create network of River Reach. River Reach is digitized /traced in flow direction by starting from top end of river.

Bank lines

Bank lines layer identifies conveyance area of main channel from overbank floodplain-areas. Left and Right Banks are traced by starting from top end.

Flow path-Centerlines

Flow path lines layer determines the downstream reach-lengths between X-Sections with in a Channel and areas of overbank .Flowpath-lines are traced in the center of flow mass in Channel, Right overbank and Left overbank for interested profiles of water surface.

XS-Cutlines

X-section cutlines identifies the locations at which X-sectional data is extracted from DTM.X-sectional cutlines are assigned by  (Construct XS-Cut lines) tool by taking an interval of 500 m

II. Assigning River and Reach Code to river

Each river has its unique name and every river reach has also a unique name.  Tool is used for assigning a name to river reach.

III. Select Flowpath and assign line-type attribute

Stream-Centerline, Left Flow path-Centerline and right Flow path-Centerline are labeled using  tool to determine the downstream reach-lengths between X-Sections with in a Channel and areas of overbank.

IV. Stream-Centerline Attribute

Stream-Centerline Attribute defines all those parameters which are related to stream-Centerline of a River, the detailed descriptions of those parameters are explained below.

Topology

Topology identifies FromNode and tonode in the form of integer data. Topology populates node from where a reach started and continued up to a node.

Length/Stations

Length/Stations determines each reach length to compute X-section river satationing.it identifies FromSta & tosta, which means station from where a reach started and the station at which it ended.

Elevation

It is the conversion process of 2-Dimensional features into 3-Dimensional features. Elevation of Stream-Centerline is extracted at center of every single GRID cell or at each triangle edge in case of TIN.

V. XS-Cutline Attribute

XS-Cutline Attribute defines all those parameters which are related to XS-Cutlines of a River, the detailed descriptions of those parameters are explained below.

River/Reach names

River and Reach names are assigned to each line which is cut at the intersection of XS-Cutline and stream-Centerline.

Stationing

River station is added to each X-Section on the basis of intersection with stream-Centerline.

Bank Stations

Bank station tool is used to add the locations of bank stations to every single X-Section.

Downstream Reach lengths

Downstream reach lengths on the basis of Flowpath assigns reach lengths.

Elevations

It is the conversion process of 2-Dimensional features into 3-Dimensional features. Elevations of XS-Cutlines are extracted at center of every single GRID cell or at each triangle edge in case of TIN.

3. **Exporting Data to HEC-RAS**

For the Hydraulic analysis of River the data is exported in HEC-RAS. Where First in Geometric data manning n for channel ,Right & left over bank is assigned then Steady-flow data is entered including Peak flood value which is estimated using Gen Extreme Value [Type I] Distribution with 100 year return period and reach boundary-conditions are assigned by providing the slope. Model is run for steady-flow.

4. **Importing data From HEC-RAS**

The output data of HEC-RAS is extracted to move in GIS environment. Following are the parameters which are processed at every single X-section.

- X-Section(River Station) Number
- Stream Center Co-ordinates, Locate elevation points at channel bed which will be minimum elevation
- Locations of floodplain boundary, measured from stream center
- Locations of bank-stations, measured from stream-center
- Reach lengths
- Water-surface elevation

Lateral co-ordinates of floodplain boundaries is determined by computed water-surface elevation.

The co-ordinates of X-sections are taken from left to right end of X-Section.Co-ordinates of bounding-points are noted when computed water-surface elevation falls in between elevation co-ordinates of 2 adjacent points.

Lateral coordinates of floodplain-boundaries are calculated by:

$$\boldsymbol{X^3} = \left\{\frac{(\boldsymbol{Z^3}-\boldsymbol{Z^1})(\boldsymbol{X^2}-\boldsymbol{X^1})}{(\boldsymbol{Z^2}-\boldsymbol{Z^1})}\right\} + \boldsymbol{X^1} \qquad \text{……………………. Eq 3-9}$$

Where:

X^1 = Lateral co-ordinate of left bounding-point

Z^1 = Elevation co-ordinate of left bounding-point

X^2 = Lateral co-ordinate of right-bounding point

Z^2 = Elevation co-ordinate of right-bounding point

X^3 = Lateral co-ordinate of floodplain-boundary

Z^3 = computed water-surface elevation

5. Stream Centerline Definition

After the output data of HEC-RAS is imported in ArcView, it becomes necessary to make a link representation of HEC-RAS streams to digital stream representation in ArcView. Following are 2 ways for obtaining stream-centerline's digital representation.

I. Reach Files

Reach file identifies and interconnect reaches or stream segments which comprise a drainage system of nation's surface-water. Reach-file basically is chain of national-hydrologic databases. This includes reach codes for every single segment of stream, downstream/upstream relationships and names of streams.

II. Dem based delineation

This Delineation is made to derive stream network in vector form Using DEM as sole point and capabilities of ArcView Spatial-Analyst extension. Using the capabilities of the ArcView Spatial Analyst extension

6. Cross-section geo-referencing

The digital stream and RAS stream are compared by X-section referencing. It is also necessary to describe downstream and upstream boundaries of RAS stream over digital stream. 3-dimensional map co-ordinates are assigned to every vertex of each X-section.

7. Integrated-terrain model formation

Accurate information regarding topography is essential for the production of floodplain map. Data model which is considered best for representation of large scale terrain in GIS is TIN model.

8. Floodplain mapping

Floodplain delineation is final step after the completion of terrain model. Stream-floodplains are represented as computed water-surface elevation at every X-Section in HEC-RAS. These elevations are carried in ArcView along with distances from stream-centerline to right and left boundaries of floodplain. Thus water-surface elevation and its extent about floodplain are known at every X-section. The 3-dimensional flood-plain view is essential for flood-plain visualization.

Chapter IV
RESULTS AND DISCUSSION

4.1 RESULTS REGARDING FLOOD FREQUENCY ANALYSIS

For the flood frequency analysis instantaneous annual recorded stream flow data is evaluated from the daily discharge data at Chakdara Station Swat River taken from Surface Water Hydrology Pakistan WAPDA from year 1963 to 2010, The hydrograph is shown in Figure 4.1. The maximum instantaneous flow record at Chakdara Station Swat River is used for frequency analysis using Normal Distribution, Log-Normal Distribution, Extreme Value Type 1 Gamble Distribution , Log-Pearson Distribution and Frequency factor distributions against 2,5,10,20,25,50,100,500,1000, and 10000 year return period, which is summarized in Table 4.1.

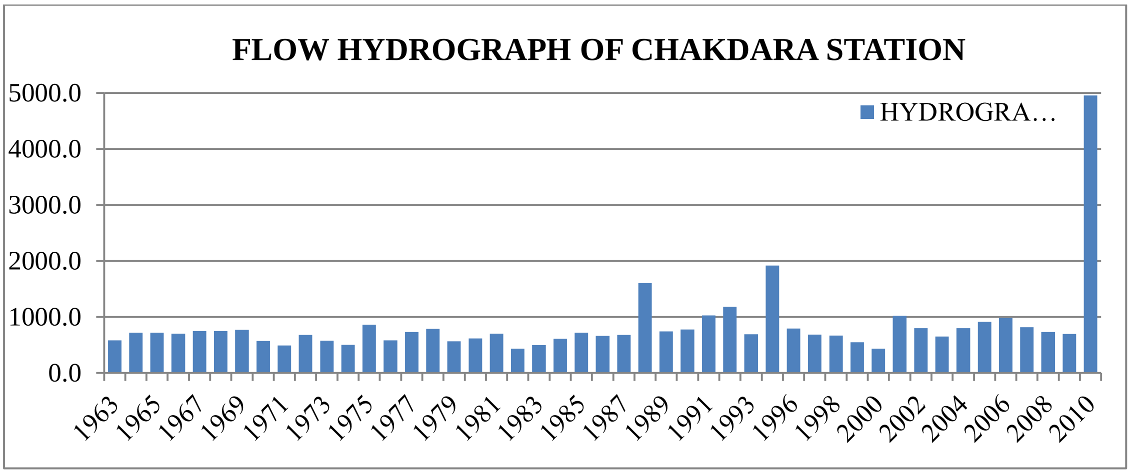


Figure 4.1: Instatntaneous Flow Hydrogrpaph of Chakdara Station

In order to determine which one distribution fits best to the reach ,the described distributions were compared against given dataset of discharge readings using Easyfit model for the study of distributions fittness. The Probability Difference Charts for described distributions are explained below.

Table 4.1: Estimated Discharges Using Different Statistical Distributions

S. No.	Time period	Normal Distribution (Cumecs)	Log Normal Distribution (Cumecs)	Extreme Value Type I (Cumecs)	Frequency Factor (Cumecs)	Log Pearson III (Cumecs)	Gamble (Cumecs)
1	2	872.83	758.03	734.63	734.63	612.84	734.63
2	5	1580.71	1079.33	1478.08	1478.08	864.57	1478.08
3	10	1951.10	1298.53	1970.31	1970.31	1218.38	1970.31
4	20	2256.88	1512.68	2442.46	2442.46	1790.24	2442.46
5	25	2345.94	1581.45	2592.24	2592.24	2040.79	2592.24
6	50	2600.94	1796.13	3053.62	3053.62	3123.59	3053.62
7	100	2830.26	2013.98	3511.60	3511.60	4902.17	3511.60
8	500	3294.41	2539.11	4569.91	4569.91	15135.27	4569.91
9	1000	3472.77	2775.56	5024.90	5024.90	25352.51	5024.90
10	10000	4001.59	3614.08	6535.53	6535.53	157332.03	6535.53

4.1.1 Probability Density Function(PDF)

Probability-density function is evaluated to determine probability that Variate has value of y. It is a relationship between Variate taken on X-axis and the respective probabilities on Y-axis.. We cannot determine the exact probability against a value, because it may be zero. Therefore probability is determined with some tolerance if c and d are the maximum and minimum tolerance then PDF is evaluated by **Eq. 4.1**. The area under the curve is determined from c to d and the whole area under the curve should be equal to 1.

Discharge values of both observed record data at Chakdara Station by WAPDA gauge and distributional data is taken on X-axis while the respective probabilities on Y-axis. The empirical(observed) PDF is plotted as histogram, which consists of vertical bars[bin] .Each Vertical bar defines sample data falling within the respective interval. While theoretical PDF for various distributions are displayed as continuous scaled curve on the basis of numbers of interval. Scale means multiplication of PDF values with interval width. Following are the results of PDF Plots of specified distributions obtained from simulation of Easy-fit Model.

The results obtained from Easyfit simulation model are depicting that Gen Extreme Value Type I distribution is following the observed data record, strating from Zero probability for nil discharge and limb is rising and decreasing with increase and decrease of observed data set ,while for very high discharges the distribution is completely following the observed data record, the log normal distribution is computing 0.83 probability for nil discharge record and following the observed data record for very high discharges.Discussing about log pearson 3 the probability is more than 1 for nil discharge so estimation is over estimate .The probability of Gumbel max, Gumbel min, Normal distribution is less than the observational probability, thus the estimate by these distributions is Under Estimate, so from above all discussion it is concluded that discussing about Probability-Density Function the Gen Extreme Value [type I] distribution is comparatively best than others.

$$\int_c^d \boldsymbol{f}(\boldsymbol{y})\boldsymbol{dy} = \boldsymbol{P}(\boldsymbol{c} \leq \boldsymbol{Y} \leq \boldsymbol{d}) \qquad \text{……………………. Eq 4-1}$$

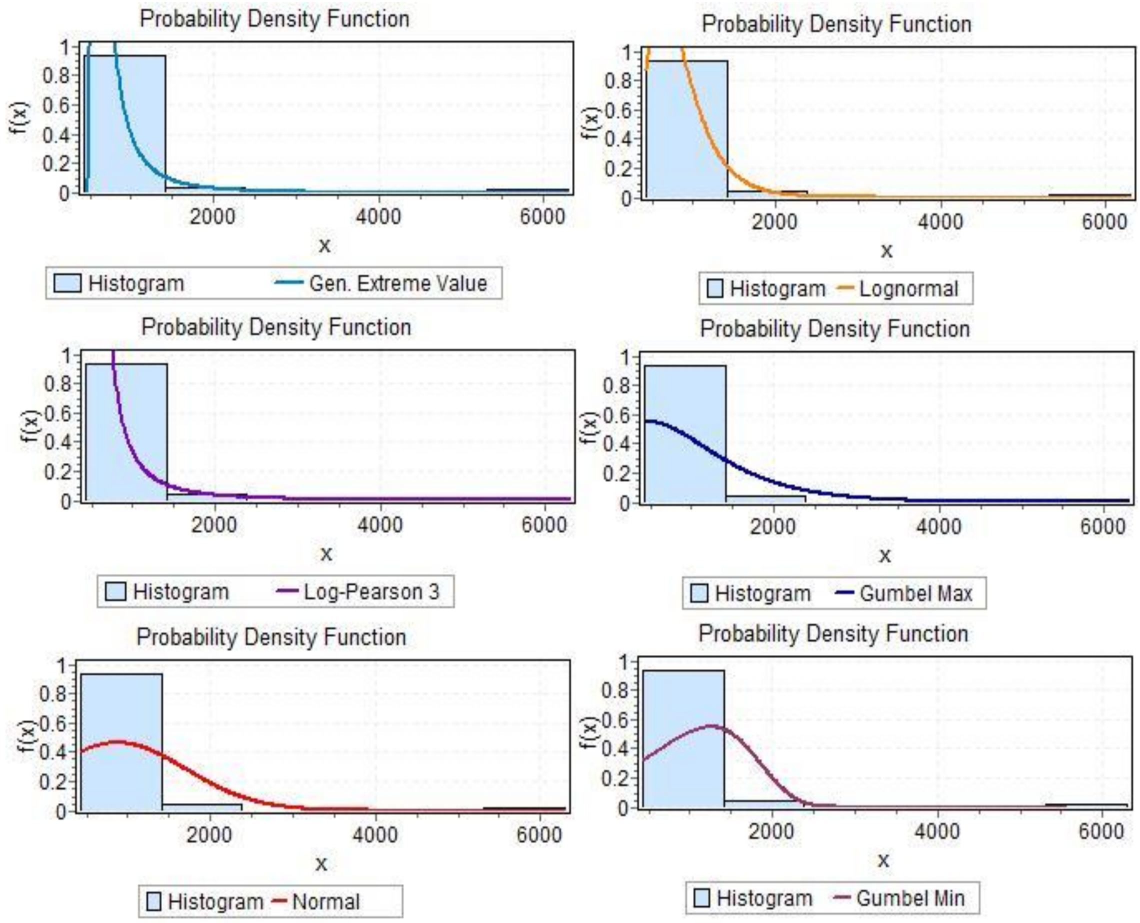


Figure 4.2: PDF Plots of Different Statistical Distributions

4.1.2 Cumulative-Distribution Function (CDF)

Cumulative-distribution function(CDF) is created to determine probability of Variate equal or less than y. . It is a relationship between Variate taken on X-axis and the respective probabilities on Y-axis.

The empirical(observed)CDF is plotted in the form of stepped dis-continuous line, depending upon numbers of bin and theoretical CDF for various distributions as continuous curvefor this research case CDF is determined by

$$\boldsymbol{F(x) = \int_{-\infty}^{x} f(u)du} \qquad \text{……………………. Eq 4-2}$$

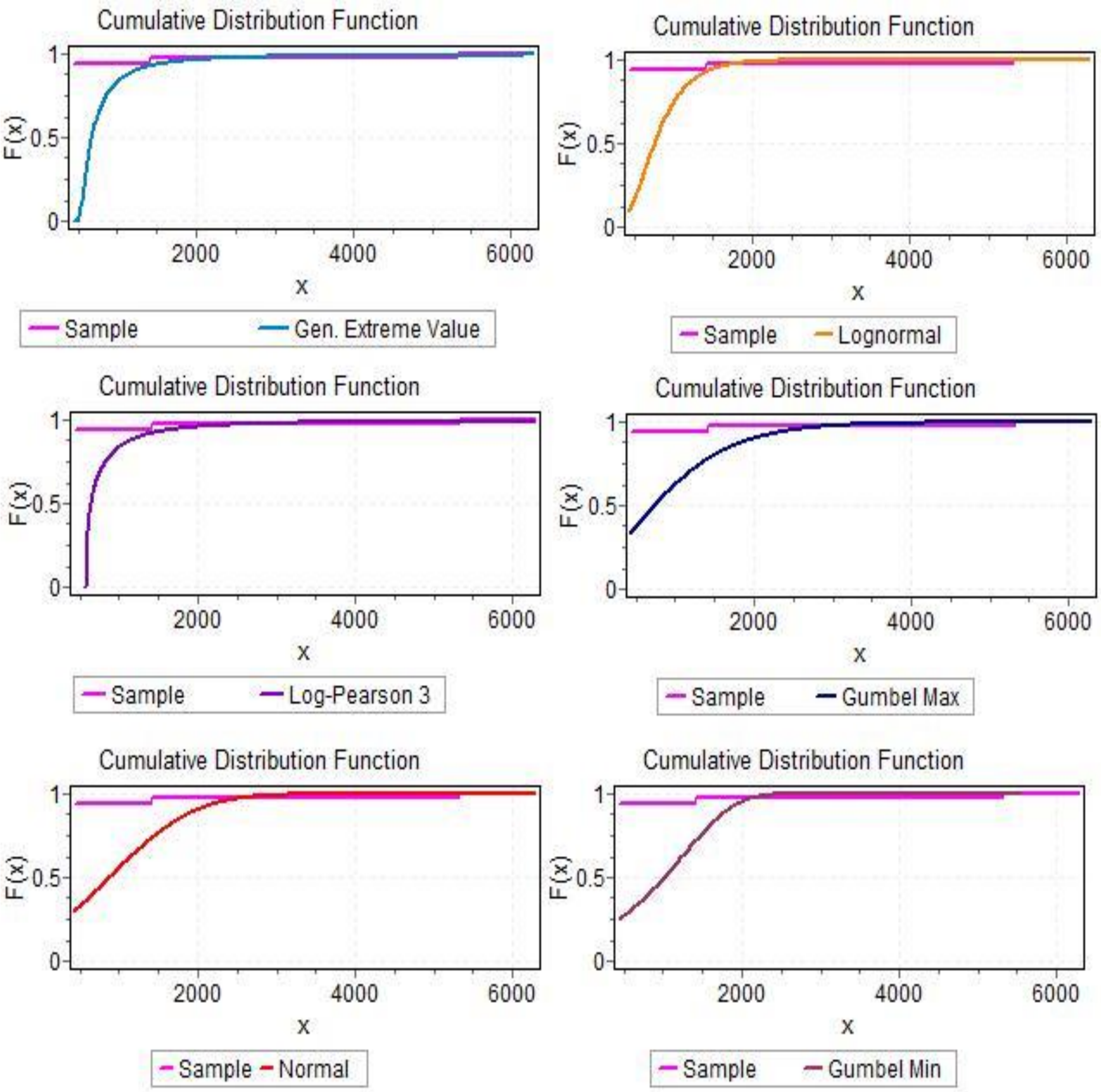


Figure 4.3: CDF Plots of Different Statistical Distributions

The results obtained from Easyfit simulation model are depicting that Gen Extreme Value [Type I] distribution is obeying probability of observed data record of discharges. For very high and medium discharges the probability of Gen Extreme Value [Type I] distribution is 1 and for low discharges the probability is strating from Zero and limb is rising to probability 1. The log Normal distribution is neither obeying the probability of observed data record of discharges, while for low discharges the probability is 0.1 instead of Zero probability and for medium and high discharges the probability is more than 1 so the estimate is over estimate. The log pearson 3 distribution is not estimating discharge less than 600 Cumecs,while for medium and high discharges the distribution is following the observed discharge data record. The probability of Gumbel max,Gumbel min and Normal distribution is more than Zero for nil discharge and the probability is more than 1 for high discharges ,Thus the results obtained from the simulation of Easyfit model it is concluded that log- Gen Extreme Value [Type I] distribution is comparatively better than the specified distributions.

4.1.3 (P-P) Probability-Probability Plot

The P-P plot is graph between probabilities of distributional (Theoretical) and observed (input) data set values. Such graphs define the points at which data is following and the points at which data is not following a theoretical distribution. The Probabilities of empirical (observed) data set is taken on Horizontal axis while the theoretical(distributional) one on Vertical axis. A reference line at 45^o is taken to check the departure of data sets from each other greater the departure from reference line indicates failure of a distribution for the data set. For correct modelling the plot of specified distribution should be approximately linear. Following are the results of P-P Plots of specified distributions obtained from simulation of Easy-fit Model.

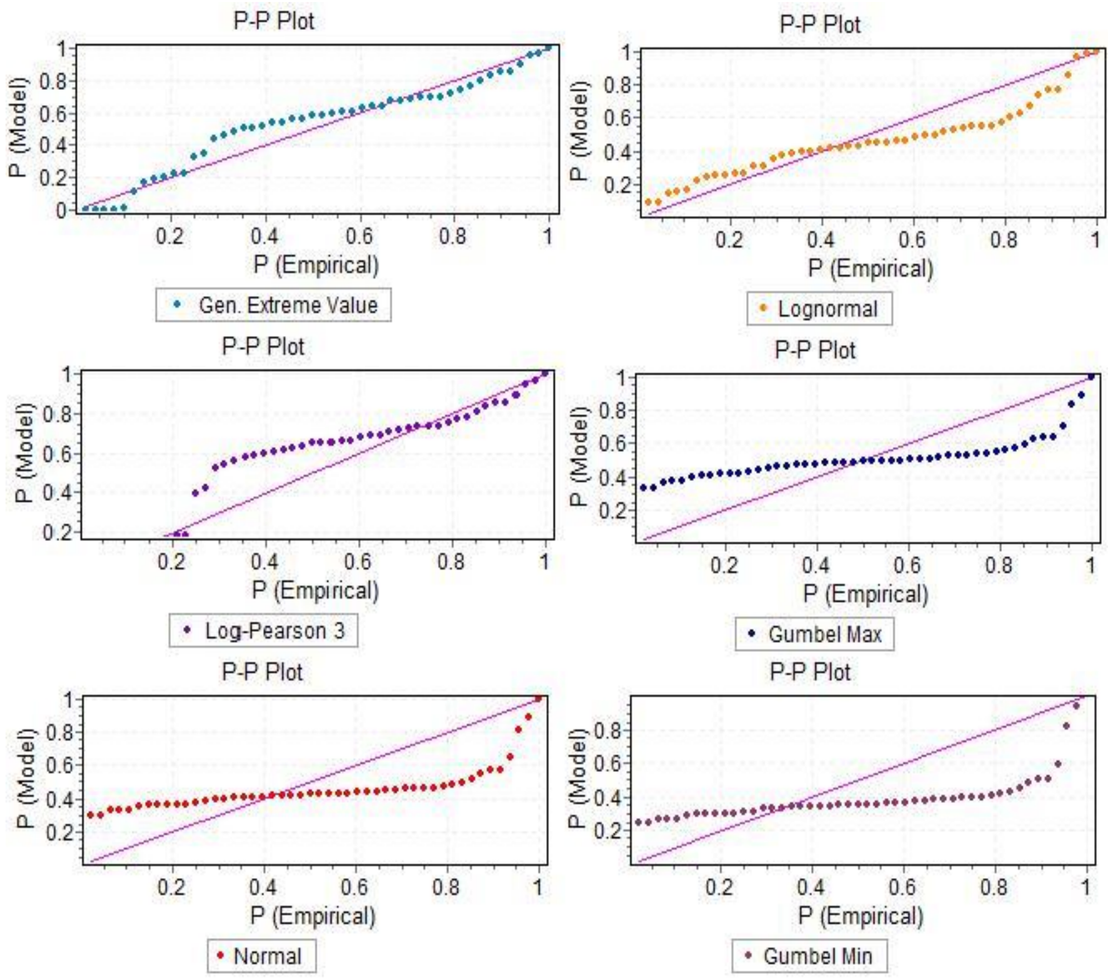


Figure 4.4: P-P Plots of Different Statistical Distributions

The results obtained from Easyfit simulation model are depicting that departure between reference line and probability of distribution is more against higher discharges and show low probability against higher and higher probability against low discharge values than the observed probability using log Normal distribution, Similar is the case for Gumbel Max, Gumbel Min, Normal and Log-Pearson.3 distributions . The Gen Extreme Value [Type I] distribution also shows lower probabilities against higher discharge values but approximately shows linear plot for lower and medium discharge values, comparatively better than others. Thus the results obtained from the simulation of Easyfit model it is concluded that l Gen Extreme Value [Type I] distribution is comparatively better than the specified distributions.

4.1.4 Quantile-Quantile Plot

The Q-Q plot is graph between quantiles of distributional (Theoretical) data set values and observed (input) data set values. The empirical (observed) data set is taken on Horizontal axis while the distributional (Theoretical) one on Vertical axis. A reference line at 45^o is taken to check the departure of data sets from each other, greater the departure from reference line indicates failure of a distribution for the data set.

For correct modelling the plot of specified distribution should be approximately linear, given by

$$\mathbf{F^{-1}}\left[\mathbf{F_n}(\mathbf{x_i}) - \frac{\mathbf{0.5}}{\mathbf{n}}\right] \quad \text{……………………. Eq 4-1}$$

The results of Q-Q Plots of specified distributions obtained from simulation of Easy-fit Model is shown in Figure .

The results obtained from Easyfit simulation model are depicting that departure between reference line and quantiles of distribution, the Normal, Gumbel max, Gumbel min and log pearson 3 distribution measures low discharge against very higher and very lower observed data st of dscharges and measures higher discharge against medium discharge values so shows departure for entire discharge values, at some places as positive and at some places as negative. But in case of Gen Extreme Value [Type I] distribution though will measure lower discharge values against higher discharge values however follow a linear relationship against lower to medium discharge values.

The Q-Q plots of Normal, Log Pearson, Gumbel Max and Gumbel min is indicating more departure from reference line than Log Normal Distribution, So it is concluded that the plot of Gen Extreme Value [Type I] fits best,

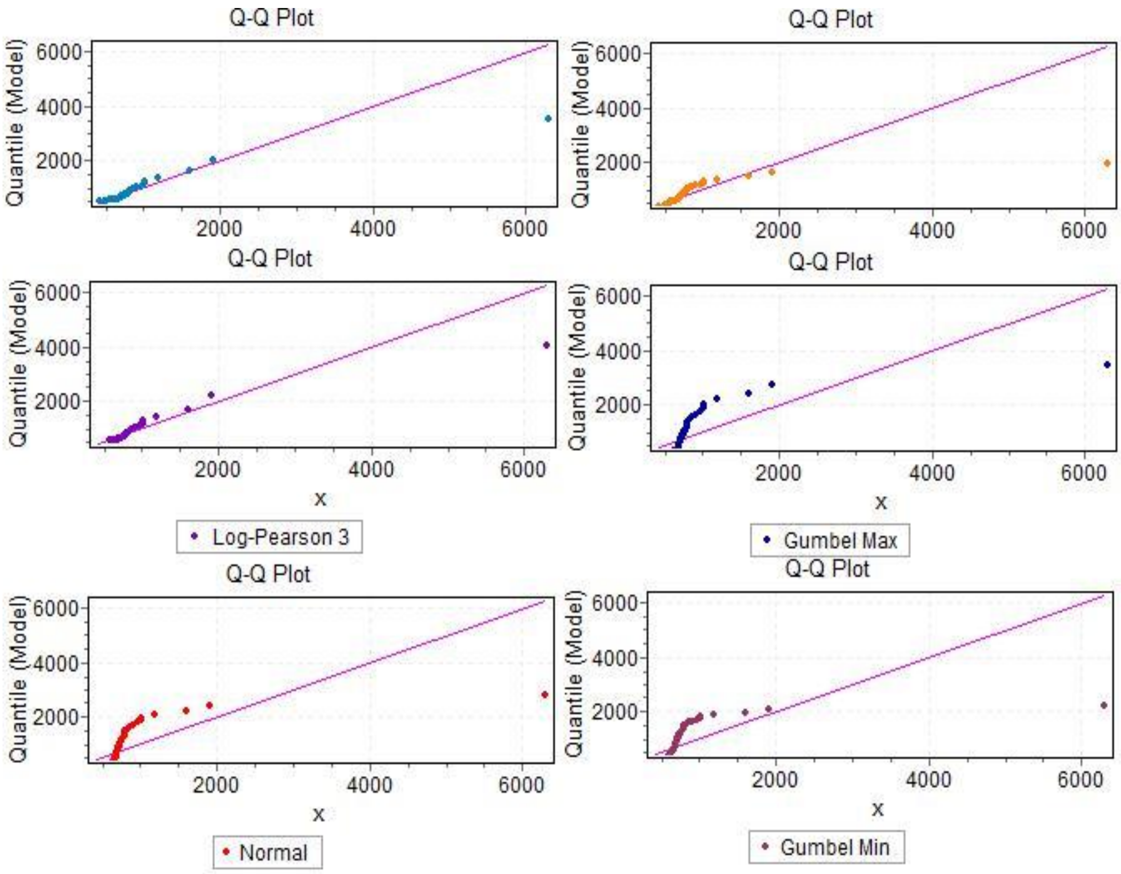


Figure 4.5: Q-Q Plots of Different Statistical Distributions

4.1.5 Probability-Difference Graph (PDG)

It is a plot between empirical and theoretical CDF. The plot determines well fit theoretical distribution against observed data, it also compares goodness-of-fit(GOF) of numerous fitted distributions and is displayed by scatterplot. The observed data is taken on X-axis while the difference in between ECDF and TCDF on Y-axis, given by

$$\mathbf{Diff}(\mathbf{y}) = \boldsymbol{F_n}(\mathbf{y}) - \mathbf{F}(\mathbf{y}) \qquad \text{……………………. Eq 4-2}$$

Following are the results of Q-Q Plots of specified distributions obtained from simulation of Easy-fit Model.

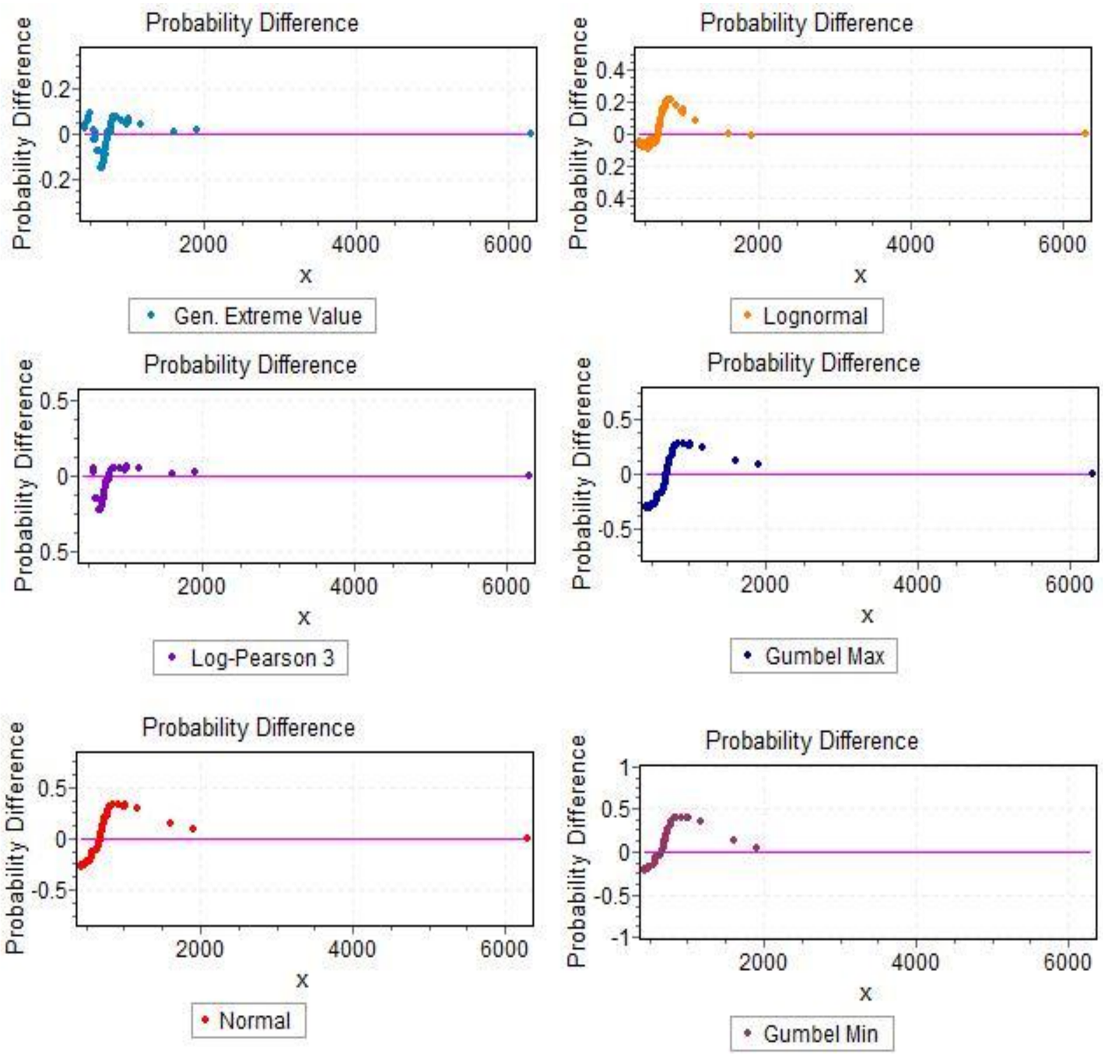


Figure 4.6: PDG Plots of Different Statistical Distributions

The results obtained from Easyfit simulation model are depicting that Normal distribution will show negative difference (Under-estimates) than the refered line for very low discharges while positive difference for medium discharges (Over-Estimates) and an accurate measure for high discharges.Similarly the Gumbel Max, log normal and Gumbel Min distribution will show negative difference (Under-estimates) than reference for very low & higher discharges while positive difference for medium discharge values (Over-Estimates) and an accurate measure for high discharges. The Log-Pearson.3 distribution showed firstly positive difference and then negative difference (Under-estimates) than reference for very low discharges and accurate measure for higher for medium discharges (Over-Estimates).While the Gen Extreme Value [Type I] distribution though shows positive difference for medium discharge up to 0.14 and negative difference upto 0.17 , but is following the trend for very higher discharges.

Thus the results obtained from the simulation of Easyfit model it is concluded that Gen Extreme Value [Type I] distribution is comparatively better than the specified distributions.

4.2 RESULTS OF SIGNIFICNCE TEST

To measure compatibility of a random sample from data with theoretical probability distribution function(PDF) tests are performed called goodness of fit(GOF).Defining test statistic,(function of data) by measuring distance between data and hypothesis and calculation of probability of the obtained data have larger value than observed value is general procedure behind these tests and we call this probability as Confidence level. Small probabilities (<1%) indicates poor fit, while High probabilities (≈1%) corresponds to best fit which happens often.

In order to determine the best fit distributions from lognormal, Gen Extreme Value [Type I], Normal, Gamble-Max, Gamble-Min and Log-Pearson 3 against the flow data on WAPDA Gauge at Chakdara Station for a reach from Utror Valley Kalam to Bazkhela of 75 km, Anderson Darling, Kolmogrov smirnov and Chi-Squared are the significance tests applied for the selection of a Probability

Distribution using Easyfit Model. Easy Fit is an application for data analysis and simulation, allowing fitting the probability distributions into sample data. It is the combination of classical-Statistical analysis methods & advanced data-analysis techniques which helps in taking decision about probability data. The Results are shown in the Figure . It has been found that Gen Extreme Value [Type I] is the best-fit Distribution among the other specified distribution for the Study area considering Kolmogrov smirnov and Chi-Squared with superior ranking and at ranked 2 using Anderson Darling.

Goodness of Fit - Summary

#	Distribution	Kolmogorov Smirnov		Anderson Darling		Chi-Squared	
		Statistic	Rank	Statistic	Rank	Statistic	Rank
1	Gen. Extreme Value	0.17146	1	7.9399	2	2.2393	1
2	Gumbel Max	0.33374	4	8.9553	3	81.89	4
3	Gumbel Min	0.40873	6	15.509	5	N/A	
4	Log-Pearson 3	0.2535	3	34.074	6	N/A	
5	Lognormal	0.21912	2	3.1544	1	21.464	2
6	Normal	0.34443	5	10.166	4	47.706	3

Figure 4.7: Ranked Summary of Significance Tests

This indicates that Gen Extreme Value [Type I] is the best-fit Distribution for the Study area considering Kolmogrov smirnov and Chi-Squared with superior ranking and at ranked 2 using Anderson Darling.

Stat1

Descriptive Statistics

Statistic	Value
Sample Size	48
Range	5863.8
Mean	872.83
Variance	7.0772E+5
Std. Deviation	841.26
Coef. of Variation	0.96384
Std. Error	121.43
Skewness	5.9861
Excess Kurtosis	38.661

Percentile	Value
Min	433.25
5%	460.03
10%	503.47
25% (Q1)	613.06
50% (Median)	719.25
75% (Q3)	799.6
90%	1041.4
95%	1776.1
Max	6297

Figure 4.8: Descriptive Statistics of Gen Extreme Value [Type I] Distribution

4.3 DISCUSSION

Change in River Regime

The river regime of the river was well defined before flood 2010 which are shown in initial imageries from Figure 4.9 to Figure 4.11 but after the flood 2010 regime of the river was completely changed which are shown in later imageries from Figure 4.12 to Figure 4.15.

Figure 4.9: Imagery View of River Swat Regime on 13/6/2006

Figure 4.10: Imagery View of River Swat Regime on15/9/2009

Figure 4.11: Imagery View of River Swat Regime on 7/6/2010

Figure 4.12: Imagery View of River Swat Regime on 4/5/2011

Figure 4.13: Imagery View of River Swat Regime on 27/5/2012

Figure 4.15: Imagery View of River Swat Regime on 28/5/2014

Figure 4.14: Imagery View of River Swat Regime on 14/11/2013

4.4 TRIANGULAR-IRREGULAR NETWORK

Using Calibrated digital-Elevation model Triangular irregular network of study area is evaluated using Raster to TIN (3D Analyst)tool taking Z Tolerance 4.4994 and Maximum Number of points 1500000000 to overlook the High Quality topography of the area. The elevations are classified using equal interval with 9 classes .The elevations are evaluated in SI system. Triangular-irregular Network map is shown in Figure 4.16.

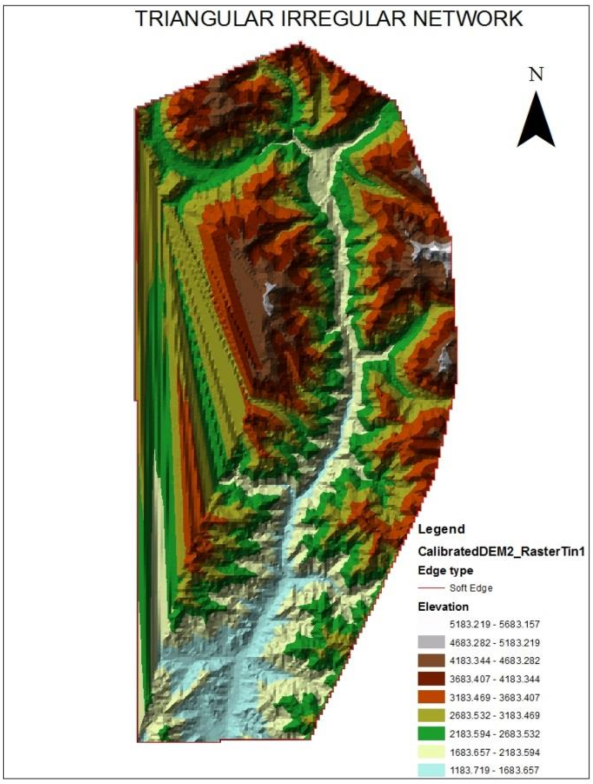


Figure 4.16: TIN Modelling of Study Area Using Calibrated DEM

Areal Contours

Using Calibrated digital-Elevation model Contours of study area is evaluated using Contour 3D Spatial Analyst tool at an interval of 200 m to overlook the topography of area. The elevations are evaluated in SI system. Contour Map is shown in Figure 4.17.

Figure 4.17: Contouring of Study Area Using Calibrated DEM

Areal Slope

Using Calibrated digital-Elevation model Slope of study area is evaluated using slope Spatial Analyst tool and measurement in Percent Rise to overlook the topography of area. The areal slope is classified using Natural Breaks (Jenks) classified approach with 9 classes .The slope is evaluated in Percent rise. Slope map using Percent Rise as an output measurement is shown in Figure 4.18 and Degree as an output measurement is shown in Figure 4.19.

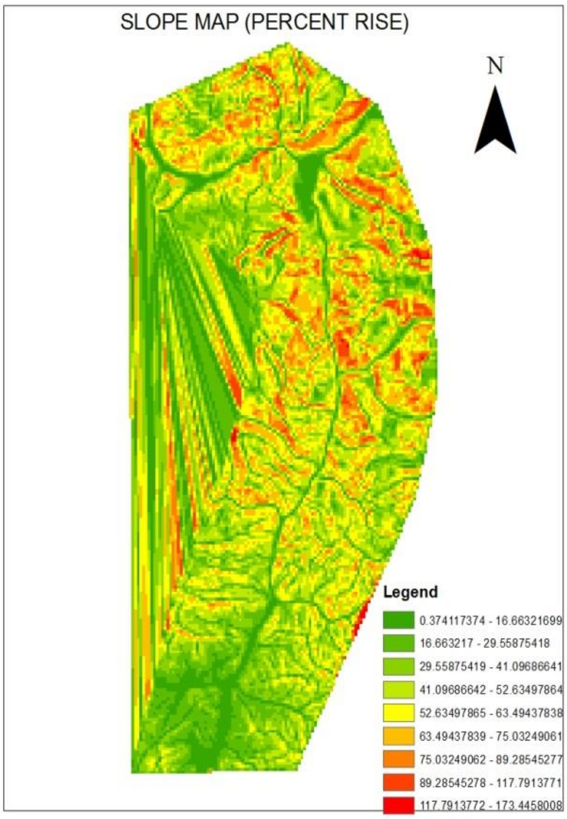


Figure 4.18: Slope Map of Study Area adopting Percent Rise Method

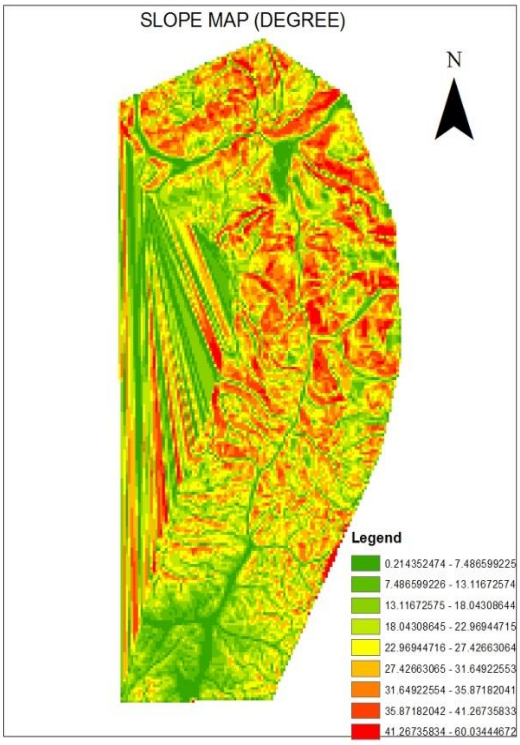


Figure 4.19: Slope Map of Study Area adopting Degree Meth

Areal Drainageline Pattern

Using Calibrated digital-Elevation model pattern for drainage of study area is evaluated using Terrain processing to overlook the pattern of area. The pattern of the area was found dendritic. Drainage line pattern map is shown in Figure 4.20.

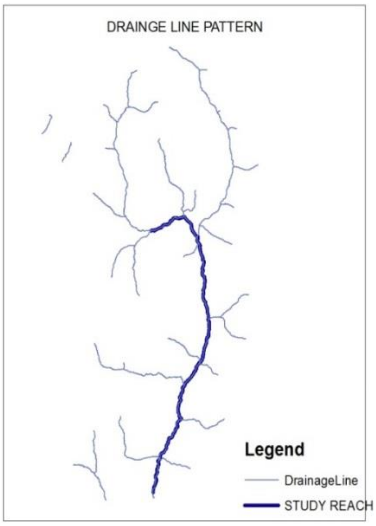


Figure 4.20: Stream Drainage Network of Study Area

Areal FlowDirection

Using Calibrated Digital-Elevation model flow direction of study area is evaluated using terrain processing to overlook the topography of area. Flow directions are classified in to 8 classes. Flow direction map is shown in Figure 4.21.

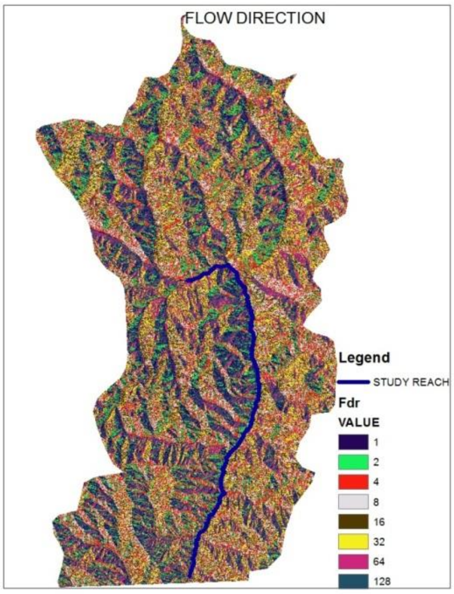


Figure 4.21: Flow Direction of Study Area

Areal Hillshade

Using Calibrated digital-Elevation model Hill-shade of study area is evaluated using Hill-shade tool to overlook the topography of area. Flow directions are classified in to 8 classes. Hill-shade map is shown in Figure 4.22.

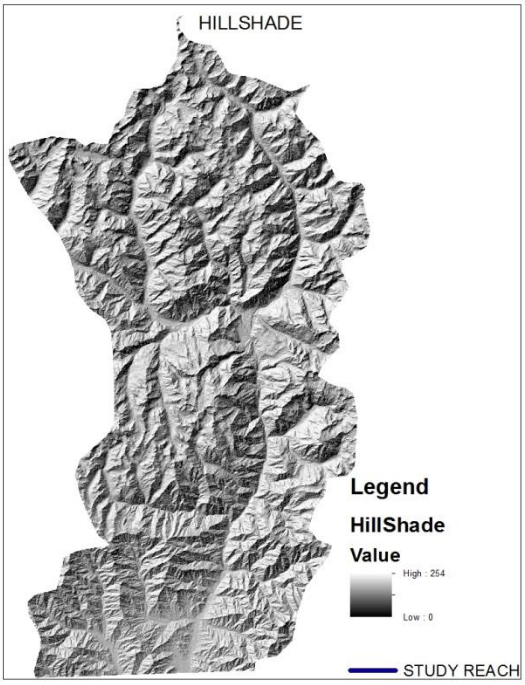


Figure 4.22: Hill shade Map of the study Area

4.5 COMPUTATION OF WATER SURFACE PROFILE

In order to describe the hydraulic behavior especially Water Surface Profile of the river, Hydraulic model HecRas for steady flow condition at discharges obtained from Frequency analysis of Data of Chakdara Station for specified reach of 75 km From Utror Valley Kalam to Bazkhela and Best fit model declared by Easyfit (Gen Extreme Value [Type I]) is used. Following are the results regarding Steady-flow simulation for Discharge at 2 & 5 Year. Simulation for Return-period 10, 20, 25, 50, 100, 500, 1000, 10000 years are also evaluated the entire results are shown in

Annexure B. The Figures 4.23 and 4.25 are profiles of Channel Bottom(Min Ch-El), Water Surface-Elevation(W.S-El) and Critical-Watersurface (CritW.S) of the reach from Utror Valley Kalam to Bazkhela for Discharge at 2&5 Years. While Figure 4.24 and Figure 4.26 are indicating EnergyGrade Slope and Flow area. Figure 4.23 and Figure 4.25 are showing that watersurface elevation is increasing with Discharge,and also energygrade slope and Flowarea is increasing with increase of Discharge.

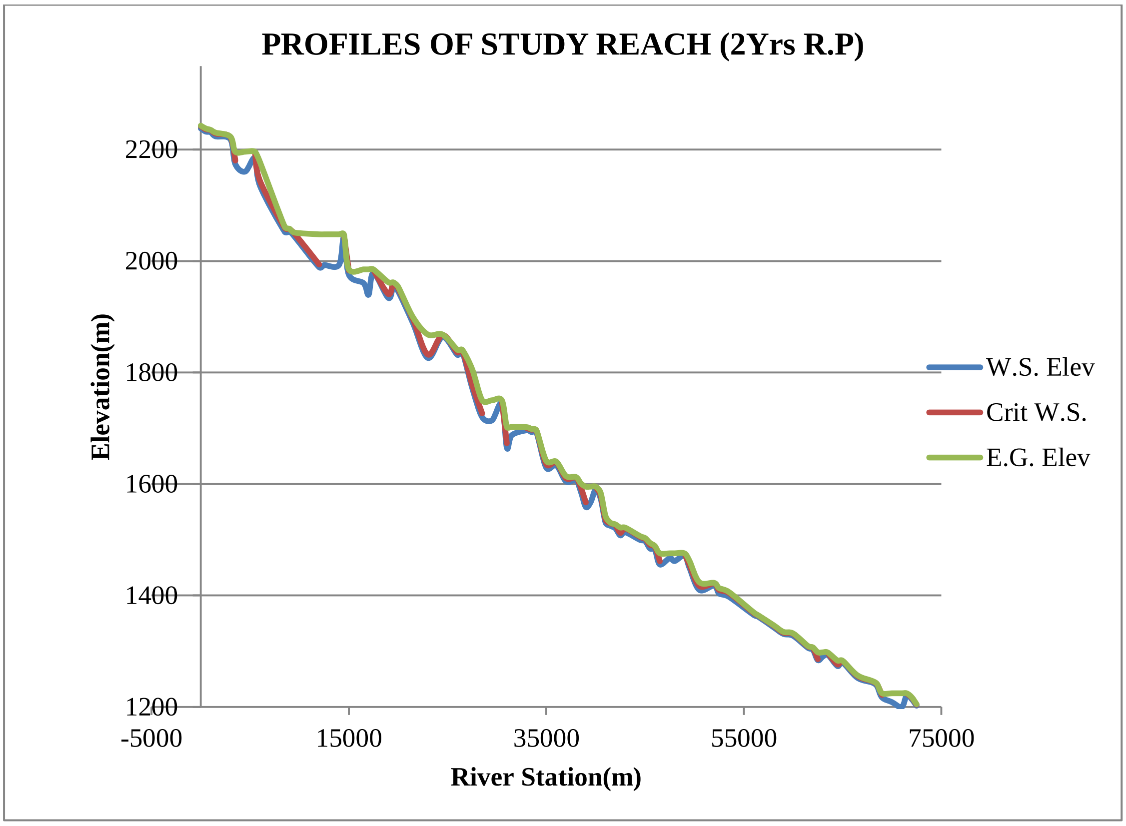
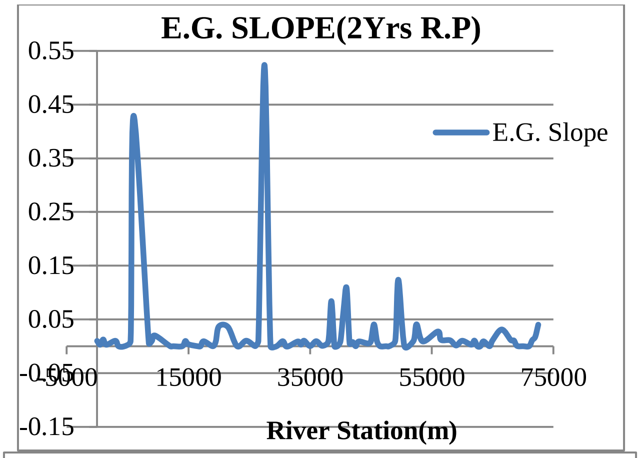


Figure 4.23: Water Surface profile w.r.t Channel Elevation for Study Reach at 2 Year Return Period



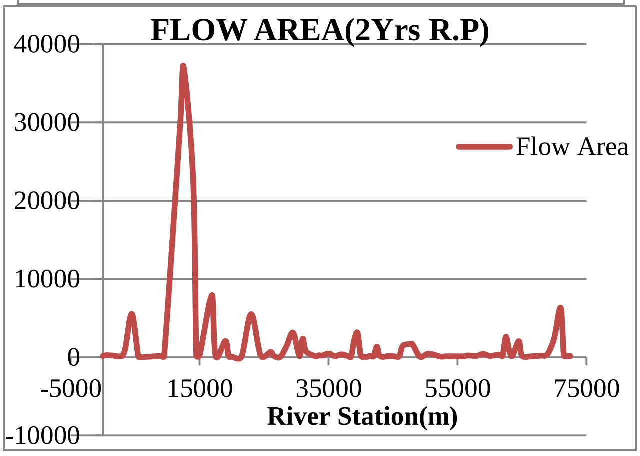


Figure 4.24: Energy Grade Slope & Flow Area of Study Reach at 2 Year Return Period

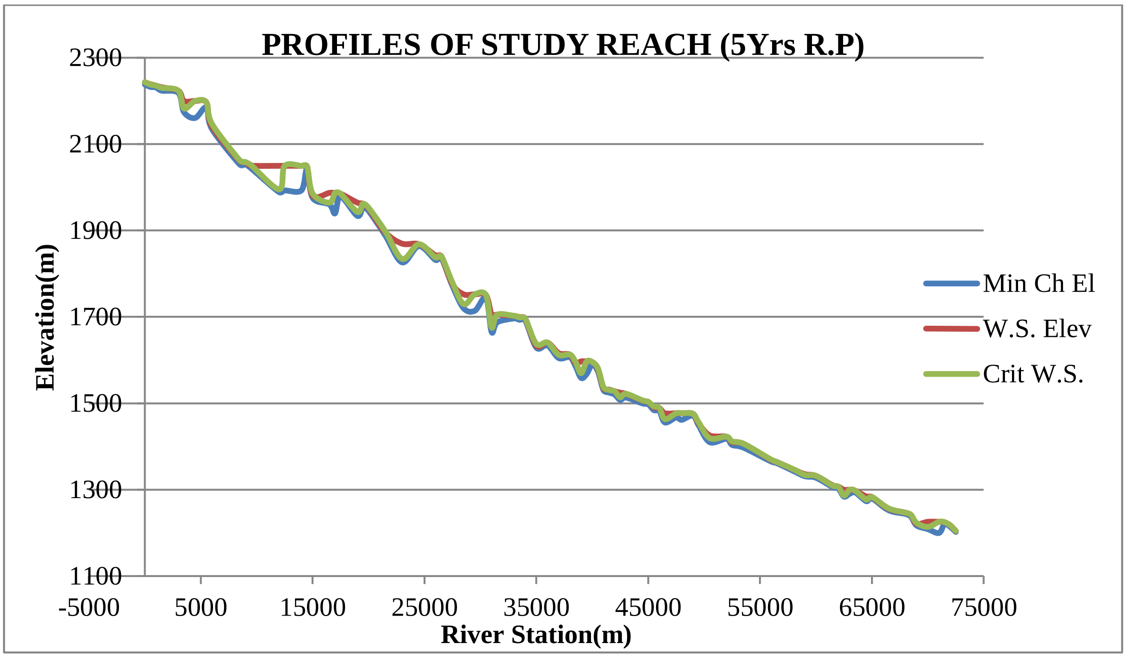
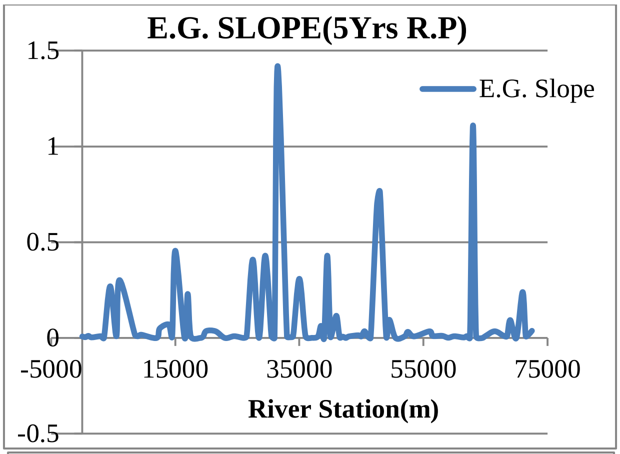


Figure 4.25: Water Surface profile w.r.t Channel Elevation for Study Reach at 5 Year Return Period



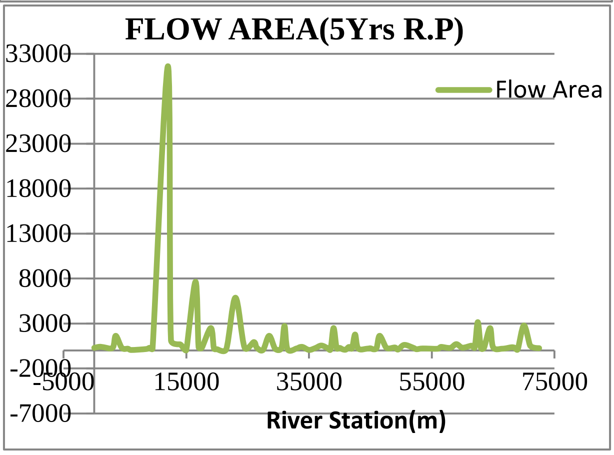


Figure 4.26: Energy Grade Slope & Flow Area of Study Reach at 5 Year Return Period

4.6 FLOOD RISK MAPPING AGAINST DIFFERENT RETURN PERIOD

The Computations which are performed using HEC-RAS software, flood – modelling results of river are represented in graphical formats. The result includes flood-zoning maps and the inundated area using GIS.

The non-availability of recorded discharge data and the inundation depth at any other spot with in study region bounded to produce results by the integration of GIS and HEC-RAS for flood event of higher magnitude, which attains supreme significance. HEC-RAS model was simulated for various possible values of flow(discharges) against different return periods. In order to mark the inundated areas, the model was simulated for probable flow values against 2, 5, 10, 20, 25, 50, 100, 500, 1000, 10000 yrs return period. The initial input considering terrain for hydraulic modelling using HEC-RAS was DEM. The fig shows similarity in inundated area of 2, 5, 10, 20, 25, 50, 100, 500, 1000, 10000 yrs return period, due to the smaller difference b/w calculated peak values of discharges.

It is observed that the results of HEC-RAS model against 100 year return period are very close to observed 2010 flood data, Model is assumed valid for study area in order to perform analysis for hazard assessment. Flood against return period of 10000 yrs affects largely communities and agricultural land located within study area. There are number of urban settlements and built-up areas which are at-risk to be inundated .Hec-Ras model forecast 14.88 km^2 area to be inundated averagely against these discharges the affected area against 2,5,10,20,25,50,100,500,1000,10000 is shown in Table 4.2.

Table 4.2: Estimated Inundated Area at Different Return Period

S. No.	**Time period**	**Peak Discharges Cumecs**	**Inundated Area** km^2
1	2	734.63	10.38
2	5	1478.08	11.34
3	10	1970.31	11.84
4	20	2442.46	12.22
5	25	2592.24	12.35
6	50	3053.62	12.72
7	100	3511.60	13.05
8	500	4569.91	13.78
9	1000	5024.90	14.06
10	10000	6535.53	14.88

Inundated maps show flood-extent at the peak-flow against return period of 2, 5, 10, 20, 25, 50, 100, 500, 1000, 10000 years in the ANNEX C. Flooded area is also overlaid graphically on Basemap, the overlay outcome is represented in Annexure A, clearly identifies the settlements at-risk including houses and agricultural land.

Table 4.3: Estimated Inundated Area at Several Flow Intensity

Type	**Flow Range**	**Average Flow** m^3/Sec	**Inundated Area** km^2
Low Flow	0-50	42.48	0
	50-100	77.97	0
	100-150	128.94	1.21
	150-200	187.79	2.63
	200-250	223.01	3.19
	250-300	279.67	4.92
	300-350	335.59	5.87
	350-400	387.45	6.31
	400-450	431.24	7.56
	450-500	468.69	7.98
	500-550	525.67	8.24
Medium Flow	550-600	577.78	8.96
	600-650	635.94	9.79
	650-700	670.97	9.98
	700-750	731.04	10.56
	750-800	776.68	10.67
	800-850	815.19	10.76
	850-900	869.92	10.81
	900-950	927.26	10.89
High Flow	950-1000	982.29	10.91
	1000-1050	1022.21	11.1
	1050-1100	1089.97	11.22
	1100-1150	1121.93	11.29
	1150-1200	1176.52	11.32

Table 4.4: Estimated Inundated Area at Several Flow Intensity

Risk Description	Infrastructture	Area In Undated
	No	Km^2
High Risk	221	2.1
Moderate to Low	180	3.6
Very Low	919	5.9
Total	1320	11.6

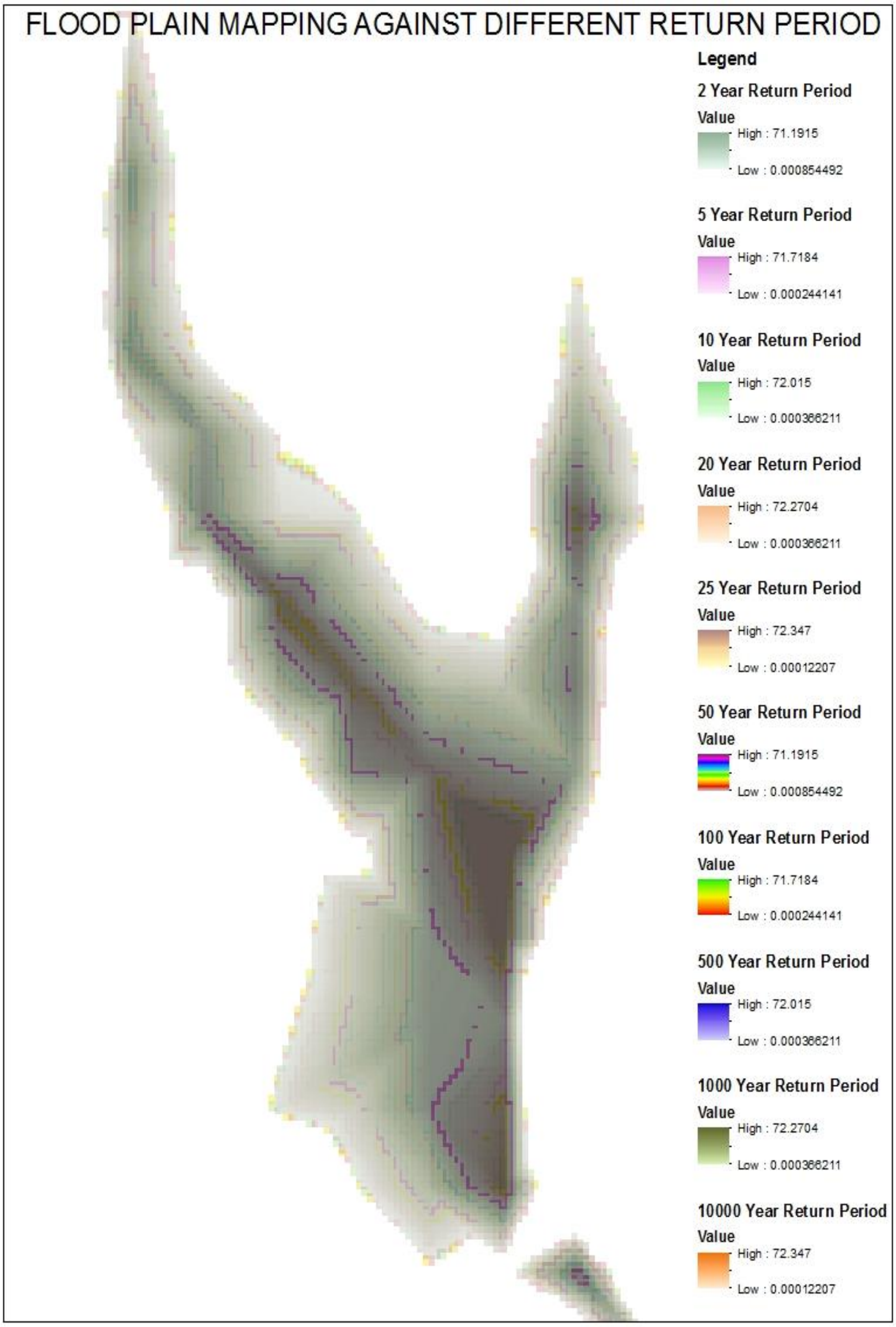


Figure 4.27: Flood Plain Mapping against different Return Period\

4.7 VALIDATION AND APPLICATIONS

In order to assess accuracy of terrain model and the floodplain maps it is required to validate the Digital-Elevation Model, which is the basic source for the generation of terrain model and the floodplain maps. Digital-elevation model is validated against the survey data on Kalam Exit bridge, which was conducted by NHA (National High-way Authority) after flood 2010 for reconstruction of Damaged Bridge. For the DEM Digital-Elevation model, Similar portion as that of survey area of Kalam-Exit Bridge is compared with ASTGTM2-N35E072-DEM taken from ASTER GTM site. Calibration Process is explained in detail in Chapter 3.

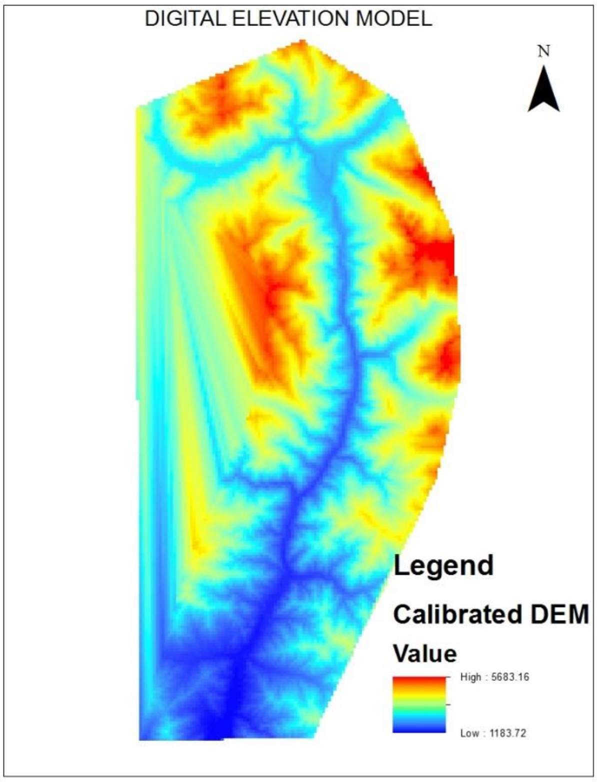


Figure 4.28: Calibrated Digital Elevation Model of Study Area

For the validation of DEM, spot elevation co-ordinates for Kalam Exit Bridge Survey Area were used for the creation of Digital-Elevation Model of Study reach. Calibrated DEM is shown in Figure 4.28 above.

This research describes automation procedure for floodplain mapping on the basis of output of hydraulic model. Delineation based on GIS results time saving and resources as compared to the manual plotting of HEC-RAS output. Following are the potential applications for this study.

Hydraulic Design

The Components of culverts, Bridges and the further drainage control facilities includes hydraulic analysis for the determination of conveyance-capacity. By Zooming the particular area of drainage-control structure, floodplain extent and depth of water at desired location can be determined by using grid-based delineation.

Terrain modeling

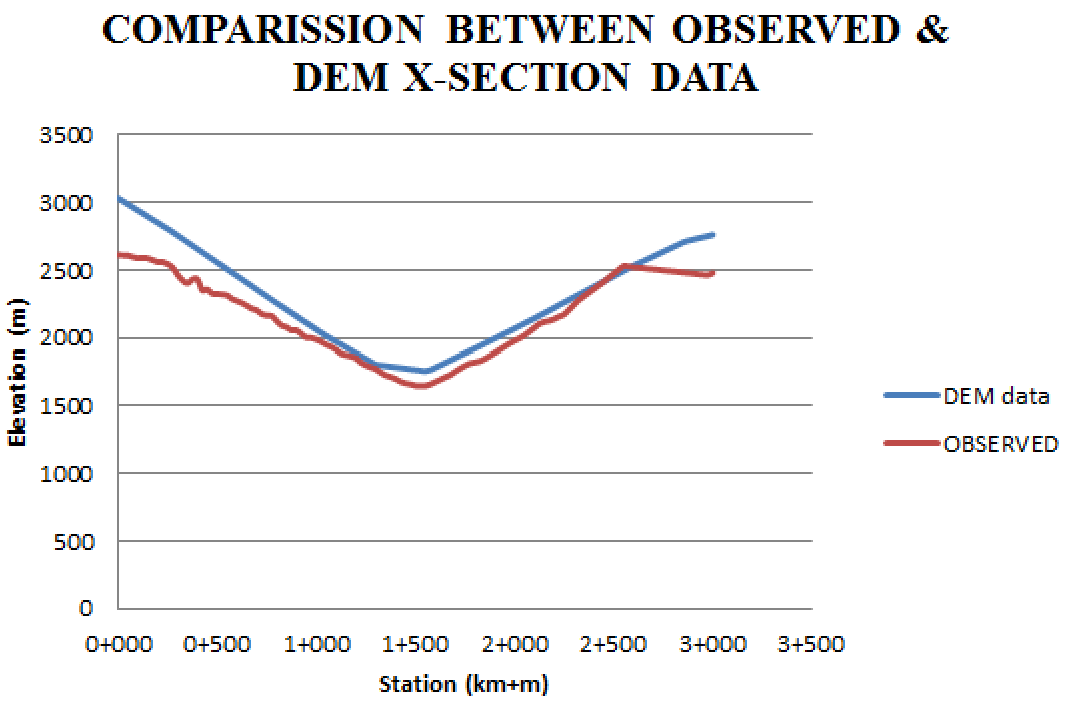
State and Local governments invest for studies of photogrammetry studies like SOP, more comprehensive DTMs also be available. However the studies never obtains data of elevation considering perennially inundated areas by water, thus it becomes it becomes important to integrate DTMs with the elevation of surveyed channel for hydraulic modelling. HEC-RAS model imports 3-dimensional river-reach and X-sectional data from GIS. Both Channel morphology and floodway, required for the hydraulic –modelling is accurately determined from integrated TIN.

Flood Warning System

Real-time analysis is carried out using recoded Flow or measured rainfall with hydrologic modelling as an input for hydraulic modelling for mapping in GIS .The information is used then for coordinating flood warning deeds like evacuations and road closures. Unfortunately velocities of stream which occur during flood are usually very high for making practical floodplain maps.

4.8 COMPARISSION BETWEEN OBSERVED & DEM CROSS-SECTIONAL DATA

Observed X-section of river & X-section extracted from digital elevation model are compared and it has been found 6% difference in between.The both X-sections are shown in Figure given below:



Chapter V
CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

- It has been found that Gen Extreme Value [Type I] is the best-fit Distribution for the Study area considering Kolmogrov smirnov and Chi-Squared with superior ranking and at ranked 2 using Anderson Darling.

- The flood inundation extents of about 10.38 Sq. km against 2 year, 11.34 Sq. km against 5 year,11.84 Sq. km against 10 year,12.22 Sq. km against 20 year,12.35 Sq. km against 25 year, 12.72 Sq. km against 50 year, 13.05 Sq. km against 100 year, 13.78 Sq. km against 500 year, 14.06 Sq. km against 1000 year, 14.88 Sq. km against 10000 year return period are found.

- At the flood inundation extent against 100 year return period,1320 are the total infrastructures which are at risk, out of which 221 are at High Risk with an inundated area of about 3.6 Sq. km, 183 at Moderate to Low Risk with an inundated area of about 2.1 Sq. km while 916 are at very low risk with an inundated area of about 5.9 Sq. km.

5.2 RECOMMENDATION

During course of the research numerous essential concepts were discovered and noted which have important influence on hydraulic data mapping process and quality of resulting output. The concepts are well explained in following paragraph.

1. ASTER GTM 30m DEM doesn't provide sufficient channel representation for flood-plain modelling. The detailed level of channel representation using DEM is not sufficient to be utilized as X-sectional data source for the hydraulic modelling. For most appropriate results finer DEM (0.5m or 1m) or observed X-Sectional data should be used.
2. For the stream-centerline definition DEM was used, the representation of stream-centerline was developed by digitizing on Google Earth; this should be revised using DOQQ base-map.
3. The Flood risk maps are generated using peak discharges from 1963-2010, the discharge data after flood 2010 should be considered for most appropriate results and the historic data should be extended up to 100 years instead of 47 years record.

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ANNEX A

HISTORICAL FLOW DATA RECORD (SWHP)

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	34.26	27.69	21.49	101.4	291.7	387.9	393.6	354.0	149.8	70.79	61.16	36.53
	2	34.26	27.10	25.32	92.9	276.4	424.8	351.1	334.1	158.9	71.92	63.43	38.23
	3	33.70	27.10	79.57	104.2	297.3	487.0	337.0	288.8	159.1	68.81	60.60	37.38
	4	33.70	27.10	201.62	100.0	320.0	438.9	359.6	280.3	173.6	65.13	52.67	36.53
	5	32.28	28.88	206.71	85.8	407.8	467.2	368.1	385.1	163.7	64.56	47.29	35.96
	6	32.85	28.88	126.58	94.3	385.1	444.6	376.6	294.5	157.7	62.86	122.61	35.68
	7	32.85	28.88	122.05	104.2	339.8	436.1	382.3	286.0	152.9	65.13	89.76	35.68
	8	32.85	29.45	186.32	102.8	339.8	410.6	393.6	314.3	150.9	64.00	75.04	33.98
	9	32.28	29.45	228.80	98.5	580.5	413.4	427.6	279.2	167.6	62.30	57.77	32.28
	10	32.28	28.88	132.81	111.3	464.4	433.2	450.2	270.1	147.8	61.73	50.69	33.41
	11	30.87	28.88	94.30	110.7	342.6	453.1	492.7	257.4	137.9	61.16	46.72	33.98
	12	31.71	28.29	75.61	162.5	286.0	447.4	523.9	274.1	139.9	59.47	45.31	35.68
	13	30.30	27.69	69.66	186.3	337.0	453.1	492.7	282.9	129.1	57.77	43.61	61.16
	14	30.30	27.69	62.86	199.9	393.6	436.1	430.4	249.2	121.5	54.93	47.57	45.02
	15	30.87	41.06	57.77	228.8	404.9	444.6	382.3	237.9	105.9	53.24	55.50	38.23
1963	16	30.87	37.94	53.80	218.6	376.6	433.2	371.0	244.7	97.4	53.80	48.70	37.66
	17	29.45	35.68	60.88	211.8	337.0	464.4	385.1	239.0	107.6	52.10	45.31	35.40
	18	30.30	32.85	51.82	191.4	300.2	472.9	399.3	244.7	96.0	50.69	45.87	35.11
	19	30.30	30.87	58.90	162.5	277.2	427.6	416.3	249.2	87.5	50.12	43.61	35.11
	20	30.30	28.29	56.92	147.0	297.3	444.6	410.6	257.4	85.2	49.55	45.31	35.40
	21	29.45	27.10	59.75	153.2	260.2	387.9	481.4	248.1	80.4	47.57	46.72	35.11
	22	30.30	25.32	71.92	162.5	236.4	404.9	399.3	226.5	77.0	45.87	47.29	34.83
	23	30.30	24.13	127.99	213.5	233.0	421.9	308.7	259.9	76.5	45.87	43.32	34.26
	24	29.45	22.46	107.04	213.5	228.0	436.1	274.1	223.1	74.5	45.87	42.76	34.26
	25	28.88	21.49	79.57	179.5	250.0	444.6	249.2	186.9	71.9	43.61	42.76	34.26
	26	28.88	21.01	77.02	171.0	244.9	416.3	250.3	185.8	76.5	42.76	43.61	33.70
	27	28.29	20.05	74.47	373.8	234.7	464.4	270.1	169.6	80.4	42.48	39.36	32.85
	28	28.29	20.53	79.57	512.5	268.7	484.2	331.3	165.7	75.0	44.17	36.53	33.13
	29	27.10		77.02	436.1	305.8	523.9	339.8	141.9	72.8	52.10	35.11	32.85
	30	27.69		79.57	339.8	334.1	464.4	362.5	137.9	70.8	57.77	35.68	32.85
	31	27.69		90.05		356.8		325.6	143.8		50.97		33.41
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	31.71	35.11	44.17	123.2	173.6	259.1	552.2	246.4	222.0	82.40	45.31	44.17
	2	31.43	35.11	43.32	115.8	198.2	233.6	589.0	250.3	220.9	77.59	43.32	43.61
	3	30.87	34.83	79.85	172.7	222.3	224.8	617.3	257.7	212.9	75.04	41.34	43.32
	4	31.71	33.13	83.25	147.0	251.5	223.4	589.0	276.1	197.1	72.77	41.63	73.91
	5	34.26	33.70	67.11	122.3	196.0	233.6	563.5	277.5	183.5	67.68	40.78	60.03
	6	50.12	33.98	60.03	113.0	200.5	224.8	532.4	270.7	176.7	67.11	40.78	51.25
	7	73.34	33.98	53.24	128.0	217.5	209.5	529.5	288.8	174.4	71.36	39.64	41.91
	8	82.40	32.85	49.27	119.5	232.5	226.0	521.0	286.0	172.7	76.46	39.08	38.23
	9	61.73	33.70	49.27	109.3	205.0	260.5	540.9	294.5	173.6	71.92	37.66	39.93
	10	49.27	32.56	66.54	143.8	231.1	256.6	543.7	387.9	172.7	66.54	36.53	37.94
	11	46.72	32.00	88.91	246.4	243.8	288.8	546.5	354.0	169.6	81.84	36.81	40.49
	12	42.76	32.00	70.79	219.7	264.2	291.7	594.7	368.1	151.8	73.91	35.68	39.93
	13	39.64	32.28	66.54	202.7	300.2	305.8	722.1	314.3	144.7	75.89	36.81	39.08
	14	38.51	33.98	73.91	199.4	320.0	303.0	682.4	311.5	145.8	75.89	35.96	37.66
	15	38.51	35.11	80.99	229.9	277.5	385.1	574.8	387.9	146.7	77.02	48.99	35.96
1964	16	36.81	36.53	80.99	339.8	276.1	404.9	489.9	458.7	160.8	75.89	33.70	34.26
	17	35.40	105.91	80.42	233.6	280.3	413.4	402.1	424.8	215.2	69.66	34.26	35.68
	18	34.26	118.65	85.23	163.7	288.8	438.9	328.5	515.4	182.4	62.86	33.13	36.81
	19	33.13	73.34	131.96	143.8	305.8	421.9	276.1	393.6	173.6	58.90	34.83	36.53
	20	32.56	61.16	112.13	143.8	277.5	385.1	218.6	351.1	165.7	59.47	32.56	36.25
	21	35.11	70.79	98.26	143.8	273.3	376.6	206.1	379.4	141.9	60.60	33.98	36.81
	22	40.49	57.20	88.91	145.0	217.5	387.9	207.3	396.4	125.2	58.33	34.26	38.51
	23	39.36	51.25	87.50	167.9	190.3	436.1	227.4	331.3	118.6	55.50	33.70	45.31
	24	37.66	45.02	102.51	190.9	172.7	470.1	278.9	297.3	109.3	54.93	33.98	43.32
	25	35.68	41.63	147.81	214.1	169.6	441.7	356.8	305.8	100.8	53.80	33.98	41.63
	26	34.83	41.34	112.13	242.7	175.6	438.9	385.1	305.8	94.3	50.12	33.41	39.93
	27	34.83	39.08	97.41	191.4	189.2	458.7	421.9	255.1	94.3	50.12	33.70	38.23
	28	34.26	39.93	97.41	173.6	205.0	478.6	407.8	241.3	92.0	51.25	34.55	36.81
	29	35.40	54.93	109.30	169.6	216.3	504.0	421.9	228.5	90.3	48.14	35.68	36.81
	30	34.83		109.30	164.8	258.0	523.9	345.5	227.1	84.7	47.57	41.34	35.96
	31	34.83		110.44		242.7		271.8	218.6		45.31		35.40

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	35.40	34.83	51.25	220.9	216.3	444.6	563.5	407.8	168.2	86.08	50.97	41.91
	2	34.83	36.81	50.69	174.7	216.3	461.6	523.9	371.0	157.2	83.53	49.55	40.78
	3	33.41	44.46	49.55	143.8	246.4	512.5	470.1	368.1	151.5	86.93	48.99	40.78
	4	33.41	182.36	48.14	145.8	283.2	529.5	438.9	351.1	148.4	86.08	50.40	41.06
	5	32.85	148.95	47.57	141.0	317.1	382.3	376.6	320.0	145.0	83.53	53.24	40.78
	6	33.41	89.76	49.27	155.7	339.8	376.6	368.1	303.0	147.2	80.42	53.24	39.64
	7	32.00	65.13	52.10	199.4	447.4	351.1	402.1	308.7	150.4	78.15	52.10	38.23
	8	31.71	54.37	58.90	191.4	382.3	404.9	455.9	291.7	151.5	79.00	49.55	37.66
	9	31.43	47.29	75.04	168.8	356.8	413.4	433.2	314.3	158.3	77.30	47.86	37.10
	10	31.15	50.69	64.00	150.9	331.3	470.1	410.6	339.8	146.1	73.91	47.86	36.25
	11	30.87	64.56	54.37	156.9	365.3	526.7	404.9	314.3	135.1	71.64	47.57	36.81
	12	30.02	83.82	54.37	175.6	371.0	640.0	404.9	297.3	124.6	73.06	47.57	36.81
	13	29.73	65.70	57.20	317.1	345.5	673.9	512.5	270.4	122.6	65.13	49.55	37.10
	14	29.73	55.50	61.16	218.6	356.8	716.4	617.3	254.9	117.5	63.71	78.15	36.81
	15	29.45	52.67	67.11	200.5	387.9	699.4	640.0	236.4	113.6	66.26	61.73	36.25
1965	16	29.17	53.80	80.99	208.4	328.5	673.9	702.3	232.2	110.4	61.73	55.50	37.10
	17	32.28	58.90	147.81	219.7	339.8	659.8	719.2	230.8	112.4	62.30	52.10	36.81
	18	37.94	62.86	105.06	472.9	345.5	654.1	676.8	229.4	112.4	61.16	51.54	35.96
	19	58.90	56.07	219.74	574.8	385.1	662.6	597.5	244.9	126.6	59.75	50.97	35.96
	20	73.34	51.25	146.96	419.1	410.6	716.4	580.5	266.2	115.5	59.75	50.12	35.68
	21	80.99	52.10	102.51	300.2	481.4	696.6	566.3	271.8	111.6	57.77	47.86	35.11
	22	58.90	50.12	105.91	283.2	444.6	682.4	549.3	390.8	126.6	56.63	47.57	35.68
	23	44.46	48.14	99.11	470.1	438.9	637.1	540.9	373.8	113.6	56.63	45.59	36.25
	24	44.46	48.14	87.50	555.0	436.1	603.1	555.0	390.8	112.4	55.50	45.59	54.93
	25	38.51	46.44	88.91	402.1	393.6	555.0	555.0	305.8	107.9	55.50	47.01	41.91
	26	38.23	45.31	78.44	294.5	337.0	552.2	651.3	260.5	102.2	54.93	45.59	39.93
	27	37.94	47.29	77.02	240.1	402.1	603.1	671.1	240.7	99.4	54.37	44.17	38.79
	28	36.53	53.24	74.47	241.3	455.9	606.0	608.8	261.9	93.7	53.80	43.32	38.79
	29	36.25	51.25	70.79	235.0	455.9	591.8	489.9	249.2	86.1	52.67	43.61	38.79
	30	37.38		75.89	224.8	430.4	560.7	430.4	225.1	86.1	53.24	42.48	37.66
	31	36.25		96.84		438.9		410.6	205.0		52.10		37.10
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	37.94	29.45	53.24	124.6	246.4	270.4	591.8	566.3	187.5	74.47	65.13	37.66
	2	37.10	28.88	52.10	125.8	246.4	269.0	501.2	472.9	191.1	72.49	63.71	38.23
	3	36.25	29.45	50.40	125.7	218.0	311.5	489.9	433.2	253.4	71.08	61.73	37.66
	4	35.96	28.88	53.80	127.7	229.4	376.6	399.3	407.8	331.3	84.38	60.60	37.10
	5	35.96	28.60	98.54	131.7	276.1	373.8	322.8	387.9	382.3	81.27	58.62	37.94
	6	35.11	30.02	67.68	126.6	339.8	385.1	276.1	402.1	334.1	78.15	56.63	38.23
	7	34.83	36.25	61.16	148.4	362.5	396.4	249.2	529.5	254.9	75.32	53.80	37.94
	8	34.83	56.07	54.37	174.1	416.3	430.4	257.7	390.8	210.1	75.32	50.97	37.10
	9	34.26	54.93	52.10	139.3	393.6	444.6	320.0	498.4	187.5	73.06	50.12	36.25
	10	33.70	45.59	53.80	127.7	348.3	416.3	376.6	382.3	181.5	74.47	47.57	36.25
	11	34.26	40.21	54.37	154.9	314.3	427.6	430.4	354.0	161.4	110.44	45.59	37.10
	12	34.83	43.61	56.07	136.2	242.1	492.7	433.2	322.8	146.1	92.03	42.76	35.96
	13	33.70	55.50	68.24	148.4	237.9	532.4	444.6	314.3	137.3	89.48	43.61	35.68
	14	33.70	67.68	71.64	382.3	212.7	540.9	438.9	288.8	136.2	82.12	41.91	36.25
	15	33.41	62.30	79.57	371.0	202.5	566.3	419.1	271.8	131.7	81.27	42.48	37.10
1966	16	33.41	48.99	79.00	356.8	205.0	560.7	387.9	269.0	187.5	77.30	42.76	37.10
	17	32.85	44.74	141.58	373.8	228.0	572.0	351.1	233.6	153.8	75.89	42.48	36.25
	18	32.56	40.78	191.14	271.8	270.4	549.3	308.7	222.3	150.4	75.32	42.48	36.25
	19	32.56	39.64	146.11	239.3	314.3	549.3	303.0	226.5	149.5	92.03	41.91	35.96
	20	32.28	39.93	96.56	252.0	351.1	620.1	308.7	237.9	140.5	92.03	41.63	34.26
	21	32.00	73.91	86.08	249.2	345.5	589.0	354.0	249.2	121.5	81.27	41.91	33.98
	22	32.56	59.75	108.74	256.3	322.8	574.8	396.4	225.1	113.6	78.15	41.63	33.70
	23	32.28	47.86	96.56	215.2	297.3	546.5	424.8	212.7	119.5	77.30	41.06	33.41
	24	31.71	47.01	91.18	242.1	291.7	555.0	461.6	215.2	121.5	75.32	40.21	33.41
	25	32.00	45.59	115.53	261.9	300.2	611.6	472.9	194.8	112.4	76.74	39.93	32.56
	26	32.00	61.73	227.95	250.6	331.3	640.0	495.5	174.1	100.2	79.00	39.93	32.56
	27	31.15	59.18	385.11	320.0	379.4	688.1	433.2	163.7	92.9	75.89	41.63	32.85
	28	30.02	57.77	226.53	470.1	359.6	705.1	416.3	167.1	90.3	73.06	40.21	33.70
	29	29.45		158.29	447.4	351.1	648.5	419.1	167.1	86.1	71.08	38.79	34.83
	30	29.17		139.32	274.7	311.5	625.8	427.6	174.1	79.0	68.81	38.23	36.81
	31	28.88		117.51		314.3		645.6	189.7		66.26		36.25

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	36.25	26.50	62.30	117.5	242.1	390.8	685.3	399.3	154.9	82.97	55.50	40.21
	2	35.68	25.82	60.60	95.7	194.8	436.1	710.8	351.1	145.0	75.32	52.10	38.23
	3	34.83	26.16	52.10	84.4	175.6	470.1	597.5	373.8	138.5	75.89	53.24	45.87
	4	34.26	28.20	46.44	80.4	177.8	413.4	555.0	427.6	145.0	79.00	48.99	44.17
	5	33.41	28.20	43.61	114.4	171.9	362.5	535.2	407.8	137.3	84.38	51.54	41.06
	6	34.83	27.86	45.59	95.7	162.5	427.6	563.5	368.1	146.1	73.91	47.86	42.48
	7	35.11	28.88	45.02	83.0	152.6	492.7	750.4	328.5	157.2	69.66	49.55	41.63
	8	35.11	58.62	45.87	76.7	187.5	538.0	620.1	322.8	157.2	70.23	47.86	40.78
	9	34.26	37.94	48.99	73.9	207.6	535.2	535.2	303.0	159.4	65.13	47.57	39.93
	10	33.98	34.83	49.55	71.1	213.8	608.8	498.4	266.2	160.6	61.73	44.17	40.21
	11	33.98	33.98	71.08	71.6	205.0	591.8	492.7	261.9	162.5	63.71	45.02	41.63
	12	33.41	32.56	93.73	68.2	168.2	637.1	495.5	247.8	165.9	66.26	42.48	40.78
	13	32.56	31.71	123.74	71.6	164.8	648.5	583.3	259.1	183.8	63.71	42.48	40.21
	14	32.28	30.87	89.48	92.0	164.8	665.4	512.5	273.3	263.3	60.60	41.06	40.78
	15	32.28	32.00	71.64	121.5	169.6	555.0	523.9	291.7	207.6	56.63	41.91	39.93
1967	16	32.28	37.94	125.73	133.9	194.8	506.9	501.2	354.0	176.7	69.66	43.61	38.79
	17	30.87	91.18	94.58	163.7	226.5	390.8	489.9	339.8	157.2	59.75	42.76	39.08
	18	30.87	61.73	74.47	184.9	246.4	328.5	504.0	317.1	136.2	54.93	40.78	38.79
	19	30.58	71.64	66.26	165.9	297.3	300.2	421.9	269.0	126.6	55.50	41.06	37.94
	20	30.87	196.24	60.60	187.5	337.0	368.1	430.4	261.9	111.6	52.67	39.93	38.79
	21	30.30	117.51	54.37	184.9	359.6	433.2	438.9	244.9	99.4	50.40	41.06	37.94
	22	30.30	78.15	52.39	177.8	362.5	523.9	455.9	236.4	100.2	50.97	40.21	38.79
	23	30.87	59.75	50.40	192.3	351.1	555.0	467.2	240.7	98.5	57.77	41.63	41.63
	24	30.87	52.67	75.04	230.8	385.1	606.0	699.4	263.3	92.0	158.29	44.17	54.37
	25	30.58	45.87	356.79	244.9	277.5	645.6	580.5	240.7	112.4	119.50	42.48	57.20
	26	28.60	44.17	215.21	291.7	230.8	662.6	526.7	225.1	127.7	95.71	41.06	72.49
	27	28.20	43.32	126.58	337.0	209.0	662.6	504.0	205.0	143.8	81.27	39.93	94.58
	28	28.60	45.87	98.54	673.9	199.9	640.0	441.7	188.6	125.7	73.91	41.91	83.53
	29	28.60		86.08	481.4	219.5	648.5	390.8	171.9	103.9	66.26	39.93	60.60
	30	27.52		79.57	294.5	269.0	727.7	373.8	160.6	89.5	63.71	40.78	52.67
	31	26.84		76.74		342.6		351.1	157.2		59.75		49.55
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	47.57	36.25	50.40	67.7	464.4	373.8	540.9	433.2	110.4	69.66	68.81	37.66
	2	46.72	34.83	48.99	63.7	410.6	396.4	560.7	421.9	106.8	67.68	72.49	35.68
	3	45.59	34.83	47.86	58.6	339.8	407.8	563.5	421.9	105.9	68.81	68.24	35.96
	4	43.61	33.98	49.55	65.7	308.7	393.6	580.5	433.2	103.1	76.74	60.60	37.94
	5	41.91	34.83	51.54	79.0	264.8	396.4	597.5	427.6	105.1	69.66	57.77	37.94
	6	42.76	39.08	50.12	103.9	239.3	467.2	628.6	521.0	103.9	67.11	54.93	37.94
	7	41.06	35.11	50.12	189.7	220.9	521.0	640.0	413.4	108.7	73.06	53.80	42.48
	8	41.06	33.70	50.97	141.6	202.5	555.0	662.6	399.3	118.6	67.68	51.54	41.06
	9	40.21	33.41	50.40	120.6	186.0	586.2	710.8	402.1	108.7	66.26	50.97	41.63
	10	41.06	32.00	54.37	117.5	177.8	583.3	682.4	413.4	105.9	66.26	50.97	48.99
	11	41.91	31.71	57.77	99.4	167.1	634.3	654.1	444.6	108.7	63.15	51.54	152.06
	12	40.21	30.87	65.70	103.1	165.9	583.3	657.0	438.9	106.8	62.30	51.54	128.84
	13	39.93	31.15	65.13	57.8	187.5	557.8	668.3	430.4	113.6	58.62	50.12	82.12
	14	38.23	31.71	89.48	158.3	218.0	540.9	631.5	433.2	119.5	73.06	47.57	72.49
	15	37.10	30.58	72.49	206.4	228.0	540.9	580.5	461.6	125.7	63.15	47.01	80.42
1968	16	37.10	30.58	66.26	146.1	211.5	572.0	543.7	427.6	138.5	63.15	45.59	68.81
	17	37.94	30.02	77.30	124.6	197.1	594.7	523.9	371.0	140.5	59.18	44.17	62.30
	18	36.81	30.58	142.72	149.5	222.3	597.5	464.4	351.1	124.6	57.77	43.32	60.60
	19	35.68	32.28	178.96	143.8	274.7	591.8	421.9	407.8	114.4	55.50	42.76	56.63
	20	43.61	40.21	181.51	164.8	274.7	589.0	416.3	354.0	97.4	54.37	42.48	53.80
	21	41.63	59.75	123.74	188.6	260.5	594.7	427.6	334.1	88.6	54.37	42.76	50.97
	22	38.23	44.74	95.71	218.0	268.4	614.5	416.3	354.0	85.2	53.24	43.32	48.99
	23	36.81	39.93	82.12	250.6	276.1	606.0	407.8	308.7	86.1	52.10	41.63	47.01
	24	38.23	36.81	73.91	222.3	264.8	606.0	385.1	257.7	85.2	52.10	39.08	47.01
	25	37.66	38.23	71.64	242.1	266.2	637.1	402.1	233.6	82.1	50.40	38.23	45.02
	26	35.96	58.62	82.12	270.4	267.6	648.5	470.1	215.2	81.3	48.99	38.79	44.17
	27	37.94	99.39	118.65	297.3	273.3	645.6	438.9	174.1	78.2	47.86	38.79	41.63
	28	40.21	75.32	105.91	300.2	259.1	642.8	464.4	150.4	79.6	45.87	37.94	42.48
	29	42.76	56.63	92.03	259.1	286.0	555.0	608.8	139.3	75.3	55.50	37.10	41.63
	30	41.63		78.15	489.9	337.0	526.7	750.4	127.7	72.5	82.97	36.81	41.91
	31	38.79		71.08		365.3		472.9	115.5		65.13		40.21

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	39.93	63.15	77.30	149.5	151.5	472.9	464.4	351.1	179.0	81.27	86.08	46.44
	2	39.64	54.37	70.23	136.2	145.0	487.0	498.4	382.3	184.9	86.08	84.38	45.87
	3	38.23	47.86	63.71	137.3	147.2	461.6	535.2	416.3	174.1	82.12	79.00	45.02
	4	40.78	47.01	76.74	129.7	149.5	492.7	566.3	441.7	161.4	80.42	73.06	43.32
	5	39.93	45.87	76.74	115.5	183.8	390.8	589.0	487.0	152.6	76.74	71.64	44.74
	6	39.93	42.76	84.38	152.6	218.0	351.1	608.8	498.4	153.8	73.91	68.81	45.02
	7	39.08	41.91	103.07	163.7	239.3	382.3	623.0	549.3	153.8	74.47	67.11	44.74
	8	39.64	41.06	95.71	183.8	300.2	419.1	631.5	560.7	152.6	71.64	62.30	42.76
	9	39.64	40.78	97.41	188.6	427.6	447.4	645.6	549.3	143.8	69.66	63.15	42.76
	10	39.64	40.78	102.22	205.0	385.1	470.1	574.8	693.8	135.1	70.23	61.16	41.91
	11	38.23	39.08	108.74	243.5	362.5	416.3	535.2	773.0	125.7	80.42	59.18	41.63
	12	37.66	34.83	120.63	288.8	291.7	447.4	458.7	600.3	127.7	113.55	60.60	41.06
	13	38.23	50.40	135.07	247.8	286.0	472.9	481.4	506.9	127.7	84.38	60.60	42.76
	14	37.10	45.59	139.32	219.5	281.8	487.0	555.0	504.0	206.4	84.38	59.18	40.21
	15	35.96	73.06	140.45	261.9	259.1	512.5	504.0	481.4	216.6	108.74	55.50	39.93
1969	16	35.96	59.18	139.32	291.7	214.1	512.5	512.5	427.6	209.0	95.71	48.99	40.78
	17	35.96	79.00	143.85	259.1	211.5	538.0	515.4	413.4	163.7	84.38	51.54	39.93
	18	35.96	64.28	171.88	205.0	214.1	569.2	526.7	407.8	140.5	79.00	50.40	39.93
	19	35.96	54.37	259.10	176.7	223.7	549.3	546.5	444.6	127.7	76.74	50.12	39.64
	20	35.11	49.55	214.08	228.0	220.9	583.3	659.8	385.1	119.5	74.47	54.93	39.08
	21	34.83	47.86	158.29	308.7	233.6	552.2	699.4	328.5	115.5	69.66	56.63	38.79
	22	35.11	44.74	141.58	239.3	263.3	487.0	702.3	291.7	105.9	67.11	52.67	38.79
	23	34.83	42.76	143.85	194.8	305.8	464.4	719.2	237.9	99.4	64.28	47.57	38.23
	24	34.26	48.99	136.20	170.8	280.3	455.9	719.2	219.5	100.2	64.28	49.55	38.23
	25	34.26	66.26	168.20	152.6	303.0	487.0	682.4	203.9	98.5	62.30	49.55	37.94
	26	48.99	56.07	356.79	157.2	328.5	501.2	631.5	201.3	95.7	60.60	48.42	38.23
	27	76.74	79.29	222.29	141.6	359.6	512.5	617.3	194.8	91.2	68.24	48.42	38.23
	28	56.63	102.22	169.62	210.1	385.1	504.0	563.5	184.9	83.5	193.69	49.55	37.94
	29	48.42		142.72	188.6	430.4	492.7	470.1	175.6	81.3	280.34	47.57	38.79
	30	47.01		132.81	164.8	470.1	444.6	419.1	179.0	80.4	144.98	45.87	38.79
	31	45.02		133.94		481.4		356.8	180.1		105.06		36.81
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	36.25	37.66	52.10	68.2	130.8	461.6	540.9	244.9	521.0	71.08	57.20	35.96
	2	36.25	36.25	45.59	70.2	136.2	504.0	549.3	247.8	404.9	73.06	54.93	35.96
	3	36.25	36.25	41.91	76.7	132.8	523.9	532.4	249.2	342.6	74.47	51.54	35.96
	4	36.25	30.02	40.78	84.4	125.7	560.7	572.0	243.5	339.8	75.89	50.12	35.68
	5	35.96	35.11	39.93	98.5	136.2	472.9	447.4	250.6	337.0	79.57	48.42	35.68
	6	33.70	34.26	40.21	126.6	160.6	371.0	342.6	247.8	294.5	283.17	47.01	35.68
	7	33.98	33.98	37.94	131.7	156.0	359.6	342.6	246.4	269.0	126.58	46.44	33.70
	8	34.83	32.85	37.94	119.5	152.6	339.8	325.6	249.2	337.0	97.41	44.74	33.98
	9	34.83	32.56	38.23	125.7	157.2	337.0	276.1	247.8	246.4	82.12	43.61	32.56
	10	35.11	32.28	50.97	141.6	167.1	356.8	237.9	250.6	223.7	81.27	43.32	32.56
	11	37.10	31.71	58.62	156.0	158.3	441.7	209.0	257.7	264.8	75.89	42.76	32.00
	12	37.10	31.15	52.10	157.2	161.4	444.6	209.0	300.2	256.3	72.49	41.63	32.28
	13	36.25	30.58	53.24	169.6	193.7	421.9	209.0	342.6	225.1	72.49	41.63	32.00
	14	35.96	30.30	58.62	161.4	187.5	314.3	213.8	314.3	230.8	70.23	40.78	32.00
	15	35.68	30.02	67.11	160.6	184.9	291.7	215.2	240.7	194.8	68.24	40.78	31.71
1970	16	35.11	29.73	70.23	212.7	220.9	215.2	273.8	250.6	179.0	68.24	41.06	33.98
	17	37.66	29.73	56.07	149.5	259.1	198.5	320.0	225.1	148.4	67.11	39.93	43.61
	18	36.25	29.73	78.15	135.1	277.5	187.5	273.3	226.5	131.7	67.11	38.79	35.96
	19	36.25	29.45	66.26	120.6	303.0	189.7	253.4	228.0	132.8	65.13	39.08	35.11
	20	35.11	29.17	60.60	119.5	328.5	233.6	311.5	219.5	154.9	63.15	39.64	35.11
	21	34.83	29.45	56.07	130.8	455.9	271.8	271.8	225.1	129.7	59.75	38.23	34.83
	22	33.98	39.08	58.62	170.8	475.7	317.1	228.0	229.4	111.6	70.23	37.66	33.70
	23	36.53	36.25	67.68	196.2	444.6	342.6	197.4	264.8	106.8	70.23	37.10	32.28
	24	34.26	35.96	66.26	192.3	382.3	402.1	181.5	239.3	95.7	72.77	36.81	32.28
	25	48.99	47.86	74.47	211.5	356.8	455.9	164.8	239.3	86.1	60.60	36.81	32.28
	26	42.48	45.02	146.11	218.0	256.3	489.9	175.6	419.1	84.4	57.20	35.68	32.56
	27	39.08	41.06	161.41	222.3	257.7	535.2	207.6	322.8	77.3	55.50	35.68	32.00
	28	36.81	67.11	116.38	206.4	328.5	546.5	247.8	300.2	78.2	59.18	36.25	31.71
	29	36.25		87.78	158.3	371.0	509.7	249.2	291.7	75.9	72.49	35.96	30.87
	30	42.76		73.91	132.8	399.3	543.7	244.9	291.7	75.3	65.13	35.68	30.87
	31	40.21		67.11		421.9		244.9	311.5		60.60		30.58

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	30.02	25.43	40.49	98.8	194.3	365.3	410.6	356.8	213.5	64.28	41.06	28.88
	2	30.02	25.43	35.40	97.1	178.4	413.4	444.6	382.3	209.0	59.75	39.36	28.60
	3	30.02	24.69	43.89	88.6	193.1	399.3	489.9	356.8	195.4	56.92	38.51	28.60
	4	29.45	24.92	38.79	121.8	212.4	407.8	373.8	328.5	194.3	55.78	38.51	28.88
	5	29.45	24.47	35.68	202.2	186.3	393.6	331.3	322.8	179.5	53.52	37.66	28.60
	6	29.17	24.47	33.98	112.4	169.6	402.1	257.7	303.0	159.7	52.10	36.81	28.60
	7	28.88	24.47	33.13	101.4	172.4	399.3	256.6	320.0	153.8	50.69	36.53	28.60
	8	28.88	24.69	33.41	118.4	210.1	461.6	256.6	342.6	129.4	50.40	35.68	28.03
	9	28.88	24.69	36.25	118.4	247.5	444.6	226.0	322.8	118.4	49.55	35.68	28.32
	10	28.88	32.28	34.55	147.8	198.8	461.6	257.7	305.8	109.0	48.99	34.55	28.32
	11	28.88	27.47	34.55	141.9	214.6	433.2	278.1	288.8	110.7	48.14	34.26	28.03
	12	28.60	26.70	37.66	126.9	207.8	419.1	320.0	247.5	126.9	48.14	33.70	28.60
	13	28.32	26.45	38.51	133.7	195.4	387.9	365.3	240.7	103.9	48.14	33.41	28.03
	14	28.03	26.19	39.08	168.5	215.8	453.1	402.1	215.8	87.8	47.01	33.41	27.75
	15	28.03	26.19	42.48	136.2	262.8	404.9	368.1	206.7	80.7	47.01	32.85	27.18
1971	16	28.03	25.43	51.54	214.6	275.5	379.4	354.0	207.8	68.8	46.44	32.56	27.18
	17	27.75	25.94	59.75	199.9	278.1	320.0	379.4	211.2	66.0	46.44	32.00	27.18
	18	27.21	25.94	63.71	169.6	322.8	331.3	314.3	197.7	64.8	45.59	32.28	26.96
	19	26.96	25.94	62.58	160.6	359.6	320.0	311.5	197.7	60.3	44.74	32.00	26.70
	20	27.21	25.94	58.62	160.6	351.1	328.5	288.8	197.7	58.0	47.01	32.56	26.70
	21	26.96	25.68	60.31	199.9	365.3	314.3	247.5	196.5	55.8	48.99	32.85	26.96
	22	27.21	24.24	62.58	172.4	365.3	322.8	218.0	171.6	58.0	46.44	32.85	27.18
	23	28.03	24.01	61.45	157.7	399.3	410.6	211.2	186.3	59.7	46.44	32.00	35.40
	24	27.47	22.65	64.85	148.7	387.9	441.7	212.4	209.0	65.4	45.59	31.15	33.13
	25	26.96	23.11	64.28	184.1	407.8	470.1	218.0	228.2	47.9	43.61	31.15	30.30
	26	26.96	73.91	63.15	216.9	368.1	365.3	226.0	267.9	52.1	42.19	31.15	29.73
	27	27.21	50.40	64.28	224.8	376.6	339.8	286.0	356.8	60.9	42.19	30.87	29.45
	28	26.70	46.16	64.28	311.5	396.4	354.0	402.1	348.3	58.6	41.34	30.30	28.88
	29	26.45		71.08	254.3	404.9	314.3	430.4	286.0	64.3	40.21	30.02	28.88
	30	25.68		80.14	196.5	410.6	354.0	410.6	243.0	71.1	40.21	29.45	29.17
	31	25.68		92.88		416.3		396.4	241.8		39.93		29.17
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	28.88	46.44	41.34	120.1	206.7	470.1	478.6	294.5	201.0	80.14	60.88	48.14
	2	28.60	42.19	43.89	120.1	177.5	475.7	495.5	294.5	179.5	77.87	60.31	47.29
	3	28.03	38.51	47.29	101.4	165.7	467.2	521.0	305.8	173.6	75.89	59.18	47.86
	4	27.18	36.53	51.25	145.8	168.5	484.2	557.8	339.8	167.6	73.91	56.92	47.29
	5	26.62	35.11	65.41	186.3	177.5	458.7	577.7	359.6	168.5	71.64	55.22	46.44
	6	26.33	33.98	54.09	171.6	230.5	447.4	540.9	509.7	170.5	69.94	54.65	46.44
	7	26.33	32.28	52.39	147.8	205.6	478.6	458.7	676.8	173.6	68.81	52.95	44.46
	8	26.05	30.30	71.64	130.3	218.0	470.1	450.2	467.2	171.6	68.24	52.67	43.61
	9	26.33	29.73	67.11	108.2	236.2	467.2	478.6	458.7	194.3	65.41	52.10	44.46
	10	26.33	29.45	54.09	107.3	213.5	472.9	501.2	402.1	180.7	64.85	51.54	44.74
	11	25.77	29.45	48.14	109.9	197.7	515.4	555.0	354.0	175.6	63.71	52.39	44.46
	12	26.05	43.04	66.54	125.2	240.7	538.0	538.0	320.0	170.5	61.45	52.95	43.61
	13	26.05	34.55	218.04	132.8	278.1	481.4	498.4	317.1	152.6	59.18	52.39	42.48
	14	26.62	33.13	137.90	150.6	447.4	495.5	489.9	325.6	148.7	58.05	52.10	41.06
	15	26.33	32.56	102.22	163.7	339.8	538.0	484.2	276.9	146.7	58.05	50.69	40.21
1972	16	26.33	31.15	88.63	271.8	297.3	574.8	484.2	257.7	144.7	58.05	50.40	40.49
	17	26.33	29.45	86.37	265.3	274.4	589.0	518.2	288.8	150.6	57.48	49.84	44.46
	18	26.05	29.17	80.14	211.2	303.0	594.7	521.0	269.3	141.9	66.54	48.99	42.19
	19	27.18	28.32	81.55	171.6	362.5	586.2	489.9	255.4	157.7	69.94	48.14	43.89
	20	28.32	28.32	117.51	148.7	362.5	555.0	436.1	276.9	204.4	64.28	47.29	42.48
	21	30.87	31.15	96.28	133.7	379.4	560.7	365.3	250.9	180.7	70.51	47.01	42.19
	22	53.52	70.51	82.97	137.1	416.3	552.2	365.3	232.8	149.8	81.55	55.78	41.06
	23	43.89	92.88	82.12	141.9	424.8	563.5	371.0	221.4	127.7	71.64	68.24	42.19
	24	38.51	110.72	102.22	155.7	458.7	583.3	356.8	230.5	111.6	68.24	61.45	42.48
	25	36.25	63.71	123.46	174.4	450.2	589.0	368.1	223.7	109.0	67.11	59.75	42.19
	26	34.26	52.95	133.66	184.1	427.6	606.0	368.1	193.1	103.9	65.41	54.65	43.61
	27	32.85	49.55	204.45	204.4	382.3	600.3	345.5	172.4	94.9	64.85	52.39	70.51
	28	31.15	44.74	185.19	274.4	379.4	597.5	334.1	158.6	90.0	63.71	50.69	50.69
	29	30.30	43.61	169.62	337.0	359.6	506.9	376.6	163.7	84.4	62.58	49.84	50.69
	30	31.15		165.65	239.6	354.0	526.7	376.6	165.7	81.6	62.58	48.70	49.55
	31	33.98		137.90		410.6		337.0	197.7		62.01		47.01

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	44.46	39.08	76.46	214.6	376.6	424.8	538.0	354.0	373.8	114.97	42.76	36.81
	2	43.89	39.93	69.94	163.7	393.6	450.2	518.2	362.5	320.0	129.41	42.48	36.81
	3	43.04	40.21	63.15	165.7	376.6	478.6	489.9	385.1	274.4	121.76	41.63	36.81
	4	42.48	39.93	55.22	175.6	371.0	481.4	512.5	453.1	243.0	104.77	41.06	37.66
	5	43.04	39.36	52.39	174.4	362.5	487.0	563.5	416.3	226.0	95.71	40.21	37.66
	6	45.59	38.79	49.55	189.7	373.8	495.5	574.8	475.7	210.1	88.63	38.79	36.53
	7	45.59	40.21	48.14	188.6	430.4	509.7	481.4	487.0	201.0	82.97	37.66	36.81
	8	44.74	42.19	69.94	177.5	419.1	521.0	433.2	518.2	185.2	81.55	37.38	36.81
	9	43.89	40.49	96.28	164.5	379.4	526.7	399.3	566.3	167.6	80.14	37.66	36.53
	10	43.04	39.93	240.69	162.5	325.6	506.9	362.5	427.6	155.7	74.47	37.66	36.25
	11	42.48	39.36	191.99	176.4	280.3	523.9	407.8	407.8	150.6	72.21	37.66	36.25
	12	42.48	39.93	128.56	205.6	303.0	535.2	410.6	399.3	149.8	71.08	37.66	36.81
	13	43.04	40.21	103.07	173.6	308.7	569.2	441.7	450.2	143.8	68.81	38.51	36.81
	14	42.48	42.48	95.71	160.6	314.3	569.2	501.2	427.6	134.5	66.54	38.51	36.53
	15	41.91	42.76	88.63	156.6	305.8	532.4	495.5	402.1	136.2	64.85	39.08	36.53
1973	16	41.63	42.76	80.14	153.8	303.0	515.4	521.0	382.3	139.9	63.71	39.08	36.81
	17	41.06	42.19	77.87	142.7	276.9	504.0	467.2	376.6	143.8	63.15	39.08	45.59
	18	40.21	42.76	75.89	147.8	305.8	501.2	467.2	359.6	142.7	64.85	39.08	41.63
	19	48.70	42.48	72.77	174.4	269.3	512.5	464.4	339.8	148.7	63.71	39.08	39.93
	20	63.71	41.06	70.51	210.1	262.8	515.4	512.5	331.3	189.7	63.15	39.08	38.51
	21	48.70	39.36	72.21	220.3	250.9	538.0	385.1	331.3	207.8	60.88	39.08	38.51
	22	43.04	39.93	78.72	229.4	276.7	509.7	438.9	331.3	177.5	58.05	39.08	37.66
	23	43.89	50.40	94.86	237.3	308.7	515.4	436.1	396.4	145.8	54.09	39.08	36.81
	24	43.89	127.71	106.47	265.3	311.5	529.5	421.9	368.1	126.0	54.09	39.08	36.53
	25	43.04	196.52	126.01	297.3	345.5	538.0	447.4	373.8	153.8	51.54	39.08	35.96
	26	42.48	148.66	160.56	320.0	362.5	538.0	470.1	359.6	140.7	48.70	39.08	35.68
	27	41.63	109.87	181.79	317.1	424.8	529.5	441.7	413.4	121.8	47.29	39.36	35.11
	28	41.06	87.78	203.31	322.8	404.9	535.2	453.1	373.8	115.0	48.14	37.66	35.11
	29	40.21		201.05	322.8	396.4	521.0	399.3	362.5	92.0	48.99	37.38	35.11
	30	39.36		157.72	339.8	387.9	518.2	365.3	362.5	102.2	44.46	36.81	34.55
	31	39.36		206.71		376.6		359.6	461.6		43.04		34.26
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	34.83	33.41	33.13	153.2	184.9	314.3	348.3	218.3	147.0	105.91	38.51	32.00
	2	34.83	36.25	32.56	154.9	174.4	331.3	368.1	236.2	136.5	88.35	37.94	32.00
	3	34.55	41.06	34.26	172.4	174.4	365.3	387.9	263.6	130.3	79.29	37.38	33.98
	4	34.55	44.74	38.51	173.6	168.5	390.8	328.5	393.6	117.8	73.06	36.81	33.41
	5	34.55	42.19	39.64	139.9	165.7	424.8	262.2	339.8	102.2	67.96	35.68	33.13
	6	33.98	40.21	36.81	123.7	157.4	387.9	225.1	317.1	100.8	63.15	36.25	32.56
	7	33.41	39.08	39.36	120.6	171.6	282.3	286.0	291.7	101.4	60.60	35.96	32.00
	8	33.13	37.66	40.78	120.6	239.8	300.2	281.2	282.3	90.9	58.05	35.40	31.71
	9	33.13	36.25	40.78	164.8	267.6	303.0	283.2	204.7	90.9	55.22	35.68	31.43
	10	33.13	35.68	39.08	133.4	221.7	365.3	334.1	193.4	88.3	54.09	35.68	31.43
	11	33.13	35.40	37.38	122.3	200.2	328.5	348.3	193.4	85.8	52.95	35.68	31.43
	12	33.13	34.83	36.25	121.5	194.5	282.3	368.1	197.9	79.3	51.54	35.68	31.43
	13	33.13	34.26	34.26	127.7	184.1	303.0	345.5	283.2	76.7	51.54	35.40	31.15
	14	32.85	34.26	33.13	147.8	172.4	368.1	393.6	278.4	76.2	50.69	34.83	31.43
	15	32.56	33.98	32.56	156.6	160.3	354.0	407.8	270.1	73.1	49.84	34.26	32.56
1974	16	32.56	33.98	40.21	135.6	164.8	390.8	504.0	214.9	70.2	49.55	33.70	35.11
	17	32.85	36.53	41.91	122.9	170.5	342.6	441.7	184.9	75.6	48.99	33.41	33.98
	18	33.41	35.96	37.66	131.7	167.6	393.6	365.3	184.9	70.8	48.70	33.13	32.56
	19	33.13	34.83	43.04	135.6	147.8	402.1	356.8	182.9	68.0	48.14	33.13	32.00
	20	36.81	34.55	92.88	149.8	138.2	385.1	390.8	180.9	68.0	47.86	32.56	31.43
	21	36.25	40.21	143.57	161.1	130.8	354.0	356.8	173.6	66.0	47.57	32.56	30.87
	22	34.26	65.41	141.02	154.9	134.8	368.1	342.6	172.4	65.4	46.72	32.56	30.87
	23	34.26	94.01	216.06	150.6	178.7	419.1	354.0	172.4	66.0	46.44	32.56	30.58
	24	34.26	55.22	203.60	149.8	191.4	320.0	339.8	165.7	67.4	46.16	32.28	30.30
	25	33.41	41.06	158.57	186.0	291.7	241.0	362.5	163.7	71.9	45.31	32.00	35.68
	26	34.55	39.93	136.49	229.6	300.2	202.5	334.1	168.5	101.4	43.89	32.00	41.06
	27	36.53	35.40	125.44	202.5	270.1	205.9	286.0	172.4	88.3	42.48	32.00	46.72
	28	35.11	34.55	120.06	200.2	210.4	204.7	248.6	160.3	94.6	41.06	32.00	53.52
	29	33.98		125.44	235.3	222.9	229.9	257.4	147.8	92.9	40.78	32.00	43.61
	30	33.70		130.82	212.7	258.5	322.8	256.0	211.5	87.2	40.21	31.71	38.51
	31	33.70		135.64		305.8		237.3	163.7		39.64		35.96

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	34.26	28.88	49.55	103.9	270.1	475.7	436.1	320.0	219.2	91.46	50.40	43.89
	2	33.13	27.81	42.19	122.3	266.2	498.4	430.4	328.5	213.5	73.91	49.84	48.99
	3	31.71	27.35	39.08	163.7	258.5	441.7	441.7	427.6	233.9	75.89	48.99	45.31
	4	30.87	27.13	110.72	135.6	271.3	379.4	433.2	421.9	215.8	78.72	48.14	46.44
	5	29.73	34.83	97.69	248.6	241.0	385.1	441.7	441.7	227.1	79.29	47.29	48.99
	6	28.60	38.51	69.38	270.1	205.9	433.2	387.9	382.3	237.3	77.30	46.44	51.54
	7	29.45	35.40	56.07	251.5	184.1	433.2	365.3	354.0	223.7	77.87	67.68	50.40
	8	29.73	40.49	45.87	189.2	176.7	441.7	396.4	337.0	206.7	78.72	63.15	50.40
	9	28.60	37.94	44.74	160.3	191.4	433.2	444.6	311.5	193.1	79.29	50.40	50.40
	10	28.26	36.25	39.36	149.8	195.7	410.6	421.9	303.0	224.8	82.97	50.69	51.25
	11	28.26	35.68	54.37	130.3	217.2	393.6	450.2	303.0	172.4	72.21	49.84	50.40
	12	28.03	35.40	49.27	122.9	225.1	399.3	492.7	317.1	155.2	67.68	48.99	49.84
	13	27.81	47.29	44.17	108.7	278.4	387.9	518.2	562.1	158.6	66.54	48.14	49.55
	14	21.92	46.16	44.46	102.2	300.2	441.7	518.2	501.2	156.6	65.41	48.14	48.99
	15	27.35	40.21	42.48	93.4	362.5	492.7	523.9	447.4	169.6	63.71	47.29	48.42
1975	16	29.45	37.94	44.17	100.8	863.7	535.2	606.0	427.6	198.8	62.01	47.01	47.86
	17	28.88	35.40	41.63	120.6	623.0	572.0	552.2	495.5	167.6	60.88	46.72	47.29
	18	26.39	36.53	41.63	171.6	444.6	589.0	492.7	668.3	168.2	65.98	46.44	47.01
	19	27.41	33.98	43.61	194.5	396.4	597.5	492.7	651.3	157.7	77.87	46.16	47.01
	20	27.35	34.26	47.86	181.8	387.9	586.2	523.9	741.9	161.7	84.95	45.87	46.44
	21	27.35	35.11	52.10	193.4	368.1	521.0	518.2	758.9	147.8	72.21	45.59	46.44
	22	27.35	33.98	334.14	262.2	379.4	438.9	518.2	617.3	165.7	69.38	45.59	46.16
	23	28.26	34.26	261.08	225.1	387.9	501.2	523.9	538.0	136.8	72.77	45.59	45.59
	24	27.35	34.26	176.70	242.4	399.3	365.3	566.3	399.3	123.5	63.71	45.31	44.74
	25	26.90	33.70	127.71	427.6	393.6	444.6	552.2	311.5	112.4	61.45	45.31	44.74
	26	26.22	33.98	98.26	453.1	404.9	487.0	492.7	305.8	103.9	57.48	45.31	46.44
	27	26.22	33.98	98.26	453.1	421.9	498.4	552.2	331.3	137.6	56.92	45.02	43.89
	28	27.01	42.48	90.33	320.0	458.7	521.0	492.7	438.9	117.5	55.78	44.74	43.89
	29	27.58		89.76	288.8	441.7	512.5	421.9	242.1	160.6	53.52	44.46	44.46
	30	28.88		88.35	273.0	478.6	484.2	450.2	242.1	152.3	52.39	44.17	43.89
	31	29.73		94.01		453.1		492.7	199.9		51.25		43.89
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	43.04	43.61	45.59	87.8	217.5	413.4	393.6	368.1	209.0	107.04	53.52	38.51
	2	43.04	42.48	43.61	83.5	202.2	450.2	382.3	580.5	248.6	97.13	50.40	39.08
	3	42.76	41.63	52.10	85.0	218.0	475.7	376.6	518.2	209.0	92.03	49.84	38.79
	4	42.76	40.21	82.12	193.1	218.0	470.1	385.1	410.6	277.5	84.95	49.84	36.25
	5	42.19	39.36	77.30	472.9	211.2	487.0	399.3	481.4	230.5	80.70	48.99	40.49
	6	40.44	37.94	62.01	279.5	226.0	467.2	421.9	390.8	185.2	77.87	48.14	40.49
	7	42.19	37.38	53.52	265.6	221.4	447.4	444.6	348.3	209.0	87.78	48.14	41.34
	8	41.63	45.59	51.54	182.9	249.8	404.9	478.6	334.1	205.6	81.55	47.29	40.49
	9	41.34	46.16	77.87	177.5	259.1	436.1	526.7	317.1	202.2	78.72	44.74	41.06
	10	41.34	41.63	82.12	218.0	320.0	436.1	518.2	317.1	159.7	72.21	46.16	38.51
	11	41.34	39.93	73.34	255.4	351.1	427.6	509.7	311.5	156.6	71.08	43.89	38.51
	12	41.06	43.04	64.28	213.5	337.0	436.1	461.6	291.7	159.7	68.81	43.89	38.51
	13	43.04	52.95	62.01	188.6	320.0	450.2	450.2	317.1	156.6	65.98	47.01	38.79
	14	70.51	61.45	71.08	173.6	294.5	458.7	458.7	305.8	156.6	64.85	45.31	38.51
	15	63.71	255.42	84.95	177.5	337.0	467.2	518.2	385.1	141.6	63.71	45.31	37.66
1976	16	50.40	99.68	103.07	179.5	356.8	487.0	481.4	441.7	131.1	63.15	44.74	34.55
	17	48.14	66.54	174.43	209.0	387.9	413.4	495.5	424.8	125.2	62.58	42.48	36.53
	18	46.16	68.24	124.31	214.6	419.1	402.1	549.3	373.8	120.9	62.01	42.19	36.25
	19	44.74	58.62	97.13	229.4	407.8	430.4	492.7	243.5	109.9	60.31	41.06	36.53
	20	45.02	63.71	98.83	280.6	371.0	339.8	467.2	385.1	109.9	59.75	41.06	37.38
	21	43.61	52.95	97.13	317.1	356.8	337.0	523.9	297.3	101.4	60.31	41.34	36.53
	22	43.04	47.86	88.63	334.1	339.8	283.2	461.6	256.6	96.3	58.05	40.49	35.96
	23	42.76	46.44	79.29	314.3	387.9	265.3	453.1	233.9	90.0	56.92	39.93	33.41
	24	44.74	41.63	87.22	322.8	376.6	252.0	461.6	218.0	90.6	56.92	37.66	33.13
	25	44.46	77.87	98.83	308.7	444.6	250.9	450.2	229.4	90.6	87.22	37.94	33.41
	26	50.69	71.08	84.95	291.7	359.6	279.5	453.1	246.4	92.9	67.11	38.51	33.41
	27	60.88	54.65	96.28	277.5	303.0	328.5	472.9	297.3	91.5	62.58	37.66	33.13
	28	62.58	47.29	126.86	262.5	297.3	356.8	402.1	219.2	89.2	60.88	37.38	32.85
	29	51.25	39.36	156.59	247.5	328.5	376.6	368.1	252.0	87.2	59.18	37.66	32.85
	30	47.29		120.06	232.5	351.1	399.3	359.6	286.0	99.7	56.92	37.66	32.56
	31	44.74		99.68		393.6		351.1	205.6		55.22		31.15

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	32.00	50.69	41.63	88.3	167.6	294.5	470.1	271.8	187.5	77.30	60.31	48.14
	2	32.56	51.82	38.51	69.7	168.5	328.5	455.9	271.8	164.5	86.37	58.05	46.44
	3	31.15	44.74	37.94	94.3	184.1	334.1	450.2	273.0	161.7	84.38	64.28	44.46
	4	31.43	42.76	37.94	110.7	177.5	342.6	430.4	300.2	163.7	81.55	64.85	44.46
	5	32.00	43.89	37.66	273.0	160.6	322.8	424.8	379.4	134.5	78.44	61.45	42.48
	6	31.15	41.63	39.08	431.8	140.7	314.3	436.1	303.0	157.7	72.21	56.92	42.48
	7	30.87	41.06	42.19	245.2	134.5	337.0	433.2	248.6	135.9	71.08	55.78	42.48
	8	30.58	40.21	38.51	176.4	148.7	371.0	433.2	238.4	139.9	65.98	61.45	42.48
	9	32.56	40.21	48.70	154.6	210.1	351.1	410.6	240.7	121.8	63.71	61.45	42.48
	10	79.29	40.49	47.01	147.8	182.9	342.6	371.0	264.2	113.3	98.83	60.31	42.48
	11	73.34	41.63	47.01	138.8	202.2	351.1	376.6	227.1	101.4	82.12	55.78	42.48
	12	52.10	41.63	43.89	139.9	220.3	314.3	532.4	210.1	92.9	72.21	56.35	44.46
	13	45.59	41.63	44.74	134.5	206.7	286.0	424.8	203.3	83.5	65.98	54.09	43.61
	14	42.76	41.06	51.25	129.4	185.2	305.8	385.1	210.1	95.7	65.98	48.99	43.61
	15	41.34	41.06	51.82	126.9	206.7	291.7	444.6	212.4	76.5	60.88	48.99	43.04
1977	16	38.23	40.21	102.22	132.0	172.4	305.8	730.6	248.6	77.3	63.71	44.74	41.34
	17	36.81	39.08	74.47	159.7	171.6	354.0	580.5	216.9	79.3	59.18	47.01	40.49
	18	36.53	35.11	61.45	171.6	198.8	382.3	447.4	202.2	88.6	56.35	46.44	38.79
	19	35.68	41.06	52.95	211.2	246.4	390.8	331.3	204.4	123.5	53.52	47.01	40.21
	20	35.68	41.63	48.14	171.6	233.9	410.6	276.9	206.7	133.7	52.39	48.70	39.93
	21	34.26	40.21	56.35	157.7	250.9	433.2	282.0	207.8	115.0	50.97	46.44	39.08
	22	33.98	37.94	71.08	162.5	274.4	478.6	288.8	209.0	104.8	48.99	47.57	38.79
	23	59.18	37.10	72.21	179.5	294.5	489.9	303.0	196.5	91.5	48.70	48.70	38.79
	24	64.28	37.94	87.22	163.7	314.3	506.9	359.6	213.5	90.0	194.25	47.01	38.79
	25	83.53	37.10	87.22	153.8	311.5	512.5	580.5	145.5	88.6	229.37	47.01	47.29
	26	58.62	35.40	95.71	156.6	305.8	487.0	566.3	177.5	90.6	116.67	45.31	48.70
	27	56.92	48.14	92.88	199.9	322.8	475.7	487.0	168.5	82.1	78.72	42.76	43.04
	28	45.59	45.59	77.30	204.4	305.8	461.6	345.5	169.6	82.1	75.04	42.19	42.48
	29	48.14		76.46	186.3	325.6	464.4	305.8	158.9	83.0	66.54	42.19	40.49
	30	43.89		94.86	162.5	320.0	600.3	297.3	196.5	83.0	67.11	51.25	40.49
	31	41.91		92.88		320.0		291.7	165.7		63.71		40.21
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	39.08	36.25	64.85	86.4	187.5	334.1	504.0	373.8	155.7	77.30	45.59	45.31
	2	39.08	35.40	62.58	84.4	193.1	348.3	487.0	345.5	136.2	75.89	48.99	43.61
	3	38.51	34.26	52.10	78.7	213.5	396.4	523.9	447.4	138.8	90.05	48.99	42.76
	4	38.23	34.26	52.39	114.1	247.5	467.2	484.2	481.4	126.9	84.38	62.58	43.04
	5	37.66	34.55	68.24	96.3	348.3	498.4	498.4	368.1	120.1	75.89	58.62	43.61
	6	36.53	44.74	87.78	97.1	342.6	489.9	764.6	373.8	115.0	73.91	96.28	43.61
	7	37.38	37.38	68.24	108.2	300.2	492.7	699.4	325.6	109.9	69.94	104.77	42.19
	8	36.81	34.26	59.75	143.8	300.2	668.3	790.0	303.0	106.5	68.24	72.21	42.19
	9	35.96	33.98	54.65	158.6	303.0	492.7	614.5	342.6	98.8	71.08	65.98	41.63
	10	35.68	33.70	244.09	186.3	314.3	404.9	515.4	382.3	136.2	69.38	75.61	41.63
	11	35.96	33.70	136.20	201.0	305.8	393.6	472.9	484.2	116.7	67.11	63.15	40.21
	12	35.96	33.98	107.32	218.0	303.0	419.1	433.2	396.4	111.6	66.54	58.05	41.34
	13	35.96	35.11	92.03	231.6	294.5	430.4	410.6	413.4	114.1	65.41	52.95	40.49
	14	42.48	35.68	84.95	250.9	294.5	419.1	407.8	291.7	119.2	64.28	52.95	40.21
	15	42.19	41.06	87.78	271.8	308.7	396.4	382.3	264.2	224.8	62.58	52.95	41.06
1978	16	39.36	37.94	378.03	248.6	305.8	359.6	362.5	241.8	184.1	64.85	53.52	41.06
	17	38.51	36.53	438.91	342.6	320.0	351.1	379.4	236.2	140.7	62.01	50.69	39.93
	18	38.51	37.94	238.43	379.4	342.6	356.8	365.3	223.7	121.8	58.05	48.70	38.79
	19	36.53	36.25	169.62	279.5	291.7	359.6	376.6	253.2	98.0	62.58	49.55	38.51
	20	36.25	35.40	136.20	227.1	294.5	402.1	373.8	314.3	80.1	61.45	48.99	39.08
	21	35.96	33.41	110.72	211.2	300.2	427.6	430.4	334.1	76.5	57.48	51.25	38.51
	22	35.68	33.41	101.37	231.6	317.1	458.7	390.8	271.8	71.6	58.05	50.40	38.79
	23	40.49	34.26	233.05	195.4	356.8	472.9	359.6	266.7	73.3	54.65	50.40	38.51
	24	39.64	35.96	80.70	186.3	387.9	489.9	354.0	265.3	82.1	56.35	49.84	38.51
	25	37.66	34.55	81.55	194.3	385.1	504.0	334.1	262.8	68.8	53.52	47.86	38.51
	26	38.51	36.25	89.20	198.8	484.2	526.7	410.6	257.7	62.6	52.39	47.86	37.66
	27	38.79	50.69	130.26	189.7	348.3	557.8	444.6	261.6	91.5	52.10	46.44	37.66
	28	42.48	55.78	126.86	210.1	365.3	549.3	373.8	269.3	91.5	50.69	45.31	37.66
	29	41.06		112.42	205.6	399.3	560.7	348.3	252.0	79.3	52.10	44.46	37.66
	30	38.79		99.68	188.6	390.8	532.4	387.9	209.0	76.5	49.84	43.89	38.51
	31	36.25		93.45		385.1		342.6	167.6		49.55		37.66

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	33.41	32.00	37.38	139.9	407.8	154.9	515.4	270.1	124.3	79.29	47.29	39.08
	2	33.41	31.71	40.78	122.9	314.3	156.3	518.2	286.0	122.9	77.59	47.01	39.08
	3	33.13	31.15	49.55	118.6	297.3	149.2	475.7	305.8	147.2	73.91	46.72	38.79
	4	32.85	31.15	43.89	122.0	256.8	156.3	467.2	371.0	125.7	71.92	45.87	39.36
	5	32.56	30.58	54.37	117.8	252.0	186.0	458.7	320.0	119.2	65.41	44.46	38.23
	6	32.56	30.02	195.10	125.2	256.3	237.9	464.4	303.0	120.6	66.26	43.61	38.51
	7	32.56	29.73	119.21	156.3	235.0	275.0	478.6	305.8	129.4	65.41	44.17	37.38
	8	32.56	29.73	100.81	164.0	232.2	317.1	509.7	320.0	173.3	64.00	59.18	36.53
	9	32.56	29.73	74.47	150.1	402.1	362.5	509.7	331.3	158.9	64.00	64.00	36.81
	10	32.56	29.73	68.24	150.9	368.1	385.1	506.9	351.1	151.8	58.33	54.93	37.10
	11	32.56	29.45	64.00	153.2	300.2	410.6	523.9	286.0	137.6	57.77	51.25	36.81
	12	32.56	28.88	54.93	163.1	279.5	416.3	515.4	260.8	148.7	58.33	48.42	36.53
	13	32.56	31.15	57.48	164.8	243.5	376.6	532.4	221.7	145.5	59.18	46.16	36.53
	14	56.63	30.58	55.22	174.1	216.6	325.6	501.2	208.7	140.5	60.60	45.87	36.53
	15	41.63	30.02	54.93	181.5	206.4	308.7	475.7	212.1	139.9	57.48	46.44	37.38
1979	16	44.46	29.73	52.39	158.9	194.0	345.5	458.7	297.3	177.8	56.63	45.02	37.38
	17	39.93	32.28	52.39	158.0	173.3	390.8	467.2	265.6	168.2	54.37	45.31	36.25
	18	35.96	42.19	50.12	212.1	177.8	421.9	427.6	267.6	154.9	54.09	43.61	37.10
	19	35.68	101.37	49.55	461.6	194.0	447.4	396.4	256.3	157.2	52.39	42.76	36.81
	20	35.11	115.25	50.97	291.7	212.1	453.1	436.1	314.3	148.7	51.82	41.06	36.81
	21	34.55	68.24	55.22	219.2	191.1	484.2	427.6	303.0	138.2	53.24	42.19	36.53
	22	34.26	54.09	55.78	216.6	173.3	453.1	413.4	271.8	131.7	30.87	41.06	36.53
	23	33.41	49.55	56.63	235.0	165.7	498.4	376.6	233.6	123.5	51.82	40.49	36.53
	24	34.26	44.46	55.22	257.7	174.1	501.2	402.1	268.7	125.7	50.69	40.78	36.53
	25	33.41	43.04	54.09	267.0	196.2	495.5	351.1	249.2	125.2	50.12	40.78	36.53
	26	33.13	43.32	54.37	286.0	216.6	515.4	286.0	204.2	117.8	48.70	40.78	36.53
	27	32.85	41.06	62.86	255.4	190.0	518.2	300.2	165.7	108.5	48.42	40.49	36.53
	28	32.85	38.79	68.24	291.7	191.4	538.0	291.7	169.1	100.2	48.70	39.93	35.96
	29	32.28		84.38	342.6	174.1	566.3	239.3	162.3	94.6	48.14	39.93	36.25
	30	32.28		308.65	410.6	160.6	555.0	233.6	138.2	85.5	48.14	39.93	40.49
	31	32.28		188.02		154.0		262.5	125.2		47.57		39.64
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	43.61	39.93	54.65	172.4	276.4	382.3	373.8	317.1	167.4	74.47	80.99	50.12
	2	41.91	39.64	49.84	201.9	314.3	376.6	365.3	260.8	162.3	73.06	73.34	49.84
	3	39.64	46.44	47.86	223.1	322.8	331.3	396.4	617.3	133.9	71.36	66.26	49.27
	4	37.10	43.04	45.59	175.8	311.5	317.1	416.3	430.4	128.8	71.36	64.56	48.14
	5	35.68	46.16	238.71	166.5	331.3	339.8	436.1	362.5	130.8	70.51	66.83	47.01
	6	35.11	43.89	206.43	226.8	337.0	382.3	450.2	320.0	116.7	69.38	64.56	46.44
	7	33.70	41.34	128.84	233.6	339.8	433.2	390.8	359.6	109.9	69.38	60.88	45.87
	8	33.41	39.93	109.02	208.7	308.7	424.8	390.8	294.5	109.9	69.38	57.77	45.31
	9	33.41	39.64	94.01	201.9	317.1	450.2	393.6	297.3	117.2	71.92	56.07	45.31
	10	33.41	39.64	86.08	188.0	303.0	492.7	368.1	249.2	152.6	75.89	54.93	45.31
	11	32.28	38.51	83.25	193.1	279.5	492.7	382.3	226.8	174.1	98.26	53.52	45.59
	12	31.71	38.23	78.15	175.0	283.2	535.2	430.4	212.1	168.2	98.26	53.24	45.59
	13	31.15	39.93	73.34	166.5	294.5	506.9	407.8	203.0	141.3	83.25	50.97	43.89
	14	30.58	63.71	69.38	176.7	294.5	438.9	407.8	211.0	130.3	79.29	50.97	43.04
	15	30.87	73.91	100.81	184.1	305.8	396.4	419.1	205.3	119.2	75.61	50.69	43.04
1980	16	32.56	56.35	122.05	199.6	288.8	385.1	368.1	201.9	110.4	71.36	49.84	42.19
	17	32.28	50.97	109.87	211.0	297.3	433.2	351.1	191.1	104.5	67.96	48.70	41.91
	18	31.43	48.70	188.02	265.3	286.0	444.6	362.5	196.2	97.1	66.26	48.14	41.34
	19	33.98	46.72	144.98	286.0	297.3	450.2	407.8	175.0	99.7	65.41	47.57	41.34
	20	32.00	48.42	126.58	277.8	273.3	453.1	339.8	154.0	90.9	64.85	46.72	41.34
	21	31.71	48.42	124.31	260.8	237.9	518.2	300.2	142.7	85.5	64.00	46.16	41.63
	22	32.00	64.00	214.36	217.8	223.1	501.2	294.5	147.2	83.8	61.73	46.16	41.63
	23	31.43	67.96	165.65	201.9	219.2	492.7	314.3	154.9	83.8	60.03	45.59	41.06
	24	31.43	59.47	268.73	198.5	223.1	492.7	286.0	154.0	112.4	58.62	45.02	41.06
	25	33.98	51.82	209.83	221.7	244.9	532.4	271.8	173.3	101.9	57.77	45.02	40.78
	26	83.25	48.42	160.56	233.6	300.2	529.5	277.5	165.7	87.8	57.48	48.14	43.32
	27	61.45	49.84	141.30	263.9	376.6	470.1	308.7	178.7	85.0	54.37	66.26	42.48
	28	47.29	79.85	135.35	273.3	396.4	492.7	274.7	164.8	81.6	53.52	55.78	42.76
	29	44.74	62.30	173.30	257.7	436.1	441.7	300.2	160.6	78.7	57.77	53.24	48.42
	30	41.63		172.45	262.2	436.1	393.6	273.3	149.2	75.6	59.47	51.25	45.02
	31	41.06		163.11		416.3		379.4			96.56		43.89

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	37.38	31.15	86.65	158.3	331.3	348.3	543.7	283.2	146.7	86.08	43.32	33.70
	2	37.38	29.45	85.52	154.0	354.0	308.7	481.4	300.2	137.9	94.58	40.78	34.26
	3	42.76	31.71	73.06	365.3	382.3	297.3	472.9	266.2	139.3	82.12	40.78	34.55
	4	46.16	37.10	68.53	269.3	424.8	291.7	470.1	259.9	143.6	76.46	40.49	34.26
	5	53.52	39.93	65.13	204.2	535.2	314.3	416.3	266.2	130.3	72.21	38.23	34.26
	6	55.78	35.40	130.26	172.2	410.6	359.6	495.5	281.8	119.2	68.53	37.38	33.41
	7	52.95	33.70	99.11	168.2	433.2	387.9	373.8	311.5	116.1	65.13	36.25	33.98
	8	49.84	33.70	83.25	156.9	337.0	365.3	368.1	300.2	101.4	62.30	34.55	32.28
	9	48.42	32.85	76.17	168.2	325.6	342.6	362.5	308.7	94.0	61.16	33.70	32.56
	10	42.76	32.56	76.17	186.3	325.6	297.3	325.6	331.3	84.7	60.60	33.41	32.28
	11	41.91	32.28	71.92	213.8	331.3	246.4	328.5	320.0	86.6	56.63	39.08	31.71
	12	39.64	32.28	65.13	244.1	311.5	212.9	351.1	308.7	82.1	60.31	57.20	32.00
	13	38.51	34.55	62.30	259.9	402.1	199.9	404.9	291.7	77.9	62.58	54.93	30.58
	14	39.08	135.64	63.15	276.4	413.4	205.0	438.9	279.5	84.7	54.93	51.82	30.58
	15	39.08	78.44	78.44	478.6	402.1	213.5	484.2	261.9	83.5	56.92	51.25	30.58
1981	16	39.08	60.60	97.13	455.9	393.6	229.1	504.0	254.0	84.7	62.01	51.25	30.58
	17	37.38	53.52	91.46	354.0	387.9	266.2	489.9	228.0	85.5	90.33	50.69	30.02
	18	35.96	48.70	84.67	334.1	404.9	320.0	467.2	211.2	90.3	71.64	50.69	30.02
	19	35.11	47.29	143.57	348.3	419.1	339.8	419.1	205.9	109.0	67.68	43.32	29.73
	20	34.26	45.87	229.93	342.6	424.8	294.5	373.8	205.9	101.4	62.01	42.19	29.45
	21	33.13	44.46	255.98	702.3	356.8	387.9	371.0	209.3	101.9	60.31	41.63	29.45
	22	32.56	42.19	176.13	447.4	368.1	339.8	379.4	205.9	104.2	56.92	41.06	29.17
	23	31.15	43.32	146.68	305.8	303.0	334.1	455.9	180.4	109.0	53.80	40.78	29.17
	24	32.85	48.14	139.32	288.8	436.1	402.1	467.2	167.4	137.1	53.24	41.63	28.88
	25	35.96	98.54	138.47	305.8	489.9	421.9	421.9	160.6	142.2	51.25	47.01	28.60
	26	33.41	70.23	135.07	322.8	489.9	450.2	351.1	174.4	91.5	50.12	44.17	28.60
	27	33.13	67.11	139.89	303.0	472.9	453.1	300.2	206.7	86.1	49.84	42.19	28.60
	28	33.41	67.96	147.25	303.0	484.2	498.4	325.6	177.8	82.1	50.97	40.78	28.88
	29	32.85		154.04	373.8	472.9	512.5	359.6	210.1	116.1	50.12	40.49	29.17
	30	30.58		281.75	337.0	458.7	540.9	294.5	164.2	90.9	47.57	36.81	28.88
	31	32.56		193.12		399.3		345.5	150.4		46.16		28.60
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	35.40	33.13	45.02	122.3	181.2	207.8	224.3	342.6	91.5	60.31	63.71	62.58
	2	35.11	33.13	42.48	115.0	218.0	158.0	193.7	433.2	87.2	58.62	62.86	64.00
	3	34.83	36.81	41.34	108.5	226.0	151.5	192.3	371.0	86.4	56.35	61.16	60.31
	4	34.83	36.81	39.08	99.7	233.0	165.7	192.8	342.6	85.5	53.52	65.13	58.05
	5	34.83	34.55	44.46	101.4	256.8	192.3	188.9	342.6	85.2	50.12	63.15	57.48
	6	34.55	32.85	44.46	94.0	275.8	214.6	185.5	351.1	84.4	50.69	60.60	56.63
	7	33.98	33.13	41.63	81.3	282.0	246.6	182.1	419.1	84.7	49.84	60.03	54.93
	8	33.13	32.56	40.21	81.8	281.2	288.8	186.9	342.6	86.4	50.12	59.18	57.20
	9	33.13	32.28	41.34	92.3	294.5	314.3	180.1	297.3	77.9	49.84	56.92	66.26
	10	33.13	31.71	53.24	105.1	311.5	308.7	194.3	371.0	74.5	47.86	55.50	64.28
	11	32.56	36.25	46.16	110.2	265.0	314.3	185.5	303.0	70.8	47.01	94.01	59.75
	12	31.71	35.40	44.74	110.2	203.9	317.1	202.5	275.0	68.8	43.32	65.13	56.92
	13	30.58	32.85	42.19	110.7	166.8	322.8	204.4	258.5	65.7	44.17	65.70	58.90
	14	30.58	32.28	41.06	119.2	140.5	328.5	196.2	233.9	66.5	39.93	63.43	69.09
	15	29.73	30.87	45.31	132.5	126.3	303.0	182.6	229.9	65.4	38.23	90.33	60.60
1982	16	29.45	34.26	53.80	180.7	115.8	305.8	184.6	251.5	63.7	38.51	150.93	56.92
	17	28.88	36.25	61.73	210.7	114.1	288.8	188.9	308.7	65.4	44.74	111.85	55.50
	18	28.88	33.13	57.48	160.3	126.3	232.2	196.2	239.6	68.2	62.86	103.36	52.67
	19	30.02	33.13	54.65	132.8	137.6	199.1	207.8	222.9	71.4	56.35	94.86	50.12
	20	29.17	42.48	51.54	133.9	148.9	199.1	225.1	222.9	66.3	59.75	86.37	47.01
	21	27.98	39.93	58.90	143.6	184.1	207.8	314.3	214.1	67.7	63.71	82.12	45.31
	22	32.28	34.55	246.64	160.3	214.1	206.4	243.5	190.3	73.6	61.16	73.62	45.02
	23	34.55	35.11	135.35	184.1	251.5	186.9	245.8	179.2	83.5	81.27	69.09	44.74
	24	32.56	34.55	92.03	203.0	238.7	163.4	337.0	172.4	78.7	89.48	66.54	43.89
	25	33.13	33.13	86.93	196.2	205.9	144.1	317.1	160.3	76.7	91.46	64.28	43.32
	26	32.85	32.56	78.44	216.1	227.7	145.5	286.0	146.1	68.5	108.45	65.13	42.76
	27	32.00	32.85	75.04	265.9	214.6	183.5	263.1	127.7	65.1	89.48	63.15	42.48
	28	31.71	42.48	72.77	192.8	211.8	199.1	256.0	113.6	64.0	78.44	60.88	43.04
	29	31.15		82.97	187.5	202.5	204.4	275.8	109.0	62.9	73.34	60.31	45.02
	30	34.83		111.85	179.2	198.2	240.1	273.0	104.8	60.6	69.66	59.75	56.92
	31	36.25		147.25		209.8		262.2	98.8		65.70		47.01

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)

Year	Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1	44.46	52.10	201.33	93.2	205.6	258.8	458.7	356.8	262.8	83.82	53.80	47.86
	2	43.04	49.27	148.38	99.4	176.1	242.7	455.9	478.6	419.1	80.14	53.24	47.57
	3	42.48	47.86	103.64	103.1	171.3	229.9	441.7	376.6	345.5	78.15	52.67	47.57
	4	41.63	46.16	90.05	118.9	163.4	209.0	371.0	348.3	263.9	76.17	51.82	47.57
	5	42.19	45.31	86.08	121.2	218.0	208.1	320.0	356.8	233.6	73.62	51.54	47.29
	6	42.48	45.02	74.19	126.6	228.2	214.6	258.8	339.8	220.9	73.62	51.82	47.29
	7	42.76	44.74	70.51	147.8	226.3	215.5	240.7	325.6	214.6	72.49	50.40	47.01
	8	42.48	42.48	77.30	165.7	251.7	215.5	243.5	337.0	201.9	71.64	50.40	46.72
	9	41.91	42.19	149.80	181.5	275.2	199.9	248.6	325.6	188.6	71.36	49.84	46.44
	10	40.78	41.63	140.17	168.2	322.8	196.5	247.5	314.3	193.4	71.08	49.84	46.44
	11	39.64	41.06	157.16	149.8	320.0	283.2	234.5	294.5	188.6	70.51	49.55	46.16
	12	39.64	40.21	127.43	162.5	270.1	328.5	229.9	276.1	180.1	70.23	49.27	46.16
	13	38.79	39.64	108.74	204.4	282.3	356.8	213.5	243.5	174.4	70.51	48.70	45.87
	14	37.66	38.23	99.39	175.3	283.2	393.6	196.0	233.6	163.4	70.23	48.70	46.16
	15	40.78	41.63	95.99	148.4	291.7	393.6	194.3	230.8	158.6	70.51	48.42	47.01
1983	16	38.79	42.48	99.39	227.7	314.3	362.5	211.8	220.0	151.2	68.24	48.42	47.01
	17	37.94	41.91	94.01	158.6	322.8	368.1	206.4	228.2	137.6	66.26	48.14	47.01
	18	37.66	41.06	96.28	138.8	342.6	325.6	127.7	245.5	128.0	65.41	48.14	47.01
	19	37.10	40.78	113.27	126.0	424.8	311.5	218.0	275.2	117.8	63.71	48.14	46.72
	20	36.25	40.49	128.56	129.4	376.6	317.1	229.9	348.3	108.2	64.28	47.86	46.72
	21	36.81	40.21	105.91	142.2	322.8	325.6	255.7	320.0	97.4	63.43	47.86	46.44
	22	37.38	39.93	98.26	159.4	278.1	339.8	280.3	305.8	92.3	61.73	47.86	48.99
	23	37.10	47.86	88.63	182.4	260.8	371.0	390.8	278.1	86.4	61.16	47.86	48.14
	24	36.25	111.85	83.25	170.5	257.7	382.3	404.9	269.0	81.6	61.16	47.57	47.29
	25	35.68	76.17	118.36	167.4	251.7	373.8	410.6	339.8	77.3	59.75	47.29	46.72
	26	37.10	63.43	233.33	207.3	243.5	393.6	390.8	498.4	74.2	58.33	47.29	46.72
	27	42.48	58.33	144.98	393.6	252.6	424.8	387.9	453.1	77.0	57.77	47.29	46.44
	28	90.90	56.35	120.63	294.5	253.7	424.8	359.6	362.5	76.5	56.92	47.57	46.44
	29	69.66		103.64	250.6	267.9	433.2	334.1	300.2	79.0	55.50	47.57	46.44
	30	67.96		96.28	237.3	236.2	433.2	339.8	259.9	79.0	55.22	48.14	46.16
	31	59.75		91.75		265.9		348.3	263.9		54.37		46.16
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	45.87	41.06	35.11	126.3	123.7	540.9	396.4	265.6	261.1	69.66	45.02	51.82
	2	46.44	43.32	34.26	376.6	129.7	597.5	399.3	254.3	317.1	69.66	43.32	51.25
	3	46.44	42.48	34.26	233.9	151.8	597.5	354.0	259.9	317.1	69.09	42.48	49.55
	4	46.44	46.44	33.41	161.1	159.4	580.5	351.1	261.1	241.8	65.70	41.91	47.01
	5	46.44	43.32	34.26	112.7	174.4	611.6	328.5	320.0	215.8	64.85	41.34	45.87
	6	45.59	41.63	34.83	107.6	190.3	603.1	311.5	275.8	210.1	63.15	40.21	45.87
	7	45.59	45.02	31.71	85.0	188.3	560.7	365.3	271.3	201.0	62.01	40.49	45.59
	8	45.59	45.02	33.13	77.0	220.3	557.8	322.8	314.3	202.2	60.31	40.21	45.87
	9	45.02	42.76	34.83	75.6	205.6	583.3	281.5	348.3	185.2	60.03	42.48	58.33
	10	45.02	44.17	35.96	68.5	172.4	549.3	267.9	291.7	156.0	63.71	48.14	52.39
	11	44.74	45.87	39.36	68.5	203.3	526.7	291.7	273.5	142.4	60.88	44.74	48.70
	12	45.02	44.17	40.21	77.0	254.3	509.7	283.2	288.8	133.1	60.88	43.61	47.57
	13	47.01	42.76	39.36	85.0	253.2	506.9	279.2	267.9	125.4	59.47	42.48	50.69
	14	45.02	41.06	37.66	105.6	226.0	506.9	283.2	271.3	145.0	58.33	42.76	48.14
	15	45.02	41.63	40.21	107.0	229.4	504.0	291.7	266.7	123.7	57.77	45.02	45.87
1984	16	45.59	44.74	54.93	97.1	200.2	492.7	345.5	359.6	111.9	57.77	43.61	45.59
	17	44.74	57.20	112.70	85.0	186.3	506.9	345.5	300.2	109.0	57.20	55.50	45.59
	18	44.17	62.01	197.37	95.7	179.2	535.2	339.8	273.5	121.2	56.63	59.47	44.74
	19	43.61	57.77	139.04	104.8	230.5	467.2	351.1	280.3	145.0	55.50	52.95	43.32
	20	43.61	65.41	90.05	133.9	198.2	419.1	356.8	308.7	131.4	54.65	49.55	42.76
	21	43.32	52.95	75.61	150.9	215.8	390.8	351.1	291.7	116.9	54.09	53.52	42.48
	22	42.76	41.63	72.21	107.6	246.4	387.9	303.0	305.8	113.3	52.95	84.38	42.48
	23	42.48	39.36	78.15	107.6	297.3	396.4	276.9	317.1	101.4	52.39	92.88	41.91
	24	41.91	36.81	84.38	113.3	276.9	416.3	276.9	273.5	109.0	51.82	73.34	41.06
	25	41.91	36.81	168.20	167.1	288.8	433.2	266.7	262.2	100.5	51.25	62.01	41.06
	26	41.06	36.81	108.45	184.3	362.5	438.9	271.3	261.1	92.0	50.69	57.77	40.49
	27	41.06	36.81	84.38	223.7	373.8	481.4	248.6	294.5	85.8	50.12	54.93	40.49
	28	41.91	35.96	57.20	212.4	365.3	501.2	267.9	286.0	82.4	50.69	54.65	40.21
	29	39.36	34.83	79.29	156.0	436.1	450.2	331.3	263.3	78.2	48.70	54.09	39.64
	30	38.23		78.72	127.7	475.7	410.6	311.5	239.6	73.3	47.01	51.82	44.17
	31	38.23		78.15		535.2		267.9	241.8		45.87		45.02

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	41.91	40.49	40.21	81.3	144.1	232.8	259.9	371.0	128.0	59.47	35.68	26.05
	2	40.21	40.49	41.34	74.5	127.1	262.2	203.3	291.7	118.9	59.47	40.21	24.81
	3	39.93	40.49	41.06	75.6	113.3	274.7	173.3	407.8	111.9	60.31	36.25	24.81
	4	39.36	41.34	42.48	78.7	107.6	286.0	167.1	328.5	116.1	61.45	35.40	24.49
	5	40.21	50.69	44.17	75.0	112.7	308.7	200.2	322.8	143.3	120.63	33.70	24.49
	6	41.91	44.17	41.34	89.2	126.3	342.6	279.2	325.6	126.3	85.80	33.70	24.81
	7	39.93	42.48	42.48	129.7	144.1	331.3	320.0	385.1	118.4	81.27	32.56	27.07
	8	38.51	42.48	40.49	190.3	235.0	294.5	339.8	342.6	111.3	67.96	31.43	60.03
	9	38.23	42.48	41.34	201.0	286.0	317.1	322.8	252.0	100.0	97.69	31.71	34.55
	10	37.66	41.06	37.10	139.9	255.4	345.5	317.1	235.0	97.1	108.45	35.68	32.56
	11	37.38	39.64	36.25	110.4	215.8	339.8	317.1	205.6	90.6	86.37	33.41	31.15
	12	37.38	38.79	36.25	96.3	182.4	317.1	410.6	196.2	87.8	73.91	32.28	29.73
	13	36.81	38.23	35.68	90.0	172.4	273.5	368.1	200.2	85.8	66.83	31.43	29.73
	14	36.81	37.94	33.70	104.8	152.6	280.3	337.0	195.1	89.2	62.01	30.58	33.13
	15	36.81	37.94	33.70	94.9	147.5	244.1	328.5	213.5	82.4	67.96	29.45	34.26
1985	16	36.53	37.94	34.26	97.7	151.8	232.8	362.5	182.4	81.3	61.45	28.88	50.12
	17	35.96	37.38	33.13	105.6	147.5	220.3	430.4	173.3	79.3	57.77	28.32	39.64
	18	58.33	37.38	33.41	114.1	148.4	218.0	430.4	175.3	91.5	53.52	27.75	37.38
	19	63.15	38.79	31.43	110.4	166.2	257.7	719.2	229.1	97.7	50.12	27.07	33.70
	20	48.14	41.34	29.17	101.4	192.3	249.8	410.6	190.3	82.4	48.14	25.74	31.71
	21	60.03	38.79	28.88	114.1	191.1	235.0	311.5	178.4	79.9	45.87	25.43	31.15
	22	49.55	36.53	31.43	115.5	201.0	222.6	271.3	169.6	85.8	44.17	31.15	30.58
	23	44.74	37.10	41.34	135.6	254.3	224.8	275.8	171.3	85.8	42.76	30.58	31.15
	24	42.76	36.53	45.87	125.4	271.3	241.8	266.7	167.9	84.4	43.32	29.45	34.55
	25	42.76	37.10	52.39	133.9	222.6	244.1	390.8	175.3	78.2	45.87	28.09	71.64
	26	54.93	37.94	67.39	132.2	192.3	249.8	376.6	169.6	70.8	47.57	27.75	80.70
	27	50.12	38.79	217.19	139.9	184.3	270.1	424.8	150.9	70.8	44.17	27.41	64.85
	28	45.59	39.64	150.08	157.7	221.4	280.3	342.6	142.4	68.5	41.34	26.73	52.39
	29	43.61		111.29	140.7	238.4	300.2	297.3	141.6	64.8	39.64	27.07	45.02
	30	43.32		89.20	141.6	223.7	288.8	300.2	146.7	60.9	38.23	26.73	42.76
	31	42.48		81.27		205.6		278.1	138.2		36.53		
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	37.66	30.30	43.32	125.4	178.4	203.3	373.8	438.9	116.9	73.91	40.78	39.36
	2	36.81	30.58	42.76	105.6	210.1	174.4	371.0	470.1	117.5	73.34	39.93	39.36
	3	34.83	30.58	42.48	97.7	229.4	169.6	382.3	515.4	114.7	71.08	38.51	39.93
	4	33.41	30.30	42.76	92.0	205.6	168.8	404.9	625.8	125.4	69.66	38.23	39.36
	5	33.13	30.30	41.91	100.0	213.5	163.7	455.9	569.2	128.0	70.79	37.38	41.06
	6	33.98	29.73	44.17	116.9	238.4	154.3	475.7	472.9	116.1	69.09	35.96	40.21
	7	34.26	29.45	43.32	126.3	261.1	158.6	526.7	470.1	107.6	67.39	35.11	41.06
	8	33.41	28.60	40.21	128.8	276.9	167.9	523.9	421.9	100.0	67.39	34.83	40.78
	9	32.56	28.32	41.63	134.8	291.7	166.2	495.5	373.8	96.3	65.70	33.13	38.51
	10	33.13	29.45	45.87	163.7	273.5	228.2	436.1	342.6	94.9	64.28	32.28	36.81
	11	32.56	34.26	122.61	174.4	275.8	274.7	404.9	337.0	93.4	63.71	31.71	179.25
	12	32.28	39.36	107.60	345.5	275.8	297.3	351.1	265.6	94.9	65.41	30.58	75.04
	13	32.28	87.22	111.29	300.2	281.5	291.7	325.6	238.4	91.5	66.26	30.30	89.20
	14	31.43	69.09	189.16	218.0	294.5	267.9	342.6	239.6	96.3	67.39	31.43	66.83
	15	30.30	57.77	167.92	190.3	300.2	283.2	373.8	233.9	107.0	62.58	61.45	58.33
1986	16	29.73	51.25	119.78	180.4	271.3	294.5	407.8	236.2	93.4	61.45	55.50	51.25
	17	29.17	51.25	116.10	167.9	276.9	291.7	495.5	232.8	84.4	63.15	43.32	44.74
	18	29.17	88.63	172.45	176.4	281.5	308.7	659.8	264.5	77.6	63.15	39.08	41.63
	19	28.60	69.66	128.84	186.9	241.8	339.8	529.5	282.6	76.2	60.31	37.66	39.08
	20	27.61	59.47	114.12	209.0	204.4	362.5	540.9	337.0	73.9	57.77	36.81	35.96
	21	27.24	72.77	90.61	218.0	177.3	368.1	495.5	373.8	74.5	54.65	35.11	34.26
	22	81.27	64.28	83.82	232.8	166.2	396.4	495.5	317.1	70.2	51.25	35.96	35.68
	23	161.12	60.03	78.15	226.0	163.7	436.1	421.9	294.5	68.5	49.27	35.96	33.41
	24	40.21	56.07	76.17	232.8	182.4	484.2	382.3	267.9	68.0	47.57	34.83	30.30
	25	34.26	52.95	70.23	325.6	216.9	484.2	354.0	265.6	68.0	47.01	39.93	30.30
	26	33.41	49.55	70.79	455.9	252.0	489.9	339.8	274.7	69.1	45.59	93.45	29.73
	27	32.28	47.57	94.30	297.3	221.4	444.6	351.1	202.2	69.7	45.02	71.64	29.45
	28	31.71	45.59	404.93	228.2	222.6	385.1	495.5	158.6	71.6	44.74	54.93	29.45
	29	31.71		236.16	186.3	253.2	402.1	396.4	145.8	88.6	43.32	46.44	28.60
	30	31.71		177.26	170.5	240.7	379.4	376.6	133.9	76.5	42.76	42.48	28.60
	31	30.58		155.18		214.6		385.1	128.8		41.91		27.98

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	27.61	22.71	41.06	136.5	261.1	371.0	424.8	281.5	212.4	68.53	98.54	51.82
	2	27.61	22.37	39.36	165.4	216.9	348.3	430.4	263.3	200.2	78.15	84.95	54.65
	3	26.50	23.39	40.78	236.2	204.4	518.2	430.4	258.8	195.1	72.77	87.78	54.65
	4	26.50	22.71	39.08	187.2	216.9	438.9	433.2	250.9	180.4	69.09	84.95	54.93
	5	26.50	21.75	46.44	146.7	238.4	419.1	453.1	244.1	184.3	71.92	79.29	55.22
	6	26.50	22.37	146.40	129.7	248.6	436.1	444.6	246.4	174.4	64.28	76.46	54.09
	7	26.14	23.73	172.45	127.1	286.0	478.6	470.1	272.4	170.5	62.58	77.59	53.52
	8	26.14	36.53	137.34	166.2	265.6	512.5	501.2	265.6	165.4	62.01	75.61	54.09
	9	25.77	34.83	102.79	261.1	250.9	481.4	487.0	274.7	193.1	60.88	75.04	53.52
	10	25.77	29.73	82.40	184.3	218.0	472.9	481.4	264.5	215.8	489.88	73.91	52.39
	11	25.09	31.15	70.23	150.1	197.1	410.6	484.2	272.4	163.7	679.60	71.64	51.25
	12	25.43	31.43	66.83	125.4	177.3	387.9	501.2	280.3	154.3	302.99	71.08	50.12
	13	27.24	31.71	82.97	114.7	181.2	382.3	458.7	272.4	144.1	218.04	70.23	49.55
	14	27.24	31.71	109.02	105.6	167.1	359.6	385.1	273.5	139.0	156.88	67.96	49.55
	15	25.77	30.30	104.21	105.6	160.3	337.0	359.6	253.2	127.1	127.14	65.70	48.70
1987	16	25.43	32.28	179.25	107.0	167.9	325.6	348.3	247.5	117.5	114.68	60.88	48.70
	17	25.43	37.66	174.43	121.2	191.1	291.7	351.1	241.8	111.3	109.02	60.03	47.01
	18	24.41	40.21	120.35	147.5	230.5	281.5	362.5	272.4	107.0	127.99	59.47	45.59
	19	24.07	35.11	113.27	158.6	226.0	291.7	365.3	235.0	102.8	110.44	57.77	45.02
	20	23.73	33.41	133.94	192.3	255.4	322.8	359.6	236.2	100.5	107.04	56.07	44.74
	21	23.73	32.56	254.29	252.0	258.8	317.1	365.3	274.7	111.9	97.13	55.50	44.74
	22	23.05	31.71	231.63	348.3	345.5	269.0	376.6	281.5	97.1	96.28	55.50	44.74
	23	23.05	32.56	288.83	354.0	317.1	227.1	441.7	271.3	87.8	96.28	54.09	44.17
	24	22.71	86.37	204.45	286.0	280.3	249.8	484.2	272.4	81.3	97.13	54.09	43.61
	25	21.44	87.78	172.45	256.6	265.6	267.9	574.8	282.6	79.9	92.31	54.09	43.32
	26	21.12	60.31	204.45	247.5	250.9	314.3	538.0	258.8	78.2	90.61	52.39	42.76
	27	20.81	49.55	175.28	257.7	291.7	320.0	504.0	250.9	75.6	90.05	52.39	43.32
	28	20.50	41.91	150.08	286.0	311.5	371.0	359.6	271.3	75.0	90.61	51.82	42.76
	29	21.44		141.58	334.1	334.1	407.8	303.0	254.3	73.9	164.52	51.82	42.48
	30	20.81		156.03	300.2	356.8	421.9	305.8	250.9	72.2	121.20	51.82	41.63
	31	20.81		140.73		339.8		303.0	237.3		105.62		39.93
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	39.93	37.38	49.55	117.5	393.6	447.4	492.7	600.3	122.3	66.54	39.93	33.70
	2	41.06	35.96	47.01	114.7	399.3	419.1	489.9	455.9	115.8	70.51	39.93	33.70
	3	36.53	35.96	47.57	175.3	334.1	376.6	492.7	382.3	124.0	71.64	39.64	33.70
	4	33.41	37.38	49.27	165.4	334.1	365.3	501.2	294.5	105.9	74.19	37.94	33.41
	5	32.56	37.38	54.65	146.7	337.0	317.1	572.0	251.7	101.4	70.51	37.66	32.85
	6	34.83	38.23	54.09	137.3	308.7	291.7	532.4	246.4	98.5	66.83	36.81	32.00
	7	35.68	39.08	76.17	134.8	303.0	286.0	461.6	258.5	93.7	64.28	36.25	31.71
	8	36.81	63.71	127.99	130.5	276.9	286.0	402.1	282.9	92.3	63.43	36.53	31.43
	9	38.51	48.14	86.37	143.3	269.0	265.6	399.3	376.6	128.3	63.43	35.96	31.43
	10	37.66	45.02	270.14	156.9	283.2	243.0	410.6	308.7	104.2	66.54	36.25	31.43
	11	35.68	44.17	356.79	141.6	311.5	236.2	416.3	291.7	101.9	62.30	35.96	31.43
	12	35.11	44.74	249.75	167.1	337.0	271.3	421.9	278.9	103.4	59.75	35.96	31.71
	13	33.13	43.61	208.98	200.2	331.3	317.1	447.4	273.5	108.7	58.90	35.40	31.43
	14	32.28	42.76	143.28	226.0	376.6	314.3	540.9	276.1	115.8	58.90	35.40	31.43
	15	31.43	42.76	118.36	233.9	379.4	305.8	1602.7	317.1	124.0	56.35	35.40	31.71
1988	16	30.58	40.78	125.44	249.8	356.8	297.3	843.8	291.7	154.9	54.37	35.40	31.43
	17	28.32	40.21	110.44	278.1	331.3	345.5	478.6	254.3	145.5	53.52	35.40	31.43
	18	28.60	37.66	111.29	328.5	314.3	382.3	379.4	232.8	156.0	52.67	34.55	33.13
	19	28.32	38.51	98.54	297.3	297.3	419.1	320.0	209.5	122.3	52.67	34.55	37.94
	20	28.32	42.76	93.45	274.7	305.8	433.2	274.7	198.2	108.7	51.82	34.55	36.53
	21	36.81	45.02	88.63	265.6	325.6	416.3	277.5	196.0	100.5	50.97	35.11	40.49
	22	48.70	56.07	90.05	278.1	311.5	453.1	356.8	190.9	102.8	49.27	35.96	50.12
	23	39.93	49.55	88.63	281.5	308.7	498.4	671.1	190.9	95.1	48.42	35.11	47.29
	24	39.93	47.01	96.28	266.7	322.8	506.9	645.6	177.8	87.8	47.57	35.11	43.32
	25	38.23	43.61	127.99	291.7	317.1	478.6	481.4	179.0	84.1	46.44	35.40	38.23
	26	36.81	44.74	255.42	311.5	320.0	498.4	328.5	203.3	81.8	45.02	35.11	36.53
	27	37.38	48.14	184.34	317.1	348.3	543.7	286.0	339.8	77.6	44.74	34.55	35.11
	28	41.91	48.14	153.48	331.3	342.6	566.3	291.7	282.9	76.5	43.32	34.26	34.83
	29	40.21	53.52	133.09	356.8	371.0	600.3	294.5	194.5	74.8	42.48	33.41	35.11
	30	38.23		131.39	359.6	421.9	521.0	257.1	158.0	70.5	40.78	33.70	44.17
	31	37.66		122.05		404.9		436.1	136.2		40.49		40.78

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	41.63	32.97	43.61	210.6	249.0	477.8	485.5	579.5	144.6	75.79	49.61	66.02
	2	42.03	32.38	42.59	123.3	544.9	446.7	401.5	461.1	132.6	73.27	50.40	67.50
	3	42.28	32.66	41.09	95.5	304.6	466.1	411.4	333.5	116.7	71.74	52.55	67.50
	4	44.06	37.89	39.62	82.8	245.8	543.3	330.5	279.1	108.9	69.90	51.70	69.39
	5	51.76	40.24	39.99	77.4	206.1	498.8	277.1	308.3	104.2	68.43	51.93	71.32
	6	77.85	39.17	40.21	73.4	176.7	449.0	245.0	302.1	102.8	66.48	51.11	73.30
	7	59.68	37.98	39.99	72.1	170.8	393.9	219.8	259.2	103.2	64.92	50.88	75.73
	8	54.79	37.19	41.09	75.6	167.8	365.7	240.5	242.5	102.5	62.74	50.09	76.38
	9	53.40	37.07	45.99	125.1	183.8	344.3	282.1	242.9	103.0	61.81	50.66	79.78
	10	51.11	36.42	46.10	102.2	187.3	351.7	335.5	282.5	99.1	61.04	50.94	79.01
	11	47.80	35.88	44.49	92.5	214.1	315.7	325.6	250.3	99.6	61.16	52.30	75.53
	12	46.84	35.35	44.60	86.6	195.8	339.1	363.1	258.2	108.7	96.64	55.35	72.99
	13	46.81	36.00	46.86	82.4	213.3	370.8	293.7	278.8	103.2	79.55	55.84	69.76
	14	45.70	36.59	46.41	81.6	250.7	376.7	356.1	254.8	100.7	103.90	54.39	67.92
	15	44.77	35.15	48.90	84.8	270.9	358.6	408.1	239.1	98.0	92.65	54.39	66.87
1989	16	43.55	34.64	50.18	87.6	271.8	382.1	367.4	227.6	98.3	75.67	54.53	65.63
	17	42.79	37.19	50.32	91.8	319.2	382.6	326.1	229.1	98.3	71.00	54.53	63.70
	18	41.77	36.85	51.28	98.5	268.3	343.1	308.6	214.2	99.9	69.02	55.16	62.71
	19	40.75	35.43	52.78	95.2	260.4	370.1	286.8	211.9	99.8	67.47	57.70	64.67
	20	40.75	35.23	54.42	95.0	290.4	387.3	276.2	218.7	113.8	65.40	57.05	64.01
	21	39.42	35.23	65.66	98.7	303.3	325.3	260.9	221.2	124.9	64.07	55.30	62.32
	22	38.57	34.16	89.20	97.3	350.9	327.1	244.1	231.3	130.2	62.43	55.47	58.98
	23	37.98	33.85	131.40	105.0	336.9	322.3	267.3	215.8	143.8	60.65	56.88	58.35
	24	37.64	35.06	98.43	117.9	287.2	325.0	304.2	215.6	175.8	59.60	57.36	61.07
	25	37.16	36.96	80.29	149.6	274.6	395.1	365.1	210.3	133.3	58.38	60.00	63.93
	26	36.71	37.89	74.70	142.8	313.5	430.6	319.1	203.3	110.9	57.02	60.17	59.18
	27	36.00	42.37	75.28	140.6	334.6	436.6	347.9	219.2	99.3	54.75	60.85	55.64
	28	35.01	46.72	76.13	138.8	330.7	433.4	388.8	214.7	89.6	53.63	62.06	53.46
	29	34.04		73.61	147.5	370.9	429.3	435.7	190.5	82.0	53.37	63.82	51.22
	30	33.39		74.88	164.6	397.1	486.8	558.2	177.8	79.6	52.10	64.18	49.92
	31	33.28		88.24		445.0		744.3	158.0		50.97		48.06
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	46.89	59.66	68.09	162.4	320.9	276.6	491.1	305.3	250.6	106.70	133.00	45.90
	2	44.97	51.70	63.53	163.5	313.5	277.2	490.6	425.2	211.5	100.20	112.00	45.87
	3	43.36	51.02	64.95	169.1	346.5	271.7	476.0	358.0	201.9	95.12	100.70	45.85
	4	46.19	47.15	64.30	186.6	370.8	275.4	468.7	375.8	218.7	92.00	98.71	45.82
	5	44.32	46.02	63.65	207.9	389.8	266.1	471.4	468.1	239.2	87.56	94.72	45.79
	6	41.37	45.87	62.43	270.3	424.7	280.8	443.5	330.1	207.4	82.92	89.74	45.28
	7	40.24	84.25	62.97	557.1	451.0	318.1	447.9	306.1	182.0	80.77	85.61	45.17
	8	39.99	167.70	64.04	403.0	452.8	337.1	425.0	346.1	179.7	79.86	80.29	45.08
	9	39.93	120.20	69.14	356.0	471.7	355.6	415.2	385.8	176.3	77.66	76.47	45.45
	10	39.70	93.47	74.80	287.2	447.7	326.9	425.9	365.6	174.3	77.43	74.03	45.85
	11	39.45	77.23	106.50	281.4	472.5	345.7	378.5	305.2	167.5	77.88	72.93	46.47
	12	39.62	70.69	88.55	268.5	495.7	358.9	357.4	281.9	156.9	79.35	70.58	46.13
	13	40.67	85.95	77.49	258.1	514.9	333.3	311.3	299.8	157.8	85.69	68.29	46.75
	14	41.52	98.34	80.65	593.8	547.4	316.3	302.2	325.8	179.8	83.40	66.62	46.89
	15	40.36	75.19	102.40	235.9	579.3	288.2	300.7	282.0	154.6	81.82	65.01	53.29
1990	16	39.87	66.62	161.70	232.7	668.9	309.7	346.5	252.4	159.1	81.25	63.42	50.09
	17	42.05	64.16	264.70	229.1	660.4	346.3	357.2	245.9	159.0	189.50	62.43	50.20
	18	44.97	60.87	230.00	284.0	615.9	388.2	365.6	246.6	159.3	197.30	60.85	49.27
	19	46.19	55.27	238.70	279.9	535.9	446.3	374.6	239.1	168.1	130.80	58.75	48.42
	20	48.99	54.36	447.50	245.5	501.5	468.2	359.2	229.3	154.7	113.10	57.82	48.51
	21	47.01	51.99	779.10	235.6	483.0	496.1	401.8	226.4	149.2	106.60	56.35	47.63
	22	45.76	52.21	544.60	224.7	477.6	509.7	324.3	222.3	147.4	102.40	55.38	47.74
	23	43.84	52.16	325.00	216.7	463.3	553.3	274.5	204.8	141.1	100.30	52.92	47.83
	24	43.78	67.84	264.40	249.4	453.3	574.7	263.0	191.8	170.2	97.44	51.00	56.49
	25	43.53	88.01	214.80	278.4	457.0	625.5	273.9	188.7	152.8	91.24	49.10	59.12
	26	43.70	104.50	190.60	288.2	434.2	630.5	281.6	187.2	136.7	91.10	47.80	63.02
	27	79.44	85.30	158.60	288.9	440.5	494.3	310.9	187.8	126.9	91.66	46.98	107.70
	28	76.52	73.16	146.10	266.2	430.8	484.5	325.9	188.6	119.2	87.16	46.95	166.30
	29	58.86		154.30	254.6	376.2	470.5	293.2	202.8	114.8	66.99	46.44	207.90
	30	52.72		191.50	297.6	334.0	481.4	284.0	333.4	110.2	86.12	45.93	124.70
	31	53.85		175.40		308.0		290.8	252.3		94.97		99.39

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)

Year	Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1	80.99	95.85	118.50	378.6	356.4	358.5	511.1	439.6	235.7	141.00	60.31	49.69
	2	69.59	91.97	121.70	420.2	352.6	456.3	497.9	429.6	227.0	123.90	59.63	49.24
	3	60.85	87.62	127.90	549.2	302.8	491.9	505.5	407.7	225.2	117.20	58.44	49.21
	4	58.75	84.98	289.80	367.2	274.1	553.0	522.3	401.0	227.6	112.80	57.73	49.81
	5	58.33	84.22	198.20	333.1	262.9	608.4	500.1	404.1	225.4	108.60	56.94	49.61
	6	57.59	101.90	169.00	364.5	266.4	691.4	491.0	388.1	254.4	104.10	56.60	49.44
	7	58.04	93.42	155.00	368.2	363.7	763.8	422.8	385.8	239.6	99.90	55.89	49.24
	8	57.31	90.64	210.50	704.6	321.7	901.4	421.6	377.1	222.4	94.58	55.50	48.28
	9	56.29	132.20	248.00	514.7	390.9	800.7	442.5	380.5	211.1	90.67	54.76	47.52
	10	55.41	291.90	205.90	439.9	379.1	763.3	458.2	362.0	202.4	87.14	54.39	46.75
	11	56.01	302.60	189.50	341.3	312.9	615.2	520.0	316.8	195.1	85.95	54.00	45.85
	12	56.77	196.50	192.60	295.8	314.5	607.8	596.4	293.8	192.9	84.11	53.32	45.96
	13	53.23	154.80	212.10	509.1	311.1	600.3	788.6	298.2	192.5	81.84	52.95	46.07
	14	53.09	151.40	185.20	523.1	401.1	695.8	1026.0	313.6	249.3	80.29	52.41	46.19
	15	51.70	142.20	176.70	516.2	434.5	720.5	592.2	326.9	228.6	79.86	51.87	46.30
1991	16	50.97	125.50	167.00	389.9	398.2	763.9	464.6	339.3	231.4	79.21	51.19	46.69
	17	50.37	121.60	161.10	318.7	407.4	814.6	374.8	365.4	290.7	77.29	50.54	46.36
	18	49.58	120.00	384.90	316.3	418.7	901.4	584.1	372.2	236.1	75.22	49.89	46.02
	19	49.07	115.90	323.40	286.0	421.8	812.8	539.2	350.8	209.8	73.58	49.24	45.70
	20	48.87	113.40	237.30	258.3	489.6	638.9	584.8	341.2	175.7	72.48	49.16	44.83
	21	48.96	113.10	223.30	275.1	604.1	548.5	711.1	369.9	157.1	72.00	48.76	45.05
	22	49.36	114.00	282.20	274.2	452.2	523.4	615.5	371.7	141.4	70.55	48.36	45.28
	23	49.13	117.20	251.60	262.8	366.4	489.0	519.0	334.7	130.7	70.27	48.28	44.54
	24	49.53	118.10	231.40	261.2	384.4	467.0	474.7	289.8	122.7	69.02	48.19	43.02
	25	49.84	137.10	215.30	280.1	447.8	424.2	452.5	263.1	118.1	67.61	48.11	42.28
	26	57.08	130.30	221.60	297.8	467.1	380.4	416.9	249.8	119.3	66.79	47.83	42.05
	27	146.90	124.70	236.60	284.8	361.6	381.3	423.4	246.8	116.4	65.66	47.69	41.06
	28	342.30	122.00	232.00	340.0	325.6	404.2	433.6	257.0	185.8	64.72	47.83	40.36
	29	174.60		261.30	300.2	336.1	453.1	432.4	240.9	164.6	63.48	47.80	39.65
	30	121.30		299.30	321.3	328.8	489.1	464.2	244.4	161.9	62.40	49.41	38.71
	31	105.10		349.20		331.0		440.0	239.5		61.69		37.78
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	36.82	105.60	76.89	132.0	335.6	318.9	531.3	502.2	266.7	119.70	81.31	53.94
	2	36.22	90.25	71.54	134.5	308.6	337.3	543.5	504.5	284.1	143.70	78.33	53.49
	3	37.98	83.80	69.73	144.1	319.6	345.9	567.2	582.2	257.8	174.70	75.48	53.23
	4	39.82	75.28	66.50	153.6	295.7	409.1	516.7	556.2	250.9	117.20	72.31	52.95
	5	42.00	70.27	66.50	181.4	264.6	466.2	551.2	590.4	213.7	112.30	69.62	52.67
	6	44.01	80.60	64.38	205.9	260.9	455.0	565.0	717.2	191.7	110.90	68.00	52.35
	7	49.16	86.32	60.48	247.1	261.2	442.4	547.3	562.2	202.3	108.90	66.36	52.07
	8	50.77	77.94	60.93	210.9	242.5	470.0	539.2	495.8	246.5	107.50	64.81	51.79
	9	45.85	72.19	60.96	189.4	233.3	496.8	546.6	442.6	457.4	104.70	63.25	51.45
	10	45.03	66.17	61.41	233.7	243.7	522.9	547.9	305.7	1180.0	102.00	61.75	51.14
	11	44.77	65.46	111.10	186.0	278.5	530.6	498.1	321.8	555.3	99.11	60.28	50.80
	12	42.79	65.20	192.30	167.7	312.9	510.7	427.9	325.6	344.8	96.47	61.75	52.84
	13	40.75	86.37	162.70	170.7	342.5	474.7	504.3	348.3	245.1	94.18	63.22	51.17
	14	40.75	74.57	126.50	177.5	349.8	495.8	577.1	371.9	232.5	91.69	64.75	50.49
	15	40.72	70.38	110.10	192.7	370.5	468.1	669.1	371.4	211.1	89.26	66.28	50.15
1992	16	40.55	68.17	102.00	212.1	353.9	511.6	645.7	378.0	231.7	86.40	67.89	49.84
	17	40.07	66.42	94.81	239.8	362.9	522.8	601.9	501.2	196.4	84.33	69.48	49.53
	18	39.73	64.24	100.10	327.4	289.7	568.4	557.6	696.1	185.6	512.70	71.15	48.87
	19	39.56	62.83	111.60	256.1	286.8	598.6	575.4	642.9	179.3	273.40	77.32	48.22
	20	39.25	62.54	146.80	251.8	272.8	616.6	603.0	524.8	173.3	153.90	75.53	47.57
	21	39.05	61.13	133.20	444.1	297.7	626.2	621.6	455.6	151.3	124.80	72.05	46.89
	22	38.74	58.92	160.50	384.1	318.0	583.6	675.5	393.8	136.4	118.40	68.91	45.93
	23	38.71	58.01	313.20	304.7	359.6	568.1	744.2	371.5	129.0	114.00	65.88	45.28
	24	45.76	57.79	300.20	287.7	388.8	542.8	627.0	361.4	116.1	109.00	62.63	45.39
	25	58.04	57.99	261.70	315.6	410.8	525.7	635.2	339.6	113.7	104.90	59.83	45.51
	26	82.75	58.84	309.10	328.2	424.4	534.5	568.3	338.7	118.1	101.20	57.00	45.59
	27	121.40	62.85	265.80	310.1	400.6	567.0	557.8	359.2	108.5	97.61	56.06	45.70
	28	90.84	65.63	189.60	357.8	366.9	579.6	556.1	320.9	109.1	94.13	55.61	45.82
	29	115.50	83.77	165.80	364.7	479.9	543.6	613.3	300.4	111.5	90.76	55.16	45.90
	30	253.90		143.80	349.7	445.0	528.9	615.2	284.2	114.3	87.50	54.70	46.02
	31	141.30		133.10		327.6		551.4	278.6		84.36		47.54

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)

Year	Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1	47.74	38.15	41.40	104.6	343.2	406.6	389.0	252.9	222.2	112.70	59.94	64.01
	2	46.44	38.04	41.74	103.7	339.3	341.7	420.6	242.1	254.8	98.91	58.84	62.51
	3	46.13	37.58	42.31	102.9	337.2	319.1	407.7	259.6	262.0	93.56	57.31	60.57
	4	46.27	37.47	42.68	102.7	314.8	294.1	405.2	287.7	220.6	88.30	57.17	58.84
	5	46.38	37.36	42.85	102.6	318.3	308.5	427.0	292.9	205.1	84.53	64.50	57.19
	6	47.12	37.78	43.21	102.4	326.9	341.3	452.9	280.1	205.0	84.25	86.71	54.42
	7	47.03	38.57	43.58	104.4	342.0	372.4	507.7	279.4	204.0	117.80	76.16	50.49
	8	47.15	39.39	57.36	110.7	373.8	403.3	568.9	263.7	199.1	127.10	80.96	49.58
	9	47.26	40.58	73.86	129.9	383.4	401.6	542.7	263.3	193.5	128.10	91.44	48.68
	10	46.92	41.43	108.10	147.2	350.9	428.9	689.2	295.4	182.5	130.90	74.63	48.17
	11	46.61	41.88	506.00	168.0	383.2	443.3	529.5	292.1	303.1	113.40	69.65	46.86
	12	46.27	46.36	693.10	168.5	211.6	458.0	463.5	263.1	262.1	104.60	68.15	45.59
	13	45.93	51.11	301.50	209.6	185.1	471.3	413.2	226.2	211.0	95.91	66.17	44.39
	14	45.62	56.23	290.80	352.3	189.9	488.1	380.1	202.3	190.2	87.19	64.21	47.37
	15	45.31	61.67	208.30	692.2	216.8	479.3	439.0	212.3	178.0	82.81	62.97	46.84
1993	16	45.20	67.72	152.00	541.9	281.1	475.8	399.5	189.5	170.9	78.39	61.67	45.87
	17	44.63	74.15	124.70	387.5	255.0	444.2	367.5	192.8	169.0	76.07	60.45	45.73
	18	44.23	66.28	115.80	281.0	215.5	430.3	355.2	220.5	155.9	75.90	63.36	45.22
	19	43.47	58.47	110.30	233.8	210.3	443.8	371.8	207.8	152.0	74.51	67.16	44.71
	20	43.10	51.39	108.90	213.7	246.4	457.7	381.8	192.7	123.2	73.10	64.10	43.81
	21	42.34	44.88	107.10	221.7	295.2	472.7	411.0	177.0	132.4	71.97	62.37	43.27
	22	41.97	39.34	111.10	223.8	356.8	498.8	551.5	177.2	134.5	71.63	61.41	42.73
	23	41.77	39.68	348.10	232.7	376.8	537.5	581.1	179.9	178.0	71.03	75.99	42.20
	24	41.60	39.68	290.20	246.2	393.6	559.2	584.4	191.0	144.8	69.25	78.19	41.32
	25	40.21	41.46	205.90	275.0	408.6	504.7	619.7	258.1	132.3	68.03	77.03	41.18
	26	38.83	41.63	158.90	319.3	445.4	451.2	501.6	233.9	127.5	66.34	74.17	41.03
	27	38.71	41.43	130.90	325.7	444.1	382.8	373.6	212.5	116.3	65.91	71.97	42.14
	28	38.60	41.43	120.40	348.8	447.6	304.2	288.8	202.1	114.6	64.51	70.33	44.06
	29	38.49		112.50	350.7	431.0	296.5	262.7	199.4	113.8	63.31	68.17	45.22
	30	38.37		109.90	347.6	415.8	330.1	229.4	201.5	117.3	62.68	65.60	42.62
	31	38.26		106.10		395.3		216.9	205.4		61.55		38.54
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	39.62	53.94	58.16	156.0	256.4	358.0	688.1	455.5	296.2	83.29	87.87	50.69
	2	43.10	52.33	61.21	157.5	258.9	401.1	759.2	456.9	296.7	83.88	87.39	50.69
	3	42.56	51.70	73.13	170.5	384.9	417.7	746.6	445.6	288.9	83.40	85.47	50.66
	4	44.71	54.73	87.31	293.4	361.1	414.8	675.1	477.1	293.2	84.33	83.94	48.65
	5	45.59	87.79	77.88	586.3	341.6	436.7	603.0	473.8	268.8	87.84	81.73	48.65
	6	45.00	66.45	72.39	515.1	351.2	478.6	601.3	477.8	253.5	112.80	78.84	55.33
	7	45.87	62.83	68.68	297.3	308.6	520.5	620.7	448.8	217.3	100.90	76.07	75.36
	8	49.64	59.26	66.87	210.2	360.7	522.6	648.4	504.7	214.4	92.40	75.28	112.50
	9	47.66	55.86	65.09	165.0	365.4	526.5	660.7	477.6	199.7	88.72	73.86	80.32
	10	46.16	52.58	65.77	159.2	282.2	472.8	662.7	603.2	181.2	85.41	72.42	69.73
	11	45.17	51.19	65.32	136.9	249.0	429.6	714.2	768.9	162.8	138.00	71.94	66.17
	12	43.27	49.53	67.86	124.0	259.4	391.1	625.2	552.4	158.8	142.60	95.12	62.77
	13	42.79	51.00	72.31	123.3	257.4	366.7	624.7	488.7	149.1	118.80	80.26	60.87
	14	44.32	54.82	89.48	133.3	296.9	344.7	820.4	458.6	148.3	103.70	72.56	60.11
	15	45.48	53.18	109.10	193.1	267.4	332.8	759.2	412.0	139.5	100.20	68.74	57.22
1994	16	43.13	56.03	101.90	161.0	294.7	359.6	569.7	400.1	149.3	95.26	65.57	54.34
	17	40.84	54.59	106.50	148.8	339.1	406.0	491.5	389.1	140.5	91.92	64.01	54.19
	18	40.33	53.77	105.00	145.9	355.0	449.1	488.3	349.1	151.1	89.43	61.89	55.10
	19	40.75	54.45	142.20	141.4	398.1	496.9	492.6	311.2	127.5	86.97	60.05	55.47
	20	43.78	57.42	250.40	146.3	428.2	526.8	493.0	286.0	113.1	87.36	58.86	55.86
	21	41.86	72.02	176.10	133.7	445.5	560.0	514.4	290.9	107.4	83.37	56.32	55.13
	22	39.51	70.21	141.40	131.7	442.7	601.6	551.9	300.0	112.7	79.49	54.48	56.06
	23	38.97	61.24	125.30	129.8	439.9	652.4	575.8	343.4	103.7	76.41	54.02	59.74
	24	38.86	57.65	125.90	132.1	417.4	718.9	628.4	395.9	100.5	73.72	54.08	59.57
	25	38.74	55.47	123.80	151.6	365.4	676.7	519.5	419.2	96.4	81.59	54.17	58.86
	26	38.21	56.54	125.60	179.0	374.7	685.6	477.1	398.7	91.8	107.80	53.71	59.51
	27	78.62	57.62	118.50	213.7	371.5	692.5	448.7	413.4	85.8	127.00	53.77	65.20
	28	62.34	58.16	118.40	245.8	408.1	685.1	449.3	359.3	84.7	108.00	54.28	88.69
	29	58.01		117.00	295.5	437.8	669.8	447.9	320.3	84.2	92.94	52.21	85.75
	30	57.36		169.20	336.3	422.3	660.9	445.2	295.7	84.1	90.98	51.70	71.06
	31	54.28		154.70		371.0		452.1	290.9		89.06		67.07

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	59.83	41.18	69.76	213.6	225.9	263.8	439.1	377.8	210.9	86.63	57.82	51.87
	2	58.07	40.36	66.70	176.4	204.6	315.7	463.2	373.7	193.1	81.96	56.54	50.09
	3	55.33	41.32	64.44	138.0	211.2	326.8	484.3	531.1	159.5	74.94	52.55	48.39
	4	54.05	38.54	61.18	131.8	229.2	338.7	513.8	1022.0	151.8	74.51	54.90	46.75
	5	52.78	35.88	58.33	121.1	242.8	354.2	535.4	718.5	146.8	71.54	54.28	44.43
	6	52.24	33.37	55.58	135.9	249.3	406.5	539.7	621.5	136.3	70.35	52.58	44.46
	7	51.68	33.00	53.26	143.4	257.3	467.7	551.2	608.2	126.4	67.52	51.59	46.13
	8	51.82	34.55	58.75	174.6	270.9	483.9	565.9	657.9	123.8	66.34	50.26	49.10
	9	49.86	30.76	62.91	345.3	293.0	517.8	574.0	425.4	135.2	66.39	48.34	48.82
	10	58.61	33.65	55.61	468.0	299.5	535.1	557.7	391.1	129.6	62.88	47.74	47.54
	11	54.39	105.80	52.61	356.6	319.5	533.9	542.6	381.0	140.8	62.18	47.49	49.78
	12	50.32	124.70	51.02	299.8	336.2	506.3	529.6	372.7	127.9	61.84	46.58	45.48
	13	49.10	81.31	49.81	258.8	336.1	512.8	527.8	370.6	124.1	64.16	46.33	44.46
	14	49.24	68.06	46.41	239.7	341.0	507.7	532.1	383.1	118.5	76.07	45.96	44.09
	15	47.49	61.52	45.03	240.9	343.0	513.3	544.2	364.5	114.2	102.40	46.29	43.38
1995	16	47.69	56.06	48.05	249.2	323.4	527.0	540.8	354.4	108.9	109.10	46.19	46.92
	17	47.88	52.84	44.97	233.1	294.5	533.7	527.1	441.6	103.8	123.40	46.13	45.56
	18	46.78	56.77	49.27	298.9	297.1	528.8	551.6	395.6	95.5	101.50	46.72	46.44
	19	46.98	54.87	57.79	399.1	299.6	506.1	681.9	327.2	88.2	92.71	46.05	48.62
	20	47.69	52.95	70.86	366.7	278.3	462.5	638.6	308.8	87.0	86.68	45.00	50.54
	21	47.09	50.69	78.73	306.0	265.9	428.7	653.7	318.5	84.7	82.92	45.17	53.29
	22	44.54	49.86	84.82	294.2	260.5	366.4	581.0	325.1	86.0	77.97	45.96	50.35
	23	42.70	49.07	135.40	300.2	242.0	328.8	589.7	307.6	87.0	75.31	46.13	43.07
	24	44.66	48.96	394.30	305.4	211.2	319.2	607.7	298.9	101.6	72.65	46.61	38.21
	25	44.71	47.18	842.20	323.8	204.1	336.3	1918.0	291.2	91.0	69.73	47.09	37.95
	26	43.81	47.97	749.60	340.7	253.9	336.9	892.4	286.3	86.8	63.90	47.57	37.10
	27	45.51	77.54	492.10	358.1	214.0	362.2	649.2	255.1	83.8	62.26	48.39	37.13
	28	45.90	80.09	551.30	292.4	202.8	369.4	545.7	252.5	87.3	60.62	66.59	37.16
	29	45.65		512.80	276.8	215.6	392.0	515.4	248.1	99.9	58.58	56.18	36.93
	30	43.47		391.70	261.9	214.1	425.3	495.1	252.0	93.8	60.73	53.66	36.68
	31	41.40		284.20		208.6		412.2	249.1		58.69		36.73
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	36.73	37.73	56.21	98.1	322.3	350.4	490.2	547.9	160.8	83.70	52.19	36.08
	2	36.57	36.45	63.93	94.7	294.5	381.7	491.2	472.5	157.6	82.48	49.80	36.39
	3	35.97	35.96	84.37	96.0	270.0	407.6	478.4	454.5	191.8	93.17	48.14	37.20
	4	36.20	37.39	74.82	93.5	252.1	452.4	531.8	512.4	162.8	85.10	46.06	37.13
	5	35.64	38.51	68.94	169.7	207.3	452.2	633.6	444.0	147.4	89.90	44.86	35.86
	6	35.48	38.76	70.39	321.5	180.3	458.4	527.6	461.6	147.0	76.53	43.35	36.51
	7	35.31	39.72	92.50	221.7	185.3	504.7	522.5	418.3	148.0	74.51	42.15	36.55
	8	35.14	44.39	86.25	182.7	194.4	559.1	517.7	397.2	143.2	73.33	40.33	36.81
	9	34.98	42.67	73.43	148.4	204.0	591.6	532.9	368.7	147.7	71.61	38.70	36.35
	10	35.39	42.92	66.55	134.8	205.6	653.0	542.0	359.6	140.0	69.82	39.64	35.79
	11	37.07	42.12	85.20	130.3	186.3	597.1	537.7	382.3	138.5	69.01	39.97	34.96
	12	37.53	41.64	282.80	149.3	176.4	597.1	542.2	375.0	136.2	69.66	39.73	34.50
	13	38.71	41.94	263.10	207.9	176.0	749.3	579.2	385.5	136.7	69.00	40.06	33.56
	14	40.59	152.60	161.20	184.6	202.8	795.6	469.6	513.5	136.5	68.74	40.40	33.60
	15	48.33	145.30	349.10	193.3	201.6	767.2	445.1	485.2	150.0	67.75	40.22	33.15
1996	16	51.06	85.38	430.30	244.8	196.8	684.8	436.4	467.9	145.2	65.78	39.92	32.69
	17	46.11	66.71	244.40	306.5	191.2	616.6	326.5	379.8	136.6	65.85	38.71	32.24
	18	44.64	56.28	186.80	289.7	223.0	566.1	291.5	350.5	129.8	69.37	38.09	32.28
	19	45.15	52.75	189.10	275.6	277.9	480.0	292.5	453.5	123.8	69.45	37.20	31.58
	20	44.23	52.06	158.20	306.6	310.0	469.3	311.4	313.4	117.9	76.26	36.47	31.86
	21	43.31	50.60	379.20	290.9	318.0	583.1	346.6	240.7	114.0	70.09	35.33	31.66
	22	45.94	50.29	220.60	257.1	510.3	564.0	340.0	235.3	114.2	68.77	33.65	31.29
	23	43.68	46.83	169.70	251.3	410.1	599.7	330.6	230.1	107.1	67.21	32.87	30.79
	24	43.03	83.19	146.50	273.5	408.7	602.1	296.0	224.3	102.6	66.21	31.76	30.62
	25	41.75	62.42	122.00	342.7	489.6	610.7	301.5	226.6	98.4	64.25	31.14	30.00
	26	41.17	58.07	118.00	355.5	400.8	614.0	331.3	182.9	94.8	62.28	32.16	30.88
	27	40.60	58.17	118.30	271.1	445.4	611.0	351.1	165.7	92.5	60.88	33.10	30.91
	28	40.03	58.65	119.10	275.4	421.2	625.2	363.0	151.3	90.2	58.48	33.40	30.93
	29	39.45	58.28	144.50	314.2	413.5	634.1	402.2	157.9	88.5	56.74	34.35	30.53
	30	38.88		135.70	348.5	382.3	572.2	423.9	177.0	86.0	54.35	35.29	30.56
	31	37.60		106.40		382.5		439.6	169.1		54.28		30.58

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	30.49	27.54	25.60	107.8	245.6	270.7	347.2	429.3	142.5	75.88	54.40	40.39
	2	30.14	34.04	42.33	199.1	255.3	273.1	331.7	372.3	129.8	73.42	53.17	38.67
	3	29.56	31.59	37.85	167.7	261.3	256.2	336.3	322.5	129.1	69.49	51.22	39.48
	4	30.78	29.35	32.67	190.3	295.0	323.6	319.3	279.5	127.6	84.46	49.04	39.32
	5	30.43	28.38	32.10	153.4	256.3	308.5	340.3	236.6	128.8	80.29	47.44	38.49
	6	29.44	28.06	33.88	119.2	266.5	333.9	346.2	207.6	134.0	82.56	46.67	39.29
	7	29.27	27.77	34.44	104.2	362.4	381.1	376.3	205.8	150.7	96.60	45.58	38.76
	8	29.08	27.17	43.52	101.2	502.1	401.5	401.3	209.0	194.5	77.64	45.22	36.90
	9	28.67	27.04	56.06	112.1	358.2	389.3	435.4	228.2	166.9	71.24	59.02	37.01
	10	28.70	27.33	46.99	110.8	274.0	396.6	517.9	245.5	151.1	68.25	55.54	36.06
	11	28.86	27.20	55.99	112.6	240.9	366.0	431.6	289.4	143.3	67.07	49.39	35.35
	12	28.81	26.63	64.10	200.1	244.8	368.0	410.6	330.1	133.2	65.43	47.36	37.28
	13	28.83	25.76	53.67	153.9	242.6	352.7	419.4	469.1	132.7	65.45	44.81	37.92
	14	28.36	25.29	47.57	684.5	191.7	362.1	432.5	301.8	126.0	62.51	43.46	39.22
	15	27.73	24.48	52.40	458.1	179.2	365.5	457.4	256.4	125.8	61.29	43.67	37.07
1997	16	26.81	24.36	92.16	288.4	180.7	367.9	473.4	233.2	129.2	60.23	43.80	35.80
	17	26.26	23.93	73.23	209.2	178.1	360.0	462.3	222.2	129.8	63.49	42.80	35.81
	18	25.94	23.65	73.52	198.8	170.5	383.2	442.1	221.2	119.5	66.19	41.84	34.07
	19	41.06	23.22	138.70	189.8	159.7	378.2	482.8	223.7	114.6	74.13	39.79	34.26
	20	36.80	23.06	97.19	187.3	166.3	406.6	487.4	230.1	113.8	70.88	38.35	33.97
	21	33.29	22.80	70.42	210.1	168.9	404.8	442.7	237.9	116.9	82.69	38.38	33.87
	22	32.02	22.50	61.11	198.8	197.8	386.3	435.9	253.3	107.8	102.00	38.05	32.83
	23	30.78	21.79	56.57	202.6	212.1	386.0	390.1	232.7	103.5	95.92	36.79	34.21
	24	30.29	21.57	50.39	259.3	238.8	393.1	357.4	215.4	97.5	78.80	36.16	33.26
	25	29.25	28.90	49.21	281.2	282.7	393.6	343.2	240.3	89.9	71.46	36.16	32.39
	26	29.27	28.25	50.20	271.1	320.4	426.6	331.9	199.1	90.2	66.45	38.60	32.48
	27	29.89	26.50	59.51	265.7	353.1	462.6	340.7	183.4	89.4	66.80	52.02	32.23
	28	29.06	24.56	80.89	244.4	338.9	449.6	351.8	255.1	85.7	62.11	46.94	32.27
	29	28.66		130.30	244.9	299.9	417.6	345.3	197.5	84.0	60.00	43.05	37.60
	30	28.24		98.70	253.6	265.9	386.2	365.0	166.3	82.5	62.53	42.18	34.73
	31	28.02		92.65		250.4		412.6	154.7		57.40		33.06
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	32.15	64.08	96.25	155.8	598.6	269.3	600.9	279.5	138.9	78.93	43.57	34.81
	2	32.03	60.75	96.20	168.8	435.8	265.4	619.3	293.8	132.9	79.75	43.42	33.88
	3	32.50	50.10	118.50	196.9	533.4	265.3	461.6	283.1	130.2	76.30	43.60	33.41
	4	32.19	45.08	434.60	219.9	416.4	263.7	488.1	290.6	155.0	75.64	43.36	34.44
	5	32.48	41.83	213.60	178.8	342.6	277.8	526.5	301.5	149.9	75.46	42.71	33.13
	6	31.70	40.60	171.30	171.7	296.5	302.4	536.2	338.7	150.3	71.42	42.33	32.09
	7	32.46	39.50	147.90	171.7	271.4	293.7	522.9	287.1	153.8	69.38	41.97	32.41
	8	48.95	39.22	138.20	239.7	240.6	272.8	515.4	270.8	156.7	66.53	46.01	31.41
	9	39.66	38.44	129.60	282.1	237.8	265.0	522.1	247.3	169.5	63.94	45.13	30.74
	10	36.76	36.88	124.60	224.2	235.6	265.5	557.0	233.8	155.4	66.25	43.51	30.44
	11	35.50	37.44	121.60	190.4	250.2	302.1	609.4	237.2	156.8	63.63	42.03	30.85
	12	38.88	39.78	129.00	185.6	260.8	361.1	598.0	267.6	149.8	60.75	41.59	30.51
	13	36.40	44.12	121.10	191.7	261.5	328.3	667.8	249.4	163.7	58.17	41.10	30.38
	14	35.40	88.69	119.60	203.5	320.0	264.2	548.1	262.0	145.7	55.83	40.73	29.81
	15	49.03	110.50	119.20	201.1	361.0	246.9	504.3	324.5	126.5	56.02	40.62	29.92
1998	16	41.65	100.90	121.00	207.7	414.0	239.9	642.9	317.7	113.7	54.97	39.92	29.85
	17	38.63	184.20	124.70	246.1	455.8	254.7	531.9	264.6	103.8	54.97	39.79	29.76
	18	38.56	154.80	127.80	254.0	500.3	268.8	472.8	240.6	96.6	54.32	39.24	29.64
	19	37.94	112.30	132.30	255.8	416.7	284.5	427.6	226.7	93.2	51.94	37.70	29.49
	20	37.42	100.50	126.70	264.6	386.3	337.4	400.0	224.5	91.8	50.66	37.29	29.25
	21	36.60	91.18	124.60	287.0	367.9	385.5	392.5	229.3	89.1	50.02	37.12	29.91
	22	35.43	89.00	148.50	295.1	342.1	364.0	389.6	222.7	87.4	48.60	36.56	29.52
	23	34.64	85.72	157.30	315.9	368.4	298.8	371.4	211.3	83.1	47.26	36.07	29.03
	24	34.51	113.90	135.40	336.1	387.8	279.9	361.3	208.6	79.2	45.94	35.44	27.91
	25	34.24	120.40	123.70	557.5	441.9	266.4	352.8	185.2	77.7	45.59	35.60	27.38
	26	33.15	106.20	120.80	571.7	395.8	292.6	390.8	184.0	77.0	46.77	35.72	26.82
	27	33.13	100.50	124.70	409.1	425.7	356.3	353.8	171.9	75.9	49.91	35.08	26.48
	28	33.49	95.94	135.90	340.3	373.5	429.4	302.0	158.1	75.5	47.24	34.83	26.10
	29	33.21		131.10	327.4	326.5	489.7	280.9	150.9	75.0	47.00	34.44	25.56
	30	32.78		141.50	374.9	269.2	535.4	282.1	148.4	74.5	45.12	35.55	25.12
	31	41.54		141.30		268.0		279.3	146.1		44.45		23.61

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	25.17	41.24	41.96	144.2	297.9	361.4	418.7	311.0	140.5	137.00	45.76	46.95
	2	24.76	40.55	42.92	140.3	332.7	363.3	398.6	301.7	157.4	116.40	43.18	47.13
	3	23.56	46.42	47.09	115.4	288.4	393.4	377.5	311.2	134.2	103.60	42.81	44.90
	4	28.39	40.19	65.62	117.1	240.2	407.8	359.2	276.8	128.3	92.06	54.45	44.43
	5	70.97	38.91	120.10	130.4	226.4	401.1	328.7	249.8	126.1	89.51	116.40	43.93
	6	76.67	39.26	110.70	141.3	267.6	431.9	316.3	254.3	149.0	81.39	90.74	43.32
	7	64.46	37.97	401.30	163.1	306.1	435.8	290.3	262.3	130.0	77.00	71.55	41.06
	8	61.10	38.50	529.30	164.2	261.2	471.8	311.4	305.5	121.7	72.12	69.85	41.26
	9	61.95	37.82	237.10	188.7	323.3	534.5	306.6	299.2	123.1	76.64	62.64	39.45
	10	46.64	38.21	159.90	153.0	321.7	448.8	289.5	369.3	109.9	73.72	57.03	39.89
	11	41.53	46.51	126.60	192.6	386.9	408.0	367.7	314.0	101.6	70.59	53.15	38.60
	12	42.28	120.00	105.50	378.4	474.9	380.2	377.5	280.3	95.9	67.80	52.85	39.20
	13	39.87	99.58	90.74	247.5	386.9	382.3	302.3	269.4	94.5	65.64	60.88	36.97
	14	37.17	81.27	82.24	210.2	315.4	343.2	237.3	228.6	98.8	62.32	57.33	36.69
	15	36.07	62.19	76.26	182.7	312.2	373.7	246.0	217.0	101.2	63.53	63.32	35.71
1999	16	34.06	56.86	76.06	201.2	331.9	414.9	231.6	194.7	100.7	58.30	59.39	35.11
	17	33.40	89.00	158.10	225.2	375.2	436.0	247.7	186.9	104.5	60.43	57.50	34.93
	18	33.12	107.00	126.50	218.1	423.4	408.5	258.6	162.8	114.9	57.62	53.97	34.75
	19	33.15	120.80	107.80	242.0	447.0	442.2	307.4	157.2	120.6	56.41	48.65	34.25
	20	33.62	90.79	106.80	227.9	448.2	457.8	399.9	165.4	170.8	54.61	46.93	33.95
	21	54.79	70.77	94.06	259.6	495.8	387.8	347.7	186.0	138.5	54.16	46.90	34.26
	22	50.38	58.46	84.55	251.1	547.8	339.4	329.2	182.9	130.5	52.73	47.69	33.13
	23	47.84	63.76	82.90	224.4	486.2	329.5	270.6	195.3	160.0	52.81	52.37	33.46
	24	55.89	64.20	103.10	208.4	385.2	317.0	249.7	166.6	214.7	52.53	49.10	32.93
	25	50.34	53.02	133.70	216.7	426.4	284.1	244.9	165.1	164.9	52.36	48.54	32.87
	26	42.98	45.39	114.30	239.9	332.6	307.7	231.3	199.5	128.8	52.00	50.19	32.56
	27	43.87	38.22	108.60	263.8	302.6	341.0	236.4	184.4	113.2	49.18	47.59	32.17
	28	44.43	39.96	103.50	278.3	369.9	383.0	232.9	168.1	98.8	46.87	47.51	31.14
	29	38.95		106.20	252.7	364.3	394.9	245.1	157.3	170.2	47.02	47.50	33.42
	30	38.32		125.10	267.6	403.1	392.8	268.3	152.5	199.4	46.58	47.67	32.84
	31	44.03		140.30		343.7		299.1	143.8		46.17		32.62
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	32.43	48.98	29.68	155.8	153.5	204.4	294.0	378.6	165.4	70.67	46.04	37.31
	2	31.87	54.44	30.95	128.9	178.4	224.6	251.2	340.5	157.9	117.40	46.50	35.38
	3	31.36	43.97	30.76	119.0	212.7	237.5	246.4	288.2	151.9	86.59	47.10	36.53
	4	31.04	39.02	45.81	105.7	205.1	233.5	279.5	237.7	167.1	78.18	46.80	37.41
	5	30.28	36.26	58.77	91.4	207.0	180.2	241.7	218.3	149.6	71.05	45.10	35.99
	6	29.96	35.33	47.37	82.2	229.2	163.1	222.9	207.7	144.9	140.40	45.90	34.47
	7	29.26	34.48	43.57	83.2	238.9	162.5	215.7	222.6	147.1	146.70	46.58	33.45
	8	29.14	33.87	44.18	80.0	282.7	185.3	227.6	189.3	160.3	129.10	50.30	37.03
	9	28.47	34.94	43.02	76.7	318.2	196.3	226.4	181.3	133.8	104.30	67.69	36.20
	10	27.90	53.57	44.14	89.2	376.2	204.8	221.8	231.2	124.2	90.10	54.34	34.89
	11	31.90	41.08	44.30	108.1	403.4	177.3	255.3	240.9	116.9	82.71	52.20	34.23
	12	53.38	37.04	49.91	132.2	392.1	174.4	257.6	194.2	114.6	76.04	48.84	32.63
	13	61.77	35.60	44.92	151.9	388.3	217.7	271.4	221.5	108.5	72.82	48.08	32.91
	14	51.68	34.94	42.86	144.5	354.7	222.2	288.1	189.3	110.4	70.62	49.44	31.73
	15	46.11	35.10	42.71	145.5	303.1	245.4	273.0	186.9	102.4	67.02	46.05	30.92
2000	16	39.57	37.08	42.16	138.2	303.7	263.4	258.6	185.4	99.1	64.56	45.21	30.35
	17	37.30	41.20	49.71	147.9	310.2	252.3	286.4	191.8	106.1	64.15	45.45	40.24
	18	36.24	37.55	41.61	162.8	334.9	256.9	236.6	205.5	105.4	63.01	46.07	48.39
	19	38.60	35.59	40.73	201.6	304.5	226.6	200.3	181.7	105.9	61.77	44.12	38.83
	20	37.74	34.33	39.82	173.3	274.4	255.2	192.9	166.4	184.4	59.58	43.23	37.58
	21	35.94	33.42	39.44	175.0	272.2	291.7	192.3	155.7	155.2	58.88	43.05	36.88
	22	35.85	33.08	39.84	184.4	305.4	224.8	216.2	148.8	169.5	58.18	43.06	37.11
	23	36.07	31.56	38.61	177.5	280.7	220.6	270.4	134.5	139.1	56.51	44.76	36.59
	24	34.86	32.36	39.71	198.9	261.3	217.9	208.1	145.8	116.4	54.40	47.27	37.32
	25	34.91	30.43	48.15	197.7	277.5	240.0	211.7	122.9	103.0	52.47	46.13	37.11
	26	34.80	30.52	51.80	194.7	306.6	239.5	280.6	114.0	84.8	50.94	43.63	36.88
	27	33.73	29.86	83.34	176.5	300.1	250.4	218.8	117.4	110.5	49.80	40.94	35.97
	28	31.99	30.79	94.32	168.2	300.0	248.6	211.5	123.1	97.4	48.04	39.55	37.68
	29	31.54	28.83	133.30	140.0	302.5	287.6	222.4	145.4	94.5	47.01	38.44	39.79
	30	31.33		192.20	140.9	252.1	354.0	435.6	158.7	82.8	46.49	38.02	37.95
	31	32.96		184.90		219.1		284.7	167.4		46.90		36.07

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	35.98	27.72	29.01	63.0	155.0	250.9	268.0	195.0	138.5	69.48	40.23	36.72
	2	35.05	26.22	26.78	61.0	185.8	266.2	251.1	182.8	131.9	65.22	130.20	36.18
	3	34.48	25.14	26.71	67.0	173.9	269.6	282.1	185.1	146.1	55.22	115.70	35.86
	4	34.82	24.58	27.32	57.9	164.2	264.2	275.9	210.6	141.5	64.67	82.72	36.13
	5	35.14	24.53	26.50	51.5	173.7	267.7	235.7	189.8	132.6	62.29	68.37	35.55
	6	33.44	23.82	36.22	62.8	202.2	232.2	246.5	196.3	123.7	59.17	60.26	33.90
	7	34.55	24.22	28.58	74.6	236.1	227.7	293.5	203.8	127.8	59.07	55.71	34.00
	8	33.82	24.04	25.31	87.9	223.7	229.3	244.1	215.1	121.4	56.53	52.89	34.19
	9	32.79	21.90	23.73	102.3	223.2	228.8	278.2	208.3	118.0	55.60	49.62	32.16
	10	32.52	21.68	22.74	99.5	222.4	235.7	262.0	194.8	99.2	54.99	48.66	30.95
	11	32.36	20.94	23.24	130.2	259.9	245.3	262.6	180.4	111.5	55.53	48.00	32.32
	12	31.62	18.78	21.30	115.6	270.5	259.6	269.6	180.2	104.4	55.12	45.28	32.01
	13	32.13	18.57	41.46	100.3	283.9	297.2	320.7	177.2	105.0	52.62	43.56	31.14
	14	31.36	20.44	55.10	177.1	300.0	275.7	251.9	197.5	108.7	49.72	42.77	32.53
	15	30.75	19.68	42.39	146.9	307.7	306.6	235.9	178.5	121.1	48.52	42.56	32.05
2001	16	29.68	19.67	40.47	126.7	305.4	521.6	263.3	367.4	103.7	48.27	42.90	30.94
	17	30.15	22.96	38.72	118.2	308.8	438.8	220.7	270.6	105.9	47.93	41.46	31.66
	18	30.32	27.73	37.85	147.7	286.1	265.1	198.6	238.6	103.2	47.40	41.04	35.21
	19	29.31	29.31	40.08	124.1	300.8	206.0	182.3	220.1	99.4	46.70	40.69	41.96
	20	28.73	26.85	37.85	163.0	280.4	177.4	191.5	209.3	99.7	47.08	41.03	35.39
	21	27.42	27.48	41.31	122.8	257.0	175.2	221.6	208.3	102.5	45.84	35.70	34.30
	22	30.02	25.24	41.90	114.7	248.3	182.6	348.1	182.8	97.9	45.58	35.69	33.51
	23	30.18	33.60	35.89	109.8	257.8	180.4	1020.0	195.4	94.8	44.94	35.91	34.32
	24	28.78	50.87	32.81	111.9	248.4	196.1	508.5	187.4	96.5	44.14	33.58	35.28
	25	27.30	44.14	36.93	107.4	253.9	162.4	401.8	171.1	96.6	43.29	34.78	33.31
	26	26.40	37.46	36.28	104.7	232.1	166.9	318.6	163.7	94.7	42.06	32.98	32.57
	27	26.43	31.90	40.38	104.0	254.7	170.1	283.0	159.5	94.0	41.26	34.00	32.15
	28	24.84	30.52	45.18	112.0	262.0	197.0	257.7	153.3	86.2	38.57	36.14	31.55
	29	24.41		96.31	139.9	225.5	204.1	255.8	150.9	83.0	37.22	36.27	31.10
	30	26.72		67.43	140.4	217.6	221.5	299.0	148.4	75.7	38.72	37.35	30.60
	31	27.10		62.11		222.6		215.3	149.6		41.30		29.73
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	27.84	30.82	44.74	146.3	150.2	295.4	313.0	171.0	197.9	57.38	48.26	32.08
	2	28.44	31.88	45.76	155.9	152.2	355.2	317.7	149.3	212.0	51.51	48.83	31.22
	3	27.58	36.41	46.10	161.7	148.5	387.9	319.4	162.9	204.0	48.11	35.72	31.65
	4	27.30	32.92	45.98	164.2	160.5	456.5	369.9	180.7	175.1	45.50	37.01	32.56
	5	26.75	32.63	46.57	162.1	168.1	441.3	436.8	208.7	153.5	45.53	37.38	32.15
	6	28.67	33.29	45.84	125.4	212.2	422.7	350.4	220.1	129.9	45.87	37.65	31.64
	7	27.97	33.74	44.81	120.2	228.9	454.3	333.7	383.8	111.4	45.82	37.81	31.33
	8	28.34	36.45	52.38	122.3	224.4	442.4	309.7	254.2	96.9	46.04	37.90	31.03
	9	28.67	34.97	54.25	123.6	231.3	447.0	304.6	245.9	96.5	45.98	38.11	30.74
	10	29.06	33.22	55.01	127.1	234.8	355.0	306.4	233.6	93.4	46.63	38.19	31.22
	11	28.73	33.69	56.87	128.2	236.2	347.4	258.6	251.7	86.6	46.42	38.27	30.67
	12	28.60	33.82	68.22	130.5	247.6	318.9	224.7	308.0	81.3	46.52	38.36	30.35
	13	28.53	34.18	71.50	130.4	269.3	324.0	209.3	318.1	76.5	47.29	38.21	30.29
	14	25.60	34.89	73.42	140.0	300.2	313.4	198.4	798.1	75.3	47.01	35.59	30.19
	15	27.88	34.89	75.14	144.5	344.1	337.4	204.4	443.9	77.5	48.59	36.23	30.58
2002	16	27.65	35.83	78.05	147.3	323.2	377.2	214.7	317.1	79.0	47.97	35.80	30.41
	17	27.81	36.78	79.81	155.0	318.7	350.0	220.8	298.6	79.5	47.17	35.61	29.61
	18	29.53	37.00	81.59	165.3	344.8	312.6	251.5	233.0	77.4	46.62	33.53	30.56
	19	30.43	49.73	84.22	172.0	323.0	287.0	249.7	218.1	99.7	46.98	33.46	30.46
	20	31.33	53.02	84.96	181.6	284.0	260.2	249.6	203.7	81.1	46.48	33.21	30.10
	21	34.52	55.69	88.42	184.9	274.3	257.8	284.8	197.0	77.1	45.71	33.38	30.48
	22	33.93	60.32	90.56	212.1	299.6	299.7	294.9	226.2	75.0	45.28	33.55	30.55
	23	34.94	61.61	94.55	257.9	287.2	335.6	275.0	199.5	73.1	45.15	33.09	30.91
	24	35.00	57.64	153.80	231.8	303.0	638.5	245.5	198.8	82.4	45.27	33.07	31.83
	25	33.74	55.31	151.60	228.3	325.7	431.9	229.8	195.9	71.5	45.11	33.24	32.54
	26	34.43	50.42	148.20	203.4	356.4	325.3	224.2	233.1	82.4	44.65	33.20	32.98
	27	32.13	48.59	140.10	198.0	436.9	318.7	222.6	228.8	72.3	45.61	32.98	32.45
	28	31.29	44.61	135.40	182.1	360.8	320.6	257.5	233.4	67.4	46.49	33.17	32.35
	29	30.26		133.70	163.0	316.7	353.7	226.2	217.1	62.2	47.02	32.74	31.74
	30	30.33		133.80	149.9	286.0	329.6	210.1	229.3	60.7	47.47	32.51	31.19
	31	31.44		136.70		304.6		186.1	207.4		48.00		30.96

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	31.11	29.37	87.14	200.2	442.1	334.6	479.1	318.0	153.8	85.42	50.03	52.19
	2	30.83	28.71	147.40	186.6	452.1	424.0	528.6	313.4	150.6	80.42	49.41	51.05
	3	30.58	27.65	110.50	179.2	368.3	472.5	489.1	302.1	155.7	78.71	49.27	34.27
	4	30.45	26.97	89.56	159.7	296.8	494.2	619.8	439.0	182.5	70.94	49.08	34.40
	5	30.25	26.46	76.44	135.6	259.5	496.9	516.1	337.8	197.2	69.28	51.18	35.06
	6	29.57	28.23	77.43	119.0	245.9	507.3	530.8	300.2	185.8	68.52	49.18	34.99
	7	30.26	29.30	77.38	119.2	250.5	515.9	501.0	290.6	182.0	68.28	50.79	34.38
	8	29.78	29.89	79.02	135.3	273.0	557.7	458.7	281.0	157.3	62.42	50.05	34.12
	9	29.57	30.51	79.74	136.1	282.1	500.2	541.6	266.9	147.4	68.71	49.60	34.20
	10	29.56	29.64	79.04	196.8	264.7	520.9	497.8	232.0	138.5	66.67	52.10	33.89
	11	29.48	29.91	78.86	210.0	261.0	531.0	454.8	233.4	116.8	66.81	54.08	34.12
	12	29.21	29.23	79.69	235.4	260.3	471.1	456.8	200.9	113.1	63.20	55.55	34.92
	13	29.68	30.13	79.75	233.3	235.9	437.0	468.4	193.0	110.9	62.10	53.60	36.00
	14	28.98	28.70	80.92	237.3	253.8	480.6	444.9	166.7	102.8	61.40	52.42	36.16
	15	29.04	29.02	81.40	325.3	245.4	466.2	432.1	149.0	98.7	58.49	51.79	36.51
2003	16	29.11	29.79	72.27	566.0	242.7	475.0	449.5	148.2	105.1	55.42	56.19	36.91
	17	28.81	29.65	67.54	349.3	288.5	483.4	444.3	158.1	98.1	53.09	53.41	36.95
	18	28.68	29.76	66.73	291.3	351.3	467.5	411.5	166.8	97.2	52.54	55.30	36.35
	19	28.36	30.05	63.25	650.9	377.6	480.2	396.0	230.3	96.3	53.32	55.05	36.57
	20	27.98	31.01	65.83	339.7	369.1	489.0	428.7	239.2	91.6	52.97	53.96	37.08
	21	27.88	33.61	77.05	278.1	396.6	615.4	433.6	221.1	85.3	51.81	53.43	37.14
	22	28.36	32.08	105.20	250.3	443.2	505.3	422.2	161.3	83.1	50.39	54.28	37.76
	23	28.64	32.58	97.67	248.1	406.4	493.6	413.1	140.9	82.5	50.04	54.41	38.09
	24	27.31	32.82	105.80	279.6	338.9	509.4	386.3	135.4	106.3	50.19	53.81	38.82
	25	26.19	33.18	129.40	344.0	335.2	533.1	377.1	145.5	101.4	50.21	53.21	39.06
	26	25.39	33.53	157.80	449.4	351.2	561.1	366.2	141.5	98.7	50.47	53.47	37.25
	27	24.92	33.86	160.10	301.8	307.6	578.0	360.7	154.9	93.5	50.33	54.35	37.96
	28	24.16	30.52	167.70	271.8	284.8	598.4	354.9	153.4	91.0	50.26	55.38	37.94
	29	23.08		404.80	282.2	268.5	547.7	347.4	151.5	97.9	50.19	54.85	36.79
	30	35.53		279.50	300.7	257.3	535.8	349.4	152.5	90.6	49.54	54.11	35.94
	31	32.16		237.20		298.8		312.4	164.9		49.71		35.36
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	34.21	32.66	77.66	101.7	267.9	304.3	439.6	269.3	181.6	94.84	122.00	92.89
	2	33.31	34.40	59.20	137.1	219.1	303.6	442.7	295.9	166.0	92.39	109.50	92.03
	3	32.54	36.20	54.30	141.5	212.3	313.0	451.7	272.3	154.7	94.95	105.00	89.97
	4	30.90	38.89	52.56	151.6	207.4	330.4	471.2	266.5	115.7	93.03	103.40	88.62
	5	30.22	39.41	48.78	157.9	203.4	351.4	494.7	251.6	115.9	90.26	103.30	66.75
	6	30.60	41.13	51.58	161.4	204.7	344.1	516.5	239.1	115.7	86.80	103.40	68.59
	7	31.59	42.98	53.47	168.2	207.8	352.1	549.4	239.7	115.8	82.65	102.20	70.76
	8	31.12	44.47	61.52	185.4	217.8	366.7	558.9	253.9	123.0	79.31	102.10	71.53
	9	30.89	47.89	86.48	181.5	220.1	379.4	800.1	256.7	127.0	417.80	102.10	72.13
	10	29.93	135.00	93.47	174.8	222.5	386.7	498.9	247.4	134.0	575.40	101.20	72.72
	11	30.09	142.20	136.80	157.8	224.7	390.6	454.7	237.5	141.5	455.80	101.30	72.72
	12	29.66	160.60	138.40	156.0	229.0	389.4	437.3	237.7	149.2	362.30	101.30	72.75
	13	29.41	90.79	105.80	157.6	285.1	418.1	447.7	232.5	156.9	233.80	100.30	72.42
	14	29.55	91.54	105.20	159.7	289.5	422.3	452.5	228.9	176.8	201.40	100.20	71.98
	15	29.77	90.73	109.10	161.4	291.3	438.9	476.2	228.4	177.4	166.40	99.23	70.69
2004	16	29.70	91.47	115.10	166.0	335.0	451.8	454.5	229.6	292.0	143.80	97.99	70.41
	17	29.78	91.11	131.00	177.4	317.8	512.0	437.4	258.1	263.8	146.40	98.56	70.40
	18	30.04	93.49	138.10	175.5	324.1	489.9	402.2	253.6	222.1	146.60	96.70	72.79
	19	29.91	95.17	142.50	173.0	326.6	524.9	222.4	309.0	145.1	145.00	96.16	78.07
	20	29.73	96.62	148.40	169.3	336.8	527.9	218.3	301.2	140.6	144.60	94.21	79.55
	21	31.16	88.54	161.10	174.5	346.5	526.1	213.3	297.5	148.1	145.30	94.20	79.58
	22	32.31	89.47	131.70	169.4	370.9	521.1	219.0	283.4	141.4	143.90	93.75	77.27
	23	34.02	89.76	132.90	175.0	349.8	494.6	217.0	261.9	136.0	140.40	94.54	75.97
	24	35.15	89.80	133.60	197.1	337.4	388.8	212.4	252.5	129.0	141.50	94.31	73.76
	25	33.70	91.07	124.10	193.2	316.8	399.4	207.4	245.3	113.7	140.80	94.03	68.30
	26	31.86	90.65	97.82	203.4	313.6	354.6	220.4	242.4	111.7	137.50	93.27	67.84
	27	30.25	92.38	102.30	384.4	304.2	368.1	223.6	238.9	110.0	135.80	92.95	67.03
	28	29.90	92.32	101.10	388.8	298.6	378.5	291.5	228.7	105.3	137.70	90.68	65.56
	29	29.77	85.43	100.90	300.2	290.8	398.5	294.8	219.4	98.2	135.20	92.48	65.45
	30	30.09		101.00	284.2	293.1	420.2	300.4	204.9	90.0	130.70	93.35	65.98
	31	33.17		101.60		298.6		292.8	194.6		125.90		294.00

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	185.50	74.19	134.50	264.4	442.4	446.6	896.1	541.4	260.4	175.00	127.90	87.67
	2	165.50	73.81	123.90	264.6	450.4	445.7	812.5	541.8	260.9	168.80	119.60	91.38
	3	136.80	75.18	118.30	266.7	460.7	458.2	784.9	528.6	267.0	165.70	119.40	91.76
	4	120.20	75.50	143.80	267.8	466.2	468.8	773.2	526.4	266.5	169.60	117.60	91.36
	5	105.90	77.37	218.10	271.0	475.2	467.9	674.0	523.1	274.5	169.50	114.70	92.94
	6	99.57	219.70	220.80	302.2	482.3	474.2	651.0	527.6	277.9	164.40	113.70	91.73
	7	96.94	228.00	224.50	307.0	488.3	479.1	634.5	528.9	298.1	162.20	112.00	90.61
	8	89.87	233.10	252.40	372.0	480.6	496.4	650.7	539.0	296.3	159.90	109.20	88.99
	9	88.63	189.70	265.20	380.6	485.3	504.0	692.6	530.3	294.4	163.30	109.20	89.10
	10	89.18	217.80	247.30	326.3	471.2	512.4	727.5	502.7	295.8	161.50	102.60	88.92
	11	90.78	323.70	223.80	259.8	465.6	524.1	783.6	486.0	305.1	165.10	104.40	89.90
	12	90.44	440.90	202.20	258.2	467.5	529.2	864.4	473.7	293.7	162.90	102.20	90.12
	13	87.52	418.20	214.20	244.5	473.6	519.3	913.6	472.4	264.7	157.10	110.40	89.53
	14	78.46	267.90	251.40	243.0	479.6	527.9	901.7	468.7	252.9	147.90	108.70	88.53
	15	80.62	187.80	258.30	241.7	464.7	522.5	846.6	459.6	241.7	151.80	106.50	88.99
2005	16	78.42	164.10	263.60	247.4	476.0	548.3	811.0	458.2	237.6	152.00	103.60	88.56
	17	75.80	160.80	297.60	266.8	470.8	589.8	722.2	476.3	233.9	152.20	102.10	83.97
	18	73.29	145.00	387.80	296.9	471.9	688.5	723.0	488.5	227.3	167.10	100.00	83.33
	19	73.12	143.00	793.70	317.6	443.7	677.9	705.0	477.7	214.5	165.00	97.01	81.60
	20	70.69	141.90	517.80	350.4	445.2	688.4	698.9	468.3	203.3	153.70	100.40	80.59
	21	68.45	139.20	501.40	360.3	432.2	698.5	690.2	425.6	198.1	148.00	97.37	79.99
	22	67.08	136.90	481.00	382.1	411.5	694.5	715.2	370.1	195.0	148.60	95.47	85.98
	23	68.55	134.70	460.80	408.1	401.7	760.8	698.0	335.9	194.7	145.60	86.46	83.70
	24	69.80	134.30	427.20	457.5	383.7	789.1	697.5	312.7	197.6	147.10	86.66	85.85
	25	70.94	133.40	397.30	475.7	376.0	798.2	683.7	312.4	200.5	150.40	85.81	83.85
	26	72.59	137.80	366.70	489.2	368.7	877.1	678.2	308.4	182.5	168.70	85.63	84.16
	27	73.84	135.30	336.50	476.7	385.7	901.7	657.4	315.2	182.6	152.40	99.81	86.09
	28	75.12	134.10	315.70	473.5	393.5	866.3	633.1	309.1	185.3	149.90	103.30	86.35
	29	77.30		293.40	423.1	403.9	889.1	601.0	296.7	176.4	150.30	101.70	85.68
	30	75.35		268.20	432.0	424.0	877.0	569.7	277.3	170.1	143.40	97.86	84.20
	31	75.21		264.80		439.0		545.7	275.1		137.10		81.98
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	80.54	104.10	159.70	165.7	331.5	462.3	511.9	436.2	384.0	178.40	160.40	149.10
	2	85.00	103.60	143.50	179.0	292.5	435.8	489.5	483.0	366.7	179.40	159.70	147.00
	3	97.33	100.90	133.80	180.8	293.4	439.7	470.5	593.6	375.4	174.50	154.00	150.20
	4	93.89	101.40	125.70	181.7	332.2	448.0	489.5	638.9	374.5	174.10	149.50	149.60
	5	92.68	101.00	137.50	179.4	355.2	423.8	472.5	982.2	366.1	171.00	146.80	164.40
	6	91.12	102.30	129.50	181.3	391.4	393.7	483.3	664.8	347.5	171.00	144.20	166.30
	7	99.21	102.40	134.10	183.2	435.0	370.1	492.6	606.5	335.2	170.30	138.30	160.90
	8	97.67	103.30	147.50	203.0	465.1	345.6	488.1	576.2	320.9	171.80	137.10	158.80
	9	96.11	102.90	149.90	230.0	477.8	335.1	490.1	507.2	309.8	168.60	137.10	164.00
	10	92.75	104.00	152.10	239.5	486.8	269.5	507.8	488.5	295.8	171.60	130.20	152.70
	11	85.25	103.80	140.80	264.8	503.4	266.6	492.7	475.9	282.5	168.60	125.20	150.00
	12	82.04	106.60	142.40	270.3	549.5	254.4	506.7	512.2	278.2	162.90	125.30	148.10
	13	77.19	106.00	149.10	197.6	496.7	262.1	572.8	490.1	282.5	162.50	122.80	146.00
	14	72.55	117.80	164.90	137.2	459.3	266.0	519.0	484.3	270.4	159.90	116.50	139.30
	15	73.44	141.60	181.10	137.3	481.1	270.8	463.8	496.3	268.7	157.60	110.30	135.70
2006	16	191.50	148.20	183.10	133.7	501.6	335.1	428.1	507.1	264.1	154.20	103.00	130.40
	17	196.80	142.10	152.90	130.5	536.9	385.6	328.5	514.9	256.7	157.70	152.00	127.40
	18	181.30	143.40	149.20	153.0	510.6	365.7	323.1	493.3	252.1	160.50	190.70	125.40
	19	160.30	149.70	156.20	137.4	485.1	363.9	328.6	446.6	236.9	163.60	186.40	124.60
	20	146.70	110.60	138.40	146.5	450.4	388.8	333.0	448.2	233.7	172.20	180.10	122.10
	21	131.70	112.60	121.60	151.9	466.5	421.6	301.5	455.9	225.8	169.30	178.70	123.90
	22	87.75	109.30	131.60	152.2	478.6	440.6	321.2	467.7	221.6	167.30	165.80	119.20
	23	88.76	143.10	138.10	213.4	490.3	459.0	334.8	455.5	212.5	167.20	158.80	118.70
	24	90.57	144.70	151.20	242.0	506.1	462.3	340.6	448.5	207.3	167.80	162.30	120.60
	25	91.88	150.40	146.90	251.6	488.7	457.4	374.8	453.1	202.5	165.90	162.40	120.60
	26	91.05	162.40	149.60	271.8	500.4	486.4	464.7	461.8	200.7	168.80	161.30	129.60
	27	90.02	183.80	152.20	286.2	487.5	504.7	570.0	451.6	203.3	164.30	158.40	124.80
	28	88.86	190.60	151.40	300.7	495.2	531.4	567.4	429.0	198.8	162.50	146.50	132.60
	29	95.20		150.30	310.1	496.6	480.3	486.0	486.7	190.8	162.60	150.00	142.70
	30	101.80		154.50	321.8	486.8	504.7	462.6	436.9	177.8	162.40	152.10	149.40
	31	105.70		160.50		440.9		459.1	381.4		161.00		157.60

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	160.50	134.30	184.80	417.0	448.1	328.3	746.3	421.7	265.0	193.40	129.20	118.10
	2	159.60	136.20	170.30	431.9	451.6	352.0	721.1	394.5	262.4	176.20	126.40	116.60
	3	157.70	137.80	185.20	370.8	459.5	374.6	687.7	363.1	264.1	170.60	128.50	116.90
	4	155.20	135.80	182.00	326.5	474.6	410.5	578.5	356.1	258.4	170.00	126.30	116.20
	5	152.00	139.30	176.80	316.7	491.1	436.8	558.1	351.1	247.7	168.00	127.70	115.90
	6	151.70	142.40	170.90	307.9	506.6	445.2	535.3	345.7	249.3	168.70	128.00	115.20
	7	148.70	147.40	165.50	315.2	523.5	453.3	513.5	339.9	268.9	164.60	126.50	112.90
	8	143.50	146.80	164.90	308.3	509.3	461.8	489.2	338.8	267.6	165.90	126.20	112.00
	9	143.60	153.10	171.80	316.0	503.1	470.7	486.6	328.6	279.0	161.30	124.40	110.40
	10	141.70	154.00	196.30	323.4	476.4	474.2	486.2	327.1	251.8	161.40	124.30	111.60
	11	139.80	168.80	199.50	329.6	445.6	488.9	491.8	333.3	241.7	162.00	123.90	109.80
	12	139.00	173.40	190.50	338.5	429.7	503.8	492.7	347.8	241.6	160.40	126.40	110.40
	13	138.80	163.60	200.40	352.8	435.2	546.7	534.5	391.8	231.1	158.50	126.30	113.60
	14	144.70	166.20	204.00	399.9	446.6	610.3	476.1	396.4	226.5	155.90	123.80	112.80
	15	142.50	171.10	213.80	392.6	451.6	670.8	488.8	384.1	222.2	156.00	123.70	110.00
2007	16	142.10	173.50	209.00	410.2	492.0	649.0	474.3	386.4	217.8	154.70	121.20	110.30
	17	137.30	176.40	205.30	456.1	518.2	602.7	459.5	348.2	227.0	155.10	120.70	112.30
	18	135.20	172.80	200.90	421.6	538.3	551.2	460.9	320.9	235.2	148.80	121.10	113.80
	19	128.00	169.10	222.40	438.0	490.3	517.8	467.5	312.4	232.8	147.20	119.80	116.80
	20	129.90	175.20	547.60	431.9	476.8	530.1	483.3	316.7	222.0	143.30	120.00	114.10
	21	133.00	186.00	492.70	422.9	472.1	543.2	499.8	312.3	228.7	144.50	118.60	111.20
	22	133.70	178.10	439.00	409.7	463.1	610.6	504.3	303.3	230.3	140.50	118.60	112.00
	23	135.10	166.20	443.10	419.0	454.4	569.0	511.8	299.2	227.5	138.20	116.30	111.70
	24	135.60	161.10	442.50	422.0	437.6	579.0	511.3	295.6	225.0	136.60	116.30	110.30
	25	133.40	149.40	427.60	382.0	424.1	589.7	495.7	301.0	218.6	137.10	115.20	109.90
	26	131.10	153.50	404.50	391.1	402.4	572.4	521.8	294.9	213.2	134.70	113.80	109.90
	27	133.70	150.00	372.40	390.8	384.3	616.3	514.3	293.7	210.7	140.80	111.20	107.00
	28	132.50	200.90	381.70	412.6	348.8	721.9	432.2	287.2	211.8	136.00	110.50	108.10
	29	135.90		388.00	423.1	332.0	844.2	442.1	279.6	196.3	134.50	115.30	105.80
	30	133.50		395.60	438.0	321.4	752.8	435.2	273.7	191.2	134.30	124.50	102.90
	31	130.30		405.60		315.1		419.7	266.7		132.40		102.30
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	101.60	118.50	140.10	193.3	285.7	410.4	446.6	349.0	223.3	154.70	105.90	93.32
	2	100.80	115.90	138.30	196.1	296.0	487.1	464.0	347.4	224.8	152.30	102.70	94.61
	3	99.87	117.40	173.10	193.9	313.0	510.0	470.9	365.1	219.0	142.90	101.50	96.07
	4	100.30	122.80	175.90	192.1	319.0	487.7	462.9	363.2	214.1	139.50	100.40	96.12
	5	102.20	121.50	173.30	203.1	329.1	487.2	459.8	502.7	243.7	134.90	99.06	96.04
	6	104.30	123.40	177.60	330.7	324.7	496.2	475.5	440.3	242.6	134.30	99.85	96.39
	7	107.30	127.90	183.50	321.5	328.2	559.5	486.7	423.5	240.4	132.80	100.30	100.20
	8	109.60	134.30	185.90	319.4	324.9	542.4	527.2	418.6	223.2	133.20	99.30	102.50
	9	173.50	126.50	189.60	309.1	327.7	537.1	497.3	462.3	215.8	128.30	97.38	106.40
	10	181.10	124.20	192.00	299.5	321.2	531.6	479.0	441.8	203.0	128.70	92.29	103.00
	11	176.40	120.90	197.20	275.8	327.3	535.8	497.6	413.9	209.5	128.10	93.23	102.50
	12	169.60	117.80	205.10	284.8	333.5	551.6	504.5	373.6	199.2	124.20	94.17	101.90
	13	165.10	116.30	212.60	279.0	357.8	558.0	498.0	341.5	183.0	126.80	111.30	100.70
	14	161.10	115.30	211.50	275.1	359.7	594.9	497.4	350.5	176.4	126.90	109.00	101.70
	15	157.20	118.40	181.40	303.0	370.7	646.0	496.6	342.2	175.8	130.60	113.40	100.20
2008	16	155.70	121.60	183.10	293.0	381.8	728.5	385.9	337.4	173.4	135.70	110.80	100.30
	17	156.40	119.90	180.60	279.1	392.4	629.6	373.2	312.1	172.1	133.30	110.50	105.30
	18	155.10	124.70	181.60	278.5	403.4	618.5	397.5	297.6	168.3	127.90	107.70	108.50
	19	154.60	127.00	186.30	290.2	417.6	673.7	389.9	284.4	162.9	125.60	105.80	140.40
	20	150.70	127.80	190.80	276.6	436.6	714.0	402.5	266.4	161.9	126.50	105.50	147.40
	21	145.00	124.60	184.70	262.6	446.3	582.0	539.1	257.2	158.8	125.50	104.60	153.80
	22	138.80	128.40	175.50	264.7	454.0	563.9	403.1	256.0	156.0	121.80	105.70	160.40
	23	134.60	137.40	183.10	266.4	493.1	556.3	359.3	262.8	153.2	120.00	105.00	158.60
	24	128.90	135.80	178.80	266.5	480.7	510.2	342.3	261.3	150.9	117.40	102.40	156.90
	25	129.30	138.60	176.00	263.2	468.4	529.9	328.4	257.5	150.6	115.80	97.39	133.60
	26	128.50	138.60	179.10	266.9	459.5	530.1	334.8	248.5	149.8	116.50	96.01	123.90
	27	124.20	138.10	179.90	270.5	435.6	540.4	328.3	239.8	147.3	114.20	94.31	122.60
	28	122.00	140.20	182.60	277.4	390.6	473.4	332.0	230.1	152.5	114.40	92.53	121.40
	29	120.50	139.50	179.20	281.9	364.5	466.5	327.0	244.8	155.4	113.80	93.16	118.30
	30	119.30		185.40	277.7	346.5	459.6	321.9	241.4	163.2	111.70	92.86	116.10
	31	121.70		190.70		363.0		317.1	254.4		110.20		113.40

INFLOW RECORDS OF CHAKDARA STATION (CUMECS)													
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	114.10	137.70	168.10	238.1	379.3	545.7	547.3	565.7	285.5	158.30	85.14	109.50
	2	112.10	131.60	165.70	246.0	394.3	549.6	549.7	570.6	296.9	154.50	86.91	106.10
	3	108.70	139.30	162.10	245.4	410.2	545.4	559.8	568.9	284.8	149.10	87.37	104.30
	4	112.40	153.40	177.50	248.5	417.8	538.2	567.2	564.1	263.8	146.40	87.03	101.00
	5	114.00	166.90	174.70	251.5	425.1	527.5	586.7	581.3	242.3	143.70	87.54	98.86
	6	114.20	161.20	168.70	265.5	422.8	523.6	492.7	570.8	242.6	139.10	89.44	97.22
	7	111.70	159.30	161.30	287.0	426.5	516.6	488.8	576.6	238.3	134.20	90.88	96.40
	8	110.50	154.20	156.40	319.5	434.4	509.9	483.3	491.0	226.3	130.50	90.51	94.83
	9	110.50	152.70	156.80	306.9	430.0	506.1	474.9	482.7	215.7	123.70	90.94	96.12
	10	109.30	151.80	160.00	301.0	419.1	512.6	467.9	492.4	206.3	118.60	92.41	95.09
	11	108.50	150.00	169.40	288.6	426.3	502.1	466.4	484.2	212.1	115.10	91.61	97.24
	12	108.00	150.60	177.40	312.7	429.5	492.7	482.4	465.7	204.7	110.40	90.71	96.13
	13	107.80	152.80	182.00	341.8	435.0	489.5	478.2	448.7	199.4	105.30	92.63	91.17
	14	106.90	157.70	186.20	517.8	426.1	471.3	488.4	440.8	199.0	103.80	93.81	90.18
	15	109.80	157.60	192.40	695.3	434.3	463.9	501.7	431.2	195.8	102.60	95.96	88.54
2009	16	115.60	154.80	192.60	681.3	438.5	471.2	511.1	422.9	188.0	102.30	96.55	88.58
	17	119.60	153.50	195.40	616.0	443.5	474.9	525.8	414.4	176.3	101.80	97.83	87.41
	18	165.30	161.30	197.80	433.4	444.2	470.9	541.4	398.1	168.5	101.90	98.23	88.33
	19	161.10	161.60	200.60	408.2	451.3	479.1	549.3	375.2	171.1	101.40	100.00	86.51
	20	153.80	164.60	197.00	403.3	438.8	489.8	561.1	353.3	173.7	97.01	101.10	85.15
	21	147.80	165.20	199.10	394.8	445.1	494.1	566.6	327.2	176.0	95.06	102.20	85.31
	22	141.10	169.60	203.60	385.2	454.4	493.4	548.4	331.4	177.9	93.17	103.20	87.55
	23	138.80	176.40	208.30	373.9	458.6	484.3	532.2	288.9	180.5	90.17	102.80	88.94
	24	136.50	175.60	212.50	362.4	468.1	494.2	516.8	286.7	182.9	88.55	104.10	90.46
	25	135.30	178.30	219.80	343.6	473.9	507.9	533.1	281.5	184.6	86.03	104.50	88.65
	26	150.20	173.20	225.40	352.5	476.1	517.1	546.3	273.5	180.5	84.78	104.10	88.10
	27	159.70	170.20	238.80	344.2	489.3	525.6	563.6	269.4	177.2	86.13	106.50	89.16
	28	159.20	174.90	250.40	345.4	502.3	529.5	580.3	264.3	172.8	87.91	107.30	88.05
	29	156.60		249.30	352.7	509.3	538.2	578.5	260.4	170.8	88.99	109.10	85.98
	30	152.60		220.40	370.4	518.7	549.3	562.7	265.6	163.4	86.30	107.40	83.93
	31	150.50		227.90		531.8		546.8	274.5		85.34		82.03
Year	**Day**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
	1	85.81	95.56	412.10	264.7	471.1	591.4	583.4	0.0	0.0	0.00	66.94	54.92
	2	87.14	91.00	410.40	254.5	475.8	571.0	589.0	0.0	0.0	0.00	67.35	50.82
	3	88.23	89.17	402.00	252.0	488.7	532.9	594.8	0.0	0.0	0.00	65.67	51.45
	4	89.40	87.33	392.30	254.6	520.3	509.3	590.8	0.0	0.0	0.00	63.61	52.71
	5	88.73	89.29	372.10	257.8	579.5	483.9	587.5	0.0	0.0	0.00	63.69	54.75
	6	89.82	99.86	357.00	250.9	601.2	454.5	600.8	0.0	0.0	0.00	66.10	56.22
	7	88.85	105.50	341.60	265.1	605.0	427.7	616.1	0.0	0.0	0.00	63.81	53.65
	8	90.95	245.00	335.30	282.1	563.3	425.9	616.5	0.0	0.0	0.00	61.26	51.94
	9	87.98	227.90	329.50	291.6	532.1	413.1	631.0	0.0	0.0	0.00	60.26	50.82
	10	87.52	244.70	321.50	327.2	501.2	421.2	643.1	0.0	0.0	0.00	60.89	49.56
	11	85.59	246.00	313.20	365.4	478.4	440.4	675.6	0.0	0.0	0.00	60.40	50.76
	12	88.21	240.80	298.90	407.0	472.5	461.1	710.6	0.0	0.0	0.00	59.82	49.86
	13	89.49	228.40	285.10	409.2	464.3	471.9	613.1	0.0	0.0	0.00	58.79	49.41
	14	89.35	216.70	278.30	399.9	436.8	481.0	576.2	0.0	0.0	0.00	57.62	50.29
	15	88.19	218.00	269.90	408.8	432.0	498.9	555.4	0.0	0.0	0.00	56.91	50.56
2010	16	86.36	240.80	269.40	384.5	483.9	473.8	544.0	0.0	0.0	0.00	55.74	50.03
	17	86.19	218.70	286.90	436.9	541.0	449.3	554.3	0.0	0.0	0.00	54.81	49.34
	18	87.33	203.50	333.20	473.7	791.4	439.9	581.1	0.0	0.0	0.00	53.55	50.10
	19	84.87	208.70	338.50	512.9	671.4	489.0	606.9	0.0	0.0	0.00	56.88	49.29
	20	84.28	215.00	343.60	474.6	571.7	522.1	620.6	0.0	0.0	0.00	55.69	48.31
	21	82.99	209.30	352.90	446.3	557.7	558.4	603.4	0.0	0.0	0.00	57.29	47.25
	22	83.88	213.40	356.80	459.5	580.0	588.5	600.3	0.0	0.0	0.00	58.82	46.76
	23	84.07	215.70	376.50	446.3	560.4	627.9	593.0	0.0	0.0	0.00	59.88	47.07
	24	83.42	221.20	400.30	381.8	542.0	602.0	567.7	0.0	0.0	0.00	57.81	46.53
	25	84.29	238.70	398.00	379.7	561.2	613.1	570.1	0.0	0.0	0.00	56.26	47.05
	26	86.13	331.30	380.60	376.6	572.4	630.0	573.1	0.0	0.0	0.00	57.93	45.59
	27	85.41	336.20	367.00	421.3	598.9	615.1	603.3	0.0	0.0	77.94	58.65	44.39
	28	82.51	355.00	358.20	504.6	543.2	599.2	635.8	0.0	0.0	74.40	57.94	45.11
	29	105.50		328.70	492.9	565.9	599.3		0.0	0.0	70.84	57.31	46.55
	30	102.50		373.60	473.2	568.0	662.6		0.0	0.0	69.13	54.75	47.32
	31	94.85		303.10		571.3					68.07		49.42

ANNEX B

COMPUTED WATER SURFACE PROFILES BY RIVER SYSTEM ANALYSIS MODEL (HEC-RAS)

WATER SURFACE PROFILES RECORDS FOR 2 &5 Years RETURN PERIOD

Reach	River Sta	Q Total (m3/s)		Min Ch. El (m)	W.S. Elev (m)		Crit W.S. (m)		E.G. Elev (m)		E.G. Slope (m/m)		Flow Area (m2)		Froude #	
		2 Year	5 Year		2 Year	5 Year	2 Year	5 Year	2 Year	5 Year	2 Year	5 Year	2 Year	5 Year	2 Year	5 Year
River-Swat	0	734.63	1478.08	2238.04	2241.92	2243.19	2241.92	2243.19	2242.92	2244.56	0.009843	0.007759	166	291.84	1.01	0.96
River-Swat	500	734.63	1478.08	2232.3	2237.48	2238.55	2236.39	2237.78	2237.91	2239.37	0.002802	0.004244	254.53	371.01	0.57	0.72
River-Swat	1000	734.63	1478.08	2231.15	2234.85	2235.42	2234.85	2235.42	2235.32	2236.07	0.012502	0.011128	241.75	413.54	1.01	1
River-Swat	1500	734.63	1478.08	2223.73	2229.89	2231.53	2228.69	2230.32	2230.44	2232.4	0.002757	0.00318	226.38	362.43	0.58	0.65
River-Swat	3000	734.63	1478.08	2218.52	2222.3	2223.52	2222.3	2223.52	2223.26	2224.79	0.01011	0.009199	169.28	296.26	1.01	1.01
River-Swat	3500	734.63	1478.08	2173.9	2196.16	2199.79	2180.16	2182.44	2196.18	2199.83	0.000016	0.00003	1232.4	1632.5	0.05	0.08
River-Swat	4500	734.63	1478.08	2160.49	2196.17	2199.82		2199.82	2196.18	0.000001	0	0.27	5537.21	283.32	0.01	
River-Swat	5500	734.63	1478.08	2184.89	2193.72	2196.58	2193.72	2196.58	2195.95	2199.52	0.009766	0.008877	111.05	194.43	1	1
River-Swat	6000	734.63	1478.08	2135	2139.36	2141.06	2143.85	2146.71	2177.55	2182.71	0.429177	0.302413	26.83	51.69	5.92	5.25
River-Swat	8500	734.63	1478.08	2052.52	2060.39	2060.81	2059.63	2062.01	2061.65	2064.99	0.005251	0.016135	147.39	163.27	0.79	1.39
River-Swat	9000	734.63	1478.08	2053.27	2057.09	2058.32	2057.09	2058.32	2058.05	2059.6	0.009844	0.008999	168.86	295.04	1.01	1.01
River-Swat	9500	734.63	1478.08	2043.83	2048.6	2050.21	2049.34	2051.13	2051.1	2053.37	0.019928	0.01705	104.75	187.62	1.45	1.41
River-Swat	12000	734.63	1478.08	1988.82	2047.96	2049.67	1993.72	1995.3	2047.96	2049.67	0	0	29804.5	31609.1	0	0
River-Swat	12500	734.63	1478.08	1992.77	2047.96	2049.67		2049.67	2047.96	0	0	0.05	37181.0	1139.76	0	
River-Swat	14000	734.63	1478.08	1992.92	2047.96	2049.67		2049.67	2047.96	0	0	0.07	22754.5	683.71	0	
River-Swat	14500	734.63	1478.08	2042.64	2046.8	2048.15	2046.8	2048.15	2047.85	2049.53	0.00967	0.008772	161.8	283.52	1	1
River-Swat	15000	734.63	1478.08	1975.55	1984.42	1980.29	1983.09	1985.4	1985.33	2031.07	0.003648	0.455838	173.72	46.82	0.66	6.61
River-Swat	16500	734.63	1478.08	1960.14	1985.05	1987.14		1964.43	1985.05	1987.14	0	0.000001	6852.32	7642.07	0.01	0.01
River-Swat	17000	734.63	1478.08	1939.58	1985.05	1987.13		1987.14	1985.05	0	0	0.23	7815.43	355.03	0.01	
River-Swat	17500	734.63	1478.08	1978.6	1983.65	1985.28	1983.65	1985.28	1984.93	1986.97	0.009256	0.008431	146.67	256.6	1.01	1.01
River-Swat	19000	734.63	1478.08	1933.84	1961.92	1964.53	1940.72	1942.96	1961.93	1964.55	0.000004	0.000011	2089.18	2494.82	0.03	0.05
River-Swat	19500	734.63	1478.08	1953.85	1960.18	1962.21	1960.18	1962.21	1961.77	1964.32	0.008734	0.008021	131.75	229.8	1	1
River-Swat	20000	734.63	1478.08	1945.49	1949.69	1950.95	1950.95	1952.71	1953.64	1956.54	0.036701	0.036485	83.39	141.18	1.94	2.02
River-Swat	21500	734.63	1478.08	1888.36	1893.91	1895.61	1895.56	1897.89	1899.11	1902.84	0.035854	0.034918	72.73	124.1	1.94	2
River-Swat	23000	734.63	1478.08	1826.22	1868.21	1869.61	1832.15	1834.19	1868.21	1869.62	0	0.000001	5504.98	5869.42	0.01	0.02
River-Swat	24500	734.63	1478.08	1863.86	1867.26	1868.35	1867.26	1868.35	1868.12	1869.5	0.010259	0.009194	178.73	311.58	1.01	1
River-Swat	26000	734.63	1478.08	1831.62	1840.68	1842.22	1835.97	1837.33	1840.75	1842.37	0.000156	0.000272	684.95	935.03	0.15	0.21
River-Swat	26500	734.63	1478.08	1836.46	1839.58	1840.61	1839.58	1840.61	1840.42	1841.86	0.010355	0.008596	180.39	300.18	1	0.98
River-Swat	27500	734.63	1478.08	1771.86	1774.58	1775.56	1777.68	1779.57	1805.57	1812.1	0.523828	0.409424	29.78	55.19	6.76	6.29
River-Swat	28500	734.63	1478.08	1720.04	1750.22	1752.28	1726.72	1729.49	1750.24	1752.32	0.000008	0.000023	1444.06	1631.74	0.04	0.06
River-Swat	29500	734.63	1478.08	1714.25	1750.23	1752.29		1752.3	1750.23	0.000004	0.000001	0.43	3144.33	174.75	0.02	
River-Swat	30500	734.63	1478.08	1743.84	1748.83	1750.44	1748.83	1750.44	1750.1	1752.12	0.00933	0.008549	147.42	257.34	1.01	1.01
River-Swat	31000	734.63	1478.08	1665.05	1702.55	1705.26	1673.25	1675.89	1702.55	1705.28	0.000002	0.000007	2370.86	2725.5	0.02	0.04
River-Swat	31500	734.63	1478.08	1687.5	1702.5	1705.16		1705.26	1702.54	0.000122	0.000076	1.42	767.58	124.47	0.11	
River-Swat	33000	734.63	1478.08	1696.38	1700.54	1702.39	1700.54	1702.39	1702.02	1704.49	0.008824	0.00799	136.21	230.3	1	1.01
River-Swat	33500	734.63	1478.08	1693.22	1698.31	1699.42	1697.31	1698.63	1698.74	1700.22	0.003051	0.004311	251.6	373.35	0.58	0.72
River-Swat	34000	734.63	1478.08	1692.49	1695.56	1696.4	1695.56	1696.4	1696.19	1697.19	0.010283	0.009435	213.55	378.2	0.98	0.97
River-Swat	35000	734.63	1478.08	1628.96	1641.17	1633.28	1635.43	1637.51	1641.29	1666.6	0.0003	0.309225	461.48	57.79	0.21	5.56
River-Swat	36000	734.63	1478.08	1634.02	1639.08	1640.66	1639.08	1640.66	1640.32	1642.29	0.009362	0.008574	149.15	261.28	1.01	1.01
River-Swat	37000	734.63	1478.08	1604.67	1613.98	1616.03	1610.37	1612.21	1614.19	1616.41	0.000632	0.000814	367.78	547.26	0.29	0.35
River-Swat	38000	734.63	1478.08	1606.65	1611.32	1612.77	1611.32	1612.77	1612.5	1614.4	0.009318	0.008341	152.63	262.19	1.01	1
River-Swat	38500	734.63	1478.08	1586.13	1591.02	1592.83	1593.57	1595.97	1601.12	1604.42	0.083981	0.063314	52.18	98	2.87	2.63
River-Swat	39000	734.63	1478.08	1558.74	1595.29	1596.96	1566.98	1569.7	1595.3	1596.97	0.000003	0.00001	2285.45	2494.69	0.02	0.04
River-Swat	39500	734.63	1478.08	1567.74	1595.29	1596.96		1596.97	1595.29	0.000006	0.000002	0.43	3119.78	240.18	0.02	
River-Swat	40000	734.63	1478.08	1590.13	1594.17	1595.47	1594.17	1595.47	1595.19	1596.82	0.009799	0.008959	164.19	286.81	1	1.01
River-Swat	40500	734.63	1478.08	1574.01	1577.95	1579.36	1579.83	1581.53	1584.46	1587.01	0.066785	0.056796	65.01	120.7	2.57	2.47
River-Swat	41000	734.63	1478.08	1530.75	1534.02	1534.96	1535.95	1537.63	1542.36	1547.34	0.108304	0.115119	57.41	94.79	3.19	3.43
River-Swat	41500	734.63	1478.08	1524.89	1529.95	1531.92	1529.34	1530.78	1530.62	1532.65	0.004782	0.003335	202.21	391.03	0.73	0.64
River-Swat	42000	734.63	1478.08	1520.35	1525.93	1527.91	1525.93	1527.91	1527.52	1530.16	0.007801	0.007036	134.71	228.35	0.96	0.97
River-Swat	42500	734.63	1478.08	1507.75	1521.86	1524.59	1512.34	1513.86	1521.87	1524.63	0.000021	0.000037	1344.72	1776.98	0.06	0.08
River-Swat	43000	734.63	1478.08	1513.38	1519.99	1522.12	1519.99	1522.12	1521.67	1524.35	0.008813	0.008082	128.04	223.44	1.01	1.01
River-Swat	44500	734.63	1478.08	1499.62	1505.62	1506.05	1504.98	1506.73	1506.49	1508.72	0.00506	0.014138	177.69	204.19	0.76	1.29
River-Swat	45000	734.63	1478.08	1498.03	1501.76	1503.44	1501.76	1503.44	1503.11	1505.36	0.009146	0.008136	142.89	240.56	1.01	1
River-Swat	45500	734.63	1478.08	1484.25	1489.15	1490.79	1490.79	1492.86	1494.36	1497.45	0.04061	0.035396	72.68	129.27	2.06	2.02
River-Swat	46000	734.63	1478.08	1482.09	1487.35	1489.04	1487.35	1489.04	1488.68	1490.8	0.009071	0.008265	143.69	251.38	1.01	1.01
River-Swat	46497.13	734.63	1478.08	1455.56	1475.69	1477.03	1461.4	1463.39	1475.7	1477.08	0.000012	0.000035	1441.07	1635.81	0.05	0.08
River-Swat	47500	734.63	1478.08	1467.18	1475.67	1477		1477.03	1475.68	0.000056	0.000028	0.69	1676.76	374.93	0.06	
River-Swat	48000	734.63	1478.08	1461.79	1475.66	1476.98		1477.01	1475.67	0.000035	0.000014	0.76	1677.43	217.7	0.05	
River-Swat	49000	734.63	1478.08	1471.71	1474.77	1475.76	1474.77	1475.76	1475.54	1476.78	0.010556	0.00958	188.66	330.49	1	1
River-Swat	49500	734.63	1478.08	1449.51	1452.69	1453.86	1454.71	1456.39	1462.04	1464.75	0.123811	0.095288	54.24	101.08	3.43	3.17
River-Swat	50500	734.63	1478.08	1409.99	1423.6	1425.68	1417.02	1419.29	1423.73	1425.99	0.000232	0.000439	465.01	617.93	0.19	0.26
River-Swat	52000	734.63	1478.08	1417.89	1421.64	1422.85	1421.64	1422.85	1422.6	1424.12	0.010053	0.009146	169.52	296.72	1.01	1.01
River-Swat	52500	734.63	1478.08	1403.58	1408.29	1409.98	1409.85	1411.87	1413.27	1415.9	0.040767	0.032148	74.28	137.17	2.06	1.92
River-Swat	53500	734.63	1478.08	1397.57	1404.41	1406.61	1404.41	1406.61	1406.14	1408.91	0.009017	0.008215	125.82	220.12	1.01	1.01
River-Swat	56000	734.63	1478.08	1365.17	1367.96	1368.64	1368.52	1369.61	1369.74	1371.65	0.027381	0.03474	124.5	192.37	1.59	1.86
River-Swat	56500	734.63	1478.08	1361.46	1363.56	1364.22	1363.56	1364.22	1364.08	1364.93	0.011882	0.010662	228.65	396.76	1	1
River-Swat	58000	734.63	1478.08	1343.19	1346.06	1346.84	1346.09	1347.06	1346.88	1348.26	0.011036	0.011487	183.17	283.46	1.03	1.12
River-Swat	59000	734.63	1478.08	1331.18	1334.69	1335.92	1333.39	1334.26	1334.84	1336.15	0.001352	0.001344	424.74	705.02	0.38	0.4
River-Swat	60000	734.63	1478.08	1327.61	1331.01	1332.09	1331.01	1332.09	1331.87	1333.24	0.010189	0.009178	179.11	310.48	1	1
River-Swat	61500	734.63	1478.08	1306.02	1309.15	1310.15	1308.49	1309.25	1309.41	1310.55	0.00282	0.002645	330.21	534.92	0.53	0.55
River-Swat	62000	734.63	1478.08	1302.86	1306.08	1307.13	1306.08	1307.13	1306.91	1308.21	0.010508	0.009493	182.68	320.02	1.01	1.01
River-Swat	62500	734.63	1478.08	1283.94	1298.01	1299.89	1285.71	1286.65	1298.02	1299.9	0.000004	0.00001	2621.03	3154	0.03	0.05
River-Swat	63000	734.63	1478.08	1290.29	1297.98	1299.82		1299.88	1298.01	0.000129	0.000099	1.11	938.87	257.93	0.12	

Reach	River Sta	Q Total (m3/s)		Min Ch. El (m)	W.S. Elev (m)		Crit W.S. (m)		E.G. Elev (m)		E.G. Slope (m/m)		Flow Area (m2)		Froude #	
		2 Year	**5 Year**		**2 Year**	**5 Year**	**2 Year**	**5 Year**	**2 Year**	**5 Year**	**2 Year**	**5 Year**	**2 Year**	**5 Year**	**2 Year**	**5 Year**
River-Swat	63500	734.63	1478.08	1293.77	1296.67	1298	1296.67	1298	1297.74	1299.53	0.009081	0.008184	161.78	272.48	0.99	1
River-Swat	64500	734.63	1478.08	1273.29	1283.18	1284.3	1276.23	1277.18	1283.18	1284.32	0.000014	0.000033	2058.41	2487.2	0.05	0.07
River-Swat	65000	734.63	1478.08	1279.77	1282.42	1283.25	1282.42	1283.25	1283.09	1284.17	0.011087	0.009828	202.63	349.55	1	1
River-Swat	66500	734.63	1478.08	1252.41	1255.08	1255.81	1255.7	1256.76	1256.98	1258.75	0.031153	0.035076	120.29	194.37	1.69	1.86
River-Swat	68000	734.63	1478.08	1243.82	1246.11	1246.88	1246.11	1246.88	1246.72	1247.75	0.011246	0.010121	210.92	358.64	1	1
River-Swat	68500	734.63	1478.08	1237.17	1240.4	1241.35	1240.41	1241.48	1241.23	1242.55	0.010644	0.010565	181.49	306.56	1.02	1.06
River-Swat	69000	734.63	1478.08	1217.12	1224.47	1220.91	1221.6	1223.06	1224.62	1229.92	0.000659	0.093595	417.97	111.1	0.29	3.09
River-Swat	70000	734.63	1478.08	1208.7	1224.55	1225.7		1213.97	1224.56	1225.71	0.000006	0.000019	2421.87	2776.34	0.03	0.06
River-Swat	71000	734.63	1478.08	1199.87	1224.55	1225.7		1225.7	1224.56	0.000002	0.000001	0.24	6323.88	573.33	0.01	
River-Swat	71500	734.63	1478.08	1221	1223.78	1224.68	1223.78	1224.68	1224.48	1225.61	0.010976	0.009866	197.22	346.77	1.01	1
River-Swat	72000	734.63	1478.08	1214.13	1216.66	1217.38	1216.9	1217.81	1217.67	1218.9	0.017402	0.018871	165.09	270.42	1.25	1.36
River-Swat	72500	734.63	1478.08	1202.27	1203.75	1204.24	1204.15	1204.8	1205	1205.96	0.040098	0.037568	148.95	256.87	1.76	1.79

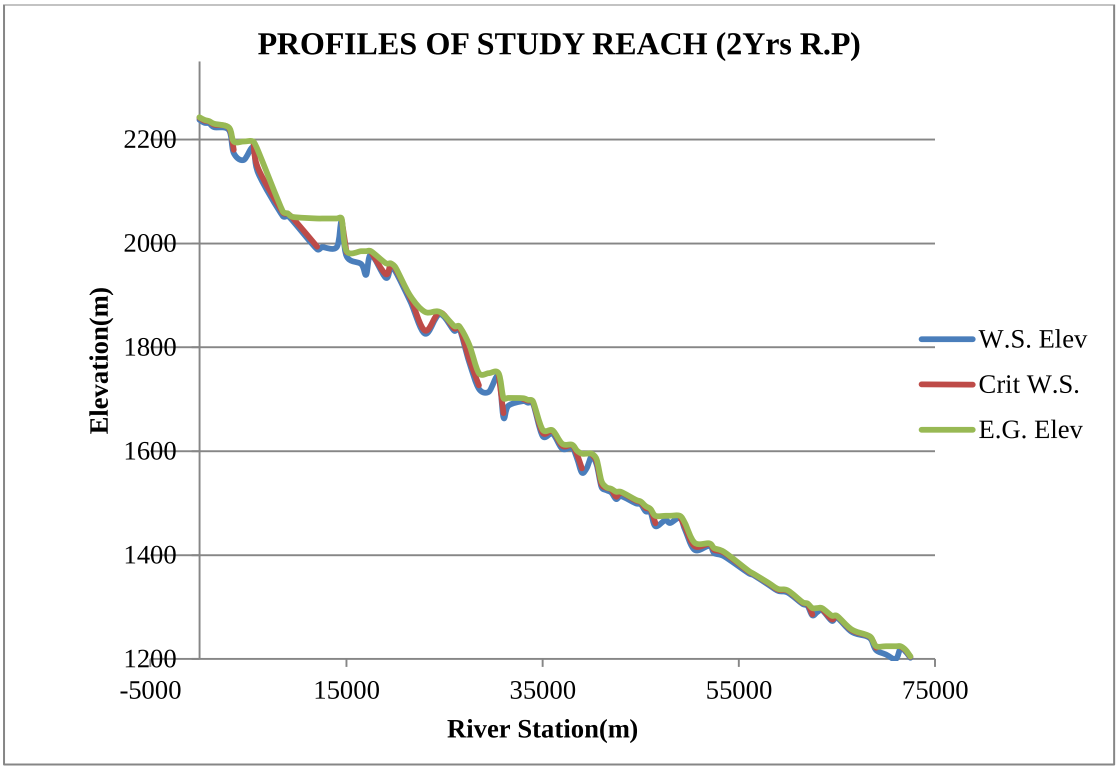
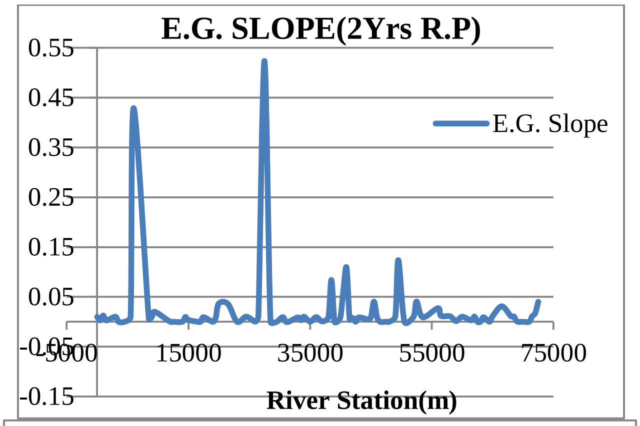


Figure 1: Water Surface profile w.r.t Channel Elevation for Study Reach at 2 Year Return Period



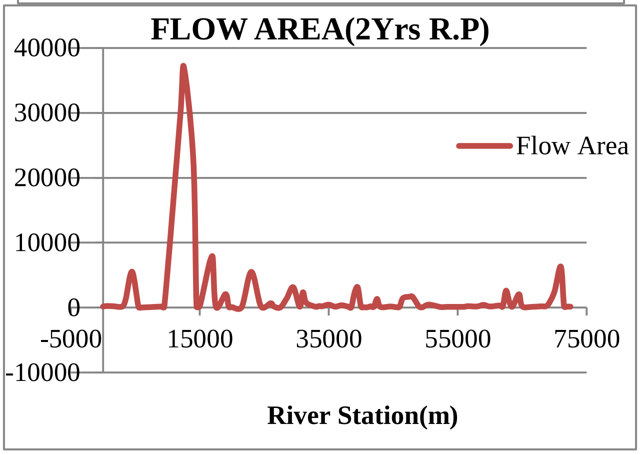


Figure 2: Energy Grade Slope & Flow Area of Study Reach at 2 Year Return Period

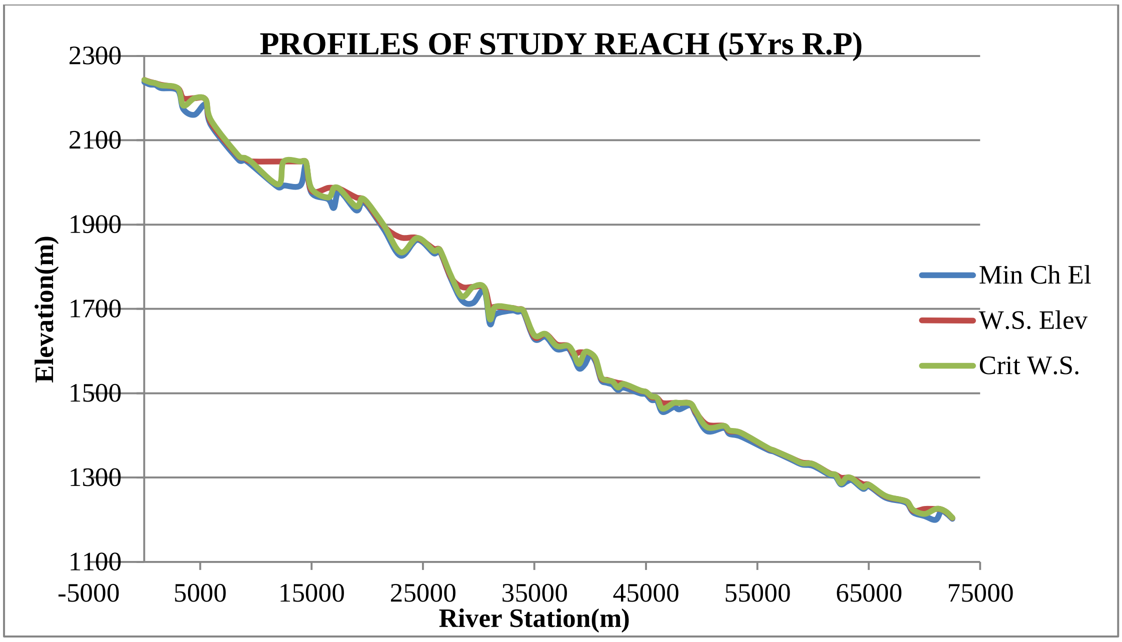


Figure 3: Water Surface profile w.r.t Channel Elevation for Study Reach at 5 Year Return Period

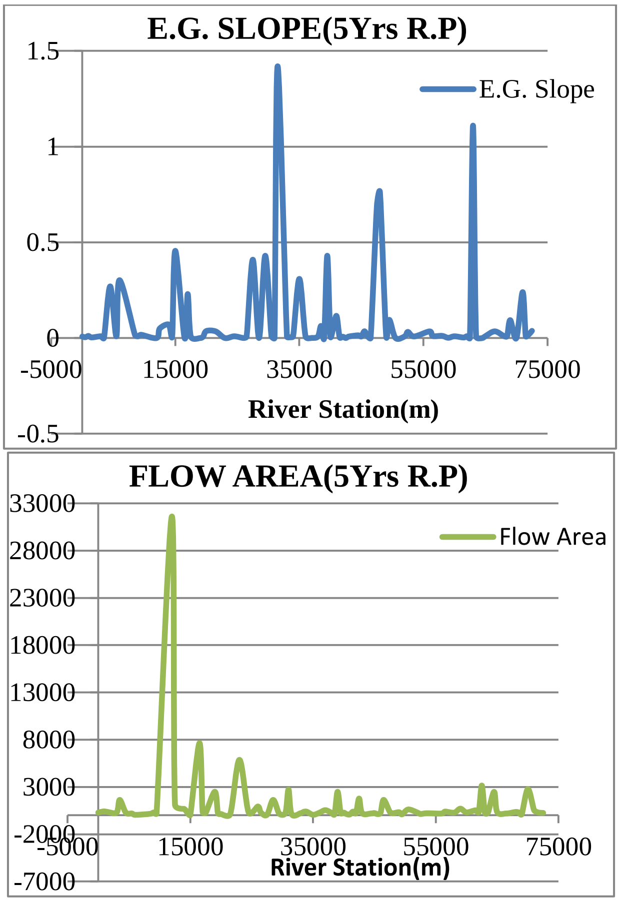


Figure 4: Energy Grade Slope & Flow Area of Study Reach at 5 Year Return Period

WATER SURFACE PROFILES RECORDS FOR 10 &20 Years RETURN PERIOD

Reach	River Sta	Q Total (m3/s)		Min Ch El (m)	W.S. Elev (m)		Crit W.S. (m)		E.G. Elev (m)		E.G. Slope (m/m)		Flow Area (m2)		Froude #	
		10 Year	20 Year		10 Year	20 Year	10 Year	20 Year	10 Year	20 Year	10 Year	20 Year	10 Year	20 Year	10 Year	20 Year
River-Swat	0	1970.31	2442.46	2238.04	2243.85	2244.4	2243.85	2244.4	2245.38	2246.06	0.007137	0.006771	371.56	444.83	0.95	0.94
River-Swat	500	1970.31	2442.46	2232.3	2237.77	2238.21	2238.46	2239.02	2240.26	2241.02	0.015185	0.015643	283.79	330.81	1.33	1.37
River-Swat	1000	1970.31	2442.46	2231.15	2235.69	2236.03	2235.69	2235.93	2236.48	2236.85	0.010641	0.0085	498.9	608.47	1.01	0.93
River-Swat	1500	1970.31	2442.46	2223.73	2232.31	2232.95	2231.15	2231.82	2233.38	2234.18	0.003398	0.003585	439.13	506.28	0.68	0.71
River-Swat	3000	1970.31	2442.46	2218.52	2224.13	2224.64	2224.13	2224.64	2225.56	2226.19	0.008854	0.008603	372.83	442.76	1.01	1.01
River-Swat	3500	1970.31	2442.46	2173.9	2201.6	2203.09	2183.6	2184.55	2201.66	2203.17	0.000039	0.000046	1852.4	2044.1	0.09	0.09
River-Swat	4500	1970.31	2442.46	2160.49	2201.63	2203.14	2201.64	2203.14	0.000001	0.000002	0.33	0.39	290.88	297.13		
River-Swat	5500	1970.31	2442.46	2184.89	2198.01	2199.19	2198.01	2199.19	2201.3	2202.78	0.008511	0.008269	245.05	291.02	1	1
River-Swat	6000	1970.31	2442.46	2135	2141.93	2142.67	2148.14	2149.35	2185.03	2186.89	0.261237	0.234206	67.74	82.9	4.99	4.8
River-Swat	8500	1970.31	2442.46	2052.52	2061.72	2062.45	2063.21	2064.21	2066.7	2068.15	0.016797	0.017345	199.17	230.95	1.44	1.48
River-Swat	9000	1970.31	2442.46	2053.27	2058.93	2059.42	2058.93	2059.44	2060.37	2061	0.008653	0.008585	371.43	437.66	1.01	1.02
River-Swat	9500	1970.31	2442.46	2043.83	2051.05	2051.78	2052.02	2052.75	2054.47	2055.35	0.015665	0.014322	240.27	291.92	1.38	1.34
River-Swat	12000	1970.31	2442.46	1988.82	2050.53	2051.24	1996.15	1996.87	2050.53	2051.24	0	0	32533.	33306.	0	0
River-Swat	12500	1970.31	2442.46	1992.77	2050.53	2051.24	2050.53	2051.24	0	0	0.06	0.08	1144.3	1149.0		
River-Swat	14000	1970.31	2442.46	1992.92	2050.53	2051.24	2050.53	2051.24	0	0	0.09	0.11	691.45	697.84		
River-Swat	14500	1970.31	2442.46	2042.64	2048.81	2049.37	2048.81	2049.37	2050.37	2051.07	0.008522	0.00826	355.58	422.65	1.01	1.01
River-Swat	15000	1970.31	2442.46	1975.55	1980.98	1981.56	1986.56	1987.5	2032.44	2033.62	0.39248	0.350089	62	76.4	6.27	6.03
River-Swat	16500	1970.31	2442.46	1960.14	1988.17	1989.03	1964.96	1965.35	1988.18	1989.04	0.000001	0.000002	8043.1	8377.7	0.02	0.02
River-Swat	17000	1970.31	2442.46	1939.58	1988.17	1989.03	1988.18	1989.04	0.000001	0.000001	0.3	0.36	362.69	369.02		
River-Swat	17500	1970.31	2442.46	1978.6	1986.09	1986.77	1986.09	1986.77	1987.99	1988.83	0.008091	0.007822	323.28	384.66	1.01	1
River-Swat	19000	1970.31	2442.46	1933.84	1965.83	1966.9	1944.07	1944.97	1965.86	1966.94	0.000016	0.000021	2710.7	2895.2	0.06	0.07
River-Swat	19500	1970.31	2442.46	1953.85	1963.22	1964.07	1963.22	1964.07	1965.59	1966.65	0.007756	0.007494	288.71	343.56	1.01	1
River-Swat	20000	1970.31	2442.46	1945.49	1951.59	1952.12	1953.6	1954.32	1957.99	1959.16	0.036175	0.035544	175.72	207.82	2.05	2.06
River-Swat	21500	1970.31	2442.46	1888.36	1896.45	1897.13	1899.05	1900.01	1904.74	1906.35	0.034603	0.034577	154.48	181.53	2.02	2.05
River-Swat	23000	1970.31	2442.46	1826.22	1870.33	1870.91	1835.25	1836.1	1870.33	1870.92	0.000002	0.000003	6057.8	6216.2	0.02	0.03
River-Swat	24500	1970.31	2442.46	1863.86	1868.9	1869.36	1868.9	1869.36	1870.19	1870.77	0.008602	0.008305	393.87	467.87	0.99	0.99
River-Swat	26000	1970.31	2442.46	1831.62	1843.03	1843.7	1838.07	1838.68	1843.22	1843.94	0.000327	0.000373	1071.7	1187.7	0.23	0.25
River-Swat	26500	1970.31	2442.46	1836.46	1841.17	1841.68	1841.17	1841.68	1842.64	1843.3	0.00786	0.007276	373.71	443.47	0.97	0.95
River-Swat	27500	1970.31	2442.46	1771.86	1776.06	1776.48	1780.5	1781.27	1814.97	1817.25	0.367504	0.338829	71.29	86.35	6.09	5.94
River-Swat	28500	1970.31	2442.46	1720.04	1753.3	1754.13	1730.91	1732.09	1753.37	1754.24	0.000035	0.000047	1729.3	1811.7	0.08	0.09
River-Swat	29500	1970.31	2442.46	1714.25	1753.32	1754.17	1753.34	1754.2	0.000006	0.000009	0.55	0.66	177.9	180.5		
River-Swat	30500	1970.31	2442.46	1743.84	1751.26	1751.93	1751.26	1751.93	1753.13	1753.96	0.008155	0.007874	324.95	386.79	1.01	1
River-Swat	31000	1970.31	2442.46	1665.05	1706.66	1707.82	1677.21	1678.3	1706.68	1707.85	0.00001	0.000013	2916.6	3081.0	0.04	0.05
River-Swat	31500	1970.31	2442.46	1687.5	1706.53	1707.66	1706.66	1707.83	0.000144	0.000161	1.64	1.82	135.04	143.86		
River-Swat	33000	1970.31	2442.46	1696.38	1703.38	1704.19	1703.38	1704.19	1705.77	1706.84	0.007617	0.007428	287.6	338.7	1	1
River-Swat	33500	1970.31	2442.46	1693.22	1699.99	1699.16	1699.3	1699.84	1700.99	1701.74	0.004765	0.014733	446.1	343.21	0.77	1.32
River-Swat	34000	1970.31	2442.46	1692.49	1696.74	1697.05	1696.74	1697.05	1697.68	1698.1	0.010052	0.010102	460.55	539.36	1	1.01
River-Swat	35000	1970.31	2442.46	1628.96	1633.97	1634.53	1638.56	1639.4	1666.65	1667.55	0.248756	0.21858	77.79	95.93	5.11	4.87
River-Swat	36000	1970.31	2442.46	1634.02	1641.44	1642.09	1641.44	1642.09	1643.27	1644.08	0.00826	0.007996	329	391.49	1.01	1.01
River-Swat	37000	1970.31	2442.46	1604.67	1610.08	1610.59	1613.15	1613.88	1622.95	1624.37	0.085578	0.081215	123.95	148.5	3.09	3.05
River-Swat	38000	1970.31	2442.46	1606.65	1613.5	1614.13	1613.5	1614.13	1615.4	1616.25	0.007838	0.007418	323.47	380.63	1	0.99
River-Swat	38500	1970.31	2442.46	1586.13	1593.75	1594.52	1597.17	1598.17	1606.04	1607.37	0.056491	0.051946	126.88	153.83	2.54	2.47
River-Swat	39000	1970.31	2442.46	1558.74	1597.79	1598.47	1571.02	1572.16	1597.81	1598.51	0.000016	0.000022	2602.2	2692.4	0.05	0.06
River-Swat	39500	1970.31	2442.46	1567.74	1597.79	1598.48	1597.8	1598.5	0.000009	0.000012	0.55	0.65	247.02	252.67		
River-Swat	40000	1970.31	2442.46	1590.13	1596.12	1596.66	1596.12	1596.66	1597.64	1598.31	0.008624	0.008379	360.92	428.62	1.01	1.01
River-Swat	40500	1970.31	2442.46	1574.01	1580.02	1580.53	1582.32	1582.93	1588.13	1589.04	0.055067	0.053293	156.71	189.96	2.47	2.46
River-Swat	41000	1970.31	2442.46	1530.75	1535.46	1535.87	1538.45	1539.17	1549.47	1551.27	0.112042	0.110129	118.79	140.46	3.45	3.47
River-Swat	41500	1970.31	2442.46	1524.89	1533.04	1534.01	1531.5	1532.08	1533.75	1534.71	0.002709	0.002281	524.44	657.16	0.59	0.56
River-Swat	42000	1970.31	2442.46	1520.35	1528.95	1529.83	1528.95	1529.83	1531.53	1532.68	0.006772	0.006577	284.3	335.41	0.97	0.97
River-Swat	42500	1970.31	2442.46	1507.75	1525.95	1527.07	1514.63	1515.24	1526	1527.14	0.000046	0.000054	2003.3	2196.0	0.09	0.1
River-Swat	43000	1970.31	2442.46	1513.38	1523.21	1524.1	1523.21	1524.1	1525.68	1526.79	0.007675	0.007427	282.63	336.15	1	1
River-Swat	44500	1970.31	2442.46	1499.62	1506.69	1507.21	1507.58	1508.3	1509.93	1510.95	0.015106	0.015863	247.11	285.04	1.35	1.4
River-Swat	45000	1970.31	2442.46	1498.03	1504.33	1505.08	1504.33	1505.08	1506.54	1507.54	0.007802	0.007584	298.63	351.14	1	1.01
River-Swat	45500	1970.31	2442.46	1484.25	1491.62	1492.3	1493.95	1494.85	1498.95	1500.26	0.033205	0.030317	164.26	195.91	1.99	1.95
River-Swat	46000	1970.31	2442.46	1482.09	1489.9	1490.58	1489.9	1490.58	1491.86	1492.74	0.007873	0.007747	317.6	375.38	1	1.01
River-Swat	46497.13	1970.31	2442.46	1455.56	1477.72	1478.31	1464.4	1465.25	1477.8	1478.41	0.000053	0.00007	1740.4	1831.9	0.1	0.12
River-Swat	47500	1970.31	2442.46	1467.18	1477.69	1478.28	1477.73	1478.32	0.000068	0.000079	0.82	0.93	381.38	386.89		
River-Swat	48000	1970.31	2442.46	1461.79	1477.65	1478.22	1477.7	1478.28	0.000051	0.000065	0.95	1.11	225.43	232		
River-Swat	49000	1970.31	2442.46	1471.71	1476.23	1476.63	1476.23	1476.63	1477.41	1477.94	0.008972	0.008283	410.64	486.49	1	0.98
River-Swat	49500	1970.31	2442.46	1449.51	1454.44	1454.92	1457.22	1457.92	1466.1	1467.32	0.086135	0.081034	130.24	156.56	3.07	3.03
River-Swat	50500	1970.31	2442.46	1409.99	1426.69	1427.51	1420.38	1421.32	1427.12	1428.06	0.00056	0.000668	700.32	770.95	0.3	0.33
River-Swat	52000	1970.31	2442.46	1417.89	1423.46	1423.95	1423.46	1423.95	1424.87	1425.5	0.008806	0.008617	373.38	442.24	1.01	1.01
River-Swat	52500	1970.31	2442.46	1403.58	1410.85	1411.61	1412.85	1413.66	1417.16	1418.12	0.028943	0.026089	177	216.2	1.86	1.8
River-Swat	53500	1970.31	2442.46	1397.57	1407.71	1408.62	1407.71	1408.62	1410.29	1411.43	0.007941	0.007715	276.57	328.46	1.01	1.01
River-Swat	56000	1970.31	2442.46	1365.17	1368.97	1369.23	1370.15	1370.6	1372.7	1373.64	0.038237	0.041436	230.22	262.44	1.98	2.09
River-Swat	56500	1970.31	2442.46	1361.46	1364.53	1364.81	1364.53	1364.81	1365.37	1365.75	0.009847	0.009244	489.56	573.91	0.99	0.98
River-Swat	58000	1970.31	2442.46	1343.19	1347.24	1347.57	1347.59	1348.05	1349.03	1349.69	0.011963	0.012338	338.38	386.88	1.17	1.21
River-Swat	59000	1970.31	2442.46	1331.18	1336.51	1337	1334.71	1335.09	1336.78	1337.31	0.001327	0.001321	859.4	1000.0	0.41	0.41
River-Swat	60000	1970.31	2442.46	1327.61	1332.62	1333.09	1332.62	1333.09	1333.95	1334.54	0.008467	0.007884	389.42	465.93	0.99	0.97
River-Swat	61500	1970.31	2442.46	1306.02	1310.67	1309.06	1309.66	1310.02	1311.15	1312.2	0.002614	0.037151	652.63	312.08	0.56	1.92

Reach	River Sta	Q Total (m3/s)		Min Ch El (m)	W.S. Elev (m)		Crit W.S. (m)		E.G. Elev (m)		E.G. Slope (m/m)		Flow Area (m2)		Froude #	
		10 Year	**20 Year**		**10 Year**	**20 Year**	**10 Year**	**20 Year**	**10 Year**	**20 Year**	**10 Year**	**20 Year**	**10 Year**	**20 Year**	**10 Year**	**20 Year**
River-Swat	62000	1970.31	2442.46	1302.86	1307.66	1308.07	1307.66	1308.07	1308.87	1309.41	0.009006	0.008909	404.53	476.92	1	1.01
River-Swat	62500	1970.31	2442.46	1283.94	1300.86	1301.67	1287.15	1287.61	1300.87	1301.69	0.000015	0.000019	3444.9	3697.6	0.05	0.06
River-Swat	63000	1970.31	2442.46	1290.29	1300.77	1301.57	1300.85	1301.66	0.00014	0.000148	1.27	1.4	277.07	293.12		
River-Swat	63500	1970.31	2442.46	1293.77	1298.72	1299.32	1298.72	1299.32	1300.47	1301.25	0.007762	0.00751	340.17	401.17	1	1
River-Swat	64500	1970.31	2442.46	1273.29	1284.88	1285.37	1277.65	1278.05	1284.91	1285.41	0.000044	0.000055	2720.6	2920.7	0.09	0.1
River-Swat	65000	1970.31	2442.46	1279.77	1283.68	1284.04	1283.68	1284.04	1284.73	1285.2	0.008708	0.007952	439.77	526.57	0.97	0.95
River-Swat	66500	1970.31	2442.46	1252.41	1256.08	1256.3	1257.29	1257.71	1259.92	1260.98	0.041253	0.046463	226.91	254.94	2.05	2.19
River-Swat	68000	1970.31	2442.46	1243.82	1247.29	1247.63	1247.29	1247.63	1248.28	1248.72	0.009685	0.009378	447.73	528.91	1	1
River-Swat	68500	1970.31	2442.46	1237.17	1241.8	1242.16	1242.05	1242.46	1243.19	1243.7	0.010526	0.010564	384.99	457.71	1.08	1.1
River-Swat	69000	1970.31	2442.46	1217.12	1221.44	1221.89	1223.78	1224.36	1230.93	1231.69	0.082798	0.074884	144.32	176.05	2.97	2.87
River-Swat	70000	1970.31	2442.46	1208.7	1226.25	1226.7	1214.62	1215.17	1226.28	1226.73	0.000028	0.000039	2965.1	3123.9	0.07	0.09
River-Swat	71000	1970.31	2442.46	1199.87	1226.26	1226.71	1226.27	1226.72	0.000003	0.000003	0.31	0.37	590.08	603.54		
River-Swat	71500	1970.31	2442.46	1221	1225.15	1225.53	1225.15	1225.53	1226.16	1226.6	0.009085	0.008256	445.88	544.98	0.98	0.96
River-Swat	72000	1970.31	2442.46	1214.13	1217.71	1217.95	1218.24	1218.61	1219.56	1220.14	0.020241	0.021968	326.75	372.23	1.43	1.51
River-Swat	72500	1970.31	2442.46	1202.27	1204.5	1204.73	1205.1	1205.34	1206.4	1206.74	0.035545	0.033139	325.46	392.78	1.78	1.74

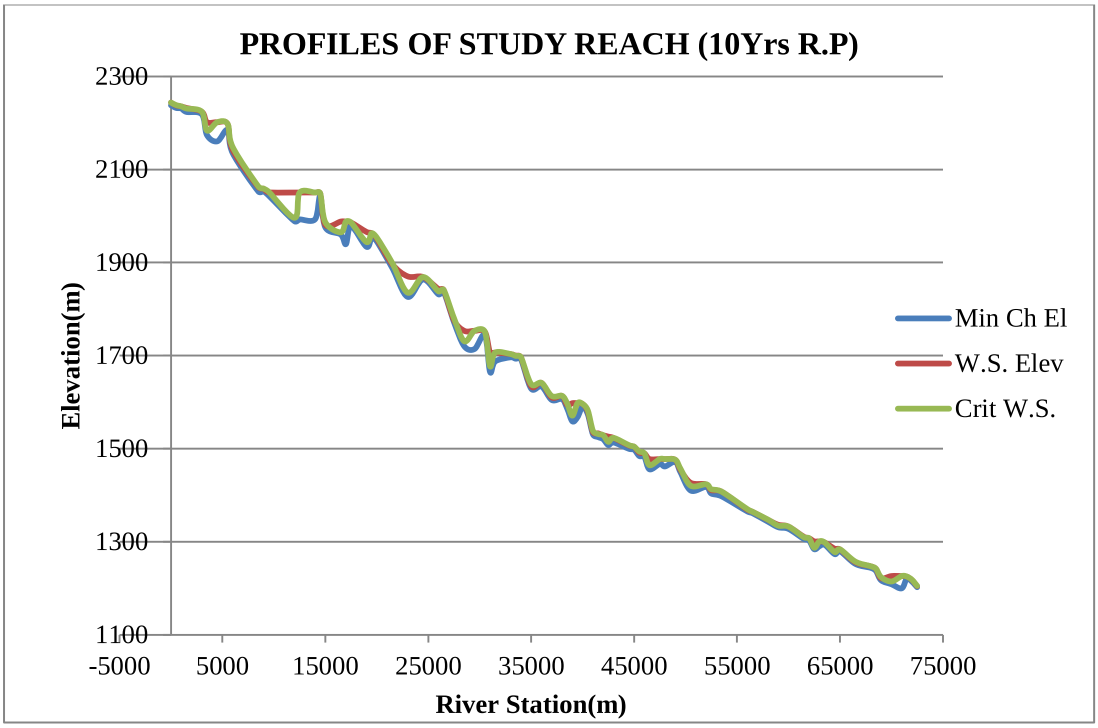


Figure 5: Water Surface profile w.r.t Channel Elevation for Study Reach at 10 Year Return Period

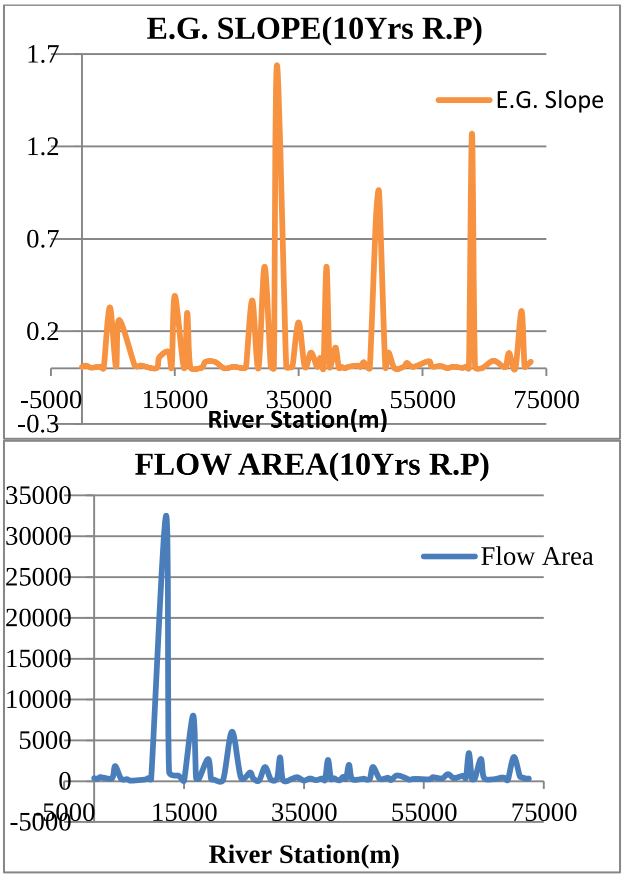


Figure 6: Energy Grade Slope & Flow Area of Study Reach at 10 Year Return Period

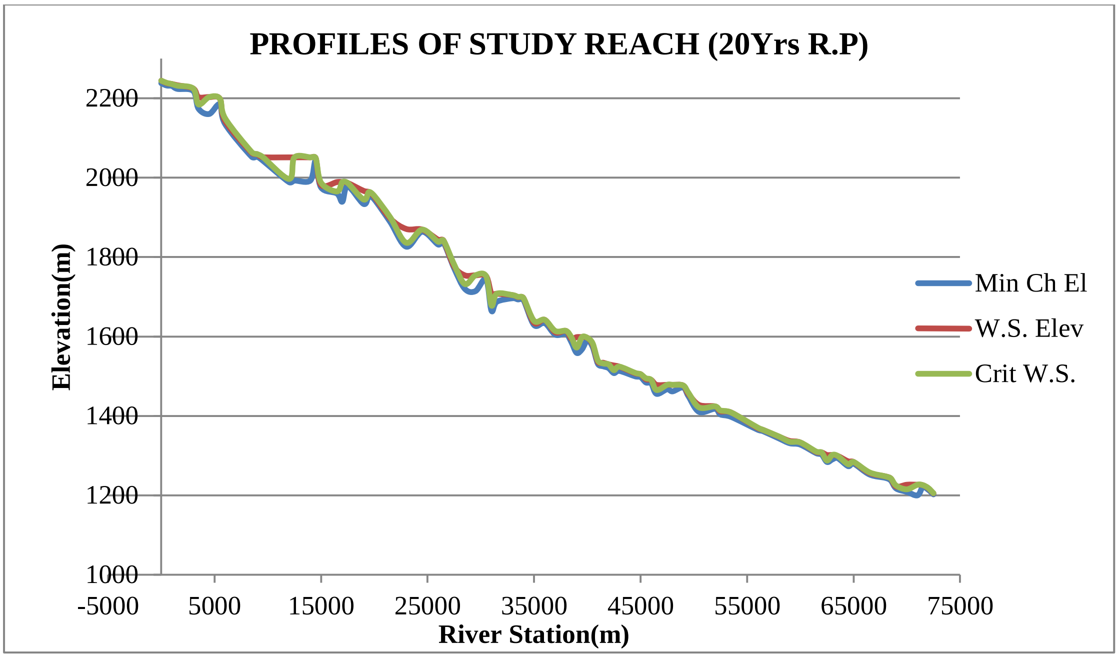


Figure 7: Water Surface profile w.r.t Channel Elevation for Study Reach at 20 Year Return Period

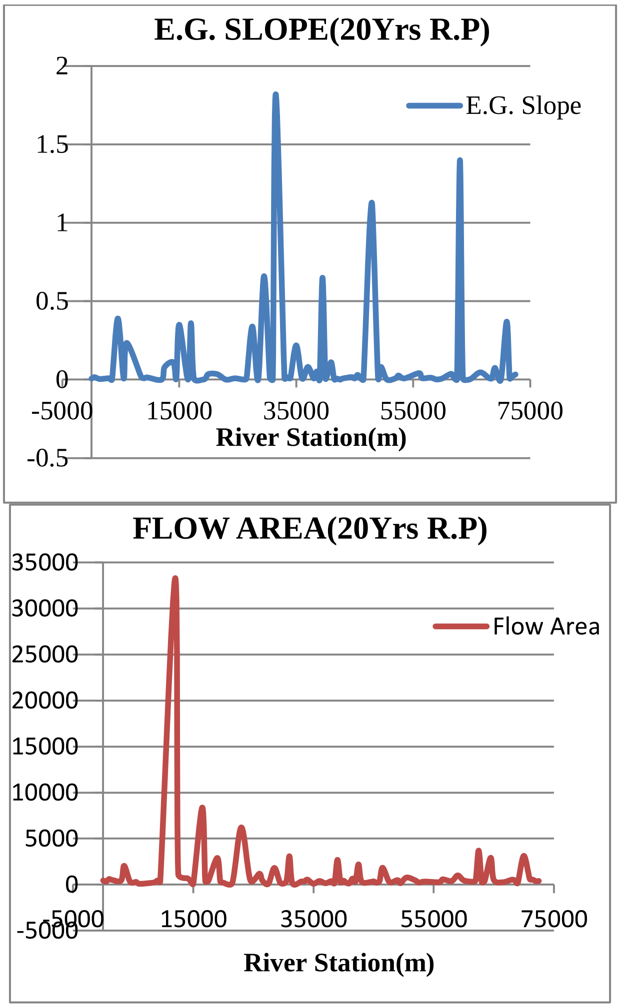


Figure 8: Energy Grade Slope & Flow Area of Study Reach at 20 Year Return Period

WATER SURFACE PROFILES RECORDS FOR 25 &50 Years RETURN PERIOD

Reach	River Sta	Q Total (m3/s)		Min Ch El (m)	W.S. Elev (m)		Crit W.S. (m)		E.G. Elev (m)		E.G. Slope (m/m)		Flow Area (m2)		Froude #	
		25 Year	50 Year		25 Year	50 Year	25 Year	50 Year	25 Year	50 Year	25 Year	50 Year	25 Year	50 Year	25 Year	50 Year
River-Swat	0	2592.24	3053.62	2238.04	2244.56	2245.02	2244.56	2245.02	2246.26	2246.83	0.00668	0.006458	467.55	535.85	0.94	0.93
River-Swat	500	2592.24	3053.62	2232.3	2238.33	2238.71	2239.17	2239.64	2241.25	2241.88	0.015741	0.015921	345.4	389.76	1.38	1.4
River-Swat	1000	2592.24	3053.62	2231.15	2236.18	2236.64	2235.99	2236.22	2236.97	2237.37	0.007412	0.005244	657.39	805.99	0.88	0.77
River-Swat	1500	2592.24	3053.62	2223.73	2233.13	2233.64	2232.01	2232.58	2234.41	2235.08	0.003641	0.003821	526.52	585.29	0.72	0.74
River-Swat	3000	2592.24	3053.62	2218.52	2224.79	2225.22	2224.79	2225.22	2226.37	2226.91	0.008534	0.008301	464.35	530.55	1.01	1
River-Swat	3500	2592.24	3053.62	2173.9	2203.53	2204.78	2184.85	2185.67	2203.61	2204.88	0.000048	0.000054	2102.09	2272.9	0.1	0.1
River-Swat	4500	2592.24	3053.62	2160.49	2203.58	2204.84	2203.58	2204.85	0.000002	0.000002	0.41	0.46	298.96	304.22		
River-Swat	5500	2592.24	3053.62	2184.89	2199.53	2200.51	2199.53	2200.51	2203.21	2204.45	0.008223	0.008053	304.94	347.51	1	1
River-Swat	6000	2592.24	3053.62	2135	2142.89	2143.52	2149.71	2150.66	2187.43	2188.94	0.227245	0.209041	87.67	102.27	4.75	4.62
River-Swat	8500	2592.24	3053.62	2052.52	2062.67	2063.28	2064.5	2065.34	2068.58	2069.83	0.017506	0.017967	240.59	269.23	1.5	1.53
River-Swat	9000	2592.24	3053.62	2053.27	2059.49	2059.72	2059.59	2060.02	2061.19	2061.77	0.009046	0.010419	448.75	481.22	1.05	1.13
River-Swat	9500	2592.24	3053.62	2043.83	2052.07	2052.87	2052.97	2053.58	2055.56	2056.21	0.013408	0.011307	312.89	377.14	1.3	1.22
River-Swat	12000	2592.24	3053.62	1988.82	2051.45	2052.06	1997.09	1997.67	2051.45	2052.06	0	0	33536.6	34212.	0	0.01
River-Swat	12500	2592.24	3053.62	1992.77	2051.45	2052.06	2051.45	2052.06	0	0	0.08	0.09	1150.52	1154.7		
River-Swat	14000	2592.24	3053.62	1992.92	2051.45	2052.06	2051.45	2052.06	0	0	0.12	0.13	699.73	705.22		
River-Swat	14500	2592.24	3053.62	2042.64	2049.51	2049.96	2049.51	2049.96	2051.27	2051.87	0.008317	0.007752	440.81	500.05	1.01	1
River-Swat	15000	2592.24	3053.62	1975.55	1981.73	1982.2	1987.78	1988.58	2033.81	2035.19	0.337738	0.312101	81.07	94.69	5.95	5.79
River-Swat	16500	2592.24	3053.62	1960.14	1989.28	1990.01	1965.47	1965.84	1989.29	1990.01	0.000002	0.000002	8476.37	8762.2	0.02	0.02
River-Swat	17000	2592.24	3053.62	1939.58	1989.28	1990.01	1989.29	1990.01	0.000001	0.000001	0.37	0.43	370.87	376.22		
River-Swat	17500	2592.24	3053.62	1978.6	1986.97	1987.52	1986.97	1987.52	1989.07	1989.78	0.007767	0.007682	403.28	457.88	1	1.01
River-Swat	19000	2592.24	3053.62	1933.84	1967.21	1968.13	1945.25	1946.02	1967.26	1968.18	0.000023	0.000027	2950.34	3114.0	0.07	0.08
River-Swat	19500	2592.24	3053.62	1953.85	1964.33	1964.99	1964.33	1964.99	1966.96	1967.85	0.007399	0.007213	360.86	408.05	1	1
River-Swat	20000	2592.24	3053.62	1945.49	1952.29	1952.71	1954.54	1955.15	1959.47	1960.52	0.035091	0.035182	218.35	246.66	2.06	2.08
River-Swat	21500	2592.24	3053.62	1888.36	1897.32	1897.91	1900.29	1901.1	1906.86	1908.16	0.03474	0.034308	189.48	215.26	2.06	2.07
River-Swat	23000	2592.24	3053.62	1826.22	1871.09	1871.58	1836.37	1837.11	1871.1	1871.59	0.000003	0.000004	6262.84	6398.0	0.03	0.03
River-Swat	24500	2592.24	3053.62	1863.86	1869.49	1869.88	1869.49	1869.88	1870.93	1871.42	0.008223	0.007978	490.89	561.1	0.99	0.99
River-Swat	26000	2592.24	3053.62	1831.62	1843.9	1844.47	1838.87	1839.39	1844.15	1844.76	0.000386	0.000425	1222.38	1322.8	0.25	0.27
River-Swat	26500	2592.24	3053.62	1836.46	1841.82	1842.25	1841.82	1842.25	1843.5	1844.07	0.007194	0.006861	463.69	527.64	0.95	0.95
River-Swat	27500	2592.24	3053.62	1771.86	1776.61	1776.98	1781.5	1782.15	1817.72	1819.26	0.329276	0.306505	91.26	106	5.88	5.75
River-Swat	28500	2592.24	3053.62	1720.04	1754.38	1755.09	1732.44	1733.43	1754.49	1755.23	0.000051	0.000064	1836.36	1907.6	0.1	0.11
River-Swat	29500	2592.24	3053.62	1714.25	1754.42	1755.14	1754.45	1755.17	0.00001	0.000012	0.69	0.78	181.27	183.46		
River-Swat	30500	2592.24	3053.62	1743.84	1752.11	1752.67	1752.11	1752.67	1754.21	1754.91	0.007874	0.007732	404.45	460.44	1.01	1.01
River-Swat	31000	2592.24	3053.62	1665.05	1708.16	1709.14	1678.62	1679.54	1708.2	1709.19	0.000014	0.000017	3130.13	3273.9	0.05	0.06
River-Swat	31500	2592.24	3053.62	1687.5	1708	1708.96	1708.17	1709.16	0.000166	0.000179	1.87	2.02	146.44	153.91		
River-Swat	33000	2592.24	3053.62	1696.38	1704.44	1705.15	1704.44	1705.15	1707.16	1708.08	0.007363	0.007211	354.68	402.35	1	1.01
River-Swat	33500	2592.24	3053.62	1693.22	1699.24	1699.5	1700	1700.45	1702	1702.74	0.015477	0.0172	352.32	382.91	1.35	1.44
River-Swat	34000	2592.24	3053.62	1692.49	1697.17	1697.44	1697.17	1697.44	1698.22	1698.58	0.009703	0.009075	571.97	649.85	0.99	0.98
River-Swat	35000	2592.24	3053.62	1628.96	1634.66	1635.08	1639.66	1640.4	1668.52	1670.39	0.217184	0.205906	100.55	115.99	4.88	4.8
River-Swat	36000	2592.24	3053.62	1634.02	1642.29	1642.83	1642.29	1642.83	1644.31	1645	0.007885	0.007763	411.57	468.27	1	1.01
River-Swat	37000	2592.24	3053.62	1604.67	1610.73	1611.18	1614.08	1614.71	1624.82	1625.89	0.080371	0.076333	155.89	179.71	3.05	3.01
River-Swat	38000	2592.24	3053.62	1606.65	1614.33	1614.86	1614.33	1614.86	1616.51	1617.25	0.007272	0.007101	398.98	449.79	0.99	0.99
River-Swat	38500	2592.24	3053.62	1586.13	1594.75	1595.42	1598.46	1599.28	1607.77	1608.78	0.050836	0.047172	162.16	188.57	2.46	2.4
River-Swat	39000	2592.24	3053.62	1558.74	1598.67	1599.24	1572.48	1573.41	1598.72	1599.31	0.000024	0.000031	2719.02	2796.5	0.07	0.08
River-Swat	39500	2592.24	3053.62	1567.74	1598.68	1599.26	1598.7	1599.29	0.000013	0.000016	0.68	0.77	254.31	259.07		
River-Swat	40000	2592.24	3053.62	1590.13	1596.82	1597.26	1596.82	1597.26	1598.51	1599.08	0.008278	0.008066	450.23	511.73	1	1
River-Swat	40500	2592.24	3053.62	1574.01	1580.67	1581.09	1583.11	1583.65	1589.32	1590.08	0.052887	0.051421	200.09	231.18	2.46	2.45
River-Swat	41000	2592.24	3053.62	1530.75	1535.99	1536.34	1539.37	1539.95	1551.79	1553.3	0.109444	0.107857	147.22	167.37	3.47	3.48
River-Swat	41500	2592.24	3053.62	1524.89	1534.3	1535.14	1532.26	1532.75	1535	1535.83	0.002169	0.001855	700.23	829.65	0.54	0.51
River-Swat	42000	2592.24	3053.62	1520.35	1530.09	1530.87	1530.09	1530.87	1533.03	1534.01	0.006534	0.006366	351.02	399.12	0.97	0.97
River-Swat	42500	2592.24	3053.62	1507.75	1527.4	1528.35	1515.43	1515.99	1527.47	1528.43	0.000057	0.000064	2253.39	2421.0	0.1	0.11
River-Swat	43000	2592.24	3053.62	1513.38	1524.36	1525.08	1524.36	1525.08	1527.11	1528.04	0.007363	0.007253	352.63	400.98	1	1
River-Swat	44500	2592.24	3053.62	1499.62	1507.36	1507.81	1508.5	1509.12	1511.26	1512.13	0.016073	0.016548	296.58	331.71	1.42	1.45
River-Swat	45000	2592.24	3053.62	1498.03	1505.3	1505.95	1505.32	1505.96	1507.84	1508.69	0.007528	0.007363	367.29	416.09	1.01	1.01
River-Swat	45500	2592.24	3053.62	1484.25	1492.5	1493.1	1495.09	1495.88	1500.66	1501.72	0.029664	0.027579	205.69	236.84	1.94	1.9
River-Swat	46000	2592.24	3053.62	1482.09	1490.8	1491.4	1490.8	1491.4	1493	1493.74	0.007641	0.007422	394.54	451.01	1.01	1
River-Swat	46497.1	2592.24	3053.62	1455.56	1478.48	1478.98	1465.5	1466.21	1478.6	1479.13	0.000076	0.000094	1859.2	1939.5	0.12	0.14
River-Swat	47500	2592.24	3053.62	1467.18	1478.45	1478.95	1478.5	1479.01	0.000082	0.00009	0.96	1.06	388.5	393.21		
River-Swat	48000	2592.24	3053.62	1461.79	1478.39	1478.88	1478.46	1478.96	0.00007	0.000084	1.16	1.3	233.92	239.51		
River-Swat	49000	2592.24	3053.62	1471.71	1476.75	1477.09	1476.75	1477.09	1478.09	1478.55	0.008083	0.007697	510.78	579.48	0.97	0.97
River-Swat	49500	2592.24	3053.62	1449.51	1455.06	1455.48	1458.12	1458.71	1467.67	1468.56	0.079665	0.074986	164.75	190.57	3.02	2.96
River-Swat	50500	2592.24	3053.62	1409.99	1427.74	1428.43	1421.59	1422.42	1428.33	1429.13	0.000702	0.000799	791.6	853.55	0.34	0.36
River-Swat	52000	2592.24	3053.62	1417.89	1424.09	1424.46	1424.09	1424.46	1425.69	1426.23	0.008446	0.008183	462.5	518.52	1.01	1.01
River-Swat	52500	2592.24	3053.62	1403.58	1411.83	1412.46	1413.9	1414.62	1418.42	1419.27	0.025513	0.023894	227.97	264.19	1.79	1.75
River-Swat	53500	2592.24	3053.62	1397.57	1408.88	1409.65	1408.88	1409.65	1411.77	1412.73	0.007655	0.007492	344.47	392.64	1.01	1.01
River-Swat	56000	2592.24	3053.62	1365.17	1369.3	1369.52	1370.74	1371.12	1373.92	1374.76	0.042354	0.04492	272.18	301.04	2.12	2.2
River-Swat	56500	2592.24	3053.62	1361.46	1364.88	1365.12	1364.88	1365.12	1365.86	1366.2	0.009204	0.008843	597.42	675.27	0.99	0.98
River-Swat	58000	2592.24	3053.62	1343.19	1347.68	1347.98	1348.19	1348.58	1349.89	1350.46	0.012262	0.012377	403.63	449.82	1.21	1.24
River-Swat	59000	2592.24	3053.62	1331.18	1337.14	1337.57	1335.19	1335.51	1337.46	1337.92	0.001322	0.00131	1042.56	1176.1	0.41	0.42
River-Swat	60000	2592.24	3053.62	1327.61	1333.24	1333.63	1333.24	1333.63	1334.71	1335.2	0.007665	0.00741	491.51	561.19	0.97	0.96

Reach	River Sta	Q Total (m3/s)		Min Ch El (m)	W.S. Elev (m)		Crit W.S. (m)		E.G. Elev (m)		E.G. Slope (m/m)		Flow Area (m2)		Froude #	
		25 Year	50 Year		25 Year	50 Year	25 Year	50 Year	25 Year	50 Year	25 Year	50 Year	25 Year	50 Year	25 Year	50 Year
River-Swat	61500	2592.24	3053.62	1306.02	1309.1	1309.26	1310.13	1310.45	1312.48	1313.17	0.038844	0.040567	319.63	350.38	1.97	2.04
River-Swat	62000	2592.24	3053.62	1302.86	1308.2	1308.57	1308.2	1308.57	1309.57	1310.02	0.00881	0.00859	500.71	571.36	1.01	1.01
River-Swat	62500	2592.24	3053.62	1283.94	1301.9	1302.6	1287.73	1288.13	1301.93	1302.63	0.00002	0.000024	3773.68	3997.3	0.06	0.07
River-Swat	63000	2592.24	3053.62	1290.29	1301.8	1302.48	1301.9	1302.59	0.00015	0.000157	1.44	1.55	297.86	311.46		
River-Swat	63500	2592.24	3053.62	1293.77	1299.5	1300.01	1299.5	1300.01	1301.48	1302.15	0.007461	0.007298	419.63	475.8	1	1
River-Swat	64500	2592.24	3053.62	1273.29	1285.51	1285.92	1278.17	1278.49	1285.55	1285.97	0.000059	0.000069	2980.43	3153.8	0.1	0.11
River-Swat	65000	2592.24	3053.62	1279.77	1284.15	1284.47	1284.15	1284.47	1285.34	1285.74	0.007779	0.007279	553.46	637.31	0.95	0.93
River-Swat	66500	2592.24	3053.62	1252.41	1256.37	1256.57	1257.82	1258.18	1261.28	1262.18	0.047714	0.051105	263.94	290.86	2.23	2.33
River-Swat	68000	2592.24	3053.62	1243.82	1247.74	1248.03	1247.74	1248.03	1248.85	1249.23	0.009297	0.009077	553.93	629.32	1	1
River-Swat	68500	2592.24	3053.62	1237.17	1242.26	1242.55	1242.59	1242.9	1243.85	1244.26	0.010595	0.010664	479.51	544.62	1.1	1.12
River-Swat	69000	2592.24	3053.62	1217.12	1222.02	1222.41	1224.54	1225.05	1231.9	1232.5	0.072686	0.067001	186.16	217.02	2.84	2.76
River-Swat	70000	2592.24	3053.62	1208.7	1226.83	1227.18	1215.33	1215.81	1226.86	1227.23	0.000042	0.000053	3170.24	3301.7	0.09	0.1
River-Swat	71000	2592.24	3053.62	1199.87	1226.84	1227.19	1226.85	1227.2	0.000004	0.000005	0.39	0.45	607.36	618.01		
River-Swat	71500	2592.24	3053.62	1221	1225.65	1226	1225.65	1226	1226.73	1227.09	0.008012	0.007163	578.1	690.26	0.95	0.91
River-Swat	72000	2592.24	3053.62	1214.13	1218.02	1218.18	1218.72	1219.04	1220.33	1220.9	0.022432	0.024286	384.82	418.52	1.53	1.61
River-Swat	72500	2592.24	3053.62	1202.27	1204.8	1204.99	1205.42	1205.64	1206.84	1207.13	0.032614	0.030664	413.26	476.14	1.74	1.71

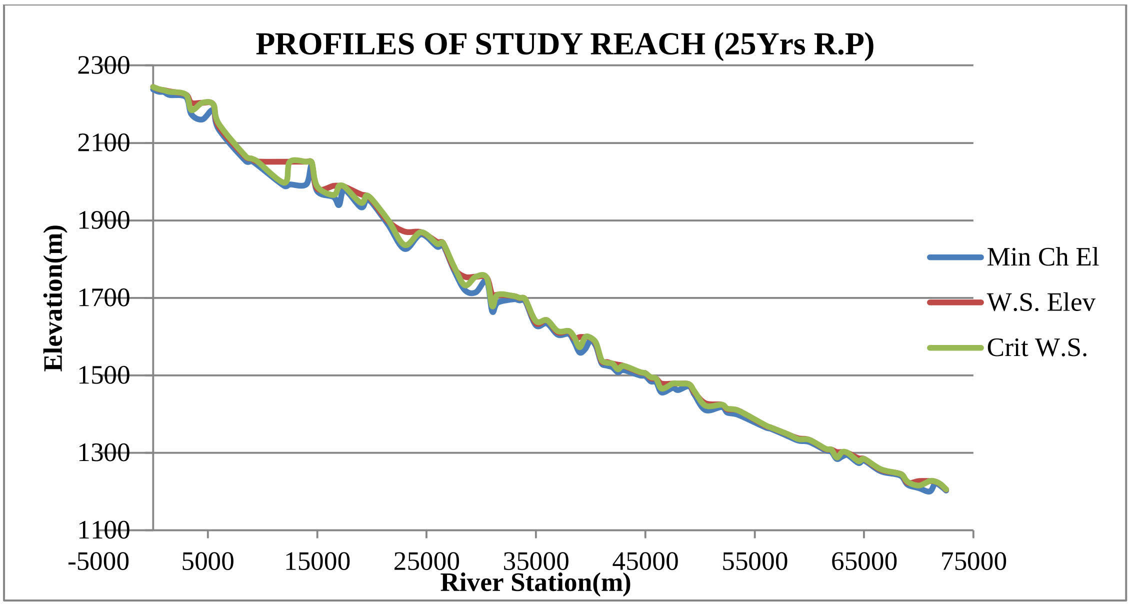


Figure 9: Water Surface profile w.r.t Channel Elevation for Study Reach at 25 Year Return Period

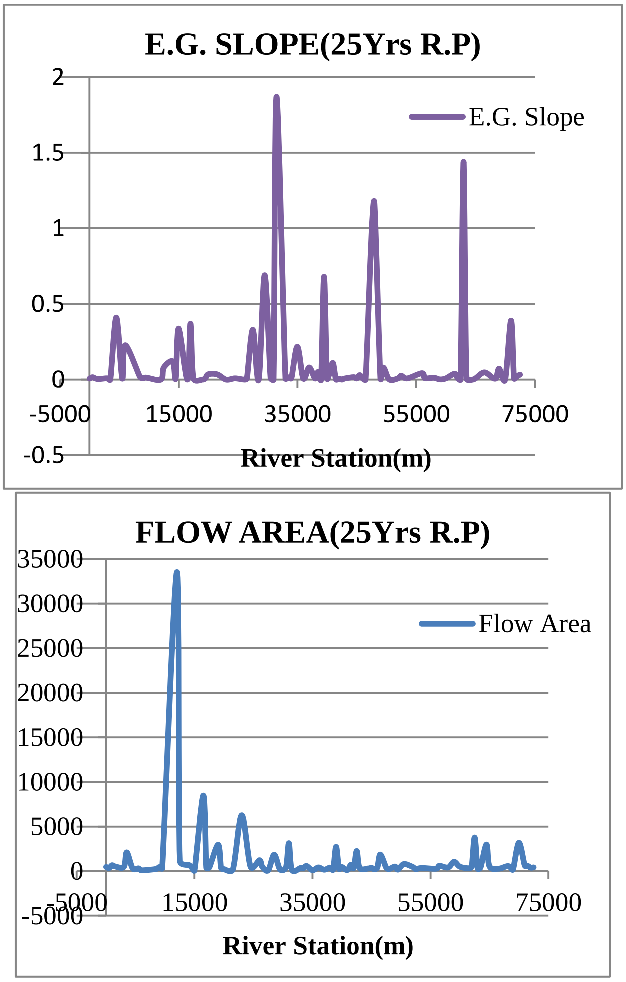


Figure 10: Energy Grade Slope & Flow Area of Study Reach at 25 Year Return Period

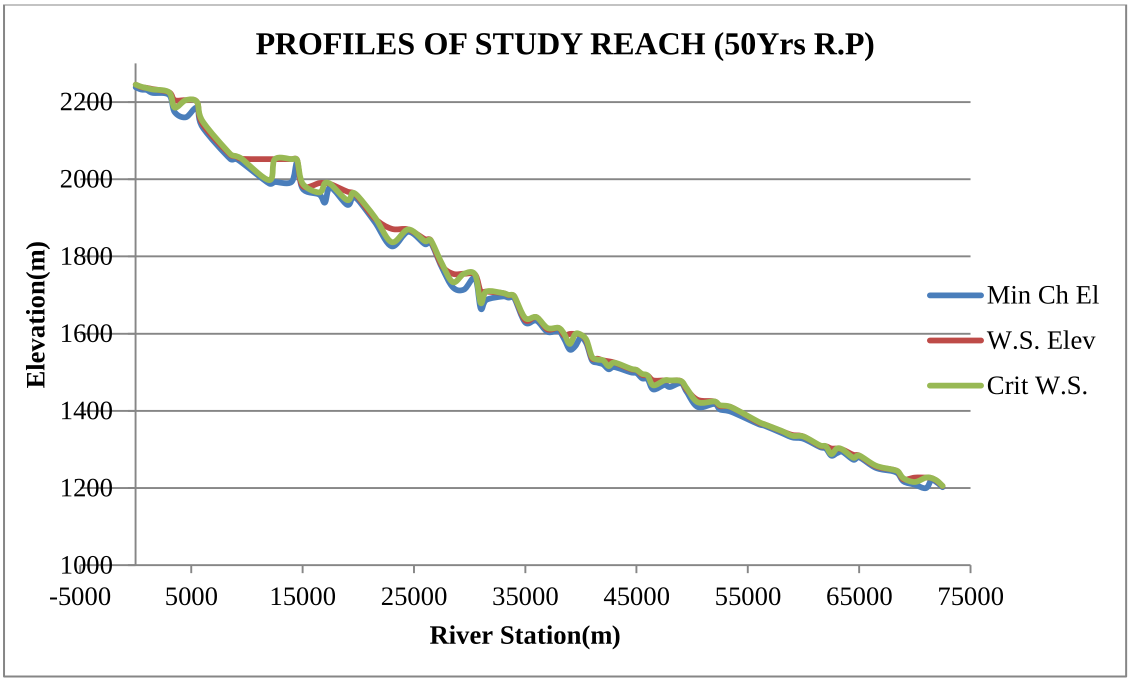


Figure 11: Water Surface profile w.r.t Channel Elevation for Study Reach at 50 Year Return Period

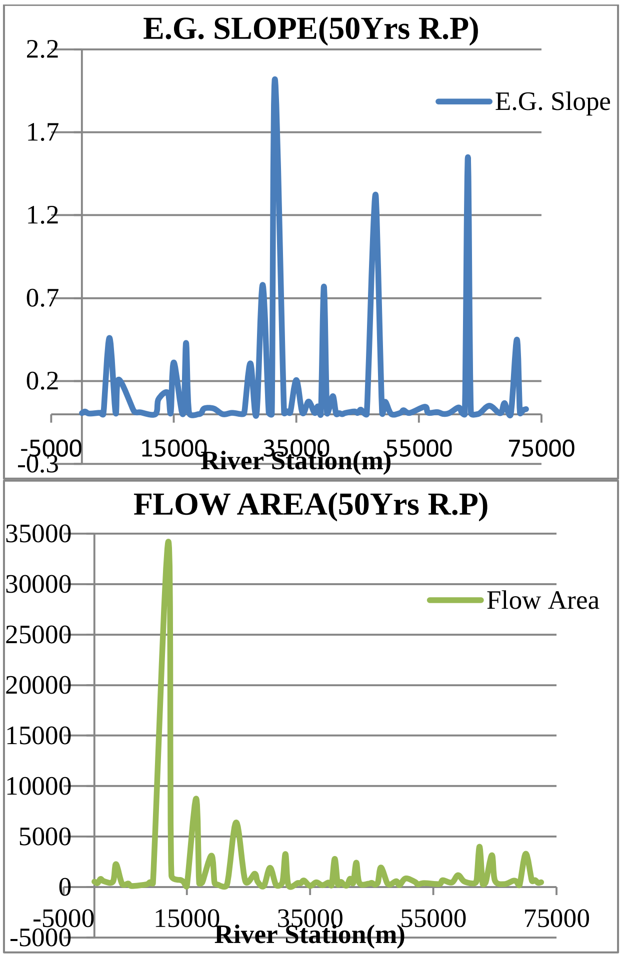


Figure 12: Energy Grade Slope & Flow Area of Study Reach at 50 Year Return Period

WATER SURFACE PROFILES RECORDS FOR 100 &500 Years RETURN PERIOD

Reach	River Sta	Q Total		Min Ch El	W.S. Elev		Crit W.S.		E.G. Elev		E.G. Slope		Flow Area		Froude #	
		(m3/s)		(m)	(m)		(m)		(m)		(m/m)		(m2)			
		100 Year	500 Year		100 Year	500 Year	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year
River-Swat	0	3511.6	4569.91	2238.04	2245.44	2246.28	2245.44	2246.28	2247.34	2248.39	0.006296	0.006057	601.53	746.15	0.93	0.93
River-Swat	500	3511.6	4569.91	2232.3	2239.05	2239.76	2240.05	2240.91	2242.45	2243.6	0.015992	0.015906	432.89	530.13	1.42	1.43
River-Swat	1000	3511.6	4569.91	2231.15	2237.08	2238.05	2236.44	2236.87	2237.78	2238.71	0.004046	0.002642	949.29	1269.55	0.69	0.59
River-Swat	1500	3511.6	4569.91	2223.73	2234.09	2235	2233.1	2234.16	2235.68	2236.92	0.00399	0.004337	640.08	757.13	0.76	0.81
River-Swat	3000	3511.6	4569.91	2218.52	2225.61	2226.34	2225.61	2226.34	2227.39	2228.38	0.0081	0.007746	594.59	723.02	1	1
River-Swat	3500	3511.6	4569.91	2173.9	2205.93	2208.2	2186.4	2187.92	2206.04	2208.34	0.000059	0.000071	2433.92	2769.96	0.11	0.12
River-Swat	4500	3511.6	4569.91	2160.49	2205.99	2208.28	2206	2208.29	0.000003	0.000003	0.51	0.61	309.01	318.53		
River-Swat	5500	3511.6	4569.91	2184.89	2201.4	2203.41	2201.4	2203.41	2205.57	2207.84	0.007771	0.00665	388.39	500.15	1	0.95
River-Swat	6000	3511.6	4569.91	2135	2144.09	2145.24	2151.57	2153.46	2190.4	2194.03	0.195439	0.17572	116.47	147.67	4.51	4.36
River-Swat	8500	3511.6	4569.91	2052.52	2063.83	2064.94	2066.1	2067.66	2070.99	2073.39	0.018385	0.01922	296.27	354.77	1.56	1.62
River-Swat	9000	3511.6	4569.91	2053.27	2059.92	2060.32	2060.41	2061.19	2062.32	2063.53	0.011705	0.014446	511.58	576.04	1.2	1.35
River-Swat	9500	3511.6	4569.91	2043.83	2053.59	2055.01	2054.15	2055.29	2056.84	2058.21	0.009954	0.008147	439.32	577.04	1.16	1.07
River-Swat	12000	3511.6	4569.91	1988.82	2052.62	2053.79	1998.19	1999.23	2052.62	2053.79	0	0	34845.7	36171.6	0.01	0.01
River-Swat	12500	3511.6	4569.91	1992.77	2052.62	2053.79	2052.62	2053.79	0	0	0.1	0.13	1158.66	1166.73		
River-Swat	14000	3511.6	4569.91	1992.92	2052.62	2053.79	2052.62	2053.79	0	0	0.15	0.19	710.33	720.86		
River-Swat	14500	3511.6	4569.91	2042.64	2050.35	2051.25	2050.35	2051.25	2052.42	2053.56	0.007431	0.006627	555.75	691.99	0.99	0.96
River-Swat	15000	3511.6	4569.91	1975.55	1982.64	1983.53	1989.28	1990.7	2036.22	2038.47	0.290149	0.253694	108.28	139.16	5.65	5.39
River-Swat	16500	3511.6	4569.91	1960.14	1990.66	1992.01	1966.16	1966.87	1990.67	1992.02	0.000003	0.000004	9022.07	9563.97	0.03	0.03
River-Swat	17000	3511.6	4569.91	1939.58	1990.66	1992.01	1990.67	1992.02	0.000002	0.000003	0.48	0.6	381.04	390.99		
River-Swat	17500	3511.6	4569.91	1978.6	1988.05	1989.06	1988.05	1989.06	1990.43	1991.75	0.007472	0.007099	513.79	629.46	1	1
River-Swat	19000	3511.6	4569.91	1933.84	1968.96	1970.66	1946.68	1948.1	1969.02	1970.75	0.000032	0.000042	3266.47	3590.96	0.08	0.09
River-Swat	19500	3511.6	4569.91	1953.85	1965.64	1966.96	1965.64	1966.96	1968.67	1970.35	0.006927	0.006533	457.11	565.02	1	0.99
River-Swat	20000	3511.6	4569.91	1945.49	1953.1	1953.91	1955.72	1956.85	1961.48	1963.38	0.035239	0.034779	273.76	335.21	2.1	2.12
River-Swat	21500	3511.6	4569.91	1888.36	1898.45	1899.52	1901.83	1903.32	1909.35	1911.85	0.033947	0.033557	240	293.69	2.08	2.1
River-Swat	23000	3511.6	4569.91	1826.22	1872.03	1872.94	1837.77	1839.18	1872.05	1872.97	0.000005	0.000008	6521.5	6777.63	0.03	0.04
River-Swat	24500	3511.6	4569.91	1863.86	1870.24	1870.96	1870.24	1870.96	1871.86	1872.75	0.007737	0.00742	630.34	780.73	0.98	0.98
River-Swat	26000	3511.6	4569.91	1831.62	1844.99	1846.05	1839.86	1840.81	1845.32	1846.48	0.000461	0.000536	1414.75	1606.67	0.28	0.3
River-Swat	26500	3511.6	4569.91	1836.46	1842.65	1843.47	1842.65	1843.47	1844.59	1845.67	0.006556	0.006164	590.89	727.27	0.94	0.93
River-Swat	27500	3511.6	4569.91	1771.86	1777.32	1778.03	1782.74	1783.95	1820.65	1822.95	0.288551	0.253947	120.41	153.91	5.63	5.39
River-Swat	28500	3511.6	4569.91	1720.04	1755.72	1757.01	1734.33	1736.25	1755.9	1757.28	0.000077	0.000109	1972.86	2109.31	0.12	0.14
River-Swat	29500	3511.6	4569.91	1714.25	1755.79	1757.12	1755.83	1757.18	0.000015	0.000021	0.88	1.08	185.44	189.5		
River-Swat	30500	3511.6	4569.91	1743.84	1753.2	1754.23	1753.2	1754.23	1755.54	1756.84	0.007498	0.00727	517.21	637.5	1	1
River-Swat	31000	3511.6	4569.91	1665.05	1710.03	1711.86	1680.37	1682.06	1710.1	1711.95	0.00002	0.000027	3407.34	3688.19	0.07	0.08
River-Swat	31500	3511.6	4569.91	1687.5	1709.83	1711.62	1710.06	1711.9	0.000191	0.000214	2.15	2.41	160.69	174.57		
River-Swat	33000	3511.6	4569.91	1696.38	1705.8	1707.16	1705.8	1707.16	1708.92	1710.65	0.007075	0.006778	448.44	552.04	1	1
River-Swat	33500	3511.6	4569.91	1693.22	1699.73	1700.21	1700.87	1701.7	1703.43	1704.93	0.018738	0.021691	411.78	474.93	1.51	1.64
River-Swat	34000	3511.6	4569.91	1692.49	1697.65	1698.13	1697.65	1698.13	1698.91	1699.62	0.008942	0.008518	711.15	848.33	0.98	0.99
River-Swat	35000	3511.6	4569.91	1628.96	1635.5	1636.36	1641.06	1642.42	1671.3	1673.39	0.191062	0.16771	132.47	169.5	4.68	4.48
River-Swat	36000	3511.6	4569.91	1634.02	1643.32	1644.34	1643.32	1644.34	1645.61	1646.87	0.007621	0.007313	523.78	648.44	1.01	1
River-Swat	37000	3511.6	4569.91	1604.67	1611.58	1612.41	1615.28	1616.52	1626.88	1628.89	0.073304	0.067905	202.62	254.06	2.98	2.92
River-Swat	38000	3511.6	4569.91	1606.65	1615.38	1616.47	1615.38	1616.47	1617.94	1619.36	0.006892	0.006473	500.3	614.23	0.99	0.98
River-Swat	38500	3511.6	4569.91	1586.13	1596.04	1597.3	1600.05	1601.6	1609.73	1611.65	0.044411	0.039658	214.2	272.3	2.35	2.27
River-Swat	39000	3511.6	4569.91	1558.74	1599.78	1600.89	1574.26	1575.97	1599.86	1601.01	0.000038	0.000056	2869.61	3023.66	0.09	0.1
River-Swat	39500	3511.6	4569.91	1567.74	1599.8	1600.92	1599.83	1600.97	0.00002	0.000028	0.86	1.05	263.52	272.73		
River-Swat	40000	3511.6	4569.91	1590.13	1597.62	1598.46	1597.62	1598.46	1599.6	1600.7	0.007826	0.006951	564.12	698.37	1	0.97
River-Swat	40500	3511.6	4569.91	1574.01	1581.45	1582.12	1584.13	1584.95	1590.81	1592.51	0.050423	0.050065	260.68	322.23	2.45	2.47
River-Swat	41000	3511.6	4569.91	1530.75	1536.66	1537.33	1540.47	1541.54	1554.62	1557.08	0.106077	0.101031	187.03	232.09	3.49	3.46
River-Swat	41500	3511.6	4569.91	1524.89	1535.9	1537.53	1533.22	1534.14	1536.59	1538.25	0.001587	0.001218	951.85	1228.26	0.48	0.44
River-Swat	42000	3511.6	4569.91	1520.35	1531.56	1533.01	1531.56	1533.01	1534.91	1536.77	0.006274	0.006076	444.31	545.36	0.97	0.97
River-Swat	42500	3511.6	4569.91	1507.75	1529.2	1530.94	1516.46	1517.27	1529.3	1531.07	0.000071	0.000085	2575.84	2900.79	0.12	0.13
River-Swat	43000	3511.6	4569.91	1513.38	1525.76	1527.13	1525.76	1527.13	1528.88	1530.6	0.007122	0.006879	448.36	553.46	1.01	1.01
River-Swat	44500	3511.6	4569.91	1499.62	1508.19	1509	1509.62	1510.69	1512.95	1514.62	0.017157	0.018008	363.4	434.81	1.49	1.55
River-Swat	45000	3511.6	4569.91	1498.03	1506.56	1507.8	1506.57	1507.8	1509.48	1511.1	0.007195	0.00696	463.73	567.45	1	1.01
River-Swat	45500	3511.6	4569.91	1484.25	1493.65	1494.8	1496.56	1497.97	1502.69	1504.61	0.026087	0.023536	267.15	336.48	1.87	1.82
River-Swat	46000	3511.6	4569.91	1482.09	1491.9	1492.56	1491.94	1493.02	1494.41	1495.83	0.007449	0.008873	500.18	570.74	1.01	1.12
River-Swat	46497.13	3511.6	4569.91	1455.56	1479.45	1480.42	1466.81	1468.15	1479.62	1480.68	0.000112	0.000153	2015.52	2179.74	0.15	0.18
River-Swat	47500	3511.6	4569.91	1467.18	1479.42	1480.41	1479.49	1480.5	0.000098	0.000113	1.14	1.33	397.6	406.88		
River-Swat	48000	3511.6	4569.91	1461.79	1479.33	1480.28	1479.43	1480.43	0.000098	0.000129	1.44	1.72	244.71	255.66		
River-Swat	49000	3511.6	4569.91	1471.71	1477.39	1478.02	1477.39	1478.02	1478.97	1479.86	0.007529	0.00725	640.42	771.14	0.97	0.98
River-Swat	49500	3511.6	4569.91	1449.51	1455.87	1456.7	1459.24	1460.31	1469.24	1470.6	0.070336	0.062177	216.77	276.62	2.9	2.78
River-Swat	50500	3511.6	4569.91	1409.99	1429.04	1430.29	1423.18	1424.7	1429.85	1431.36	0.00089	0.00108	911.39	1034.73	0.39	0.43
River-Swat	52000	3511.6	4569.91	1417.89	1424.82	1425.58	1424.82	1425.58	1426.74	1427.82	0.00796	0.00755	572.03	689.43	1.01	1.01
River-Swat	52500	3511.6	4569.91	1403.58	1413.03	1414.24	1415.29	1416.65	1420.07	1421.71	0.022089	0.018381	298.97	380.84	1.71	1.6
River-Swat	53500	3511.6	4569.91	1397.57	1410.34	1411.77	1410.35	1411.79	1413.6	1415.38	0.007353	0.007083	439.12	542.58	1.01	1.01
River-Swat	56000	3511.6	4569.91	1365.17	1369.7	1370.08	1371.46	1372.12	1375.57	1377.31	0.047535	0.052743	327.29	383.53	2.28	2.43
River-Swat	56500	3511.6	4569.91	1361.46	1365.38	1365.78	1365.38	1365.9	1366.51	1367.13	0.008028	0.008146	770.79	931.02	0.95	0.98
River-Swat	58000	3511.6	4569.91	1343.19	1348.19	1348.86	1348.95	1349.72	1351.05	1352.08	0.013324	0.012295	482.69	595.62	1.29	1.28
River-Swat	59000	3511.6	4569.91	1331.18	1337.95	1338.75	1335.8	1336.39	1338.34	1339.19	0.001303	0.001291	1302.74	1573.77	0.42	0.43
River-Swat	60000	3511.6	4569.91	1327.61	1333.99	1334.74	1333.99	1334.74	1335.65	1336.57	0.007157	0.006699	630.5	787.29	0.96	0.95

Reach	River Sta	Q Total (m3/s)		Min Ch El (m)	W.S. Elev (m)		Crit W.S. (m)		E.G. Elev (m)		E.G. Slope (m/m)		Flow Area (m2)		Froude #	
		100 Year	500 Year		100 Year	500 Year	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year	100 Year	500 Year
River-Swat	61500	3511.6	4569.91	1306.02	1309.4	1309.72	1310.73	1311.35	1313.84	1315.25	0.042149	0.04433	379.03	443.4	2.1	2.2
River-Swat	62000	3511.6	4569.91	1302.86	1308.91	1309.57	1308.91	1309.57	1310.44	1311.28	0.008366	0.008144	640.62	788.12	1	1.01
River-Swat	62500	3511.6	4569.91	1283.94	1303.22	1304.52	1288.51	1289.3	1303.26	1304.57	0.000027	0.000035	4206.36	4651.16	0.07	0.09
River-Swat	63000	3511.6	4569.91	1290.29	1303.1	1304.37	1303.23	1304.53	0.000162	0.000172	1.64	1.84	323.86	349.36		
River-Swat	63500	3511.6	4569.91	1293.77	1300.48	1301.47	1300.48	1301.47	1302.77	1304.03	0.007168	0.006889	529.69	650.51	1	1
River-Swat	64500	3511.6	4569.91	1273.29	1286.29	1287.05	1278.76	1279.37	1286.36	1287.14	0.000079	0.000101	3313.96	3647.63	0.12	0.14
River-Swat	65000	3511.6	4569.91	1279.77	1284.76	1285.35	1284.76	1285.35	1286.1	1286.84	0.006966	0.006421	716.83	897.45	0.93	0.91
River-Swat	66500	3511.6	4569.91	1252.41	1256.75	1257.14	1258.52	1259.23	1263.01	1264.62	0.053897	0.057242	316.62	377.16	2.4	2.51
River-Swat	68000	3511.6	4569.91	1243.82	1248.29	1248.85	1248.29	1248.85	1249.57	1250.28	0.008926	0.008597	700.99	861.57	1.01	1.01
River-Swat	68500	3511.6	4569.91	1237.17	1242.81	1243.33	1243.19	1243.78	1244.63	1245.4	0.0107	0.010828	606.88	741.12	1.13	1.16
River-Swat	69000	3511.6	4569.91	1217.12	1222.77	1223.52	1225.53	1226.48	1233.05	1234.12	0.062566	0.054772	247.27	316.7	2.7	2.58
River-Swat	70000	3511.6	4569.91	1208.7	1227.48	1228.11	1216.21	1217.11	1227.54	1228.2	0.000064	0.000092	3418.86	3668.34	0.11	0.13
River-Swat	71000	3511.6	4569.91	1199.87	1227.5	1228.14	1227.51	1228.15	0.000006	0.000009	0.5	0.63	627.23	646.17		
River-Swat	71500	3511.6	4569.91	1221	1226.26	1226.76	1226.26	1226.76	1227.39	1228.01	0.00691	0.006766	781.72	961.32	0.9	0.91
River-Swat	72000	3511.6	4569.91	1214.13	1218.39	1218.89	1219.34	1219.95	1221.36	1222.17	0.024217	0.021971	461.39	575.9	1.62	1.59
River-Swat	72500	3511.6	4569.91	1202.27	1205.11	1205.32	1205.84	1206.28	1207.51	1208.47	0.031139	0.034871	516.9	588.61	1.74	1.88

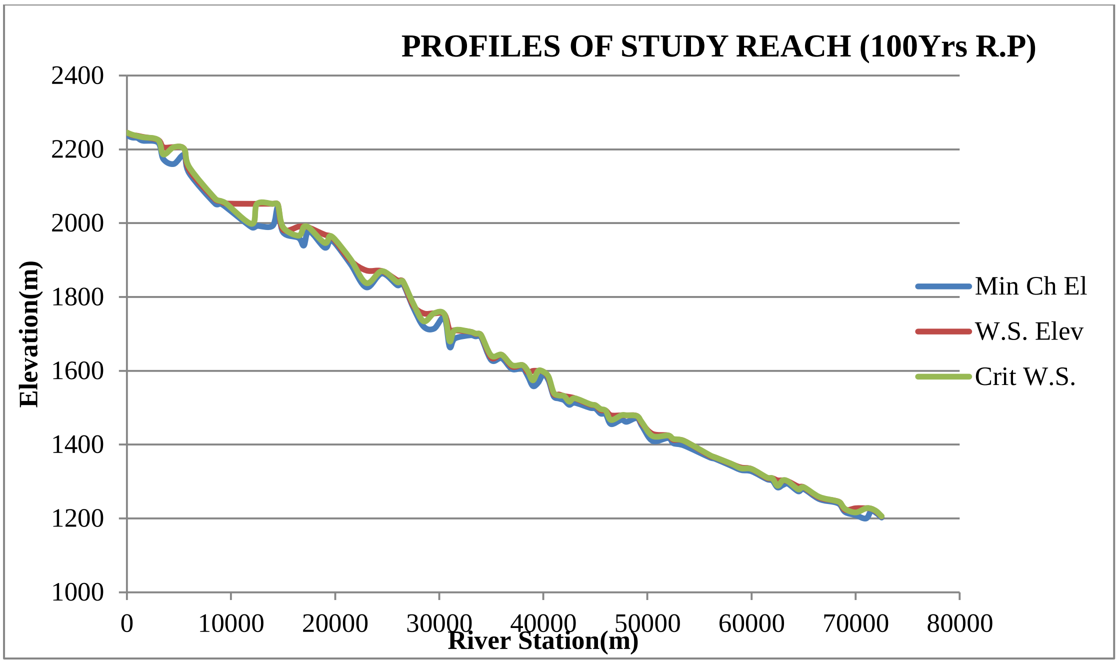


Figure 13: Water Surface profile w.r.t Channel Elevation for Study Reach at 100 Year Return Period

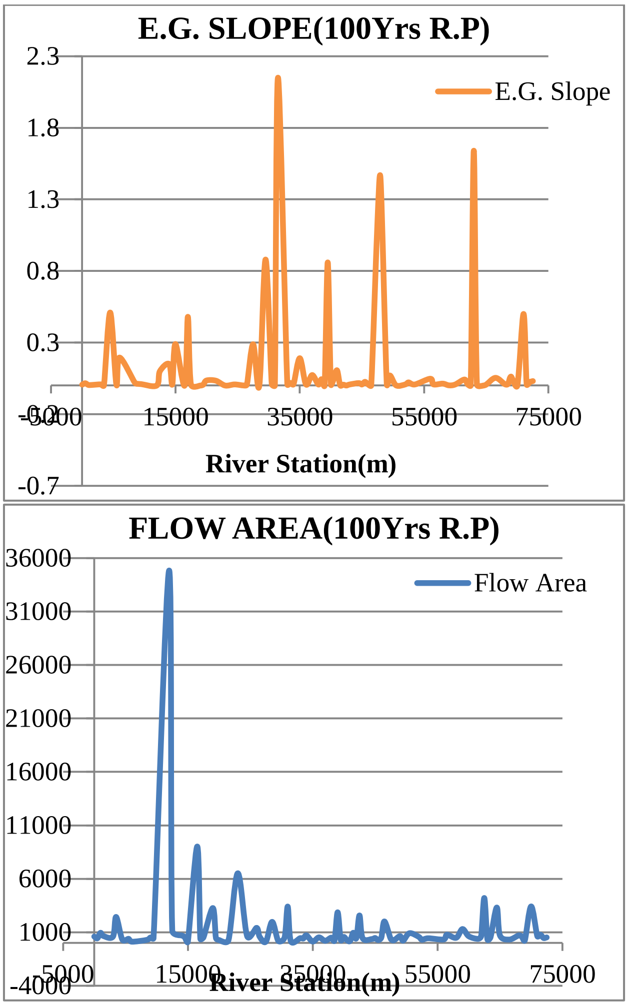


Figure 14: Energy Grade Slope & Flow Area of Study Reach at 100 Year Return Period

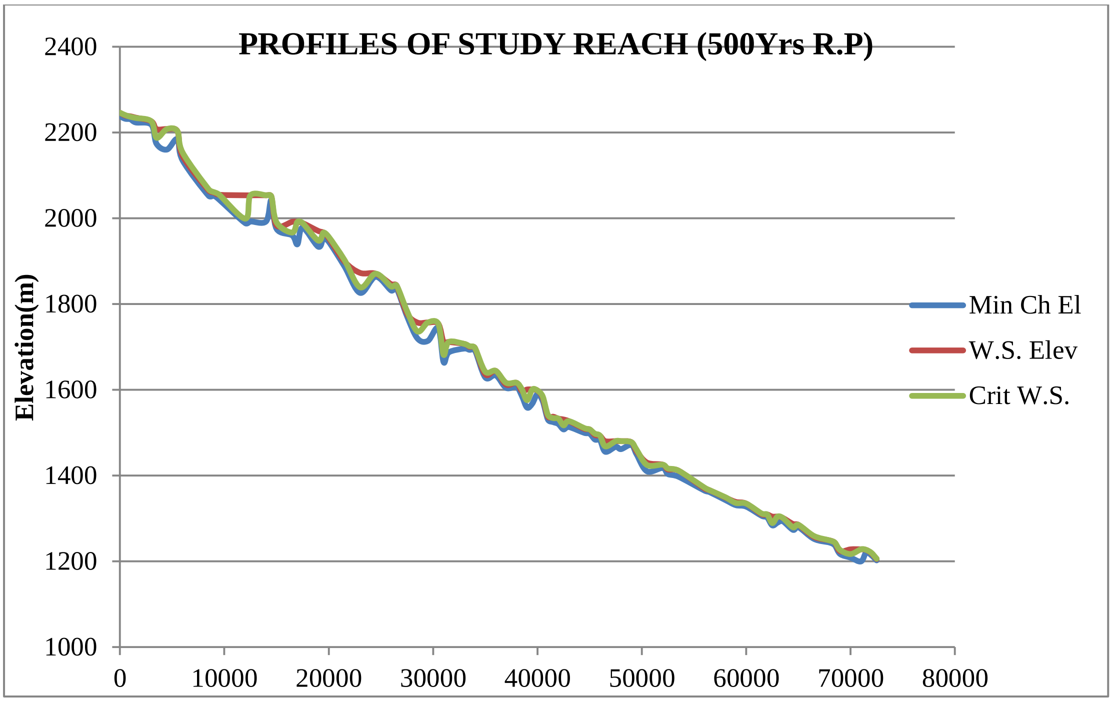


Figure 15: Water Surface profile w.r.t Channel Elevation for Study Reach at 500 Year Return Period

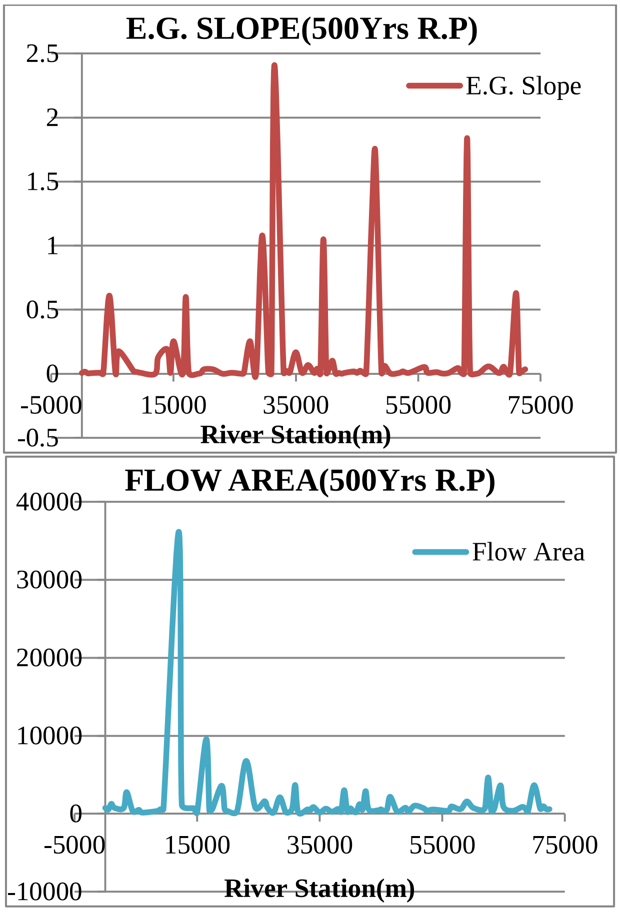


Figure 16: Energy Grade Slope & Flow Area of Study Reach at 500 Year Return Period

WATER SURFACE PROFILES RECORDS FOR 1000 &10000 Years RETURN PERIOD

Reach	River Sta	Q Total (m3/s) 1000 Year	Q Total (m3/s) 10000 Year	Min Ch El (m)	W.S. Elev (m) 1000 Year	W.S. Elev (m) 10000 Year	Crit W.S. (m) 1000 Year	Crit W.S. (m) 10000 Year	E.G. Elev (m) 1000 Year	E.G. Elev (m) 10000 Year	E.G. Slope (m/m) 1000 Year	E.G. Slope (m/m) 10000 Year	Flow Area (m2) 1000 Year	Flow Area (m2) 10000 Year	Froude # 1000 Year	Froude # 10000 Year
River-Swat	0	5024.9	6535.53	2238.04	2246.61	2247.59	2246.61	2247.59	2248.79	2249.98	0.005949	0.005726	807.8	1002.43	0.93	0.93
River-Swat	500	5024.9	6535.53	2232.3	2240.03	2240.86	2241.23	2242.17	2244.04	2245.35	0.015894	0.015644	569.97	700.02	1.44	1.45
River-Swat	1000	5024.9	6535.53	2231.15	2238.45	2239.7	2237.05	2237.62	2239.11	2240.36	0.002306	0.001657	1402.7	1825.47	0.56	0.49
River-Swat	1500	5024.9	6535.53	2223.73	2235.32	2236.23	2234.57	2235.76	2237.4	2238.82	0.004528	0.005129	800.43	931.7	0.83	0.89
River-Swat	3000	5024.9	6535.53	2218.52	2226.62	2227.52	2226.62	2227.52	2228.77	2229.97	0.007489	0.006761	776.52	956.87	0.99	0.97
River-Swat	3500	5024.9	6535.53	2173.9	2209.03	2211.41	2188.51	2190.25	2209.2	2211.63	0.000076	0.000089	2899.4	3282.55	0.12	0.14
River-Swat	4500	5024.9	6535.53	2160.49	2209.13	2211.53	2209.14	2211.56	0.000004	0.000005	0.65	0.78	322.05	332.06		
River-Swat	5500	5024.9	6535.53	2184.89	2204.18	2206.4	2204.18	2206.4	2208.68	2211.07	0.006312	0.005439	550.28	717.33	0.93	0.88
River-Swat	6000	5024.9	6535.53	2135	2145.69	2147.07	2154.17	2156.24	2195.3	2198.7	0.168651	0.14925	161.02	205.29	4.31	4.13
River-Swat	8500	5024.9	6535.53	2052.52	2065.37	2066.61	2068.25	2070.06	2074.34	2077.24	0.019543	0.020509	378.49	452.46	1.64	1.71
River-Swat	9000	5024.9	6535.53	2053.27	2060.48	2060.93	2061.5	2062.4	2064.03	2065.64	0.015544	0.018842	601.78	679.73	1.4	1.56
River-Swat	9500	5024.9	6535.53	2043.83	2055.66	2056.94	2055.73	2056.98	2058.75	2060.43	0.007315	0.006587	645.17	792.61	1.02	1
River-Swat	12000	5024.9	6535.53	1988.82	2054.25	2055.6	1999.63	2000.77	2054.25	2055.6	0	0	36697.	38278.1	0.01	0.01
River-Swat	12500	5024.9	6535.53	1992.77	2054.25	2055.6	2054.25	2055.6	0	0	0.14	0.18	1169.8	1179.25		
River-Swat	14000	5024.9	6535.53	1992.92	2054.24	2055.59	2054.25	2055.6	0	0.000001	0.21	0.26	724.97	737.16		
River-Swat	14500	5024.9	6535.53	2042.64	2051.58	2052.65	2051.58	2052.65	2054	2055.33	0.006452	0.00582	746.79	936.27	0.96	0.94
River-Swat	15000	5024.9	6535.53	1975.55	1983.89	1984.95	1991.27	1992.98	2039.18	2041.4	0.240769	0.208823	152.52	196.33	5.29	5.03
River-Swat	16500	5024.9	6535.53	1960.14	1992.55	1994.16	1967.18	1968.17	1992.56	1994.18	0.000005	0.000007	9781.5	10444.3	0.03	0.04
River-Swat	17000	5024.9	6535.53	1939.58	1992.54	1994.16	1992.56	1994.18	0.000003	0.000004	0.65	0.79	394.94	406.35		
River-Swat	17500	5024.9	6535.53	1978.6	1989.43	1990.62	1989.43	1990.62	1992.27	1993.85	0.006931	0.006315	674.65	831.2	1	0.98
River-Swat	19000	5024.9	6535.53	1933.84	1971.32	1973.27	1948.67	1950.37	1971.41	1973.41	0.000046	0.00006	3720.0	4118.4	0.1	0.11
River-Swat	19500	5024.9	6535.53	1953.85	1967.49	1969.01	1967.49	1969.01	1971	1972.93	0.006359	0.006081	611.83	755.8	0.98	0.98
River-Swat	20000	5024.9	6535.53	1945.49	1954.22	1955.18	1957.29	1958.6	1964.12	1966.23	0.034657	0.033667	360.43	443.77	2.13	2.14
River-Swat	21500	5024.9	6535.53	1888.36	1899.93	1901.15	1903.9	1905.63	1912.81	1915.76	0.033373	0.033144	316.01	385.87	2.11	2.14
River-Swat	23000	5024.9	6535.53	1826.22	1873.3	1874.35	1839.7	1841.29	1873.33	1874.4	0.000009	0.000014	6878.1	7181.61	0.05	0.06
River-Swat	24500	5024.9	6535.53	1863.86	1871.23	1872.03	1871.23	1872.03	1873.09	1874.12	0.007353	0.007154	841.55	1034.8	0.98	0.99
River-Swat	26000	5024.9	6535.53	1831.62	1846.45	1847.66	1841.21	1842.35	1846.94	1848.29	0.000566	0.00066	1681.6	1906.92	0.31	0.34
River-Swat	26500	5024.9	6535.53	1836.46	1843.8	1844.79	1843.8	1844.79	1846.09	1847.36	0.006018	0.005646	784.88	970.46	0.93	0.92
River-Swat	27500	5024.9	6535.53	1771.86	1778.31	1779.16	1784.42	1785.8	1823.81	1826.22	0.242511	0.21292	168.15	215.03	5.31	5.08
River-Swat	28500	5024.9	6535.53	1720.04	1757.51	1758.97	1736.98	1739.13	1757.82	1759.43	0.000124	0.000172	2163.0	2324.95	0.15	0.18
River-Swat	29500	5024.9	6535.53	1714.25	1757.63	1759.16	1757.7	1759.26	0.000024	0.000034	1.16	1.42	191.07	195.73		
River-Swat	30500	5024.9	6535.53	1743.84	1754.62	1755.83	1754.62	1755.83	1757.35	1758.85	0.007205	0.006905	686.85	849.92	1.01	1
River-Swat	31000	5024.9	6535.53	1665.05	1712.57	1714.67	1682.73	1684.69	1712.67	1714.81	0.00003	0.000041	3800.2	4142.42	0.08	0.1
River-Swat	31500	5024.9	6535.53	1687.5	1712.32	1714.38	1712.62	1714.75	0.000222	0.000244	2.5	2.78	179.97	196.01		
River-Swat	33000	5024.9	6535.53	1696.38	1707.67	1709.26	1707.67	1709.26	1711.33	1713.35	0.006728	0.006493	593.41	729.24	1	1
River-Swat	33500	5024.9	6535.53	1693.22	1700.4	1700.97	1702.01	1702.97	1705.53	1707.36	0.022812	0.025607	500.42	583.61	1.69	1.82
River-Swat	34000	5024.9	6535.53	1692.49	1698.34	1698.93	1698.34	1698.93	1699.9	1700.8	0.00824	0.007892	908.41	1081.93	0.98	0.99
River-Swat	35000	5024.9	6535.53	1628.96	1636.68	1637.7	1642.94	1644.48	1674.38	1676.49	0.161222	0.140534	184.72	236.86	4.42	4.21
River-Swat	36000	5024.9	6535.53	1634.02	1644.73	1645.89	1644.73	1645.89	1647.36	1648.81	0.007221	0.006971	699.7	863.8	1	1
River-Swat	37000	5024.9	6535.53	1604.67	1612.74	1613.71	1617.01	1618.44	1629.63	1631.8	0.065878	0.059726	275.93	346.9	2.89	2.81
River-Swat	38000	5024.9	6535.53	1606.65	1616.87	1618.16	1616.87	1618.16	1619.92	1621.61	0.006413	0.006117	658.72	806.83	0.98	0.98
River-Swat	38500	5024.9	6535.53	1586.13	1597.8	1599.31	1602.21	1603.99	1612.34	1614.43	0.037863	0.033512	297.52	379.32	2.23	2.14
River-Swat	39000	5024.9	6535.53	1558.74	1601.32	1602.61	1576.6	1578.64	1601.46	1602.81	0.000064	0.000091	3084.5	3269.18	0.11	0.13
River-Swat	39500	5024.9	6535.53	1567.74	1601.35	1602.66	1601.42	1602.75	0.000031	0.000043	1.12	1.36	276.32	286.77		
River-Swat	40000	5024.9	6535.53	1590.13	1598.81	1599.82	1598.81	1599.82	1601.13	1602.42	0.006645	0.005992	756.99	945.04	0.96	0.94
River-Swat	40500	5024.9	6535.53	1574.01	1582.38	1583.17	1585.33	1586.42	1593.16	1594.95	0.049837	0.048265	347.85	432.6	2.48	2.48
River-Swat	41000	5024.9	6535.53	1530.75	1537.59	1538.36	1541.97	1543.19	1558.04	1560.94	0.09931	0.095143	250.82	310.42	3.46	3.44
River-Swat	41500	5024.9	6535.53	1524.89	1538.19	1540.22	1534.49	1535.48	1538.92	1540.98	0.001119	0.000907	1344.0	1716.25	0.43	0.4
River-Swat	42000	5024.9	6535.53	1520.35	1533.58	1535.26	1533.58	1535.26	1537.5	1539.67	0.006004	0.005868	587.43	719.45	0.97	0.98
River-Swat	42500	5024.9	6535.53	1507.75	1531.61	1533.61	1517.59	1518.57	1531.75	1533.79	0.000091	0.000109	3029.2	3422.46	0.13	0.15
River-Swat	43000	5024.9	6535.53	1513.38	1527.68	1529.27	1527.68	1529.27	1531.27	1533.25	0.006749	0.006504	598.56	739.17	1	1
River-Swat	44500	5024.9	6535.53	1499.62	1509.29	1510.14	1511.11	1512.47	1515.3	1517.45	0.018462	0.018776	462.56	546.86	1.58	1.63
River-Swat	45000	5024.9	6535.53	1498.03	1508.3	1509.78	1508.3	1509.78	1511.74	1513.64	0.006849	0.006586	611.37	750.77	1	1
River-Swat	45500	5024.9	6535.53	1484.25	1495.25	1496.58	1498.5	1500.16	1505.35	1507.51	0.022794	0.020955	365.37	459.19	1.81	1.77
River-Swat	46000	5024.9	6535.53	1482.09	1492.82	1493.58	1493.45	1494.71	1496.41	1498.19	0.00943	0.011064	599	687.1	1.16	1.27
River-Swat	46497.13	5024.9	6535.53	1455.56	1480.8	1481.97	1468.64	1470.11	1481.1	1482.4	0.000171	0.000228	2246.4	2455.04	0.19	0.22
River-Swat	47500	5024.9	6535.53	1467.18	1480.8	1482	1480.9	1482.13	0.000118	0.000134	1.4	1.6	410.58	421.89		
River-Swat	48000	5024.9	6535.53	1461.79	1480.66	1481.81	1480.83	1482.05	0.000141	0.00018	1.83	2.16	260.01	273.27		
River-Swat	49000	5024.9	6535.53	1471.71	1478.27	1479.05	1478.27	1479.05	1480.21	1481.31	0.007147	0.006845	824.49	993.36	0.98	0.98
River-Swat	49500	5024.9	6535.53	1449.51	1457.02	1457.99	1460.74	1461.97	1471.13	1472.68	0.059485	0.052729	301.99	384.81	2.74	2.63
River-Swat	50500	5024.9	6535.53	1409.99	1430.77	1432.17	1425.3	1427.04	1431.95	1433.71	0.001156	0.00139	1084.1	1235.15	0.45	0.49
River-Swat	52000	5024.9	6535.53	1417.89	1425.89	1426.85	1425.89	1426.85	1428.25	1429.58	0.007414	0.00699	737.51	892.45	1.01	1
River-Swat	52500	5024.9	6535.53	1403.58	1414.72	1416.22	1417.17	1418.75	1422.35	1424.18	0.01731	0.01457	415.92	535.28	1.57	1.48
River-Swat	53500	5024.9	6535.53	1397.57	1412.32	1413.95	1412.34	1413.99	1416.07	1418.12	0.00699	0.006746	585.5	722.66	1.01	1.01
River-Swat	56000	5024.9	6535.53	1365.17	1370.22	1370.65	1372.37	1373.14	1377.99	1380.13	0.054499	0.059536	406.8	479.29	2.48	2.63
River-Swat	56500	5024.9	6535.53	1361.46	1365.9	1366.26	1366.1	1366.62	1367.37	1368.12	0.008459	0.009469	986.25	1155.55	1.01	1.08
River-Swat	58000	5024.9	6535.53	1343.19	1349.18	1350.15	1350.02	1350.93	1352.45	1353.57	0.011547	0.009721	650.65	832.68	1.25	1.18
River-Swat	59000	5024.9	6535.53	1331.18	1339.06	1340	1336.61	1337.33	1339.53	1340.55	0.001285	0.001282	1684.7	2026.08	0.43	0.44
River-Swat	60000	5024.9	6535.53	1327.61	1335.01	1335.86	1335.01	1335.86	1336.92	1337.96	0.006622	0.006315	849.43	1055.45	0.95	0.95
River-Swat	61500	5024.9	6535.53	1306.02	1309.85	1310.28	1311.59	1312.33	1315.8	1317.34	0.044884	0.044228	470.33	563.85	2.24	2.27

Reach	River Sta	Q Total (m3/s)		Min Ch El (m)	W.S. Elev (m)		Crit W.S. (m)		E.G. Elev (m)		E.G. Slope (m/m)		Flow Area (m2)		Froude #	
		1000 Year	**10000 Year**		**1000 Year**	**10000 Year**	**1000 Year**	**10000 Year**	**1000 Year**	**10000 Year**	**1000 Year**	**10000 Year**	**1000 Year**	**10000 Year**	**1000 Year**	**10000 Year**
River-Swat	62000	5024.9	6535.53	1302.86	1309.83	1310.61	1309.83	1310.62	1311.61	1312.59	0.008055	0.007756	849.65	1049.21	1.01	1.01
River-Swat	62500	5024.9	6535.53	1283.94	1305.02	1306.57	1289.61	1290.57	1305.08	1306.65	0.000038	0.000048	4829.5	5396.83	0.09	0.1
River-Swat	63000	5024.9	6535.53	1290.29	1304.87	1306.39	1305.04	1306.59	0.000175	0.000183	1.91	2.12	359.29	389.85		
River-Swat	63500	5024.9	6535.53	1293.77	1301.85	1302.93	1301.85	1302.93	1304.52	1306.03	0.006798	0.006473	700.48	848.46	1	1
River-Swat	64500	5024.9	6535.53	1273.29	1287.34	1288.2	1279.61	1280.33	1287.44	1288.34	0.000111	0.00014	3778.9	4178.86	0.14	0.16
River-Swat	65000	5024.9	6535.53	1279.77	1285.58	1286.24	1285.58	1286.24	1287.12	1287.97	0.006248	0.005966	973.24	1207.12	0.91	0.91
River-Swat	66500	5024.9	6535.53	1252.41	1257.3	1257.8	1259.5	1260.35	1265.23	1266.89	0.058138	0.056075	402.64	489.99	2.55	2.56
River-Swat	68000	5024.9	6535.53	1243.82	1249.05	1249.71	1249.05	1249.71	1250.55	1251.38	0.008539	0.008169	925.94	1141.76	1.01	1.01
River-Swat	68500	5024.9	6535.53	1237.17	1243.54	1244.13	1244	1244.7	1245.69	1246.58	0.010812	0.010981	797.82	970.23	1.16	1.19
River-Swat	69000	5024.9	6535.53	1217.12	1223.8	1224.68	1226.85	1227.93	1234.56	1235.83	0.052378	0.044676	345.81	442.67	2.54	2.4
River-Swat	70000	5024.9	6535.53	1208.7	1228.35	1229.09	1217.46	1218.49	1228.45	1229.24	0.000105	0.000146	3770.1	4088.78	0.14	0.17
River-Swat	71000	5024.9	6535.53	1199.87	1228.38	1229.14	1228.4	1229.17	0.000011	0.000015	0.68	0.84	653.64	676.16		
River-Swat	71500	5024.9	6535.53	1221	1226.94	1227.5	1226.94	1227.5	1228.26	1228.99	0.006838	0.006826	1027.0	1244.59	0.92	0.94
River-Swat	72000	5024.9	6535.53	1214.13	1219.09	1219.7	1220.18	1220.84	1222.48	1223.37	0.021203	0.019263	624.94	785.57	1.57	1.53
River-Swat	72500	5024.9	6535.53	1202.27	1205.4	1205.68	1206.46	1207	1208.86	1210.07	0.036148	0.038533	617.98	716.1	1.93	2.04

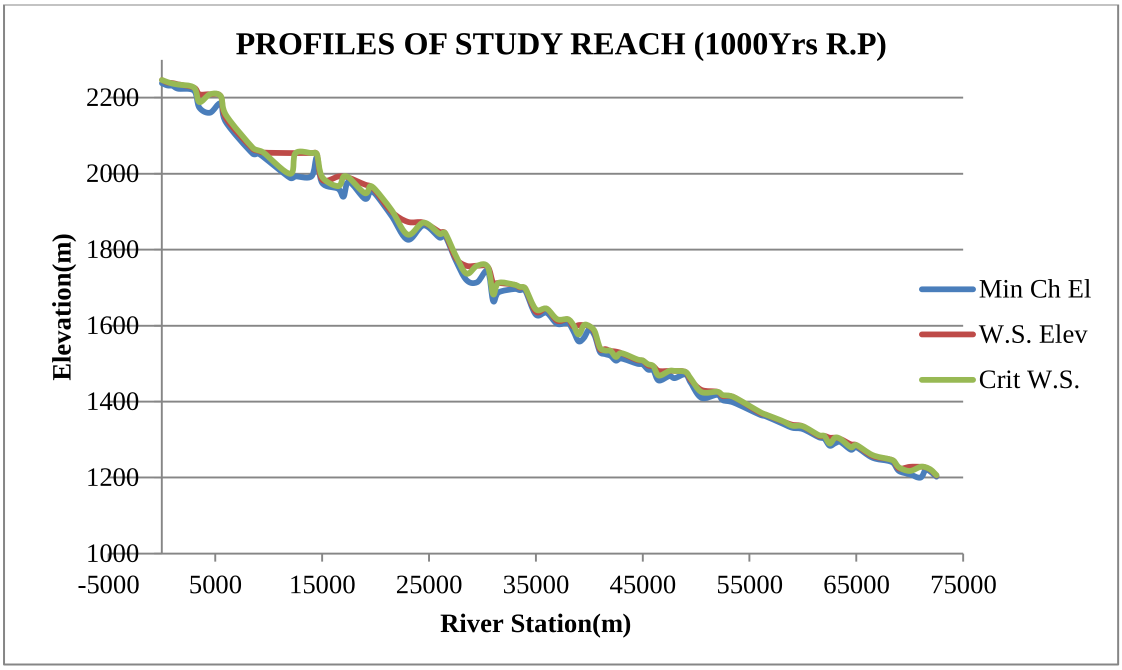


Figure 17: Water Surface profile w.r.t Channel Elevation for Study Reach at 1000 Year Return Period

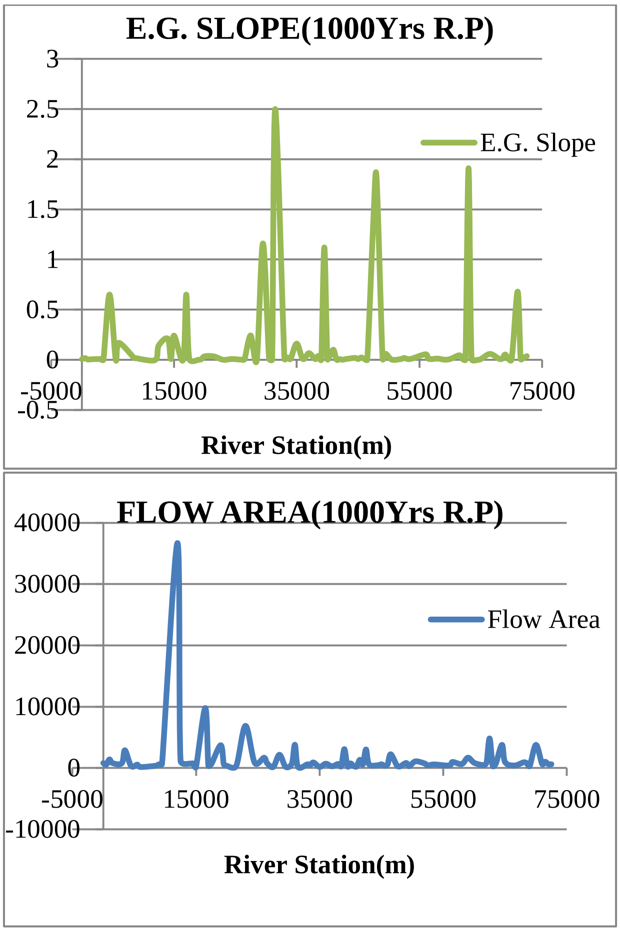


Figure 18: Energy Grade Slope & Flow Area of Study Reach at 1000 Year Return Period

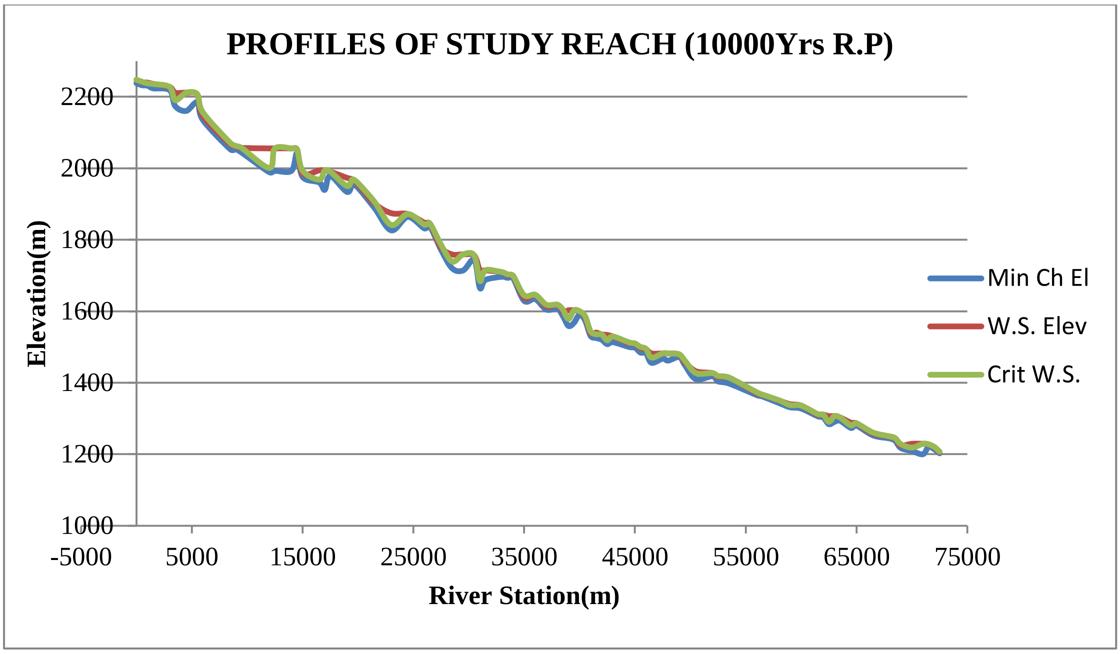


Figure 19: Water Surface profile w.r.t Channel Elevation for Study Reach at 10000 Year Return Period

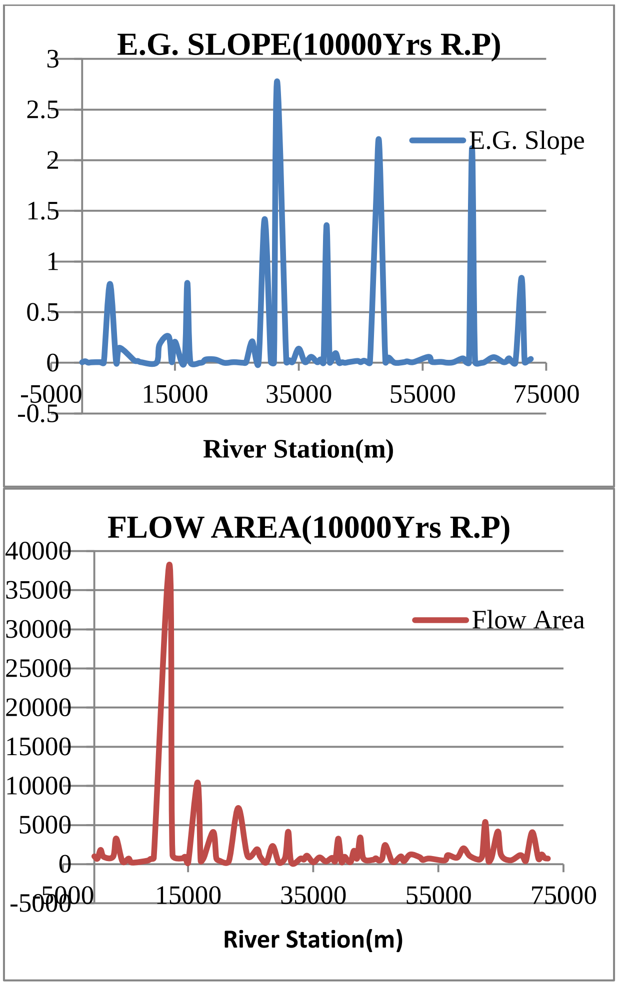
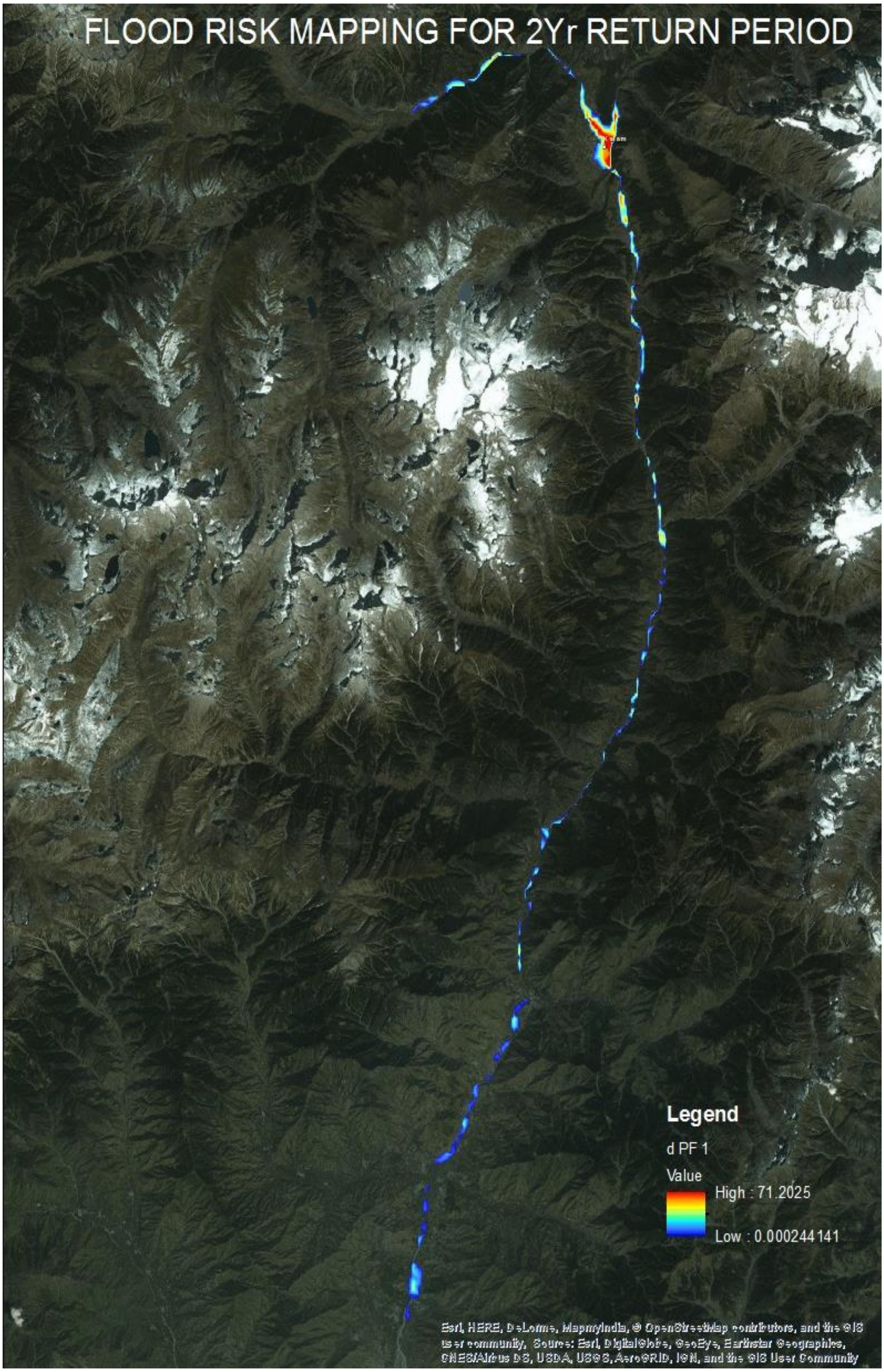
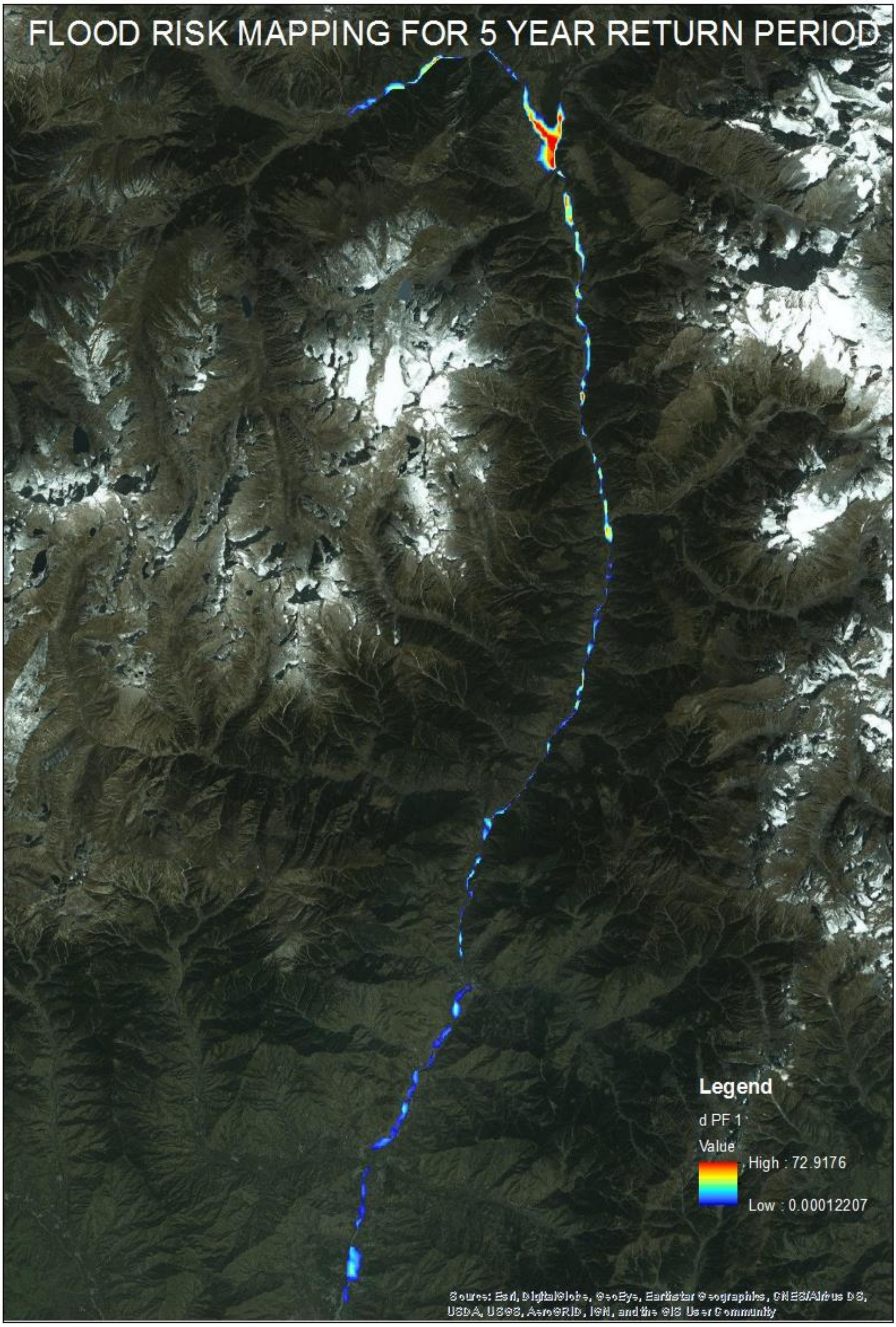


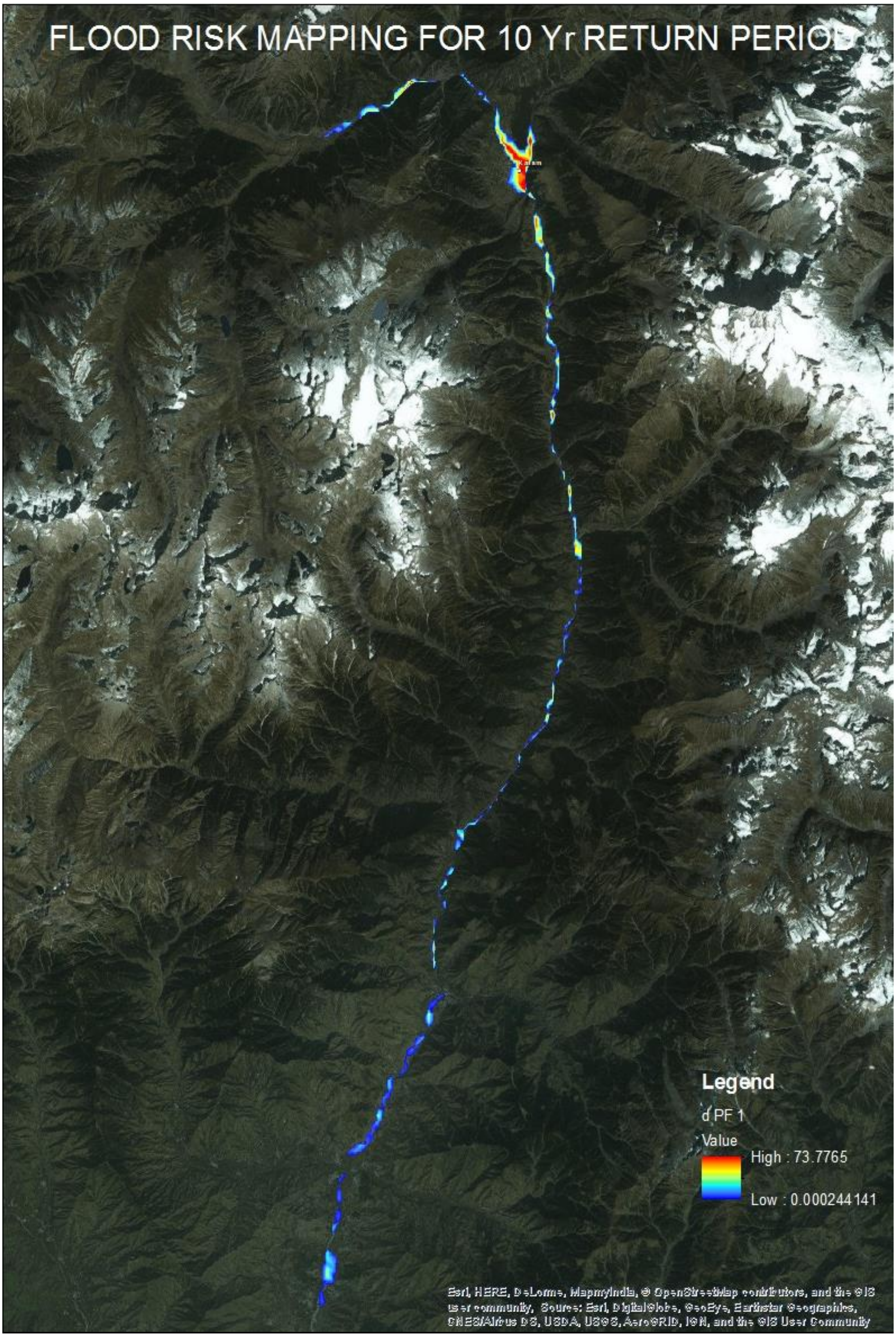
Figure 20: Energy Grade Slope & Flow Area of Study Reach at 10000 Year Return Period

ANNEX C

FLOOD RISK MAPPING FOR VARIOUS RETURN PERIODS


FLOOD RISK MAPPING FOR 2Yr RETURN PERIOD
Legend
d PF 1
Value
High : 71.2025
Low : 0.000244141
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


FLOOD RISK MAPPING FOR 5 YEAR RETURN PERIOD
Legend
d PF 1
Value
High : 72.9176
Low : 0.00012207
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


FLOOD RISK MAPPING FOR 10 Yr RETURN PERIOD
Legend
d PF 1
Value
High : 73.7765
Low : 0.000244141
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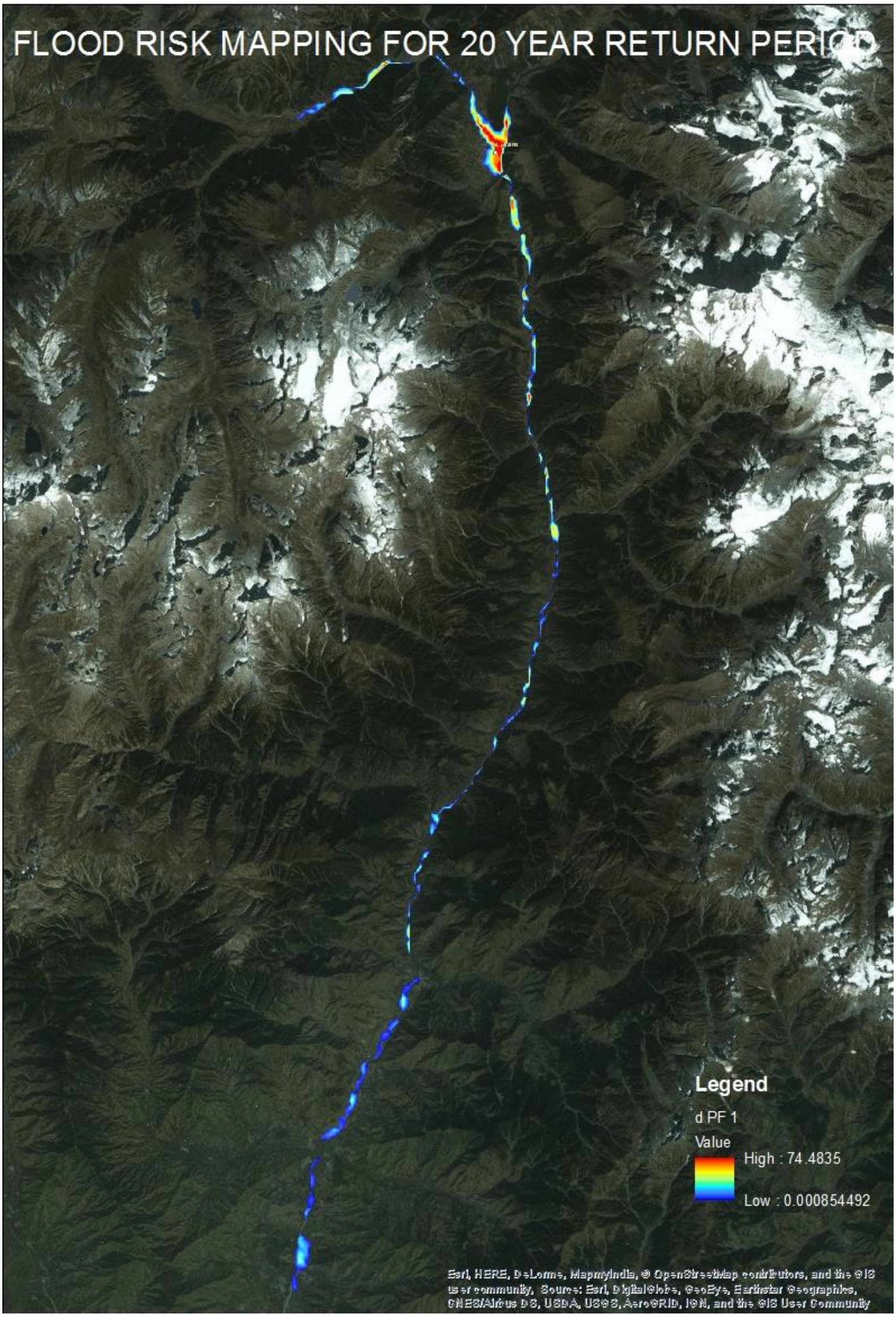
FLOOD RISK MAPPING FOR 20 YEAR RETURN PERIOD
Legend
d PF 1
Value
High : 74.4835
Low : 0.000854492
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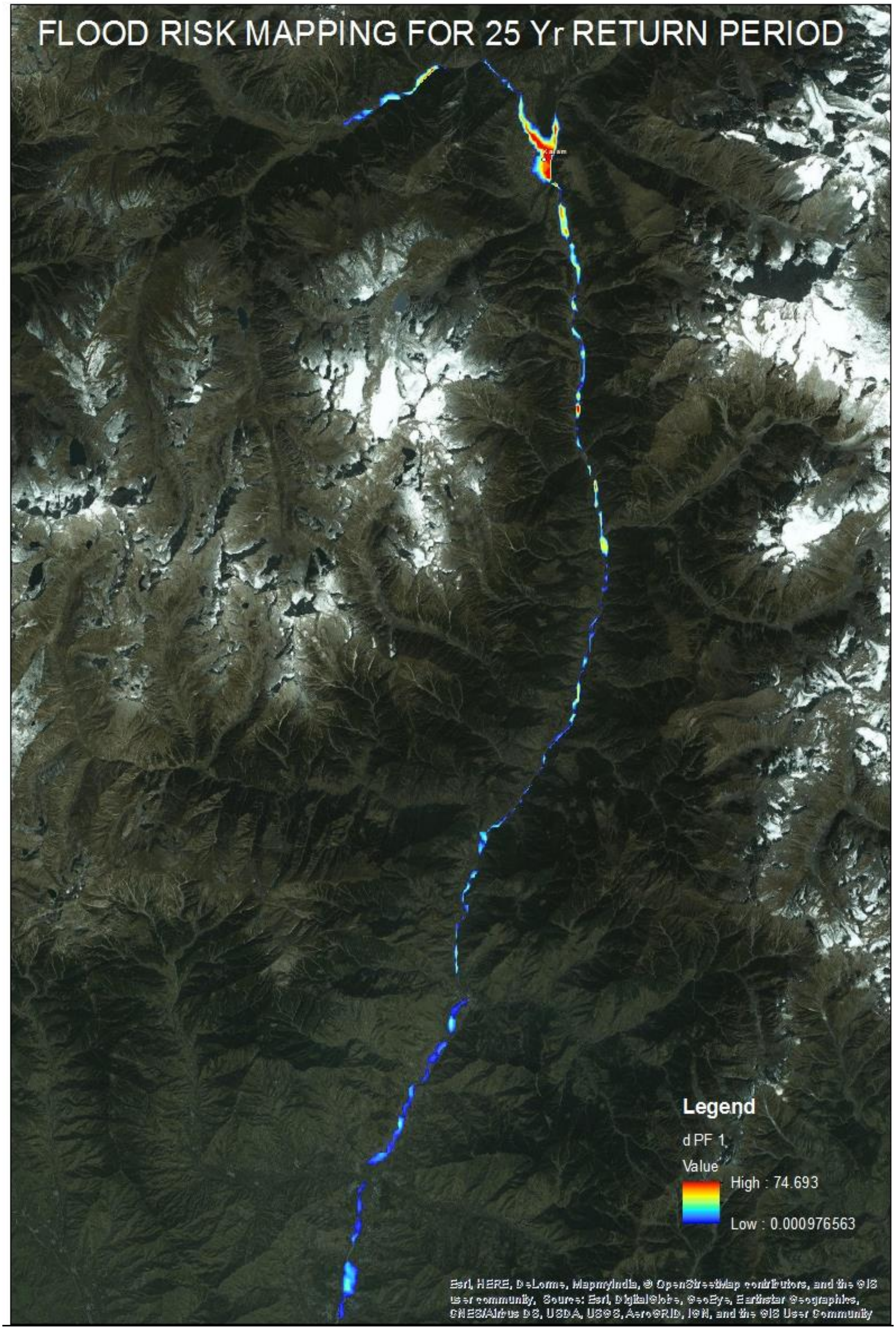
FLOOD RISK MAPPING FOR 25 Yr RETURN PERIOD
Legend
dPF 1
Value
High : 74.693
Low : 0.000976563
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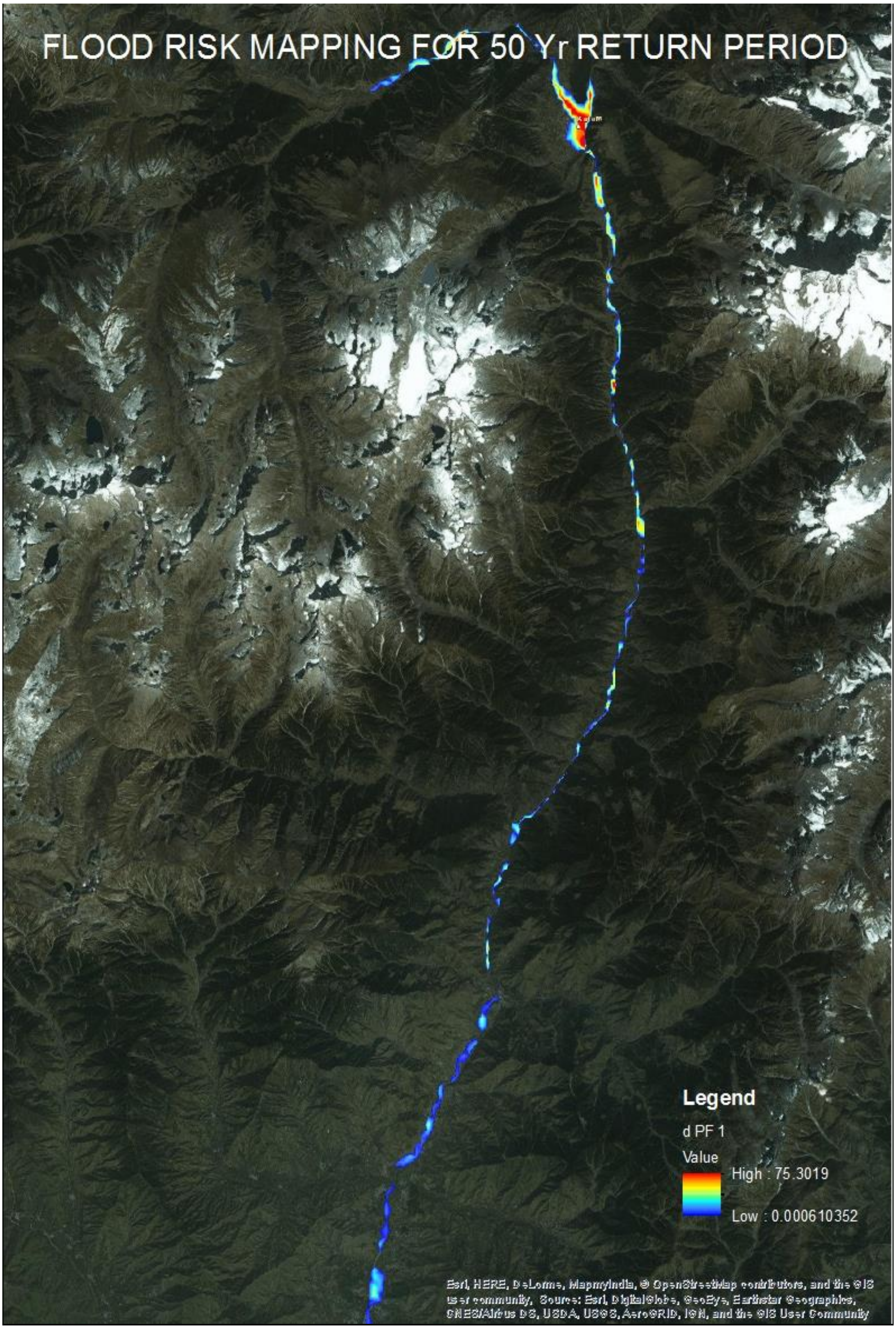
FLOOD RISK MAPPING FOR 50 Yr RETURN PERIOD
Legend
d PF 1
Value
High : 75.3019
Low : 0.000610352
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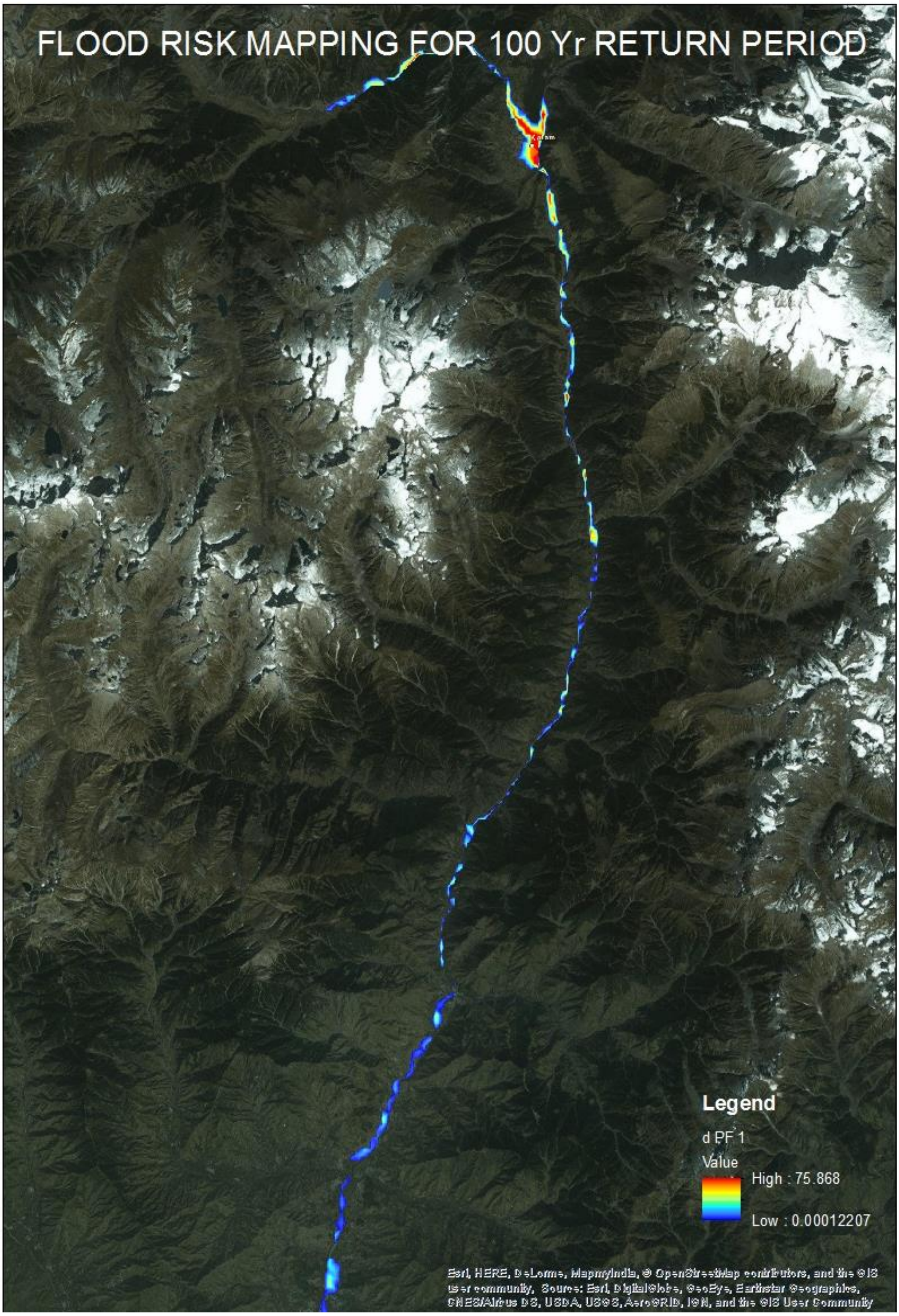
FLOOD RISK MAPPING FOR 100 Yr RETURN PERIOD
Legend
d PF 1
Value
High : 75.868
Low : 0.00012207
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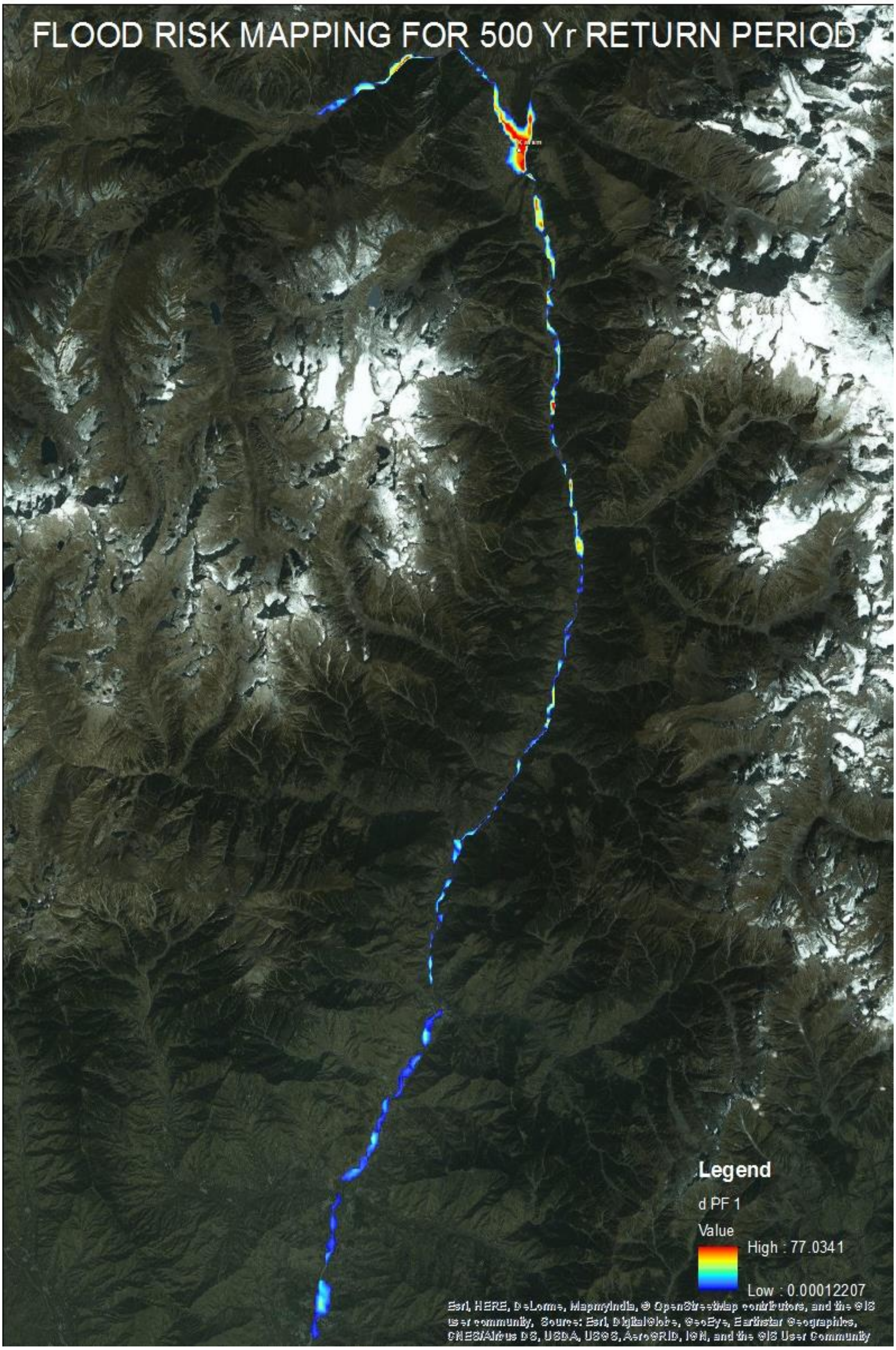
FLOOD RISK MAPPING FOR 500 Yr RETURN PERIOD
Legend
d PF 1
Value
High : 77.0341
Low : 0.00012207
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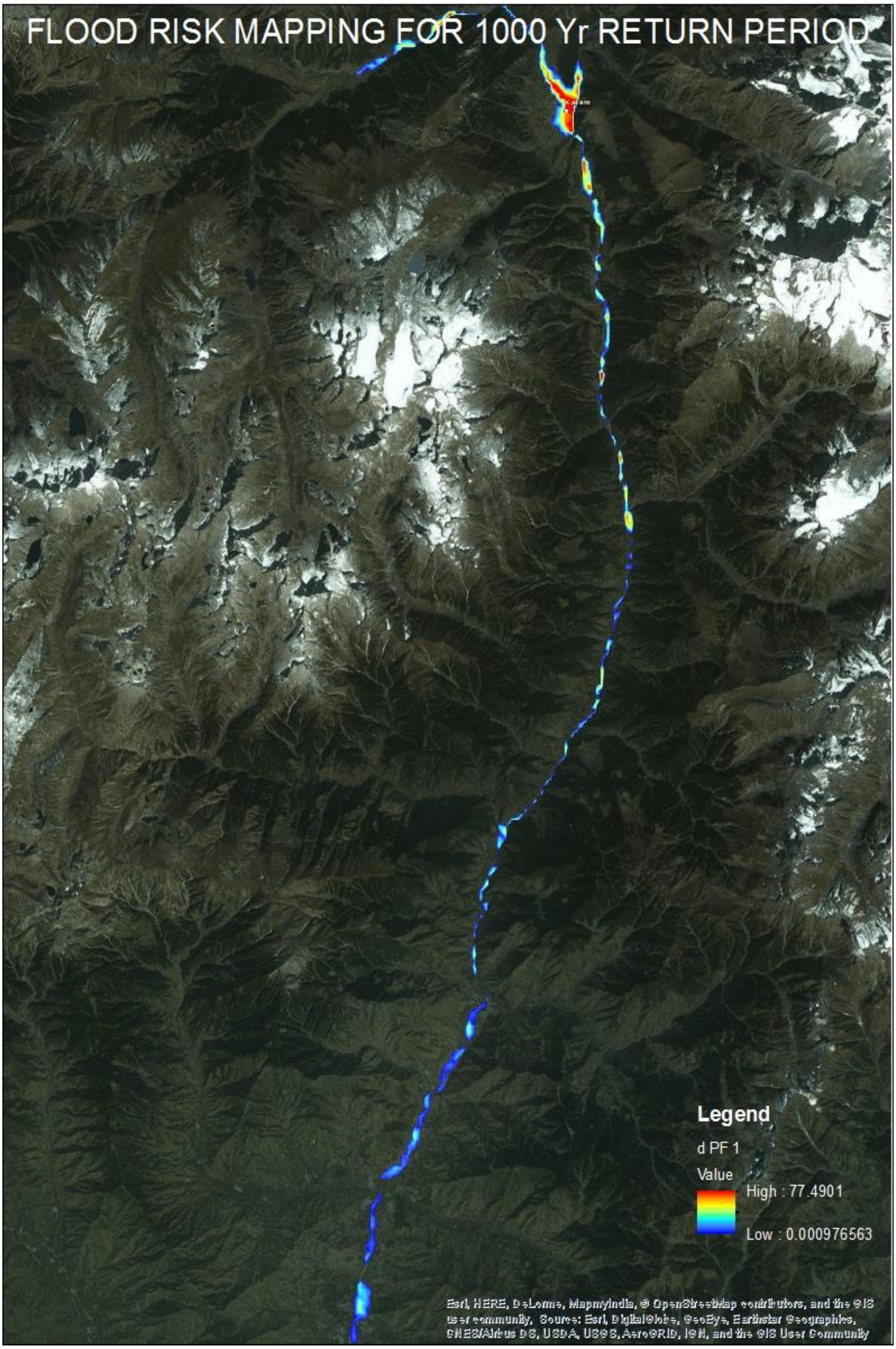
FLOOD RISK MAPPING FOR 1000 Yr RETURN PERIOD
Legend
d PF 1
Value
High : 77.4901
Low : 0.000976563
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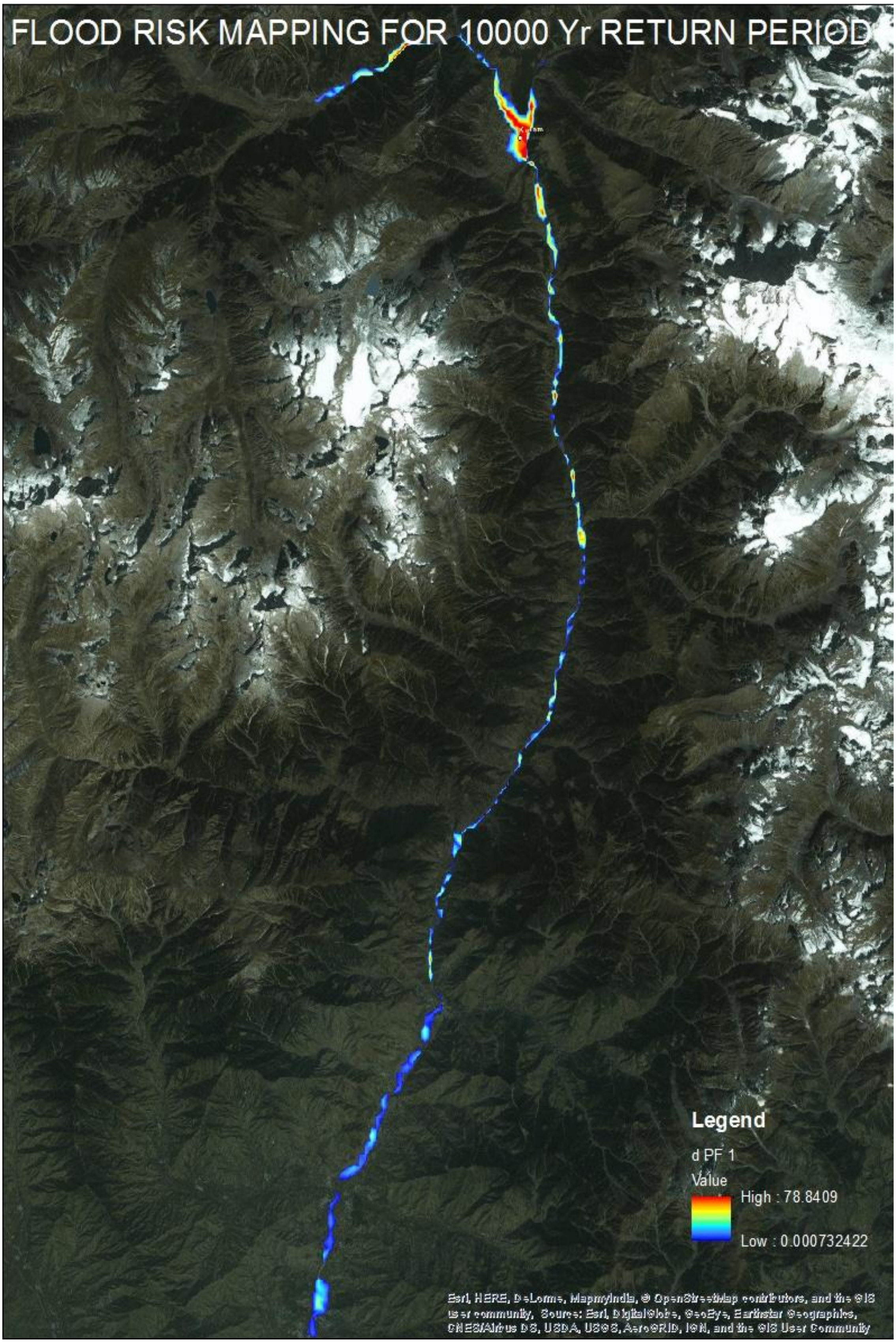
FLOOD RISK MAPPING FOR 10000 Yr RETURN PERIOD
Legend
d PF 1
Value
High : 78.8409
Low : 0.000732422
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