Table 3.4.1 FLOW DURATION CURVE AT HYDROLOGICAL STATIONS STATION NO.120(NANGRAON) (1/13)

YEAR : 1963 - 1989
TOTAL : 9862 DAYS
MAXIMUM : 1440.00
MINIMUM : 7.50
AVERAGE : 65.42

Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)
1	355.5	26	76.2	51	27.7	76	17.9
2	301.5	27	71.3	52	27.2	77	17.6
3	265.5	28	66.9	53	26.6	78	17.4
4	243.0	29	63.0	54	26.0	79	17.3
5	229.5	30	59.2	55	25.4	80	17.0
6	215.6	31	55.1	56	25.0	81	16.9
7	206.8	32	52.2	57	24.5	82	16.6
8	196.9	33	49.6	58	24.1	83	16.4
9	188.1	34	47.0	59	23.6	84	16.2
10	180.9	35	44.7	60	23.2	85	16.0
11	172.1	36	42.8	61	22.7	86	15.7
12	164.5	37	41.1	62	22.3	87	15.4
13	155.7	38	39.8	63	21.9	88	15.2
14	149.8	39	38.5	64	21.6	89	14.9
15	143.3	40	37.4	65	21.2	90	14.7
16	136.8	41	36.0	66	20.8	91	14.2
17	129.8	42	35.1	67	20.5	92	13.9
18	122.4	43	34.0	68	20.2	93	13.5
19	116.3	44	32.9	69	19.9	94	13.1
20	109.6	45	32.2	70	19.6	95	12.6
21	103.5	46	31.2	71	19.3	96	12.2
22	97.7	47	30.3	72	19.1	97	11.5
23	91.6	48	29.7	73	18.7	98	10.5
24	86.6	49	28.9	74	18.5	99	9.6
25	80.3	50	28.4	75	18.1	100	7.5

Table 3.4.1 FLOW DURATION CURVE AT HYDROLOGICAL STATIONS STATION NO. 150 (PANCHESHWAR) (2/13)

YEAR : 1984 - 1990
TOTAL : 2189 DAYS
MAXIMUM : 4731.20 CMS
MINIMUM : 107.24 CMS
AVERAGE : 593.45 CMS

Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)
1	3179.4	26	734.3	51	292.9	76	161.6
2	2664.3	27	686.8	52	285.5	77	159.1
3	2371.6	28	662.5	53	277.7	78	156.8
4	2245.1	29	631.5	54	269.4	79	155.4
5	2010.8	30	599.1	55	260.7	80	153.2
6	1877.8	31	571.2	56	251.4	81	151.1
7	1736.3	32	548.0	57	243.1	82	149.0
8	1626.1	33	528.5	58	234.7	83	147.1
9	1564.8	34	502.0	59	227.9	84	146.0
10	1479.5	35	487.5	60	220.3	85	144.6
11	1416.5	36	473.0	61	215.4	86	142.2
12	1370.6	37	462.3	62	210.4	87	140.1
13	1315.7	38	453.6	63	205.4	88	138.7
14	1283.7	39	439.5	64	202.8	89	137.3
15	1236.3	40	423.4	65	200.8	90	134.2
16	1171.5	41	405.6	66	197.7	91	132.6
17	1113.3	42	390.9	67	192.4	92	130.0
18	1065.2	43	378.5	68	188.0	93	127.8
19	1017.5	44	366.2	69	183.2	94	125.3
20	982.0	45	357.0	70	180.2	95	123.3
21	952.6	46	344.8	71	175.3	96	122.0
22	907.2	47	328.1	72	172.3	97	121.0
23	874.3	48	317.6	73	169.1	98	120.6
24	833.7	49	309.5	74	165.5	99	117.4
25	783.1	50	300.0	75	164.1	100	107.2

Table 3.4.1 FLOW DURATION CURVE AT HYDROLOGICAL STATIONS STATION NO. 170 (PATAN) (3/13)

YEAR : 1966 - 1984
TOTAL : 6940 DAYS
MAXIMUM : 225.00 CMS
MINIMUM : 0.17 CMS
AVERAGE : 7.11 CMS

Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)
1	75.0	26	5.6	51	1.5	76	0.9
2	58.0	27	5.1	52	1.5	77	0.9
3	46.7	28	4.8	53	1.4	78	0.9
4	39.0	29	4.5	54	1.4	79	0.9
5	31.8	30	4.1	55	1.3	80	0.9
6	27.5	31	3.8	56	1.3	81	0.8
7	24.4	32	3.5	57	1.3	82	0.8
8	22.2	33	3.2	58	1.2	83	0.8
9	20.6	34	3.0	59	1.2	84	0.8
10	19.0	35	2.9	60	1.2	85	0.8
11	17.5	36	2.7	61	1.2	86	0.7
12	16.3	37	2.6	62	1.1	87	0.7
13	15.2	38	2.4	63	1.1	88	0.7
14	14.4	39	2.3	64	1.1	89	0.7
15	13.4	40	2.2	65	1.1	90	0.6
16	12.4	41	2.1	66	1.1	91	0.6
17	11.8	42	2.0	67	1.1	92	0.6
18	11.1	43	1.9	68	1.0	93	0.6
19	10.3	44	1.8	69	1.0	94	0.5
20	9.6	45	1.8	70	1.0	95	0.5
21	8.9	46	1.7	71	1.0	96	0.5
22	8.2	47	1.7	72	1.0	97	0.4
23	7.4	48	1.6	73	1.0	98	0.4
24	6.8	49	1.6	74	0.9	99	0.3
25	6.2	50	1.5	75	0.9	100	0.2

Table 3.4.1 FLOW DURATION CURVE AT HYDROLOGICAL STATIONS STATION NO.240 (ASARA GHAT) (4/13)

YEAR : 1963 - 1985
TOTAL : 8401 DAYS
MAXIMUM : 4246.00 CMS
MINIMUM : 78.80 CMS
AVERAGE : 502.17 CMS

Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)
1	1900.0	26	735.5	51	261.0	76	142.0
2	1750.0	27	699.6	52	252.2	77	140.0
3	1650.0	28	666.0	53	244.0	78	138.0
4	1580.3	29	637.0	54	237.0	79	136.0
5	1511.5	30	604.0	55	230.0	80	134.0
6	1460.0	31	581.0	56	223.0	81	131.8
7	1410.0	32	558.0	57	218.0	82	130.0
8	1360.0	33	531.0	58	210.0	83	128.0
9	1310.0	34	506.0	59	205.0	84	126.0
10	1270.0	35	482.0	60	200.0	85	124.0
11	1230.0	36	457.2	61	195.0	86	122.0
12	1200.0	37	435.0	62	190.0	87	120.0
13	1160.0	38	415.0	63	185.7	88	118.0
14	1130.0	39	398.0	64	181.0	89	116.0
15	1107.0	40	384.0	65	177.0	90	114.0
16	1080.0	41	367.0	66	174.0	91	112.0
17	1045.0	42	354.0	67	169.0	92	110.0
18	1010.0	43	339.9	68	164.0	93	107.0
19	970.0	44	326.0	69	161.4	94	105.0
20	935.0	45	317.0	70	158.0	95	102.0
21	895.0	46	305.0	71	155.0	96	98.1
22	860.0	47	295.4	72	152.0	97	94.4
23	820.4	48	287.0	73	149.0	98	91.3
24	788.5	49	277.0	74	147.0	99	85.4
25	758.0	50	268.0	75	144.0	100	78.8

Table 3.4.1 FLOW DURATION CURVE AT HYDROLOGICAL STATIONS STATION NO. 260 (BANGA NEAR BELGAON) (5/13)

YEAR : 1963 - 1989
TOTAL : 9862 DAYS
MAXIMUM : 6400.00 CMS
MINIMUM : 33.00 CMS
AVERAGE : 288.28 CMS

Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)
1	1580.0	26	333.0	51	122.0	76	79.0
2	1330.0	27	311.0	52	119.0	77	78.0
3	1180.0	28	292.0	53	117.0	78	78.0
4	1073.0	29	275.0	54	114.0	79	77.0
5	1010.0	30	257.0	55	112.0	80	76.0
6	954.0	31	240.0	56	110.0	81	75.0
7	917.0	32	229.0	57	108.0	82	74.0
8	870.0	33	216.0	58	106.0	83	73.0
9	832.0	34	206.0	59	104.0	84	72.0
10	794.0	35	197.0	60	102.0	85	71.0
11	762.0	36	187.0	61	100.0	86	70.0
12	728.0	37	181.0	62	98.0	87	69.0
13	692.0	38	174.0	63	96.0	88	68.0
14	660.0	39	168.0	64	95.0	89	66.0
15	632.0	40	163.0	65	94.0	90	65.0
16	600.0	41	158.0	66	92.0	91	64.0
17	567.0	42	153.0	67	90.0	92	62.0
18	536.0	43	149.0	68	89.0	93	60.0
19	505.0	44	144.0	69	87.0	94	58.0
20	476.0	45	140.0	70	86.0	95	56.0
21	451.0	46	136.0	71	85.0	96	54.0
22	426.0	47	133.0	72	84.0	97	51.0
23	400.0	48	130.0	73	82.0	98	47.0
24	378.0	49	127.0	74	81.0	99	43.0
25	354.0	50	124.0	75	80.0	100	33.0

Table 3.4.1 FLOW DURATION CURVE AT HYDROLOGICAL STATIONS
STATION NO. 262 (KHANAYATAL) (6/13)

YEAR : 1970 - 1986
TOTAL : 6209 DAYS
MAXIMUM : 1450.00 CMS
MINIMUM : 0.68 CMS
AVERAGE : 33.04 CMS

Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)
1	238.0	26	34.1	51	10.1	76	3.5
2	186.0	27	32.2	52	9.6	77	3.3
3	162.0	28	31.2	53	9.2	78	3.1
4	141.0	29	29.3	54	8.7	79	3.0
5	128.0	30	27.8	55	8.2	80	3.0
6	120.0	31	26.6	56	7.7	81	2.9
7	111.0	32	25.8	57	7.3	82	2.8
8	103.0	33	24.9	58	7.0	83	2.7
9	96.6	34	24.1	59	6.7	84	2.6
10	90.8	35	23.3	60	6.4	85	2.5
11	86.0	36	22.0	61	6.2	86	2.4
12	82.8	37	21.4	62	5.9	87	2.4
13	77.0	38	20.7	63	5.7	88	2.3
14	73.5	39	19.5	64	5.6	89	2.2
15	70.0	40	18.4	65	5.3	90	2.1
16	66.0	41	17.8	66	5.1	91	2.0
17	61.6	42	16.6	67	4.9	92	1.9
18	58.7	43	15.5	68	4.7	93	1.8
19	55.0	44	14.4	69	4.5	94	1.7
20	50.0	45	13.1	70	4.3	95	1.6
21	47.0	46	12.4	71	4.1	96	1.5
22	44.6	47	11.8	72	4.0	97	1.4
23	42.0	48	11.3	73	3.9	98	1.2
24	38.9	49	10.9	74	3.7	99	1.0
25	36.0	50	10.3	75	3.6	100	0.7

Table 3.4.1 FLOW DURATION CURVE AT HYDROLOGICAL STATIONS
STATION NO. 270 (JAMU) (7/13)

YEAR : 1963 - 1987
TOTAL : 8765 DAYS
MAXIMUM : 5120.00 CMS
MINIMUM : 50.40 CMS
AVERAGE : 428.75 CMS

Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)
1	2420.0	26	505.0	51	151.0	76	96.6
2	2020.0	27	470.0	52	148.0	77	96.4
3	1790.0	28	434.0	53	144.0	78	94.8
4	1660.0	29	399.0	54	141.0	79	93.8
5	1580.0	30	373.0	55	138.0	80	91.7
6	1490.0	31	351.0	56	134.0	81	91.0
7	1440.0	32	327.0	57	132.0	82	89.3
8	1380.0	33	302.0	58	129.0	83	87.6
9	1330.0	34	285.0	59	127.0	84	86.8
10	1280.0	35	266.0	60	125.0	85	85.9
11	1230.0	36	248.0	61	122.0	86	84.4
12	1180.0	37	236.0	62	122.0	87	84.0
13	1130.0	38	224.0	63	119.0	88	82.5
14	1070.0	39	213.0	64	117.0	89	80.8
15	1020.0	40	205.0	65	114.0	90	79.8
16	982.0	41	198.0	66	112.0	91	79.1
17	926.0	42	190.0	67	110.0	92	77.4
18	873.0	43	184.0	68	108.0	93	75.7
19	821.0	44	180.0	69	106.0	94	74.0
20	770.0	45	174.0	70	104.0	95	72.7
21	732.0	46	171.0	71	103.0	96	70.7
22	693.0	47	166.0	72	101.0	97	68.4
23	647.0	48	162.0	73	100.0	98	66.0
24	603.0	49	159.0	74	98.8	99	61.2
25	550.0	50	155.0	75	98.0	100	50.4

Table 3.4.1 FLOW DURATION CURVE AT HTDROLOGICAL STATIONS STATION NO. 280 (CHISAPANI) (8/13)

YEAR : 1962 - 1988
TOTAL : 9862 DAYS
MAXIMUM : 14700.00 CMS
MINIMUM : 24.00 CMS
AVERAGE : 1377.69 CMS

Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)
1	6340.0	26	1760.0	51	611.0	76	361.0
2	5620.0	27	1647.0	52	594.0	77	358.0
3	5259.0	28	1540.0	53	579.0	78	352.0
4	4920.0	29	1452.0	54	565.0	79	345.0
5	4650.0	30	1362.0	55	550.0	80	340.0
6	4440.0	31	1273.0	56	535.0	81	334.0
7	4266.0	32	1211.0	57	524.0	82	330.0
8	4110.0	33	1154.0	58	513.0	83	326.0
9	3990.0	34	1104.0	59	505.0	84	322.0
10	3870.0	35	1050.0	60	493.0	85	317.0
11	3720.0	36	1004.0	61	483.0	86	314.0
12	3560.0	37	951.0	62	474.0	87	310.0
13	3430.0	38	910.0	63	464.0	88	305.0
14	3300.0	39	877.0	64	453.0	89	302.0
15	3150.0	40	847.0	65	443.0	90	298.0
16	3010.0	41	815.0	66	433.0	91	293.0
17	2893.0	42	792.0	67	423.0	92	288.0
18	2730.0	43	770.0	68	412.0	93	283.0
19	2610.0	44	750.0	69	404.0	94	274.0
20	2480.0	45	730.0	70	396.0	95	262.0
21	2380.0	46	707.0	71	392.0	96	253.0
22	2252.0	47	688.0	72	385.0	97	244.0
23	2130.0	48	666.0	73	379.0	98	235.0
24	2000.0	49	646.0	74	372.0	99	217.0
25	1870.0	50	628.0	75	367.0	100	24.0

Table 3.4.1 FLOW DURATION CURVE AT HYDROLOGICAL STATIONS
STATION NO. 286 (DARADHUNGA) (9/13)

YEAR : 1972 - 1985
TOTAL : 5114 DAYS
MAXIMUM : 670.00 CMS
MINIMUM : 0.62 CMS
AVERAGE : 14.76 CMS

Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)
1	130.0	26	14.2	51	4.9	76	2.8
2	87.0	27	13.5	52	4.8	77	2.7
3	70.0	28	12.5	53	4.8	78	2.6
4	61.2	29	11.7	54	4.6	79	2.5
5	54.8	30	10.8	55	4.5	80	2.5
6	49.8	31	10.1	56	4.4	81	2.4
7	45.8	32	9.6	57	4.4	82	2.4
8	42.3	33	9.2	58	4.4	83	2.3
9	40.0	34	8.7	59	4.3	84	2.3
10	37.0	35	8.2	60	4.2	85	2.2
11	35.3	36	7.8	61	4.1	86	2.2
12	33.7	37	7.5	62	4.0	87	2.2
13	32.0	38	7.3	63	3.9	88	2.1
14	30.6	39	7.0	64	3.8	89	2.1
15	29.0	40	6.8	65	3.7	90	2.0
16	27.5	41	6.6	66	3.6	91	1.9
17	26.5	42	6.4	67	3.5	92	1.8
18	25.0	43	6.2	68	3.4	93	1.7
19	23.8	44	5.9	69	3.4	94	1.7
20	22.4	45	5.8	70	3.3	95	1.6
21	21.0	46	5.6	71	3.3	96	1.5
22	20.0	47	5.4	72	3.2	97	1.5
23	18.2	48	5.2	73	3.1	98	1.3
24	16.4	49	5.1	74	3.0	99	1.1
25	15.0	50	4.9	75	2.8	100	0.6

Table 3.4.1 FLOW DURATION CURVE AT HYDROLOGICAL STATIONS STATION NO.290 (BARGADHA) (10/13)

YEAR : 1967 - 1986
TOTAL : 6573 DAYS
MAXIMUM : 6120.00 CMS
MINIMUM : 4.04 CMS
AVERAGE : 87.26 CMS

Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)
1	960.0	26	79.6	51	23.4	76	12.5
2	580.0	27	76.0	52	22.9	77	12.0
3	432.0	28	71.3	53	22.1	78	11.8
4	351.0	29	66.8	54	21.3	79	11.4
5	305.0	30	62.8	55	20.7	80	11.0
6	282.0	31	59.0	56	20.0	81	10.6
7	258.0	32	54.8	57	19.6	82	10.5
8	236.0	33	51.8	58	19.4	83	10.0
9	214.0	34	49.5	59	18.9	84	10.0
10	202.0	35	46.5	60	18.4	85	9.7
11	188.0	36	44.3	61	18.0	86	9.5
12	176.0	37	41.8	62	17.5	87	9.2
13	166.0	38	39.6	63	17.2	88	9.0
14	158.0	39	37.2	64	16.8	89	8.8
15	149.0	40	34.9	65	16.5	90	8.6
16	140.0	41	33.4	66	16.0	91	8.3
17	133.0	42	32.2	67	15.6	92	8.1
18	124.0	43	30.6	68	15.1	93	7.8
19	117.0	44	29.4	69	14.8	94	7.5
20	110.0	45	28.5	70	14.4	95	7.2
21	104.0	46	27.4	71	14.1	96	7.0
22	98.8	47	26.8	72	13.8	97	6.3
23	92.8	48	25.7	73	13.5	98	5.9
24	88.0	49	25.0	74	13.0	99	5.2
25	83.8	50	24.2	75	12.8	100	4.0

Table 3.4.1 FLOW DURATION CURVE AT HYDROLOGICAL STATIONS
STATION NO. 330 (NAYAGAON) (11/13)

YEAR : 1965 - 1985
TOTAL : 6575 DAYS
MAXIMUM : 835.00 CMS
MINIMUM : 4.48 CMS
AVERAGE : 60.39 CMS

Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)
1	390.0	26	70.4	51	21.0	76	13.0
2	313.0	27	66.6	52	20.5	77	12.8
3	284.0	28	62.0	53	19.8	78	12.7
4	261.0	29	57.7	54	19.6	79	12.5
5	243.0	30	53.8	55	19.1	80	12.2
6	223.0	31	50.3	56	18.6	81	12.0
7	210.0	32	46.6	57	18.1	82	11.9
8	195.0	33	44.0	58	17.7	83	11.6
9	184.0	34	41.0	59	17.3	84	11.4
10	172.0	35	38.8	60	17.0	85	11.2
11	160.0	36	37.0	61	16.6	86	10.9
12	152.0	37	35.4	62	16.5	87	10.7
13	143.0	38	33.7	63	16.2	88	10.4
14	134.0	39	32.0	64	15.8	89	10.2
15	125.0	40	30.8	65	15.6	90	10.1
16	117.0	41	29.4	66	15.4	91	9.8
17	111.0	42	28.2	67	15.0	92	9.4
18	106.0	43	27.2	68	15.0	93	9.1
19	101.0	44	26.2	69	14.6	94	8.7
20	96.9	45	25.2	70	14.5	95	8.3
21	92.0	46	24.5	71	14.3	96	7.9
22	87.0	47	23.8	72	13.9	97	7.3
23	84.0	48	22.9	73	13.8	98	6.7
24	79.0	49	22.2	74	13.4	99	5.9
25	74.6	50	21.5	75	13.3	100	4.5

Table 3.4.1 FLOW DURATION CURVE AT HYDROLOGICAL STATIONS STATION NO. 350 (BAGASOTI GAON) (12/13)

YEAR : 1976 - 1985
TOTAL : 3653 DAYS
MAXIMUM : 1690.00 CMS
MINIMUM : 7.74 CMS
AVERAGE : 93.42 CMS

Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)
1	488.0	26	122.0	51	39.0	76	23.2
2	395.0	27	114.0	52	38.0	77	23.0
3	355.0	28	105.0	53	37.2	78	22.4
4	323.0	29	99.6	54	36.3	79	21.8
5	305.0	30	94.2	55	35.4	80	21.4
6	282.0	31	89.5	56	34.6	81	21.0
7	273.0	32	84.8	57	34.0	82	20.5
8	260.0	33	79.4	58	33.5	83	20.1
9	249.0	34	74.0	59	32.7	84	19.6
10	238.0	35	70.6	60	31.8	85	19.4
11	230.0	36	68.2	61	30.9	86	18.7
12	224.0	37	64.3	62	30.4	87	18.7
13	216.0	38	61.6	63	30.0	88	18.0
14	210.0	39	58.0	64	29.2	89	17.3
15	202.0	40	56.0	65	28.8	90	16.9
16	196.0	41	53.9	66	28.3	91	16.6
17	189.0	42	51.3	67	28.0	92	16.0
18	183.0	43	49.8	68	27.5	93	15.6
19	176.0	44	47.8	69	27.0	94	15.2
20	170.0	45	46.7	70	26.4	95	14.5
21	164.0	46	45.0	71	25.8	96	14.0
22	157.0	47	43.8	72	25.0	97	13.2
23	151.0	48	42.6	73	24.9	98	12.3
24	143.0	49	41.6	74	24.1	99	10.7
25	132.0	50	40.2	75	24.0	100	7.7

Table 3.4.1 FLOW DURATION CURVE AT HYDROLOGICAL STATIONS STATION NO. 360 (JALKUNDI) (13/13)

YEAR : 1964 - 1985
TOTAL : 8036 DAYS
MAXIMUM : 5110.00 CMS
MINIMUM : 1.05 CMS
AVERAGE : 123.09 CMS

Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)	Duration (%)	Runoff (CMS)
1	970.0	26	141.0	51	32.7	76	17.6
2	715.0	27	134.0	52	31.6	77	17.2
3	584.0	28	126.0	53	30.9	78	16.8
4	510.0	29	117.0	54	30.4	79	16.0
5	465.0	30	109.0	55	29.3	80	15.6
6	438.0	31	102.0	56	28.7	81	15.2
7	411.0	32	94.8	57	28.0	82	14.8
8	384.0	33	87.6	58	27.5	83	14.4
9	361.0	34	80.1	59	27.0	84	14.0
10	340.0	35	75.0	60	26.5	85	13.4
11	321.0	36	70.0	61	26.0	86	13.0
12	303.0	37	65.0	62	25.5	87	12.6
13	286.0	38	60.8	63	25.0	88	12.1
14	270.0	39	56.8	64	24.5	89	11.6
15	261.0	40	53.6	65	24.0	90	10.9
16	248.0	41	50.5	66	23.0	91	10.0
17	238.0	42	48.0	67	22.5	92	9.3
18	226.0	43	44.8	68	22.0	93	8.5
19	214.0	44	42.4	69	21.5	94	7.6
20	204.0	45	40.3	70	21.0	95	6.8
21	193.0	46	38.8	71	20.5	96	5.9
22	182.0	47	37.6	72	20.0	97	4.9
23	170.0	48	36.3	73	19.2	98	4.2
24	160.0	49	35.2	74	18.8	99	3.1
25	151.0	50	33.9	75	18.0	100	1.1

Table 3.5.1 DISCHARGE DATA MEASURED IN THE IRRIGATION PROJECTS (1/4)

NUMBER	PROJECT NAME	DISTRICT	ELEVATION	RIVER NAME	CATCHMENT AREA (km^2)	INFORMATION OF DISCHARGE m^3/s
RIVER BASIN	Karnali Zone					
K1	Juphal Irrigation Project	Dolpa	2850 m	Khur Khola		0.15 m3/s (Date 1989 Jun) Measured
K2	Garjyangkot Irrigation Project	Jumla	2430 to 2670 m	Talpunera Khola	15.75	Minimum discharge = 773.05 l/s October and September
K3	Ukhadi Khola Irrigation Project	Kalikot	1800 m (approx)	Ukhadikhola	30.6	Measured discharge on date = 1.078 m^3/s (18-5-1985)
K4	Jubitha Irrigation Project	"	2200 m to 2480 m	Khanla Gad Khola	13.82	Min discharge 0.138 m^3/s Measured discharge on date (15-5-1987)=450 l/s
K5	Dhilamghatta Irrigation Project	Mugu	2000 m	Kalgad	18	Min Flow = 0.2 m^3/s Measured discharge on date (1988, 2 Aus) 0.29 m^3/s
K6	Natharpu V.P. Irrigation Project	"				
K7	Sanyo Irrigation Project	Humla	2000 m	Sanya Khola	2.22	Min discharge = 9 l/sec Discharge on date 1944 Apr = 10 l/s
K8	Yanchu Irrigation Project	"	2100 m	Yanchu Khola	2.22 km^2	Min discharge = 38 lit/sec
RIVER BASIN	Seti Zone					
S1.	Jukot Irrigation Project	Bajura	1800 m	Bhatera Khola	1.621	Min Flow 0.13 m3/s

Table 3.5.1 DISCHARGE DATA MEASURED IN THE IRRIGATION PROJECTS (2/4)

NUMBER	PROJECT NAME	DISTRICT	ELEVATION	RIVER NAME	CATCHMENT AREA (Km^2)	INFORMATION OF DISCHARGE m^3/s
RIVER BASIN Bheri Zone						
B1	Gitachour-Rawatkot Irrigation Project	Dailekha	916 m	Sano Khola	42.25	Minmum discharge : 1.43 m^3/s
B2	Holy Bhairabikhola Irrigation Project	Jajarkot	660 m to 700	Holu Khola	17.5	Min. discharge 0.2 m^3/s
B3	Nalagad Irrigation Project	"	1000 m	Nal Gad	675	Min discharge 3.4 m^3/s
B4	Daha Gad Irrigation Project	"	2000 m	Dahakhola	24	Min discharge = 0.16 m^3/s (March) Measured discharge = 0.52 m^3/s Date (1088-5-30)
B5	Salkot Irrigation Project	Surkhet	335 to 450 m	Khamarle Khola Bhyagute Khola	3.94 6.3	Measured Flow 165 l/s (1983-1-22) Measured Flow 105 l/s (1983-1-23)
B6	Kaprichaur Irrigation Project	"	690 m	Simta Khola	80	Min. Flow 0.3 m^3/s (1979 May)
B7	Khorke Khola Irrigation Project	"	760 m	Khorke	12	Min Flow 0.008 m^3/s (Monthly)
B8	Surkhet valley Irrigation Project	"	670 m	Chingar Khola	153	Min Flow 0.998 m^3/s

Table 3.5.1 DISCHARGE DATA MEASURED IN THE IRRIGATION PROJECTS (3/4)

NUMBER	PROJECT NAME	DISTRICT	ELEVATION	RIVER NAME	CATCHMENT AREA (Km^2)	INFORMATION OF DISCHARGE m^3/s
M1.	Dhari Gad Irrigation Project	Darchula	650 m	Dhari Gad	2.86	Min Monthly Flow : 0.052 m^3/s (April) Discharge (On Date April 1987) 0.075 m^3/s
M2.	Kukure Gad Irrigation Project	"	1560 m	Kukure Gad	6.052	Min Flow 200 lit/sec Discharge (On Date April 1987) 9.61 m^3/s
M3.	Lati Nath Irrigation Project	"	1500	Dad Khola	3.9	Min. Flow 0.082 m^3/s
M4.	Dhap Irrigation Project	"	650 m to 850 m	Thali Gad Khola	36.75	Min. Flow 0.082 m^3/s (1986-4-18)
M5.	Sakyal Irrigation Project	Dadeldhura	680 m	Sakayal Khola	38	Min Flow 800 l/s Discharge (On Date 1988 May) 0.99 m^3/s
M6.	Doti Khola Irrigation Project	"	1500 m	Doti Khola	30	Min. Flow 0.241 m^3/s
M7.	Sirse Khola Irrigation Project	"	369 m to 488 m	Sirse Gad	56.6	Min Flow 0.077 m^3/s Discharge (On Date 26 Jan, 1991)
M8.	Gilla Irrigation Project	"	970 m to 1026 m	Sakyal Khola	38	Min Flow 0.85 m^3/s (1984, Feb)
M9.	Dumani Gad Irrigation Project	Baitadi	1095 m	Dumani Gad	1.38	Min Monthly Flow 1.78 lit/sec Discharge (On Date 1.78 lit/sec)
M10.	Satgad Kulo Irrigation Project	"	1554 m	Satgad	24.97	Min Flow 0.056 m^3/s Discharge (On Date 1984 Jan 19) 110 lit/sce
M11	Dilleswari M. B Irrigation Project	"	1990 m	Loli Gad	23.41	Min. Monthly Flow 0.051 m^3/s Discharge (On Date 1984 Jan) 117.06 l/s
M12	Sunwagadi Irrigation Project	"	1920 m	Sunwagadi	2.54	Min. Flow 2.5 l/s Measured (On Date 1984 Jan) 26.4 l/s
M13	Kakari Melghat Irrigation Project	"	600 m to 700 m	Sumayagad	416	Min Flow : 1.739 m^3/s (Date May 1988)
M14	Maleria Nala Irrigation Project	Kanchanpur	102 m	Maleria Nala		Discharge mensured 0.75 m^3/s
M15	Kalapani Irrigation Project	"	225 to 238 m	Shihali River Toli Nala	14.25 9.75	Min Flow 0.18 m^3/s Min Flow 0.123 m^3/s

Table 3.5.1 DISCHARGE DATA MEASURED IN THE IRRIGATION PROJECTS (4/4)

NUMBER	PROJECT NAME	DISTRICT	ELEVATION	RIVER NAME	CATCHMENT AREA (Km^2)	INFORMATION OF DISCHARGE m^3/s
RIVER BASIN	Rapti Zone					
R1.	Lunrimadi Irrigation Project	Pyuthan	762 m to 1844 m	Lungri Khola	331	Min discharge 0.813 m^3/s
R2.	Paklibesi Irrigation Project	Pyuthan	625 m	Jhimruk	1070	Measured flow 2.95 m^3/s
R3.	Maranthan Irrigation Project	Pyuthan	853 m	Dharmabati Nadi		Min discharge 6.31 m^3/s
R4.	Khangri chour Irrigation Project	Rolpa	615 m to 675 m	Deukhuri Khola		Measured discharge 2.132 cusec
R5.	Banjb Kanda Irrigation Project	Salyan	1105 m	Sharda River	177	Meausred discharge = 0.3 m^3/s
R6.	Ghatte Khola Irrigation Project	Rukum	1050 m	Ghatte Khola	0.95	Min discharge 0.011 m^3/s
	"	"		Nathi Gad	16.72	Min discharge 0.016 m^3/s
R7.	Kamal Irrigation Project	"	1400 m to 200 m	Hari Khola	1.766	Min discharge 5.609 cusecs = 0.1588 m^3/s
R8.	Nathigad Irrigation Project	"	1868 m to 1086 r	Nathi Gad	0.3	Min. Flow = 0.25 m^3/s Discharge (On Date 1988-2-18) 427 D/S
R9.	Sodi Khola Irrigation Project	Dang	615m to 705 m	Hapur Khola	20	Low flow : 30 l/sec Discharge (1988-9-18) 1.269 m^3/s
R10.	Sonpur Natri Irrigation Project	"	94 m	Burlailya	55.5	Discharge (On Date 1991 Jun) 2.2 m^3/s Min Flow - Not Available
R11.	Bahundada Irrigation Project	"	28° 04' N 82° 28' E	Sewar Khola	23.54	Min. Flow 5.1 Cusecs = 0.1444 m^3/s
R12.	Sir Khola Irrigation Project	"	76 m	Sir Khola	28	Min Flow 0.095 m^3/s
R13.	Arjun Khola Irrigation Project	"	240 m to 264 m	Ajun Khola	510.5	Discharge On Date 1984 Oct 1.02 m^3/s
R14.	Majaoo Khola Irrigation Project	Rukum	1190 m to 1400 r	Patel Khola	4.08	Flow on (1981-4-17): 24.57 l/s

Table 4.2.1 Annual Maximum Instantaneous Discharge

Unit : m3/s

Year	Station No.													
	Banbasa	170	240	250	260	262	270	280	286	290	330	340	350	360
1962	10,704		2,850					9,820						
1963	10,182		3,560	5,070	5,850		5,330	10,800						
1964	9,154		2,380	3,780	3,090		3,950	9,460			880			1,480
1965	4,525		1,300	1,400	1,310		2,250	4,300			371	209		1,020
1966	12,375	121	2,360	3,360	2,360		2,990	7,230			337	155		1,120
1967	8,826	37	2,290	3,310	5,060		2,150	9,780		2,300	327	263		1,020
1968	7,315	41.8	2,290	3,640	3,370		2,180	10,700		1,110	480	245		1,530
1969	13,609	99.2	2,650	4,370	4,460		2,910	10,500		3,880	662	119		2,500
1970	9,751	373	2,970	8,460	5,940	762	5,610	14,400		3,200	690	153		1,720
1971	6,854	173	5,050	9,600	7,030	420	3,830	14,800		752	600	246		1,020
1972	14,048	197	2,120	4,170	4,800	1,590	2,310	10,900	96	1,780	480	640		1,300
1973	4,956	261	2,270	3,840	2,960	298	4,730	10,700	305	1,430	738	730		1,900
1974	4,603	94	3,340	3,010	2,450	485	4,250	8,980	334	1,620	480	250		2,480
1975	6,949	140	2,270	3,700	4,600	558	4,730	16,000	335		477	405	1,340	3,360
1976	4,664	76	1,620	2,420	3,570	720	2,210	7,450	168		245	385	750	2,180
1977	4,434	95.6	2,380	3,250	2,270	385	2,620	9,660		1,410	484	213	2,060	4,000
1978	5,475	165	2,270	3,470	2,470	410	3,160	9,030		5,080	540		1,330	2,770
1979	4,275	106	1,620	2,320	1,790	372	4,900	6,710		2,120	380	432	1,090	1,550
1980	4,185	254	2,680	3,650	2,120	337	3,100	8,430		2,220	865	760	1,500	3,140
1981	6,726	104	2,220	3,260	1,920	1,260	5,220	8,880		5,700	805	525	3,000	5,220
1982	4,685	184	2,160	3,580	2,160	274	3,160	9,070		2,180	630	498	1,390	3,260
1983	9,620	252	2,580	4,800	3,300	1,500	3,320	21,700		6,480	880		2,000	3,480
1984	3,226	88	1,580	2,340	1,440	847	3,700	6,640		3,540	1,100	470	1,220	5,130
1985	8,093		2,160	3,830	2,870	393	4,920	8,460		3,620	590	262	695	2,070
1986	7,455			2,640		696	2,640	8,130		1,110				
1987				2,400			1,730	6,210						
1988														
1989	10,677													

Table 4.3.1 PROBABLE PEAK DISCHARGE AT HYDROPOWER POTENTIAL SCHEME SITES (1/2)

Name of Scheme	Tributary	Type of Scheme	Catchment Area	Probable Peak Discharge for Return Priods										
			km2	2	5	10	25	50	100	200	500	1,000	5,000	10,000
Karnali River Basin														
Karnali/Chisapani	Karnali	Reservoir	43,679	9,400	13,000	15,400	18,400	20,600	22,800	25,100	28,000	30,200	35,300	37,500
(The value estimated by HPC) *1				9,510	12,500	14,500	-	18,800	20,600	22,400	24,800	26,600	31,000	32,900
KR 7	Karnali	Run-of-river	21,314	2,558	3,411	3,837	4,264	5,116	5,543	5,969	6,396	6,822	8,101	8,527
KR 3/Lakharpata	Karnali	Run-of-river	21,291	2,557	3,410	3,836	4,262	5,115	5,541	5,967	6,393	6,820	8,098	8,525
Karnali Bend/KR 1A	Karnali	Run-of-river	20,120	2,513	3,351	3,770	4,189	5,027	5,446	5,865	6,284	6,703	7,959	8,378
KR 2	Karnali	Reservoir	15,739	2,327	3,103	3,491	3,879	4,655	5,043	5,431	5,819	6,207	7,370	7,758
KR 4	Karnali	Run-of-river	13,238	2,201	2,935	3,302	3,668	4,402	4,769	5,136	5,503	5,869	6,970	7,337
TR 1	Tila	Run-of-river	3,326	1,337	1,782	2,005	2,228	2,674	2,896	3,119	3,342	3,565	4,233	4,456
TR 2	Tila	Run-of-river	2,840	1,255	1,673	1,882	2,091	2,510	2,719	2,928	3,137	3,346	3,974	4,183
MKR 1	Mugu	Run-of-river	6,008	1,675	2,233	2,512	2,791	3,349	3,628	3,907	4,186	4,465	5,303	5,582
HKR 1	Humla	Run-of-river	5,964	1,670	2,227	2,505	2,783	3,340	3,618	3,897	4,175	4,453	5,288	5,567
BR1/Bheri/Babai	Bheri	Run-of-river	11,815	3,180	4,593	5,300	6,360	7,067	7,773	8,480	9,540	9,894	11,660	12,367
BR3A/Surkhet	Bheri	Reservoir	11,554	3,157	4,559	5,261	6,313	7,014	7,716	8,417	9,470	9,820	11,574	12,275
BR5/Thapna	Bheri	Reservoir	10,757	3,082	4,451	5,136	6,164	6,848	7,533	8,218	9,245	9,588	11,300	11,985
BR 4	Bheri	Reservoir	10,305	3,037	4,387	5,062	6,075	6,750	7,425	8,100	9,112	9,450	11,137	11,812
BR 6	Bheri	Run-of-river	1,367	1,380	1,993	2,299	2,759	3,066	3,372	3,679	4,139	4,292	5,059	5,365
SR 6	Seti	Reservoir	7,213	2,981	4,770	5,664	7,155	8,049	8,944	9,838	11,329	12,223	14,608	15,502
West Seti/SR 1	Seti	Reservoir	4,250	2,451	3,922	4,658	5,884	6,619	7,354	8,090	9,316	10,051	12,012	12,748
SR 3	Seti	Run-of-river	2,421	1,959	3,135	3,722	4,702	5,290	5,878	6,465	7,445	8,033	9,600	10,188
THR 1	Thuli Gad	Run-of-river	626	532	851	1,064	1,383	1,702	1,808	2,127	2,446	2,659	3,191	3,403
Mahakali River Basin														
Pancheshwar	Mahakali	Reservoir	12,600	6,858	9,745	11,550	14,077	15,881	17,686	19,491	22,017	23,822	27,792	29,597
Rupali Regulating dam	Mahakali	Reservoir												
Poornagiri	Mahakali	Reservoir	15,000	7,258	10,314	12,224	14,898	16,808	18,718	20,628	23,302	25,211	29,413	31,323
Chamliya	Chamliya	Reservoir	1,570	3,096	4,400	5,215	6,355	7,170	7,985	8,800	9,940	10,755	12,547	13,362

*1 The frequency analysis by HPC was based on the data for a period of 1962 to 1986 and the three-parameter lognormal distribution.

Table 4.3.1 PROBABLE PEAK DISCHARGE AT HYDROPOWER POTENTIAL SCHEME SITES (2/2)

Name of Scheme	Tributary	Type of Scheme	Catchment Area km2	Probable Peak Discharge for Return Periods										
				2	5	10	25	50	100	200	500	1,000	5,000	10,000
Karnali River Basin														
TR3	Tila	Run-of-river	3,105	1,301	1,734	1,951	2,168	2,601	2,818	3,035	3,252	3,469	4,119	4,336
TR4	Tila	Run-of-river	513	578	771	867	963	1,156	1,252	1,349	1,445	1,541	1,830	1,926
MKR2	Mugu	Run-of-river	5,773	1,650	2,200	2,475	2,750	3,300	3,575	3,850	4,125	4,400	5,226	5,501
MKR3	Mugu	Run-of-river	4,251	1,471	1,961	2,207	2,452	2,942	3,187	3,432	3,678	3,923	4,658	4,903
HKR2	Humla	Run-of-river	5,654	1,638	2,183	2,456	2,729	3,275	3,548	3,821	4,094	4,367	5,186	5,459
HKR3	Humla	Run-of-river	4,144	1,457	1,942	2,185	2,428	2,913	3,156	3,399	3,642	3,885	4,613	4,856
HKR4	Humla	Run-of-river	3,807	1,410	1,880	2,114	2,349	2,819	3,054	3,289	3,524	3,759	4,464	4,699
BR3B	Bheri	Reservoir	10,910	3,096	4,473	5,161	6,193	6,881	7,569	8,257	9,289	9,633	11,354	12,042
BR7	Bheri	Run-of-river	628	959	1,385	1,598	1,917	2,130	2,343	2,556	2,876	2,982	3,515	3,728
BR8	Bheri	Run-of-river	2,438	1,768	2,554	2,947	3,537	3,930	4,323	4,716	5,305	5,502	6,484	6,877
LR1	Lohore	Reservoir	733	689	919	1,034	1,148	1,378	1,493	1,608	1,723	1,837	2,182	2,297
BS1	Buriganga	Run-of-river	853	1,235	1,975	2,346	2,963	3,333	3,704	4,074	4,691	5,062	6,049	6,420
SR7	Seti	Run-of-river	978	1,316	2,106	2,501	3,159	3,554	3,949	4,344	5,002	5,397	6,450	6,845
Mahakali River Basin														
CR1	Chamliya	Run-of-river	280	1,334	1,895	2,246	2,738	3,089	3,440	3,791	4,282	4,633	5,405	5,756
CR2	Chamliya	Run-of-river	785	2,255	3,204	3,798	4,628	5,222	5,815	6,409	7,239	7,833	9,138	9,732

Table 4.4.1 PROPOSED FLOOD PATTERNS

Station no.		240	260	270	150
Duration of Flood		7-days	8-days	9-days	9-days
	1	0.021	0.025	0.006	0.154
	2	0.158	0.167	0.021	**0.332**
	3	**0.389**	**0.469**	0.188	0.224
	4	0.255	0.231	0.210	0.159
	5	0.114	0.057	**0.286**	0.057
	6	0.042	0.025	0.203	0.029
	7	0.021	0.015	0.064	0.019
	8		0.011	0.012	0.017
	9			0.009	0.010
Total		1.000	1.000	1.000	1.000

Table 4.5.1 FLOOD HYDROGRAPHS FOR RESPECTIVE PROBABILITIES (1/5)

Unit : m3/sec

Name of Scheme	Tributary	Type of Scheme	Catchment Area, km2	Day	Return Period											
					2	5	10	25	50	100	200	500	1,000	5,000	10,000	PMF
Karnali River Basin																
Karnali/Chisapani	Karnali	Reservoir	42,890	1st	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350
				2nd	4,628	4,826	4,957	5,122	5,243	5,364	5,491	5,650	5,771	6,052	6,172	7,574
				3rd	6,399	7,860	8,834	10,051	10,944	11,837	12,770	13,947	14,840	16,909	17,802	28,149
				4th	9,400	13,000	15,400	18,400	20,600	22,800	25,100	28,000	30,200	35,300	37,500	63,000
				5th	7,660	10,020	11,593	13,560	15,002	16,444	17,952	19,853	21,295	24,638	26,080	42,795
				6th	5,825	6,877	7,578	8,455	9,097	9,740	10,412	11,259	11,902	13,392	14,035	21,484
				7th	4,895	5,283	5,542	5,865	6,103	6,340	6,588	6,901	7,138	7,688	7,926	10,676
				8th	4,623	4,817	4,947	5,109	5,227	5,346	5,470	5,627	5,746	6,021	6,140	7,517
				9th	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350	4,350
KR 2	Karnali	Reservoir	15,739	1st	823	823	823	823	823	823	823	823	823	823	823	823
				2nd	906	948	970	991	1,034	1,055	1,076	1,098	1,119	1,183	1,204	1,494
				3rd	1,434	1,748	1,906	2,063	2,378	2,535	2,693	2,850	3,008	3,480	3,637	5,778
				4th	2,327	3,103	3,491	3,879	4,655	5,043	5,431	5,819	6,207	7,370	7,758	13,034
				5th	1,809	2,318	2,572	2,826	3,335	3,589	3,843	4,098	4,352	5,115	5,369	8,827
				6th	1,263	1,489	1,603	1,716	1,942	2,056	2,169	2,282	2,396	2,736	2,849	4,390
				7th	985	1,069	1,111	1,153	1,236	1,278	1,320	1,362	1,404	1,529	1,571	2,140
				8th	904	946	967	988	1,030	1,051	1,072	1,093	1,114	1,176	1,197	1,482
				9th	823	823	823	823	823	823	823	823	823	823	823	823
LR1	Lohore	Reservoir	733	1st	95	95	95	95	95	95	95	95	95	95	95	95
				2nd	128	140	147	153	166	172	178	184	191	210	216	302
				3rd	336	429	476	522	616	662	709	755	802	942	988	1,622
				4th	689	919	1,034	1,148	1,378	1,493	1,608	1,723	1,837	2,182	2,297	3,859
				5th	484	635	710	785	936	1,011	1,087	1,162	1,237	1,463	1,538	2,562
				6th	269	336	369	403	470	503	537	570	604	705	738	1,195
				7th	159	184	196	209	233	246	258	271	283	320	332	501
				8th	127	139	146	152	164	170	177	183	189	208	214	298
				9th	95	95	95	95	95	95	95	95	95	95	95	95

Table 4.5.1 FLOOD HYDROGRAPHS FOR RESPECTIVE PROBABILITIES (2/5)

Unit : m3/sec

Name of Scheme	Tributary	Type of Scheme	Catchment Area, km2	Day	Return Period											
					2	5	10	25	50	100	200	500	1,000	5,000	10,000	PMF
BR3A/Surkhet	Bheri	Reservoir	11,554	1st	1,208	1,208	1,208	1,208	1,208	1,208	1,208	1,208	1,208	1,208	1,208	1,208
				2nd	1,250	1,280	1,295	1,318	1,333	1,348	1,363	1,385	1,393	1,430	1,445	1,625
				3rd	1,354	1,459	1,511	1,590	1,642	1,695	1,747	1,826	1,852	1,983	2,035	2,659
				4th	2,486	3,406	3,866	4,557	5,017	5,477	5,937	6,627	6,857	8,008	8,468	13,943
				5th	2,639	3,669	4,184	4,957	5,472	5,987	6,502	7,275	7,532	8,820	9,335	15,465
				6th	3,157	4,559	5,261	6,313	7,014	7,716	8,417	9,470	9,820	11,574	12,275	20,622
				7th	2,592	3,588	4,086	4,833	5,331	5,829	6,327	7,075	7,324	8,569	9,067	14,994
				8th	1,643	1,956	2,112	2,347	2,503	2,660	2,816	3,051	3,129	3,520	3,677	5,539
				9th	1,290	1,349	1,378	1,422	1,451	1,481	1,510	1,554	1,569	1,643	1,672	2,022
				10th	1,269	1,313	1,335	1,369	1,391	1,413	1,435	1,468	1,479	1,534	1,556	1,819
				11st	1,208	1,208	1,208	1,208	1,208	1,208	1,208	1,208	1,208	1,208	1,208	1,208
BR3B	Bheri	Reservoir	10,910	1st	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
				2nd	1,143	1,172	1,187	1,209	1,224	1,239	1,254	1,276	1,283	1,320	1,335	1,510
				3rd	1,249	1,352	1,404	1,481	1,532	1,584	1,635	1,712	1,738	1,867	1,918	2,530
				4th	2,410	3,312	3,764	4,441	4,892	5,343	5,795	6,472	6,698	7,826	8,277	13,649
				5th	2,566	3,577	4,082	4,840	5,345	5,851	6,356	7,114	7,367	8,630	9,135	15,149
				6th	3,096	4,473	5,161	6,193	6,881	7,569	8,257	9,289	9,633	11,354	12,042	20,230
				7th	2,518	3,495	3,984	4,717	5,205	5,694	6,182	6,915	7,160	8,381	8,870	14,685
				8th	1,545	1,852	2,006	2,236	2,390	2,543	2,696	2,927	3,003	3,387	3,541	5,367
				9th	1,184	1,241	1,270	1,314	1,342	1,371	1,400	1,443	1,458	1,530	1,559	1,902
				10th	1,163	1,206	1,228	1,260	1,282	1,303	1,325	1,358	1,368	1,422	1,444	1,702
				11st	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100

Table 4.5.1 FLOOD HYDROGRAPHS FOR RESPECTIVE PROBABILITIES (3/5)

Unit : m3/sec

Name of Scheme	Tributary	Type of Scheme	Catchment Area, km2	Day	Return Period											
					2	5	10	25	50	100	200	500	1,000	5,000	10,000	PMF
BR5/Thapna	Bheri	Reservoir	10,757	1st	1,063	1,063	1,063	1,063	1,063	1,063	1,063	1,063	1,063	1,063	1,063	1,063
				2nd	1,106	1,136	1,150	1,172	1,187	1,202	1,217	1,239	1,246	1,283	1,297	1,472
				3rd	1,214	1,316	1,368	1,444	1,496	1,547	1,598	1,675	1,700	1,828	1,879	2,489
				4th	2,387	3,286	3,735	4,409	4,858	5,307	5,756	6,430	6,655	7,778	8,227	13,573
				5th	2,546	3,551	4,054	4,809	5,312	5,815	6,317	7,072	7,323	8,581	9,084	15,068
				6th	3,082	4,451	5,136	6,164	6,848	7,533	8,218	9,245	9,588	11,300	11,985	20,134
				7th	2,497	3,469	3,956	4,685	5,171	5,658	6,144	6,873	7,117	8,332	8,819	14,606
				8th	1,513	1,819	1,972	2,201	2,353	2,506	2,659	2,888	2,965	3,346	3,499	5,317
				9th	1,148	1,205	1,234	1,277	1,306	1,334	1,363	1,406	1,420	1,492	1,521	1,863
				10th	1,126	1,170	1,191	1,223	1,245	1,266	1,288	1,320	1,331	1,385	1,406	1,663
				11st	1,063	1,063	1,063	1,063	1,063	1,063	1,063	1,063	1,063	1,063	1,063	1,063
BR 4	Bheri	Reservoir	10,305	1st	983	983	983	983	983	983	983	983	983	983	983	983
				2nd	1,027	1,056	1,071	1,092	1,107	1,121	1,136	1,157	1,165	1,201	1,215	1,388
				3rd	1,137	1,238	1,288	1,364	1,414	1,465	1,515	1,591	1,616	1,742	1,793	2,393
				4th	2,331	3,216	3,659	4,323	4,766	5,209	5,651	6,315	6,537	7,644	8,086	13,355
				5th	2,492	3,483	3,979	4,722	5,218	5,714	6,209	6,953	7,201	8,440	8,936	14,834
				6th	3,037	4,387	5,062	6,075	6,750	7,425	8,100	9,112	9,450	11,137	11,812	19,844
				7th	2,442	3,400	3,880	4,599	5,078	5,557	6,037	6,756	6,995	8,194	8,673	14,377
				8th	1,441	1,742	1,893	2,119	2,269	2,420	2,570	2,796	2,872	3,248	3,399	5,190
				9th	1,069	1,126	1,154	1,197	1,225	1,253	1,281	1,324	1,338	1,409	1,437	1,774
				10th	1,048	1,090	1,111	1,143	1,164	1,186	1,207	1,239	1,249	1,302	1,324	1,576
				11st	983	983	983	983	983	983	983	983	983	983	983	983

Table 4.5.1 FLOOD HYDROGRAPHS FOR RESPECTIVE PROBABILITIES (4/5)

Unit : m3/sec

Name of Scheme	Tributary	Type of Scheme	Catchment Area, km2	Day	Return Period											
					2	5	10	25	50	100	200	500	1,000	5,000	10,000	PMF
SR 6	Seti	Reservoir	7,213	1st	770	770	770	770	770	770	770	770	770	770	770	770
				2nd	886	981	1,028	1,106	1,153	1,201	1,248	1,326	1,373	1,499	1,546	2,101
				3rd	1,557	2,194	2,512	3,043	3,362	3,680	3,998	4,529	4,847	5,697	6,015	9,768
				4th	2,981	4,770	5,664	7,155	8,049	8,944	9,838	11,329	12,223	14,608	15,502	26,044
				5th	1,861	2,743	3,184	3,919	4,360	4,801	5,243	5,978	6,419	7,595	8,036	13,236
				6th	1,039	1,257	1,366	1,547	1,656	1,765	1,873	2,055	2,164	2,454	2,563	3,845
				7th	890	987	1,035	1,116	1,164	1,213	1,261	1,342	1,390	1,519	1,568	2,138
				8th	840	896	924	971	999	1,027	1,055	1,102	1,130	1,205	1,234	1,565
				9th	822	864	885	920	941	962	983	1,018	1,039	1,095	1,116	1,363
				10th	770	770	770	770	770	770	770	770	770	770	770	770
West Seti/SR 1	Seti	Reservoir	4,250	1st	467	467	467	467	467	467	467	467	467	467	467	467
				2nd	572	649	688	752	791	830	869	933	972	1,075	1,114	1,571
				3rd	1,174	1,697	1,959	2,395	2,657	2,919	3,181	3,617	3,879	4,577	4,839	7,925
				4th	2,451	3,922	4,658	5,884	6,619	7,354	8,090	9,316	10,051	12,012	12,748	21,416
				5th	1,446	2,171	2,534	3,139	3,501	3,864	4,227	4,831	5,194	6,161	6,524	10,800
				6th	708	887	977	1,126	1,216	1,305	1,394	1,544	1,633	1,872	1,961	3,016
				7th	574	654	694	760	800	840	880	946	986	1,092	1,132	1,601
				8th	529	576	599	637	661	684	707	745	769	830	853	1,126
				9th	514	548	565	594	611	629	646	675	692	738	755	959
				10th	467	467	467	467	467	467	467	467	467	467	467	467

Table 4.5.1 FLOOD HYDROGRAPHS FOR RESPECTIVE PROBABILITIES (5/5)

Unit : m3/sec

Name of Scheme	Tributary	Type of Scheme	Catchment Area, km2	Day	Return Period											
					2	5	10	25	50	100	200	500	1,000	5,000	10,000	PMF
Mahakali River Basin																
Pancheshwar	Mahakali	Reservoir	12,600	1st	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750
				2nd	4,127	5,471	6,311	7,487	8,327	9,167	10,007	11,183	12,023	13,871	14,711	19,395
				3rd	6,858	9,745	11,550	14,077	15,881	17,686	19,491	22,017	23,822	27,792	29,597	39,660
				4th	5,194	7,142	8,359	10,062	11,279	12,496	13,713	15,417	16,634	19,311	20,528	27,314
				5th	4,191	5,572	6,434	7,642	8,504	9,367	10,230	11,437	12,300	14,197	15,060	19,870
				6th	2,622	3,115	3,423	3,854	4,162	4,470	4,778	5,209	5,517	6,195	6,503	8,220
				7th	2,192	2,442	2,598	2,816	2,972	3,128	3,284	3,503	3,659	4,002	4,159	5,029
				8th	2,050	2,219	2,325	2,473	2,579	2,685	2,791	2,939	3,045	3,278	3,384	3,974
				9th	2,012	2,160	2,252	2,382	2,474	2,567	2,659	2,789	2,881	3,085	3,177	3,693
				10th	1,904	1,991	2,045	2,122	2,176	2,230	2,285	2,361	2,415	2,535	2,590	2,893
				11st	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750	1,750
Chamliya	Chamliya	Reservoir	1,570	1st	218	218	218	218	218	218	218	218	218	218	218	218
				2nd	1,558	2,164	2,544	3,075	3,454	3,833	4,212	4,743	5,122	5,957	6,336	8,451
				3rd	3,096	4,400	5,215	6,355	7,170	7,985	8,800	9,940	10,755	12,547	13,362	17,905
				4th	2,159	3,038	3,587	4,357	4,906	5,455	6,005	6,774	7,323	8,532	9,082	12,145
				5th	1,594	2,217	2,606	3,151	3,541	3,930	4,320	4,865	5,254	6,111	6,501	8,672
				6th	709	932	1,071	1,265	1,405	1,544	1,683	1,877	2,016	2,322	2,461	3,237
				7th	467	580	650	749	819	890	960	1,059	1,129	1,284	1,355	1,748
				8th	387	463	511	578	626	674	721	788	836	941	989	1,256
				9th	366	432	474	533	574	616	658	716	758	850	892	1,125
				10th	305	344	369	403	428	452	477	511	536	590	614	751
				11st	218	218	218	218	218	218	218	218	218	218	218	218

Table 5.4.1 SEDIMENT CONCENTRATION AND LOAD DATA (STATION 280) (1/4)

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1987	JUL.	1	1,370	997	118
		2	1,270	1,002	110
		3	1,370	1,064	126
		4	1,500	1,451	188
		5	1,520	1,637	215
		6	1,380	2,541	303
		7	1,690	2,192	320
		8	1,620	2,036	285
		9	1,660	2,782	399
		10	2,200	2,841	540
		11	2,320	2,085	418
		12	2,280	4,614	909
		13	2,630	4,621	1,050
		14	2,720	3,625	852
		15	3,210	5,005	1,388
		16	2,990	4,947	1,278
		17	2,160	3,140	586
		18	1,830	2,580	408
		19	1,710	2,132	315
		20	1,740	1,690	254
		21	1,710	1,834	271
		22	1,710	1,652	244
		23	2,140	2,396	443
		24	2,800	4,927	1,192
		25	3,380	8,441	2,465
		26	4,900	29,450	12,468
		27	4,590	9,751	3,867
		28	3,570	3,839	1,184
		29	3,050	2,687	708
		30	2,880	2,411	600
		31	2,660	2,171	499

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1987	AUG.	1	2,480	2,347	503
		2	2,660	3,833	881
		3	2,400	3,352	695
		4	2,530	4,552	995
		5	2,340	2,503	506
		6	2,210	1,953	373
		7	2,400	2,744	569
		8	2,450	2,551	540
		9	2,430	2,848	598
		10	2,500	3,296	712
		11	2,640	4,406	1,005
		12	3,200	5,668	1,567
		13	4,910	12,149	5,154
		14	3,600	6,948	2,161
		15	3,080	4,175	1,111
		16	2,920	4,253	1,073
		17	2,870	4,565	1,132
		18	2,740	4,794	1,135
		19	2,490	3,970	854
		20	2,410	5,201	1,083
		21	2,430	4,606	967
		22	2,900	5,244	1,314
		23	2,680	3,135	726
		24	2,720	3,779	888
		25	2,630	3,243	737
		26	3,420	6,545	1,934
		27	2,820	3,907	952
		28	4,280	7,017	2,595
		29	4,250	7,138	2,621
		30	3,760	5,168	1,679
		31	3,580	3,650	1,129

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1987	SEP.	1	3,180	3,345	919
		2	2,940	2,874	730
		3	2,700	2,842	663
		4	2,480	2,525	541
		5	2,470	2,141	457
		6	2,540	2,369	520
		7	2,460	2,578	548
		8	2,670	3,767	869
		9	2,930	3,725	943
		10	3,160	3,421	934
		11	3,290	3,018	858
		12	2,850	2,961	729
		13	2,630	2,517	572
		14	2,350	2,108	428
		15	2,270	1,912	375
		16	2,120	1,338	245
		17	2,000	1,325	229
		18	1,860	1,213	195
		19	1,740	1,304	196
		20	1,660	1,220	175
		21	1,700	1,008	148
		22	1,680	1,102	160
		23	1,760	1,138	173
		24	1,740	905	136
		25	1,590	823	113
		26	1,480	735	94
		27	1,430	672	83
		28	1,320	570	65
		29	1,230	536	57
		30	1,170	594	60

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1989	JUN.	1			
		2			
		3			
		4			
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		6			
		7			
		8			
		9			
		10			
		11			
		12			
		13			
		14			
		15	1,230	1,089	116
		16	980	507	43
		17	830	363	26
		18	1,030	1,256	112
		19	790	1,905	130
		20	750	1,063	69
		21	750	562	36
		22	1,090	4,555	429
		23	1,040	1,924	173
		24	1,020	782	69
		25	1,050	358	33
		26	1,140	462	46
		27	1,380	491	59
		28	1,350	947	111
		29	1,640	2,220	315
		30	1,830	2,056	325

Table 5.4.1 SEDIMENT CONCENTRATION AND LOAD DATA (STATION 280) (2/4)

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1989	JUL.	1	1,870	2,293	371
		2	2,080	3,798	683
		3	2,490	1,789	385
		4	1,840	760	121
		5	1,180	676	69
		6	1,160	830	83
		7	1,490	2,676	345
		8	1,690	2,252	329
		9	2,000	2,317	400
		10	2,070	1,723	308
		11	2,940	10,399	2,642
		12	4,920	24,365	10,357
		13	2,540	5,586	1,226
		14	3,480	4,393	1,321
		15	4,520	9,657	3,771
		16	4,990	9,655	4,163
		17	3,310	4,228	1,209
		18	2,460	1,878	399
		19	3,580	1,366	423
		20	2,360	2,741	559
		21	2,740	5,436	1,287
		22	2,730	4,117	971
		23	2,840	5,939	1,457
		24	2,530	3,188	697
		25	2,280	1,960	386
		26	3,930	2,393	813
		27	2,620	2,573	582
		28	2,720	2,218	521
		29	3,520	14,969	4,553
		30	4,580	9,751	3,858
		31	5,380	9,335	4,339

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1989	AUG.	1	5,960	8,402	4,326
		2	5,240	7,833	3,546
		3	4,490	4,829	1,873
		4	3,600	2,976	926
		5	5,260	3,887	1,767
		6	2,840	3,078	755
		7	2,720	2,141	503
		8	2,820	3,137	764
		9	2,810	3,063	744
		10	3,000	5,256	1,362
		11	3,570	6,394	1,972
		12	3,760	5,442	1,768
		13	4,310	7,314	2,724
		14	4,200	5,169	1,876
		15	3,800	3,797	1,247
		16	3,730	3,856	1,243
		17	3,740	3,653	1,180
		18	3,770	3,572	1,164
		19	3,870	3,977	1,330
		20	3,910	3,267	1,104
		21	4,620	6,374	2,544
		22	5,310	8,243	3,782
		23	4,220	5,651	2,061
		24	4,460	3,849	1,483
		25	4,690	4,353	1,764
		26	5,010	7,724	3,344
		27	4,850	6,152	2,578
		28	5,820	6,166	3,101
		29	7,050	7,201	4,386
		30	5,070	6,384	2,796
		31	5,060	3,806	1,664

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1989	SEP.	1	4,740	4,120	1,687
		2	4,870	4,637	1,951
		3	4,410	4,050	1,543
		4	3,880	3,168	1,062
		5	3,390	2,215	649
		6	3,600	3,561	1,108
		7	3,200	2,643	731
		8	2,870	1,662	412
		9	2,610	1,366	308
		10	2,440	1,659	350
		11	2,530	3,854	842
		12	2,380	1,669	343
		13	2,450	1,806	382
		14	2,570	2,395	532
		15	2,550	1,499	330
		16	2,500	1,095	237
		17	2,440	962	203
		18	2,420	1,262	264
		19	2,360	1,065	217
		20	2,610	2,842	641
		21	2,580	2,053	458
		22	2,400	1,279	265
		23	2,300	1,125	224
		24	2,200	1,313	250
		25	2,090	1,008	182
		26	2,060	942	168
		27	1,990	1,051	181
		28	1,920	1,207	200
		29	1,960	1,620	274
		30	1,960	1,689	286

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1990	AUG.	1			
		2	4,020	4,491	1,560
		3	3,650	1,611	508
		4	4,370	1,594	602
		5	3,530	1,246	380
		6	920	5,347	425
		7	5,190	2,582	1,158
		8	4,620	1,964	784
		9	4,780	1,649	681
		10	5,450	2,427	1,143
		11	5,190	1,780	798
		12	5,530	2,721	1,300
		13	9,260	5,143	4,115
		14	7,470	913	589
		15	6,370	2,268	1,248
		16	5,770	1,753	874
		17	5,600	1,759	851
		18	5,860	2,475	1,253
		19	5,630	1,951	949
		20	5,140	1,578	701
		21	4,690	1,515	614
		22	4,620	1,325	529
		23	4,410	1,430	545
		24	3,530	1,626	496
		25	3,810	1,583	521
		26	3,540	1,435	439
		27	4,630	5,240	2,096
		28	3,490	1,409	425
		29	3,690	1,929	615
		30	3,940	2,238	762
		31	3,510	1,042	316

Table 5.4.1 SEDIMENT CONCENTRATION AND LOAD DATA (STATION 280) (3/4)

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1990	SEP.	1	3,150	871	237
		2	4,010	3,767	1,305
		3	3,800	3,244	1,065
		4	4,200	7,890	2,863
		5	3,860	10,351	3,452
		6	5,250	4,910	2,227
		7	4,310	2,873	1,070
		8	4,100	1,945	689
		9	3,510	1,375	417
		10	3,230	1,652	461
		11	2,990	1,486	384
		12	2,890	1,274	318
		13	3,140	1,482	402
		14	3,220	2,703	752
		15	2,990	1,490	385
		16	2,870	1,085	269
		17	2,740	1,225	290
		18	2,710	1,268	297
		19	2,670	1,738	401
		20	2,970	1,598	410
		21	2,830	1,620	396
		22	2,780	1,203	289
		23			
		24			
		25			
		26			
		27			
		28			
		29			
		30			

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1991	JUN.	1	1,090	318	30
		2	910	152	12
		3	850	164	12
		4	1,010	355	31
		5	1,900	2,116	347
		6	1,480	1,301	166
		7	1,610	2,556	356
		8	1,920	3,022	501
		9	1,750	1,732	262
		10	2,100	3,817	693
		11	2,320	3,573	716
		12	3,050	4,831	1,273
		13	2,980	2,785	717
		14	2,340	1,729	350
		15	2,350	2,272	461
		16	2,140	1,358	251
		17	2,240	1,593	308
		18	2,130	1,162	214
		19	1,790	840	130
		20	1,550	896	120
		21	1,450	772	97
		22	1,480	640	82
		23	1,620	807	113
		24	1,720	766	114
		25	1,730	902	135
		26	1,760	850	129
		27	1,790	983	152
		28	1,700	886	130
		29	1,700	1,620	238
		30	2,160	3,785	706

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1991	JUL.	1	2,030	2,154	378
		2	2,020	1,858	324
		3	1,950	1,022	172
		4	2,170	1,499	281
		5	2,480	3,246	696
		6	2,510	2,287	496
		7	2,410	2,068	431
		8	2,440	2,524	532
		9	2,150	1,782	331
		10	1,910	1,416	234
		11	1,930	1,636	273
		12	1,950	1,591	268
		13	1,980	1,206	206
		14	1,940	742	124
		15	1,970	1,927	328
		16	2,750	4,127	981
		17	2,190	2,798	529
		18	2,790	2,002	483
		19	3,470	3,440	1,031
		20	3,740	2,744	887
		21	3,940	2,679	912
		22	4,130	1,877	670
		23	3,870	1,314	439
		24	3,300	1,702	485
		25	3,190	1,888	520
		26	3,570	2,498	771
		27	3,690	5,392	1,719
		28	3,340	1,537	444
		29	3,620	2,616	818
		30	3,590	1,742	540
		31	3,440	1,196	355

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1991	AUG.	1	3,360	1,179	342
		2	3,380	883	258
		3	4,020	2,479	861
		4	5,310	4,475	2,053
		5	4,660	3,010	1,212
		6	4,060	1,613	566
		7	5,830	1,943	979
		8	5,680	4,660	2,287
		9	5,870	3,695	1,874
		10	5,570	2,722	1,310
		11	4,540	1,933	758
		12	3,870	1,131	378
		13	3,460	1,106	331
		14	3,160	1,528	417
		15	3,220	1,451	404
		16	4,170	2,825	1,018
		17	4,700	3,107	1,262
		18	5,140	3,119	1,385
		19	5,250	2,055	932
		20	5,130	1,987	881
		21	5,260	3,147	1,430
		22	5,170	2,369	1,058
		23	4,300	1,958	727
		24	4,430	2,084	798
		25	3,990	1,452	501
		26	3,780	1,139	372
		27	3,790	1,314	430
		28	3,690	891	284
		29	4,050	1,087	380
		30	4,960	2,286	980
		31	5,030	1,951	848

Table 5.4.1 SEDIMENT CONCENTRATION AND LOAD DATA (STATION 280) (4/4)

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1991	SEP.	1	4,880	1,731	730
		2	4,590	1,474	585
		3	4,190	1,331	482
		4	4,080	1,315	464
		5	4,650	3,013	1,211
		6	4,420	1,698	648
		7	4,410	1,660	632
		8	4,770	3,304	1,362
		9	4,190	1,709	619
		10	3,750	799	259
		11	3,710	1,156	371
		12	3,330	771	222
		13	3,320	1,240	356
		14	3,230	989	276
		15	3,100	956	256
		16	3,160	909	248
		17	2,980	1,947	501
		18	2,790	3,587	865
		19	2,600	3,648	819
		20	2,420	1,793	375
		21	2,280	1,729	341
		22	2,160	1,693	316
		23	1,980	1,302	223
		24	1,880	916	149
		25	1,790	797	123
		26	1,690	424	62
		27	1,620	379	53
		28	1,560	281	38
		29	1,550	344	46
		30	1,500	286	37

Table 5.4.2 **CALCULATED AVERAGE ANNUAL SEDIMENT LOAD AT CHISAPANI**

Year	Suspended Load (10^6 t)	Bed Load (10^6 t)	Total Load (10^6 t)
1962	170.36	25.55	195.92
1963	164.64	24.70	189.34
1964	119.10	17.87	136.97
1965	44.84	6.73	51.57
1966	89.88	13.48	103.36
1967	99.46	14.92	114.38
1968	114.05	17.11	131.15
1969	118.44	17.77	136.21
1970	120.85	18.13	138.98
1971	187.56	28.13	215.70
1972	83.90	12.59	96.49
1973	158.76	23.81	182.57
1974	91.09	13.66	104.75
1975	201.10	30.17	231.27
1976	83.88	12.58	96.46
1977	120.94	18.14	139.09
1978	161.55	24.23	185.78
1979	73.87	11.08	84.95
1980	149.45	22.42	171.87
1981	132.31	19.85	152.16
1982	134.61	20.19	154.81
1983	177.51	26.63	204.13
1984	82.67	12.40	95.07
1985	120.78	18.12	138.90
1986	112.02	16.80	128.82
1987	60.11	9.02	69.12
1988	143.60	21.54	165.14
TOTAL	3317.33	497.60	3814.93
AVERAGE	122.86	18.43	141.29

Table 5.4.3 SEDIMENT CONCENTRATION AND LOAD DATA (STATION 150) (1/3)

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1990	JUN.	1			
		2			
		3			
		4			
		5			
		6	463	554	22
		7	463	1,615	65
		8	696	2,998	180
		9	463	1,115	45
		10	497	761	33
		11	474	634	26
		12	497	667	29
		13	420	640	23
		14	463	788	32
		15	490	849	36
		16	446	580	22
		17	488	808	34
		18	550	1,704	81
		19	603	1,763	92
		20	654	2,327	132
		21	1,097	5,615	532
		22	815	2,083	147
		23	795	2,307	159
		24	815	2,505	177
		25	833	4,927	355
		26	680	3,674	216
		27	641	1,218	67
		28	907	2,625	206
		29	1,590	6,301	866
		30	1,016	3,303	290

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1990	JUL.	1	883	731	56
		2	1,026	4,279	379
		3	953	3,386	279
		4	847	3,859	283
		5	922	3,232	257
		6	1,000	2,664	230
		7	2,012	6,735	1,171
		8			
		9	2,056	3,142	558
		10	1,473	1,270	162
		11	1,473	2,541	323
		12	1,234	3,571	381
		13	1,131	2,047	200
		14	1,902	3,614	594
		15	1,435	2,760	342
		16	1,650	3,559	507
		17	1,837	2,313	367
		18	1,880	4,385	712
		19	1,512	2,301	301
		20	1,416	2,967	363
		21	1,379	2,257	269
		22	1,379	3,210	382
		23	1,397	1,486	179
		24	1,368	2,078	246
		25	1,570	3,102	421
		26	1,753	8,744	1,324
		27	1,630	3,005	423
		28	1,531	2,507	332
		29	1,435	2,163	268
		30	1,360	1,408	165
		31	1,306	1,641	185

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1990	AUG.	1	1,360	4,584	539
		2	1,327	9,100	1,044
		3	1,386	1,731	207
		4	1,342	1,755	203
		5	1,360	2,214	260
		6	1,980	5,024	860
		7	1,610	2,149	299
		8	1,816	7,159	1,123
		9	1,816	5,545	870
		10	1,837	2,615	415
		11	2,170	4,983	934
		12	2,530	3,950	863
		13	2,359	2,270	463
		14	1,902	1,904	313
		15	1,902	1,500	246
		16	2,605	8,256	1,858
		17	2,656	6,616	1,518
		18	2,605	3,404	766
		19	2,311	2,440	487
		20	1,945	2,177	366
		21	2,605	2,612	588
		22	1,691	2,026	296
		23	1,650	1,790	255
		24	1,416	1,930	236
		25	1,306	2,470	279
		26	1,306	1,732	195
		27	1,306	2,665	301
		28	1,386	3,022	362
		29	1,386	3,426	410
		30	1,320	1,541	176
		31	1,179	1,846	188

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1990	SEP.	1	1,342	7,814	906
		2	2,106	5,711	1,039
		3	2,264	6,517	1,275
		4	1,570	1,677	228
		5	1,610	2,297	319
		6	1,795	3,178	493
		7	1,288	1,268	141
		8	1,016	2,193	192
		9	1,206	1,848	193
		10	1,032	1,550	138
		11	1,111	1,509	145
		12	1,144	1,631	161
		13	1,570	2,127	289
		14	1,048	1,415	128
		15	1,026	2,894	256
		16	1,144	1,183	117
		17	984	1,478	126
		18	953	1,356	112
		19	969	1,584	133
		20	937	1,630	132
		21	919	1,115	89
		22	895	1,519	117
		23	877	1,710	130
		24	907	3,658	287
		25	883	2,557	195
		26	790	3,103	212
		27	753	1,420	92
		28	729	1,468	92
		29	675	2,010	117
		30			

Table 5.4.3 SEDIMENT CONCENTRATION AND LOAD DATA (STATION 150) (2/3)

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1991	MAY	1			
		2			
		3			
		4			
		5			
		6			
		7			
		8			
		9			
		10			
		11			
		12			
		13			
		14			
		15			
		16			
		17			
		18			
		19			
		20			
		21			
		22			
		23			
		24			
		25			
		26	463	1,049	42
		27	515	1,022	45
		28	508	1,206	53
		29	531	430	20
		30	508	404	18
		31	442	330	13

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1991	JUN.	1	400	362	13
		2	410	74	3
		3	454	1,194	47
		4	531	2,539	117
		5	629	1,796	98
		6	616	637	34
		7	726	3,873	243
		8	508	1,783	78
		9	790	2,487	170
		10	847	7,194	527
		11	759	3,382	222
		12	707	1,978	121
		13	748	2,454	159
		14	776	6,738	452
		15	718	3,974	246
		16	707	3,866	236
		17	712	2,423	149
		18	675	2,835	165
		19	579	1,544	77
		20	463	1,250	50
		21	463	717	29
		22	531	1,650	76
		23	591	1,149	59
		24	667	2,463	142
		25	665	3,376	194
		26	667	2,606	150
		27	629	1,236	67
		28			
		29	680	1,234	73
		30	1,097	2,043	194

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1991	JUL.	1	1,097	3,286	312
		2	907	4,724	370
		3	1,324	2,833	324
		4	931	3,180	256
		5	1,032	2,039	182
		6	1,148	4,810	477
		7	1,032	2,833	253
		8	877	1,326	100
		9	818	711	50
		10	734	556	35
		11	680	292	17
		12	670	1,382	80
		13	790	1,892	129
		14	762	745	49
		15	1,131	3,994	390
		16	1,570	3,717	504
		17	1,081	1,625	152
		18	1,081	2,847	266
		19	1,335	3,089	356
		20	1,454	3,421	430
		21	1,671	2,106	304
		22	1,671	2,250	325
		23	1,435	1,239	154
		24	1,199	554	57
		25	1,097	627	59
		26	1,691	3,204	468
		27	1,416	1,262	154
		28	1,473	2,820	359
		29	694	968	58
		30	1,379	1,270	151
		31	1,306	1,334	151

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1991	AUG.	1	1,416	1,150	141
		2	1,774	2,306	353
		3	1,816	2,643	415
		4	1,859	2,959	475
		5	1,630	1,029	145
		6	1,531	983	130
		7	1,454	789	99
		8	1,570	1,215	165
		9	2,170	3,597	674
		10	1,570	1,494	203
		11	1,306	1,192	134
		12	1,131	353	34
		13	1,065	319	29
		14	1,016	667	59
		15	1,454	1,978	248
		16	3,387	11,641	3,406
		17	3,358	5,553	1,611
		18	2,383	2,615	538
		19	1,880	2,135	347
		20	1,622	1,822	255
		21	2,943	3,604	917
		22	1,774	1,496	229
		23	1,671	1,250	180
		24	1,492	1,902	245
		25	1,570	520	71
		26	1,531	1,972	261
		27	1,492	619	80
		28	1,671	871	126
		29	1,630	808	114
		30	1,650	785	112
		31	1,570	746	101

Table 5.4.3 SEDIMENT CONCENTRATION AND LOAD DATA (STATION 150) (3/3)

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1991	SEP.	1	1,551	2,361	316
		2	1,590	461	63
		3	1,590	1,008	138
		4	1,306	902	102
		5	1,473	3,023	385
		6	1,397	624	75
		7	1,270	1,249	137
		8	1,182	890	91
		9	1,097	1,256	119
		10	1,016	263	23
		11	1,006	284	25
		12	984	332	28
		13	1,097	893	85
		14	1,000	676	58
		15	1,065	1,185	109
		16	1,091	784	74
		17	953	224	18
		18	892	523	40
		19	818	548	39
		20	781	536	36
		21	748	251	16
		22	694	459	27
		23	667	563	32
		24	634	253	14
		25	616	257	14
		26	581	713	36
		27	574	1,115	55
		28	567	737	36
		29	567	153	8
		30	529	215	10

Year	Month	Day	Water discharge (m3/s)	Sediment concentration (mg/l)	Sediment load (kt)
1991	OCT.	1	519	211	9
		2	492	479	20
		3	483	185	8
		4	468	528	21
		5	454	380	15
		6	454	207	8
		7	448	202	8
		8	435	470	18
		9	423	992	36
		10	400	871	30
		11	394	866	29
		12	380	471	15
		13	366	323	10
		14	354	289	9
		15	345	251	7
		16	341	617	18
		17	326	1,599	45
		18	326	948	27
		19	322	729	20
		20	301	1,398	36
		21	320	606	17
		22	310	304	8
		23	304	221	6
		24	310	516	14
		25	287	524	13
		26	285	652	16
		27	281	166	4
		28	278	773	19
		29	269	416	10
		30	261	842	19
		31	256	367	8

Table 5.4.4 CALCULATED AVERAGE ANNUAL SEDIMENT LOAD AT PANCHESHWAR

Year	Suspended Load (10^6 t)	Bed Load (10^6 t)	Total Load (10^6 t)
1984	33.25	6.65	39.90
1985	37.37	7.47	44.84
1986	42.79	8.56	51.35
1987	39.47	7.89	47.36
1988	75.87	15.17	91.04
1990	38.25	7.65	45.90
TOTAL	267.00	53.40	320.40
AVERAGE	44.50	8.90	53.40

Table 5.4.5 SEDIMENT DATA OF SELECTED RESERVOIRS AND RIVERS

Reservoir of River	Watershed Area (km2)	Mean Annual Sediment Load (10^6 t/yr)	Mean Annual Discharge (m3/s)
India			
Bhakra (Gobind Sagar)	56,980	34.10	472
Matatila	20,720	7.30	250
Maithan	5,206	9.50	73
Panchet	9,920	13.08	124
Hirakud	82,880	46.00	1,287
Ganga Sagar	22,533	31.70	149
Nizam Sagar	21,694	20.00	136
Shivaji Sagar	892	1.90	105
Ramganga	3,134	7.30	114
Mayurkashi	1,792	3.60	260
Girna	4,729	5.30	143
Lower Bhawani	4,200	1.80	67
Tungabhadra	28,179	26.00	399
Machkunda	1,956	0.60	38
Dantiwada	2,862	2.50	19
Mahi	25,330	31.90	254
Tawa	5,983	6.80	136
Ukai	62,230	95.80	546
Pakistan			
Tarbela	120,395	200.00	2,300
Jhelum	28,005	82.80	757
Kanshi	1,236	3.40	6
Poonch	4,240	15.80	156
Warsak	67,400	51.80	704
Hunza River	13,160	63.20	379
Gilgit River	12,095	13.60	287
Indus River (near Kachusal)	112,664	87.10	958
Shyok River	33,670	33.60	310

References for Indian data :

Bansode, Mehta and Pravesh 1982
Gupta, 1977
Murray, 1976
Murthy, 1977
Narayana and Babu, 1983

References for Pakistani data :

Goudie et al, 1984
Harza, 1969
Kalabagh Cons. Ltd., 1984
WAPDA, 1985

Source : Karnali Multipurpose Project Report Annex E Sedimentation (1989)

Table 5.5.1 Grain Size of River Bed Materials

Sample		D 50 (mm)
KR1A	Weight	75
	Tape 1	115
	Tape 2	100
	Tape 3	100
BR1	Weight	20
	Tape 1	90
	Tape 2	45
	Tape 3	110
SETI	Weight	20
	Tape 1	80
	Tape 2	85
	Tape 3	110
CHAMLIYA	Weight	35
	Tape 1	90
	Tape 2	100
	Tape 3	100

FIGURES

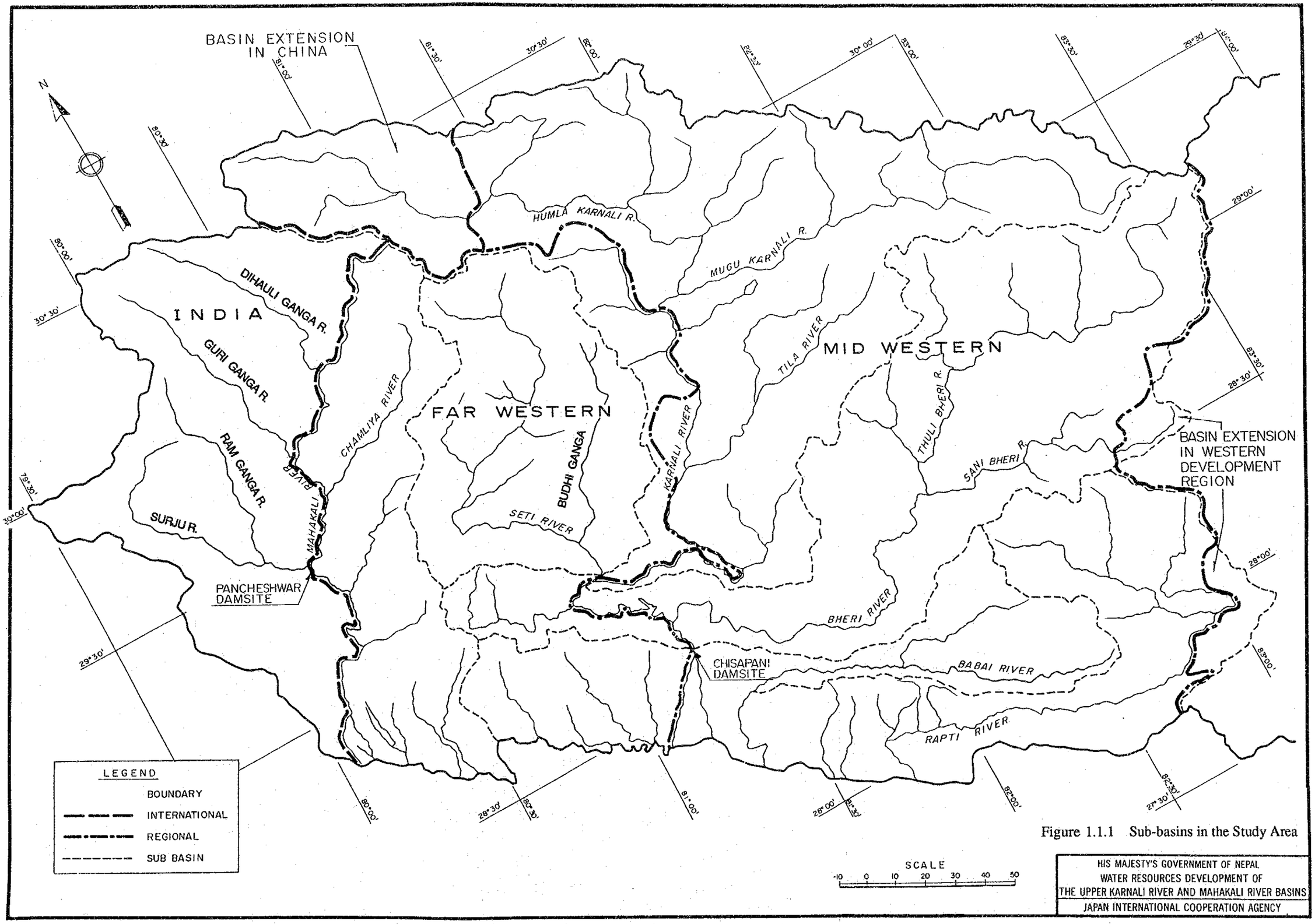

Figure 1.1.1 Sub-basins in the Study Area

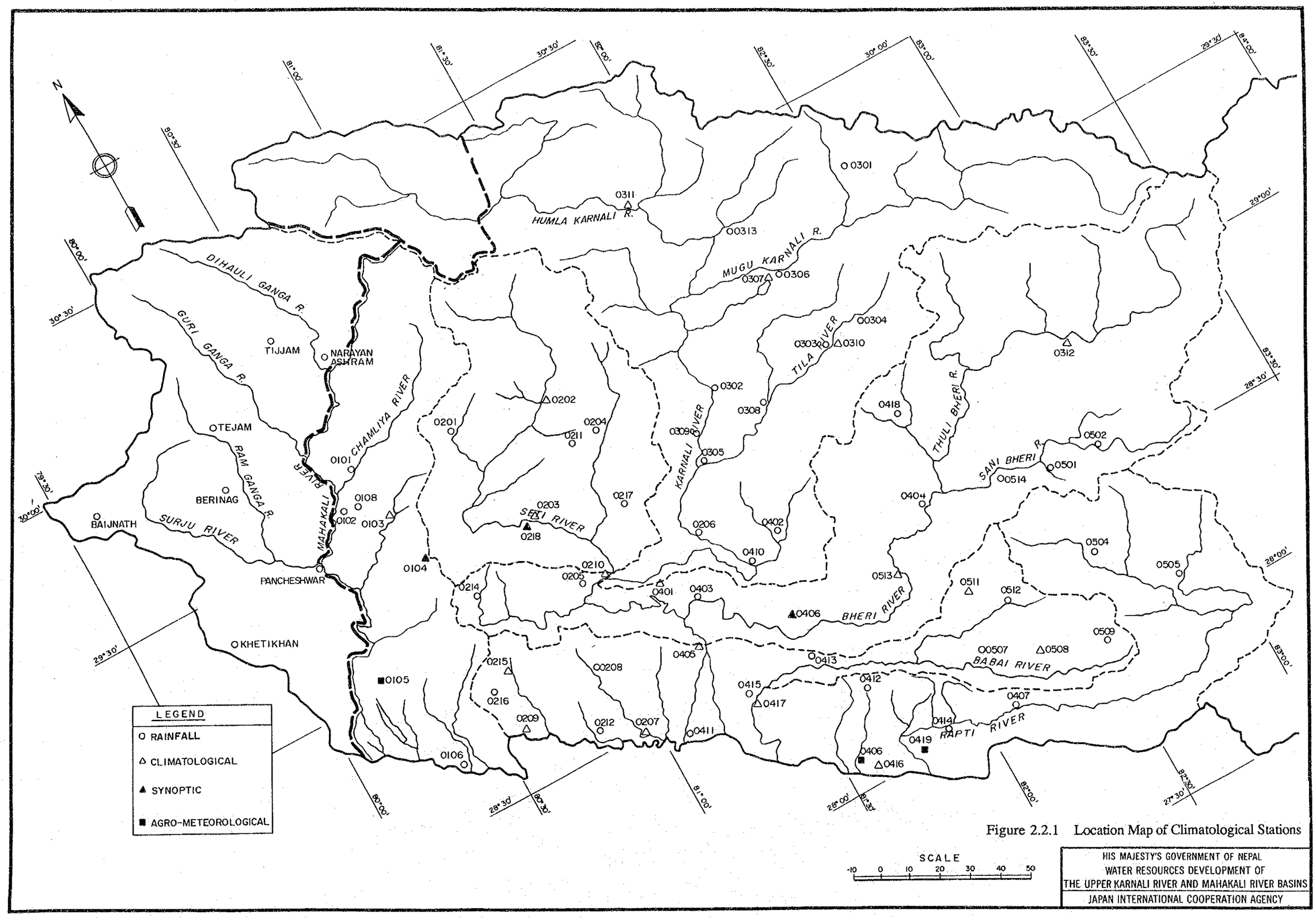

Figure 2.2.1 Location Map of Climatological Stations

Station Number	Station Name	Lat. (D.M)	Lon. (D.M)	Period of Record 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90	Nos yrs	Zone
0101	KAKERPAKHA	29 39	80 30		34	
0102	BAITADI	29 33	80 25			
0103	PATAN(WEST)	29 28	80 32		30	
0104	DADELDHURA	29 18	80 35		27	
0105	MAHENDRA NAGAR	29 02	80 13		8	
0106	BELAURI SHANTIPUR	28 41	80 21		14	
0107	DARCHULA	29 51	80 34		12	
0108	SATBANJH	29 32	80 28		11	
0201	PIPALKOT	29 37	80 52		34	
0202	CHAINPUR (WEST)	29 33	81 13		34	
0203	SILGADHI DOTI	29 16	80 59		34	
0204	BAJURA	29 23	81 19		13	
0205	KATAI	29 00	81 01		30	
0207	TIKAPUR	28 30	80 57		13	
0208	SANDEPANI	28 45	80 55		23	
0209	DHANGADHI	28 41	80 36		27	
0210	BANGGA CAMP	28 58	81 07		20	
0211	KHAPTAD	29 23	81 12		3	
0212	SITAPUR	28 34	80 49		17	
0214	KOLA GAUN	29 07	80 41		12	
0215	GODAVARI (WEST)	28 52	80 38		4	
0217	MANGALSEN	29 09	81 17		11	
0218	DIPAYAL (DOTI)	29 15	80 57		6	
0301	MUGU	29 45	82 33		19	
0302	THIBRU	29 19	81 46		30	
0303	JUMLA	29 17	82 10		26	
0304	GUTHI CHAUR	29 17	82 19		10	
0305	SHERI GHAT	29 08	81 36		21	

Figure 2.2.2 Duration of Measurements at Rainfall Gauging Stations (1/3)

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
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Station Number	Station Name	Lat. (D.M)	Lon. (D.M)	Period of Record 57–90	Nos yrs	Zone
0306	GAM SHREE NAGAR	29 33	82 09		17	
0307	RARA	29 33	82 07		10	
0308	NAGMA	29 12	81 54		17	
0309	BIJAYAPUR (RASKOT)	29 14	81 38		19	
0310	DIPAL GAUN	29 16	82 13		13	
0311	SIMIKOT	29 58	81 50		5	
0312	DUNAI	28 56	82 55		21	
0313	DARMA	29 44	82 06		7	
0401	PUSMA CAMP	28 53	81 15		23	
0402	DAILEKH	28 51	81 43		25	
0403	JAMU (TIKUWA KUNA)	28 47	81 20		25	
0404	JAJARKOT	28 42	82 12		31	
0405	CHISAPANI (KARNALI)	28 39	81 16		25	
0406	SURKHET (BIRENDRA NAGAR)	28 36	81 37		29	
0407	KUSUM	28 01	82 07		31	
0408	GULARIYA	28 10	81 21		31	
0409	KHAJURA (NEPALGANJ)	28 06	81 34		13	
0410	BALE BUDHA	28 47	81 35		19	
0411	RAJAPUR	28 26	81 06		12	
0412	NAUBASTA	28 16	81 43		15	
0413	SHYANO SHREE	28 27	81 35		13	
0414	BAIJAPUR	28 03	81 54		16	
0415	BARGADAHA	28 26	81 21		18	
0416	NEPALGANJ (REG. OFF.)	28 04	81 37		12	
0417	RANI JARUWA NURSERY	28 25	81 21		12	
0418	MAINA GAUN (D. BAS)	28 59	82 17		8	
0419	SIKTA	28 02	81 47		9	
0501	RUKUMKOT	28 36	82 38		23	
0502	SHERA GAUN	28 35	82 49		29	

Figure 2.2.2 Duration of Measurements at Rainfall Gauging Stations (2/3)

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

Station Number	Station Name	Lat. (D.M)	Lon. (D.M)	Period of Record 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90	Nos yrs	Zone
0504	LIBANG GAUN	28 18	82 38		11	
0505	BIJUWAR TAR	28 06	82 52		13	
0507	NAYA BASTI (DANG)	28 13	82 07		18	
0508	TULSIPUR	28 08	82 18		16	
0509	GHORAHI (MASINA)	28 03	82 30		16	
0510	KOILABAS	27 42	82 32		13	
0511	SALYAN BAZAR	28 23	82 10		26	
0512	LUWAMJULA BAZAR	28 18	82 17		18	
0513	CHAUR JAHARI TAR	28 32	82 01		11	
0514	MUSIKOT (RUKUMKOT)	28 38	82 29		12	
INDIA	BAIJNNATH				5	
INDIA	BERINAG				5	
INDIA	KHETIKHAN				4	
INDIA	NARAYANI				6	
INDIA	PANCHESHWAR				5	
INDIA	TEJAM				4	
INDIA	TIJJAM				3	

Figure 2.2.2 Duration of Measurements at Rainfall Gauging Stations (3/3)

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

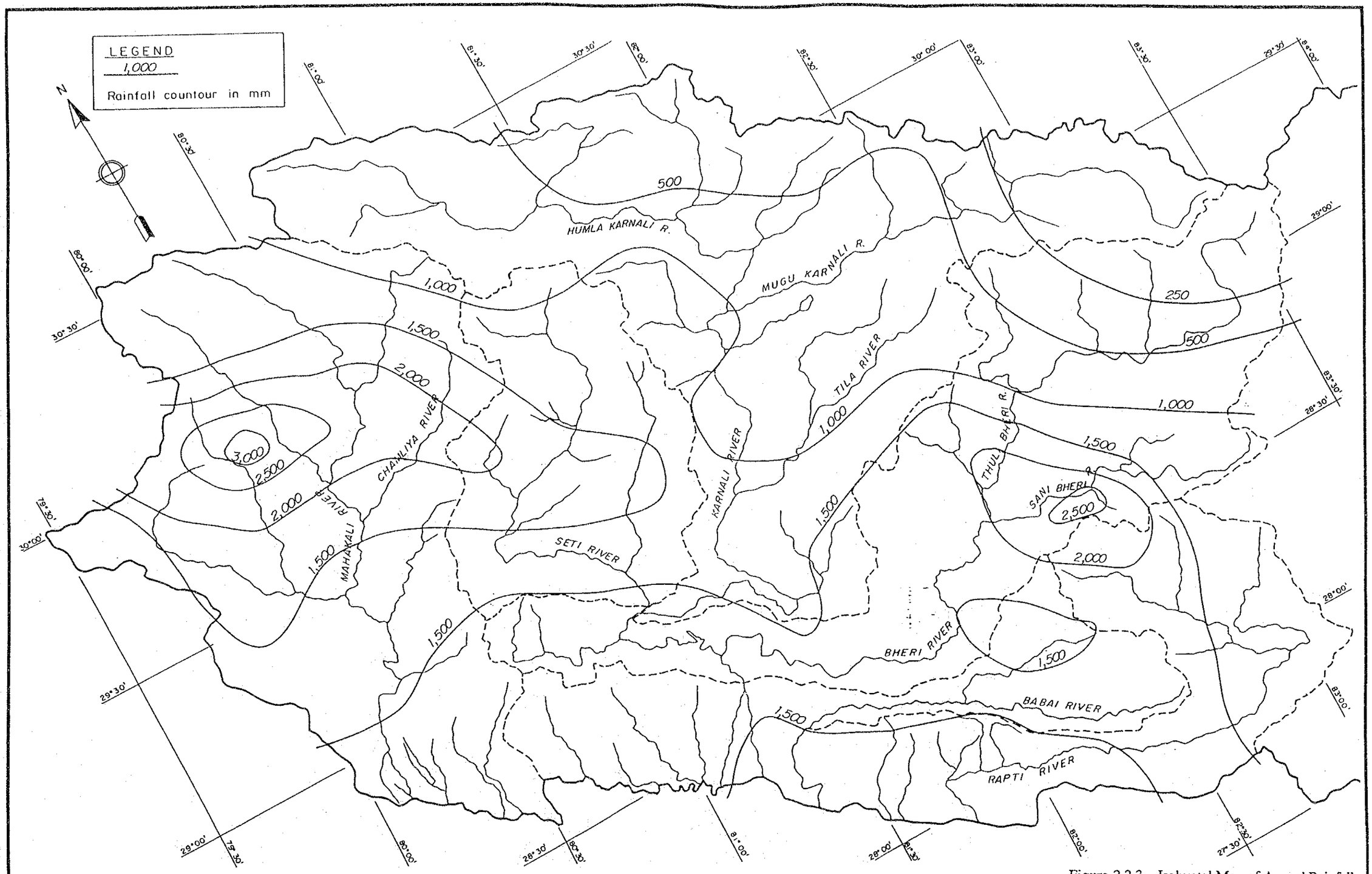

Figure 2.2.3 Isohyetal Map of Annual Rainfall

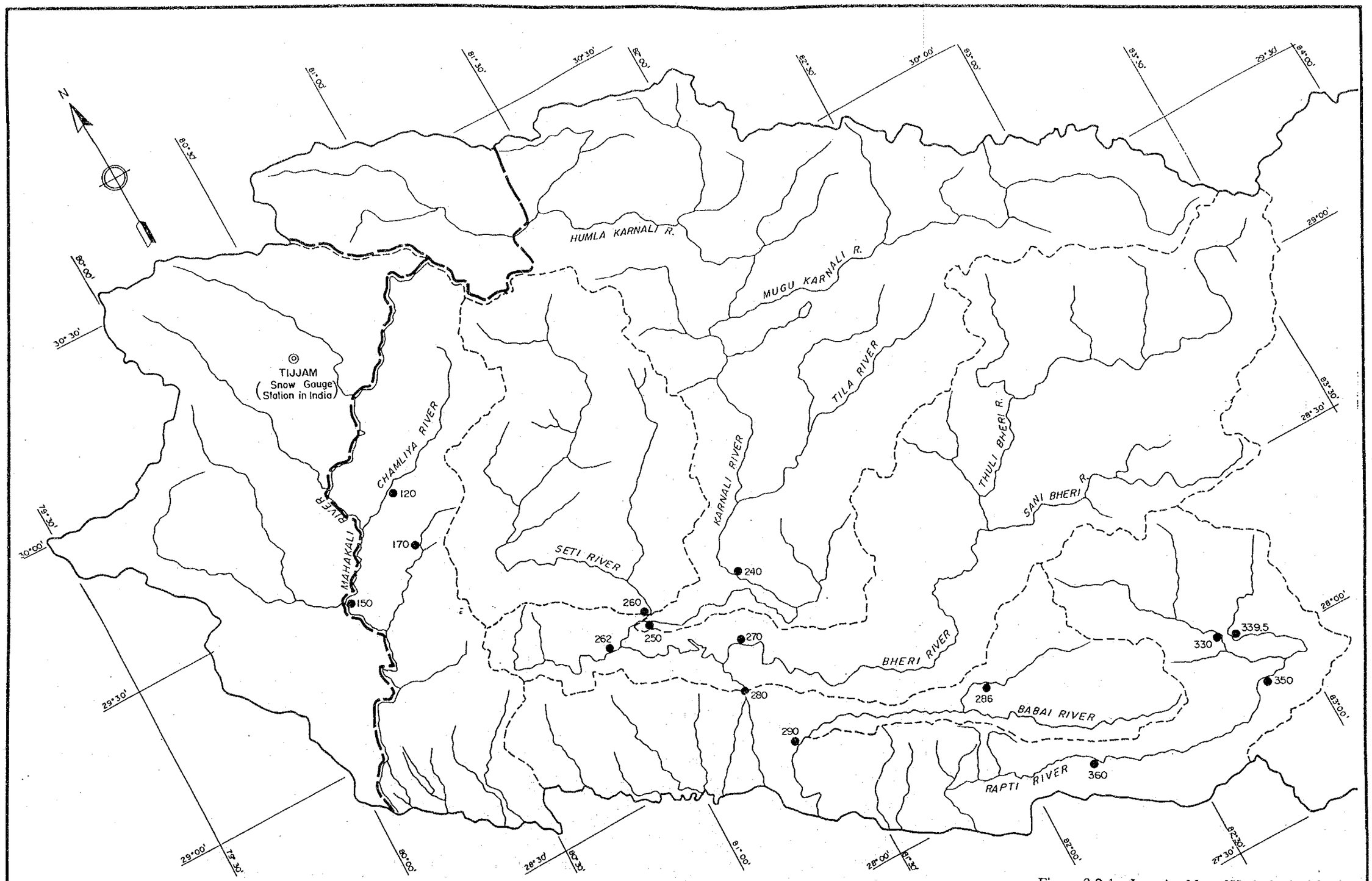

Figure 3.2.1 Location Map of Hydrological Stations

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
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Station Number	Station Name	River Name	Catchment Area (Km2)	Latitude (D.M.S)	Longitude (D.M.S)	Nrs Yrs
120	Nangraon	Chamlia	1,150	29 40 20	80 33 30	27
150	Parcheshwar	Mahakali	12,600	29 35	80 15	3
170	Patan near Baitadi	Surnaya Gad	188	29 27 30	80 33 10	19
240	Asara Ghat	Karnali	19,260	28 57 10	81 26 30	23
250	Benighat	Karnali	21,240	28 57 40	81 07 10	25
260	Banga near Belgaon	Seti	7,460	28 58 40	81 08 40	27
262	Khanayatal	Thuli Gad	896	28 56 00	80 54 00	17
270	Jamu	Bheri	12,290	28 45 20	81 21 00	25
280	Chisapani	Karnali	43,679	28 38 40	81 17 30	27
286	Daradhunga	Sarada Khola	816	28 17 58	82 01 30	14
290	Bargadha	Babai	3,000	28 25 20	81 20 10	18
330	Nayagaon	Madi Khola	1,980	28 04 20	82 84 00	19
339.5	Tigra Gaon	Jhimruk Khola	683	28 03 00	82 49 40	15
350	Bagasoti Gaon	Rapti	3,380	27 54 00	82 51 00	10
360	Jalkundi	Rapti	5,150	27 56 50	82 13 30	22

Period of Record: 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91

Figure 3.2.2 Duration of Measurements at Hydrological Stations

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

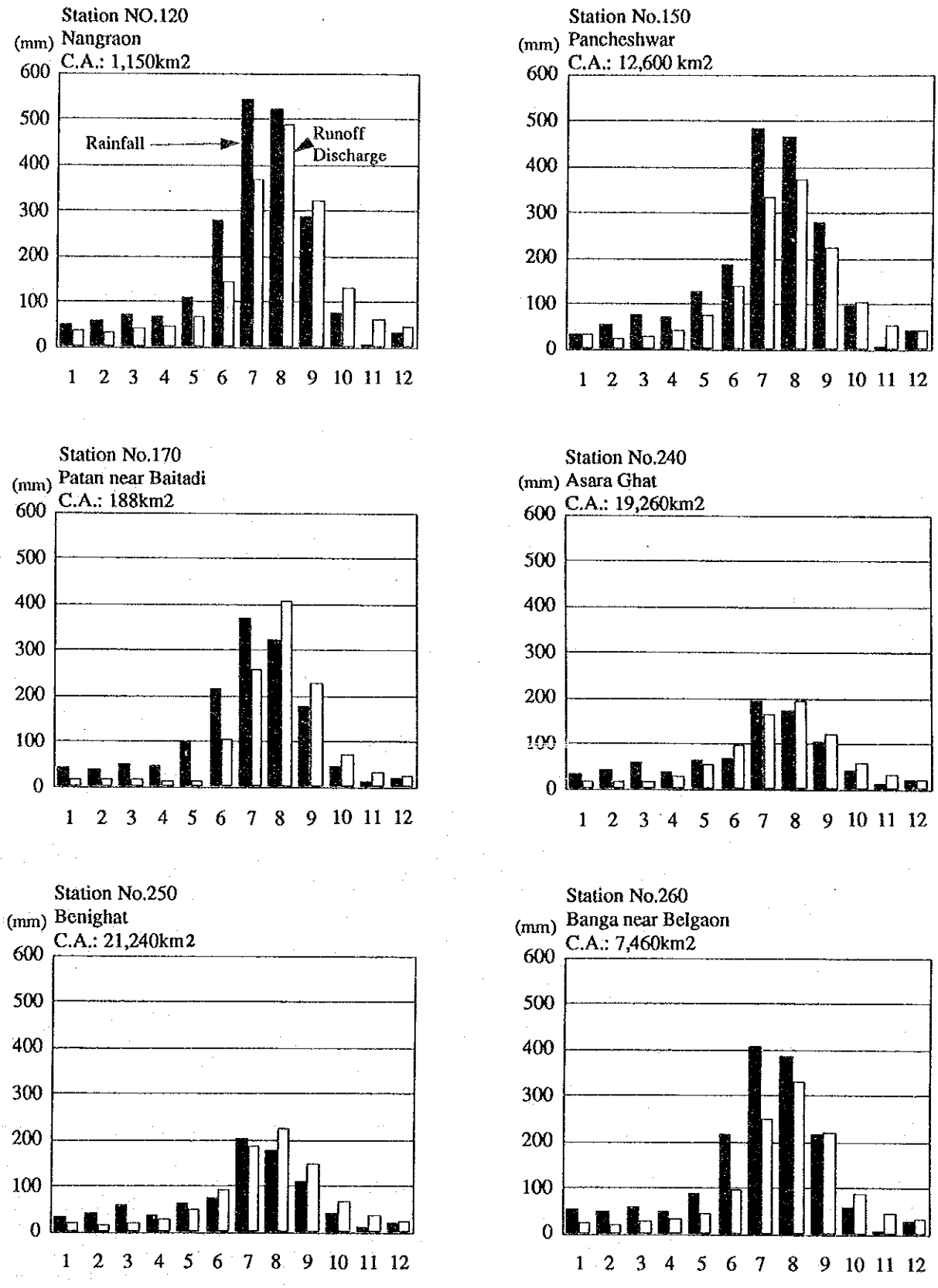


Figure 3.2.3 Distribution of Mean Monthly Discharge and Mean Monthly Rainfall **(1/3)**

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

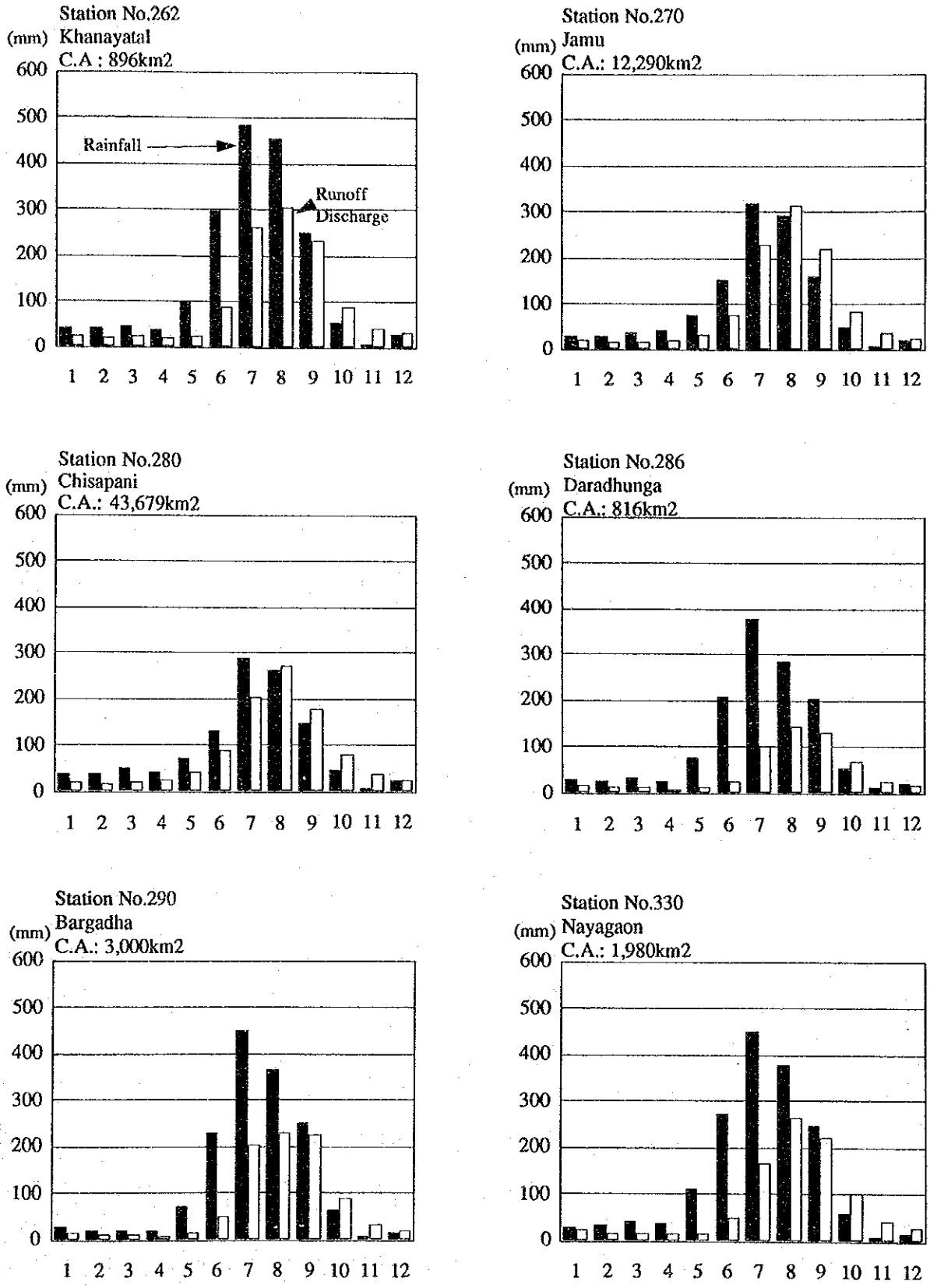


Figure 3.2.3 Distribution of Mean Monthly Discharge and Mean Monthly Rainfall (2/3)

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

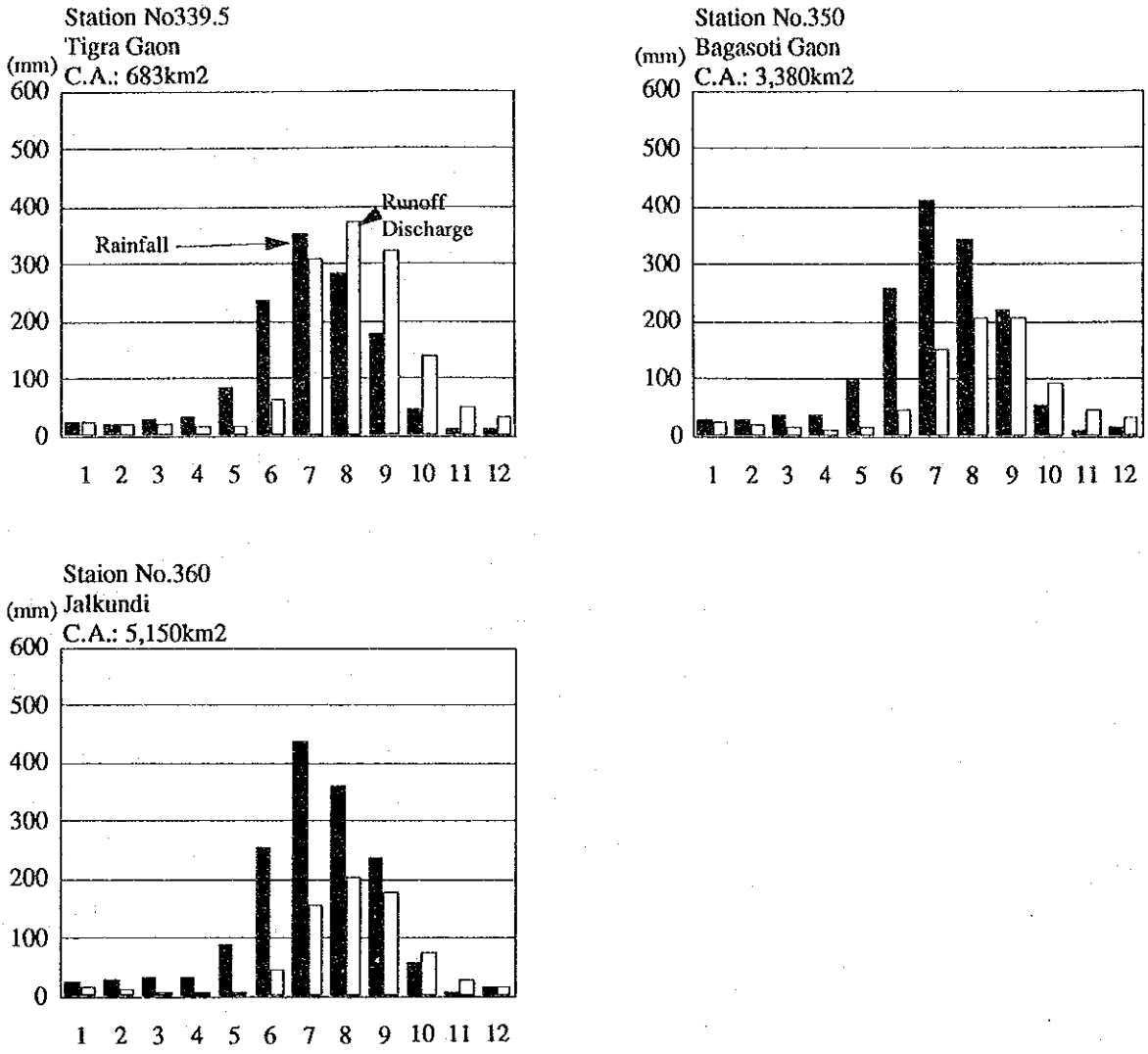


Figure 3.2.3 Distribution of Mean Monthly Discharge and Mean Monthly Rainfall (3/3)

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

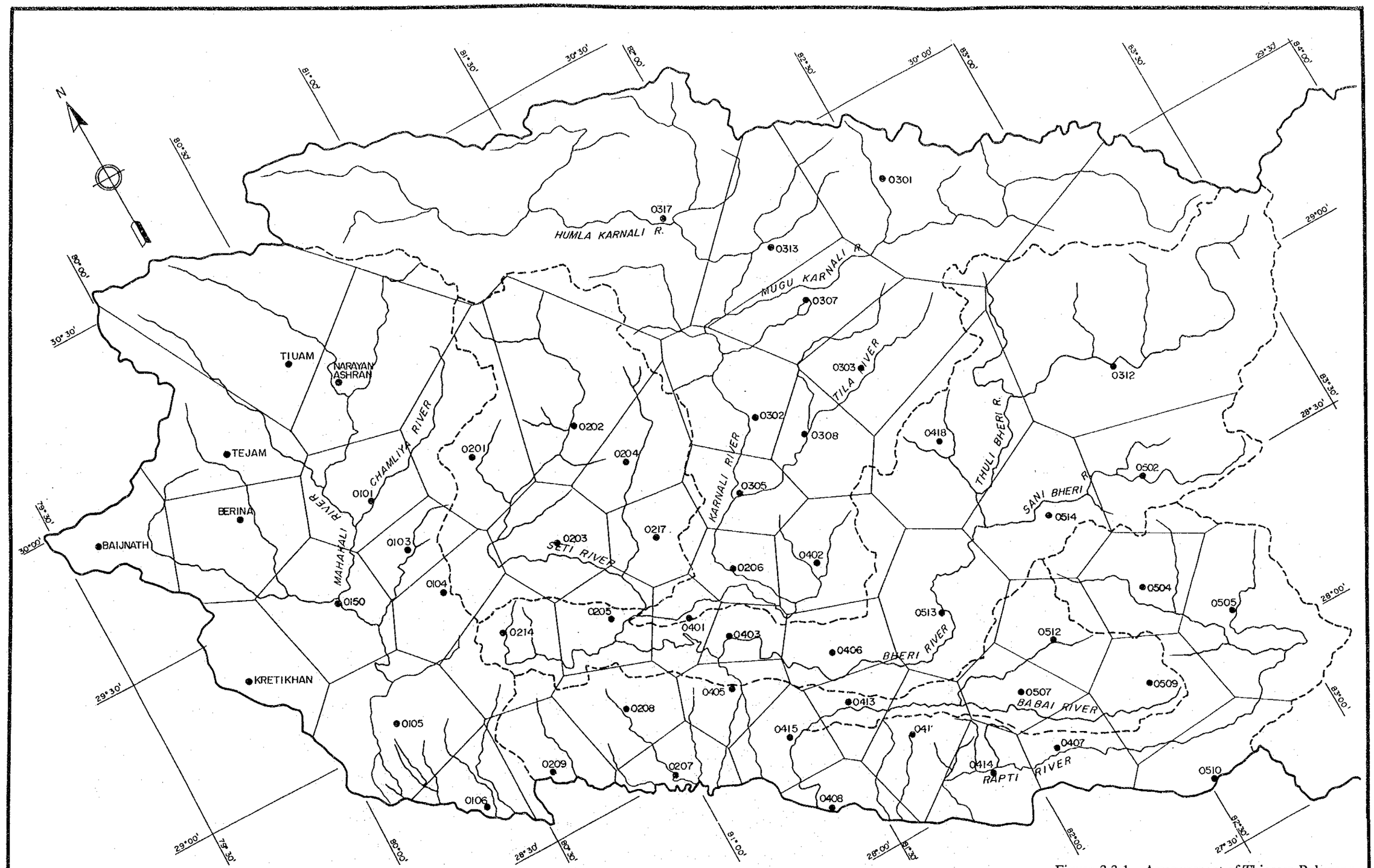


Figure 3.3.1 Arrangement of Thiessen Polygons

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

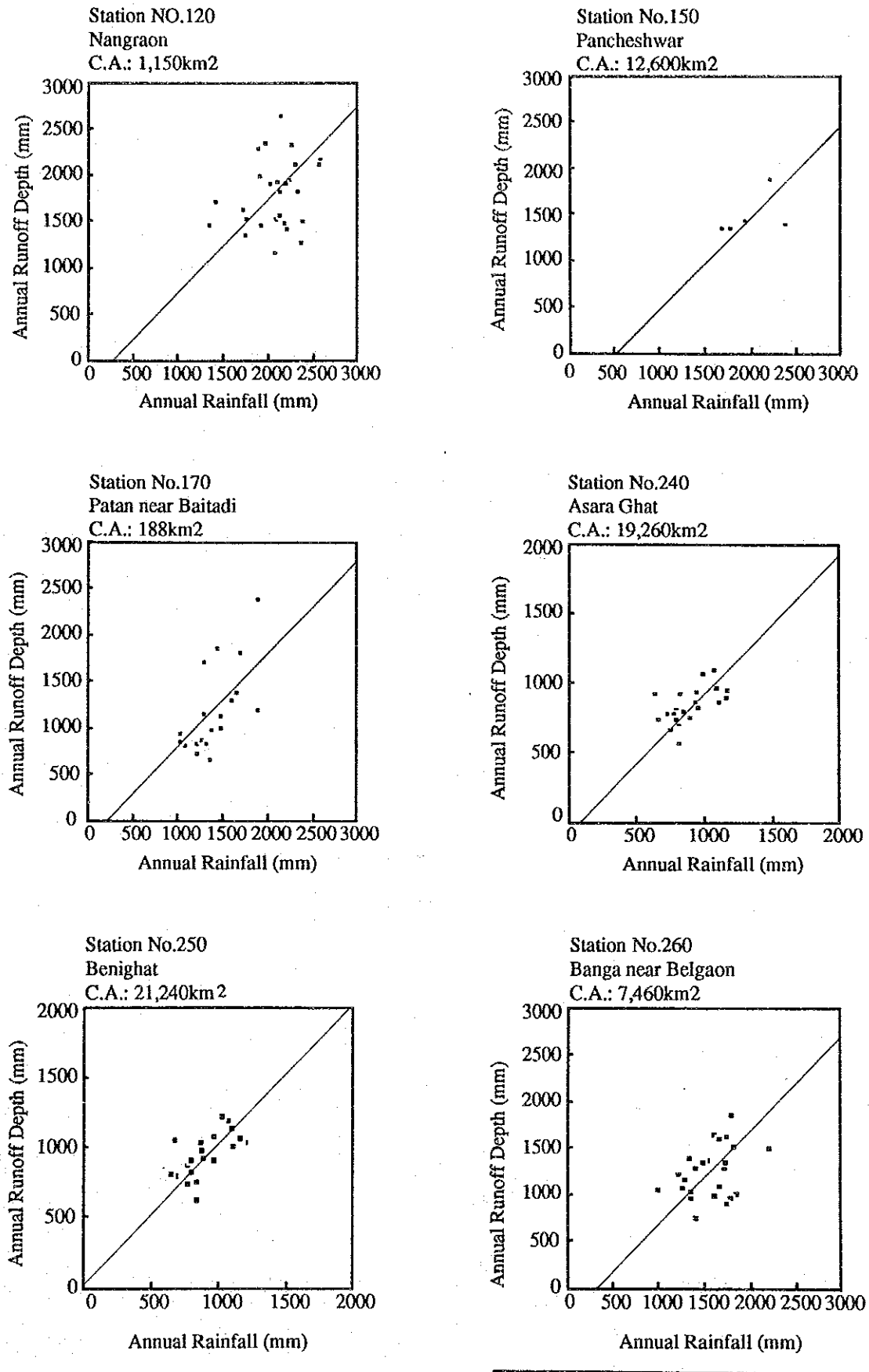


Figure 3.3.2 Rainfall-Runoff Relationship (1/3)

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

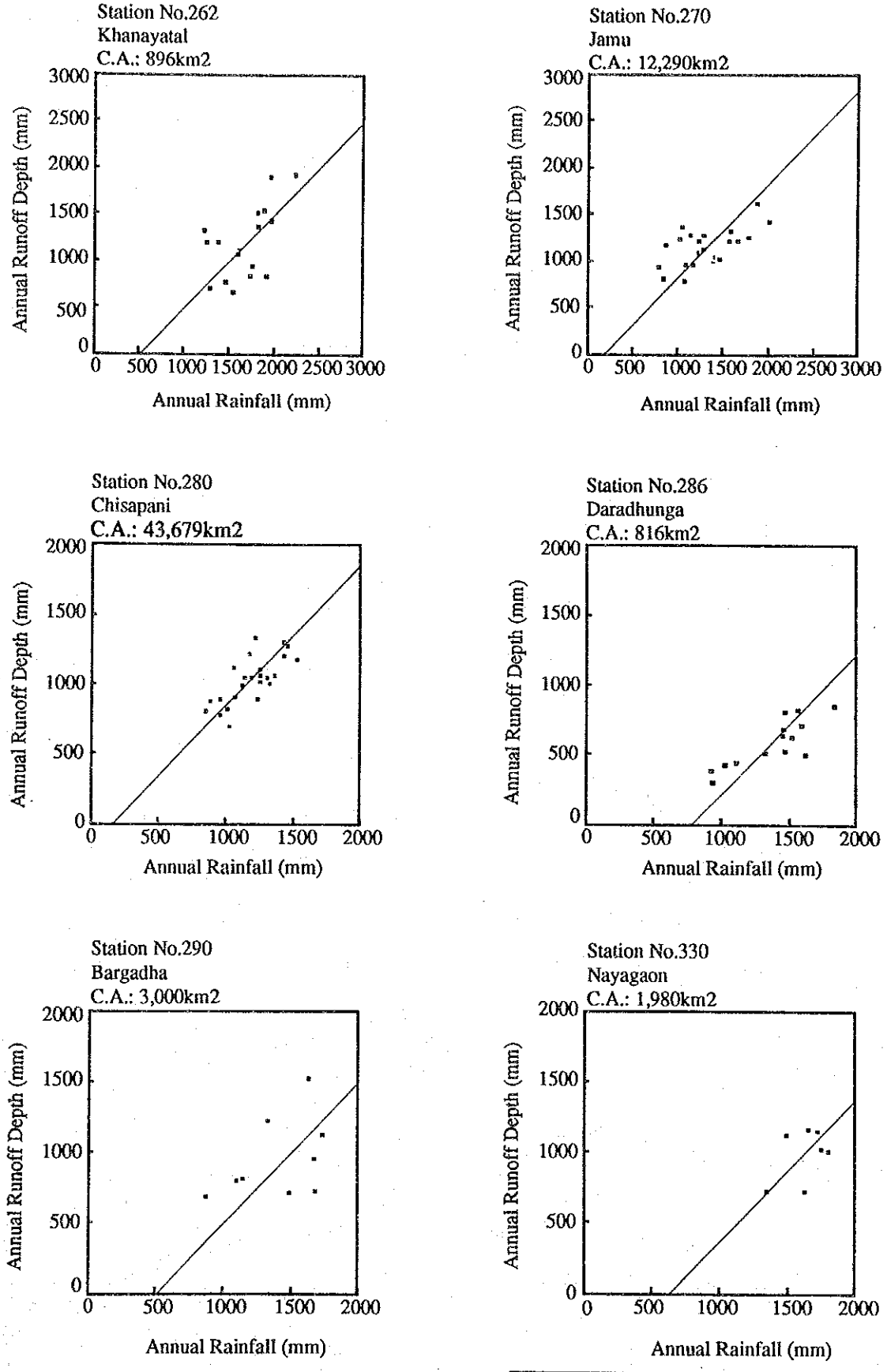
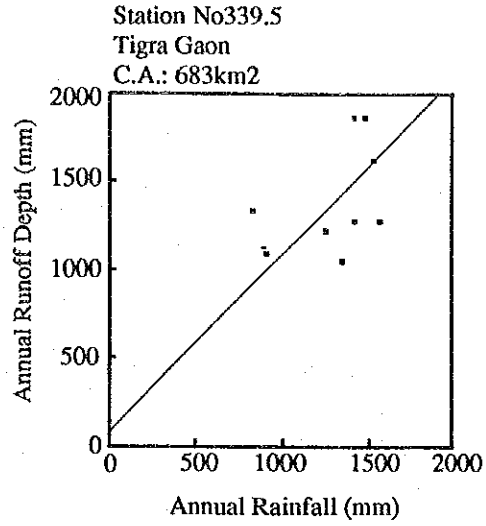
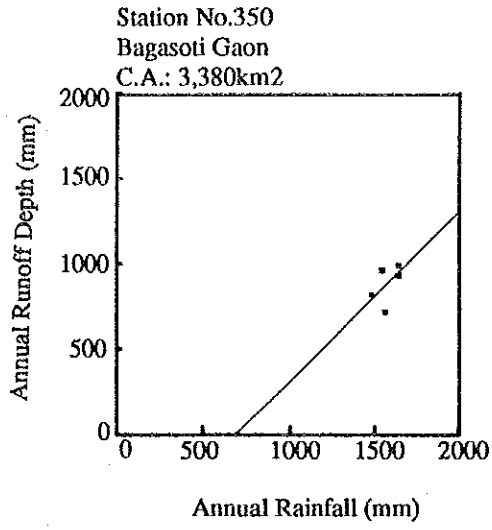


Figure 3.3.2 Rainfall-Runoff Relationship (2/3)

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY





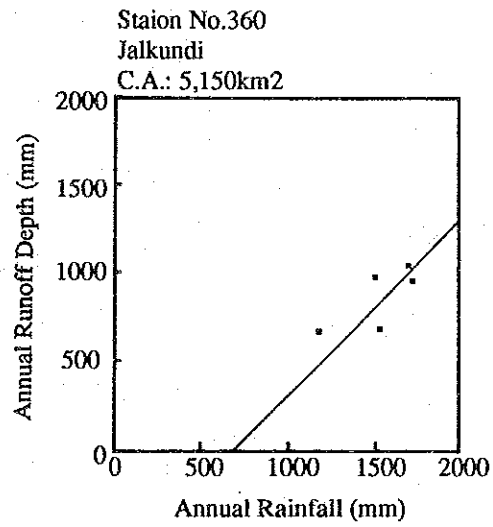
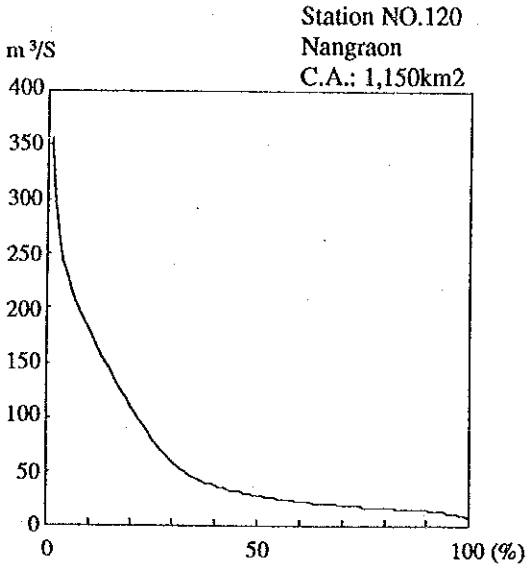
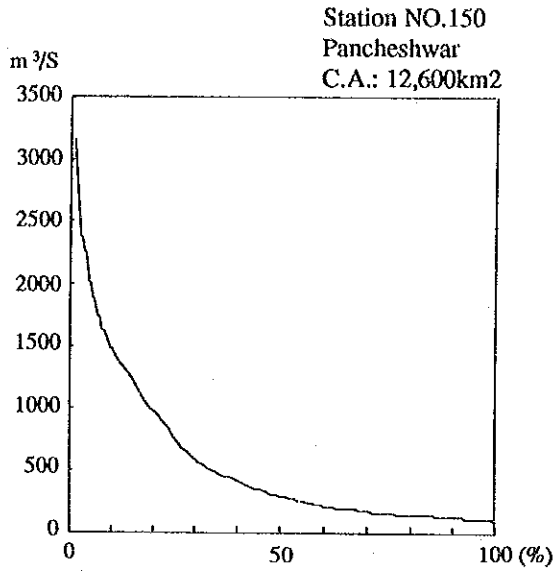
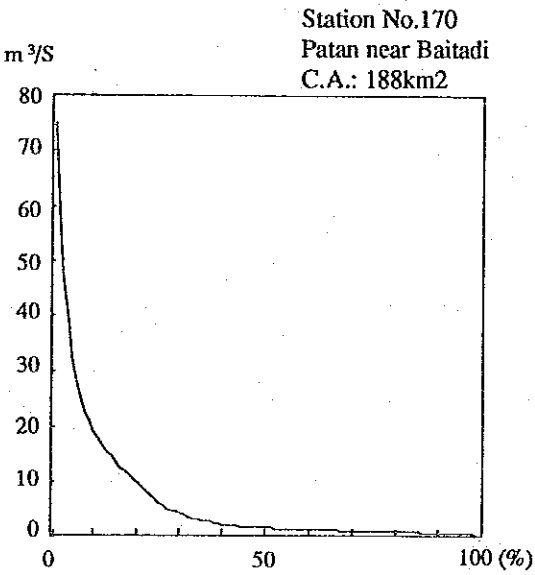


Figure 3.3.2 Rainfall-Runoff Relationship (3/3)

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY







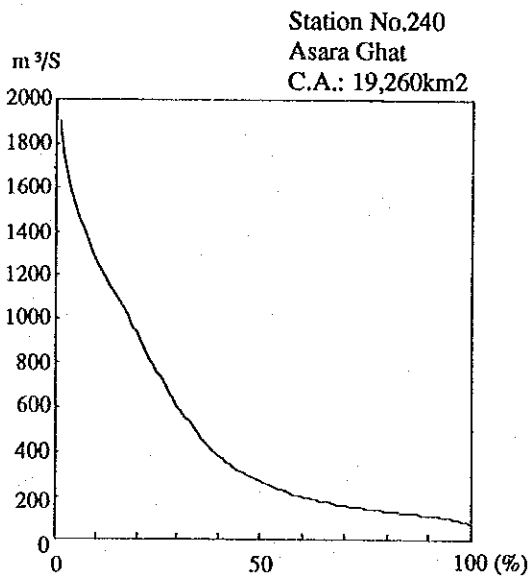
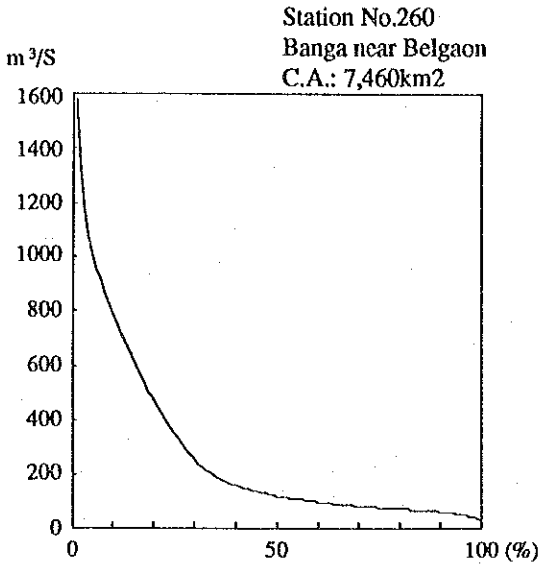
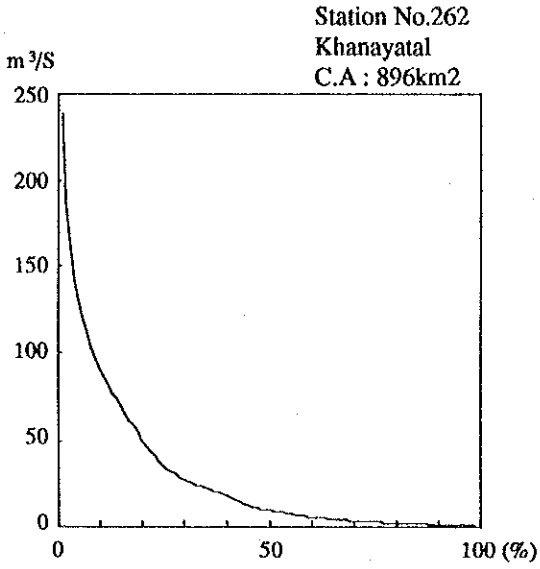
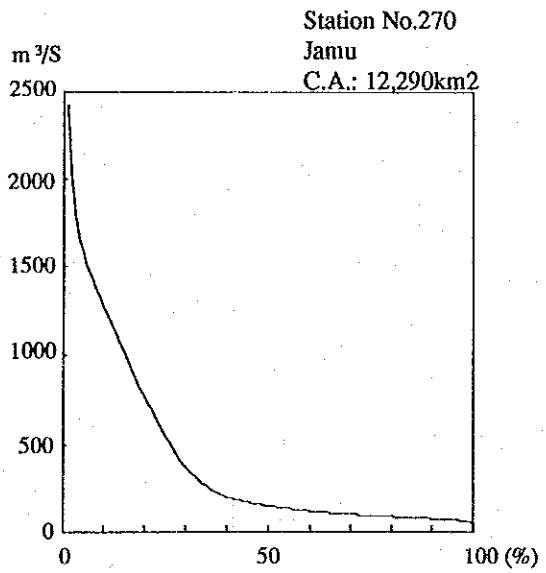


Figure 3.4.1 Flow Duration Curve at Hydrological Stations (1/4)

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY







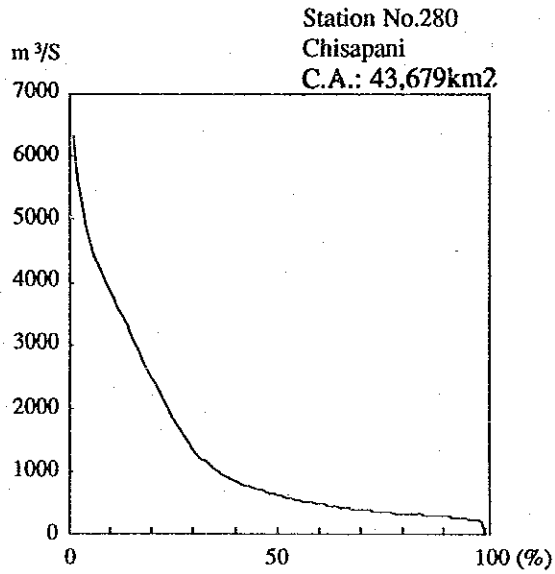
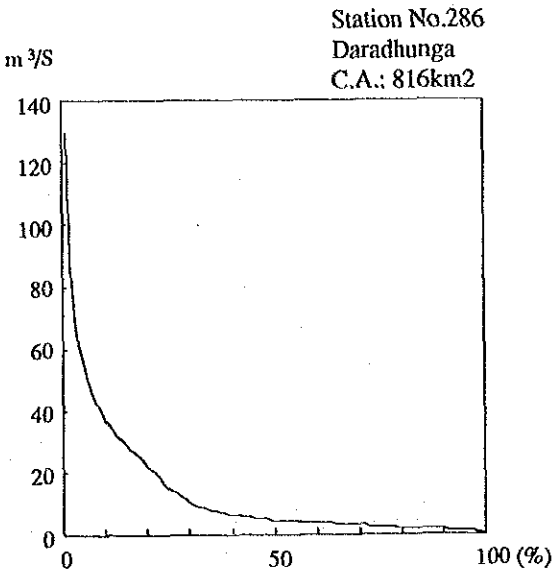
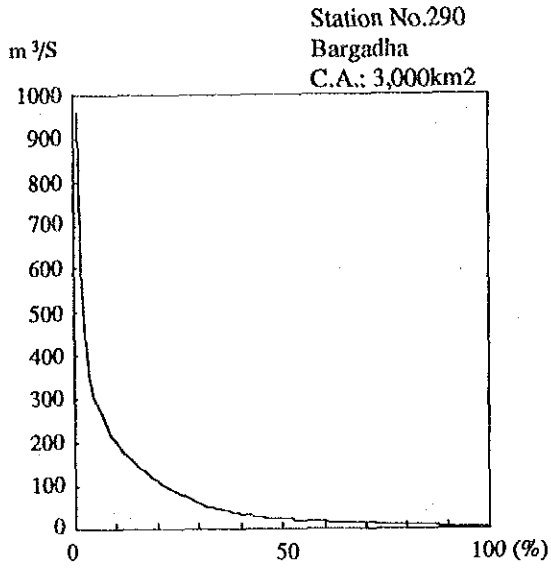
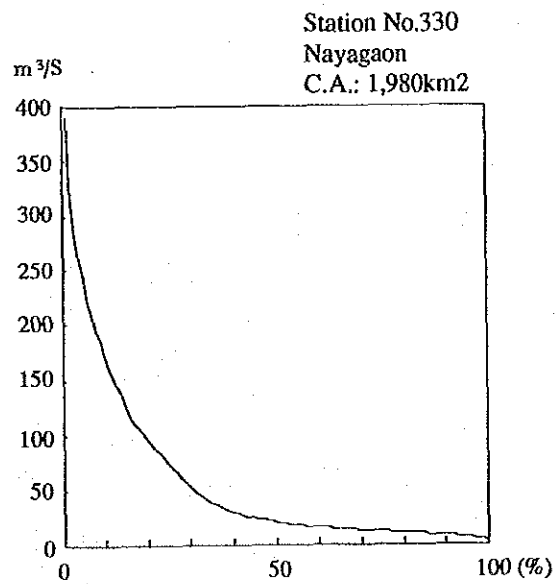


Figure 3.4.1 Flow Duration Curve at Hydrological Stations (2/4)

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY







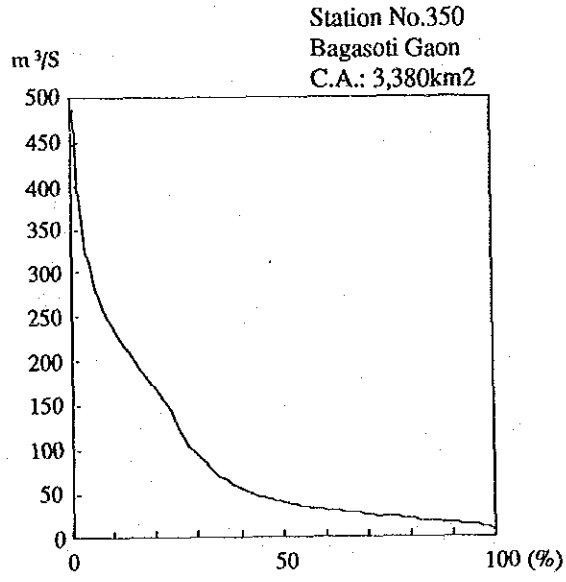


Figure 3.4.1 Flow Duration Curve at Hydrological Stations (3/4)

HIS MAJESTY'S GOVERNMENT OF NEPAL
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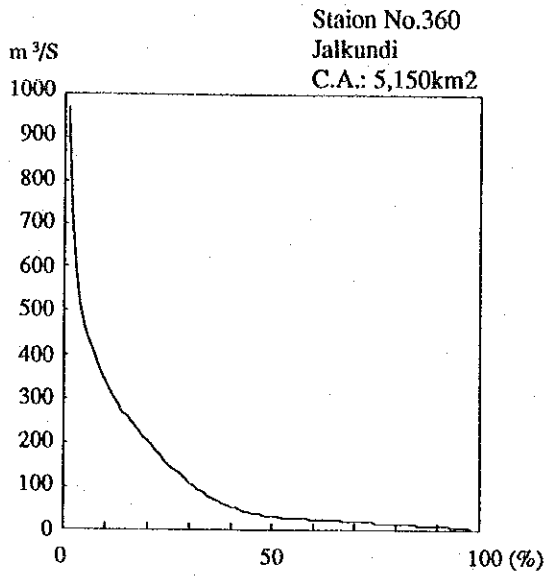

Figure 3.4.1 Flow Duration Curve
at Hydrological Stations **(4/4)**

HIS MAJESTY'S GOVERNMENT OF NEPAL
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THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
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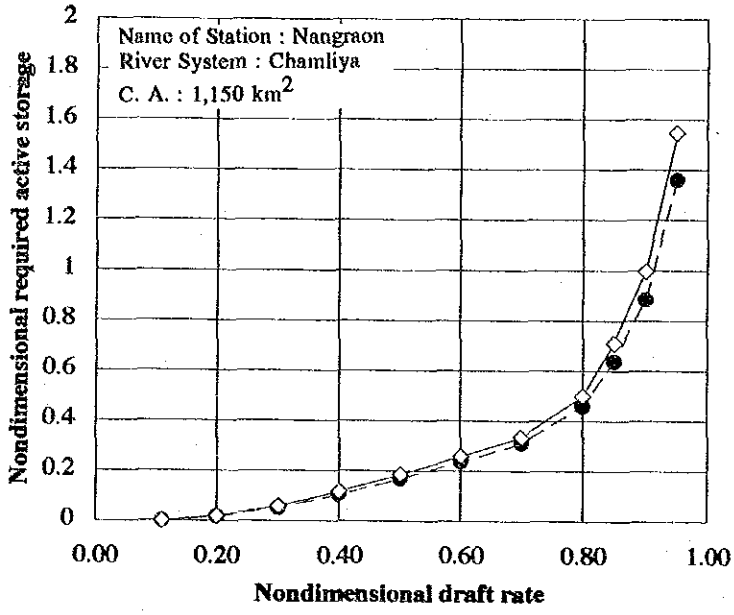
STATION 120



STATION 150

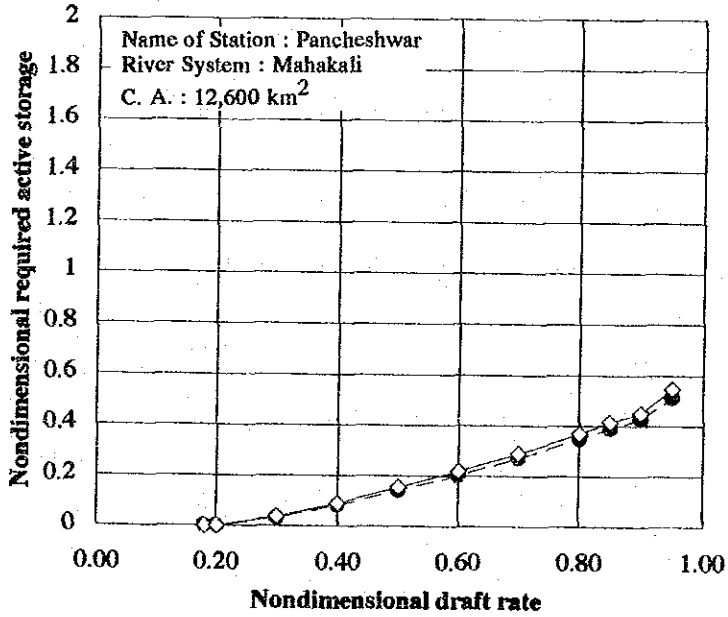


Figure 3.4.2 Storage-Draft Curves (1/7)

HIS MAJESTY'S GOVERNMENT OF NEPAL
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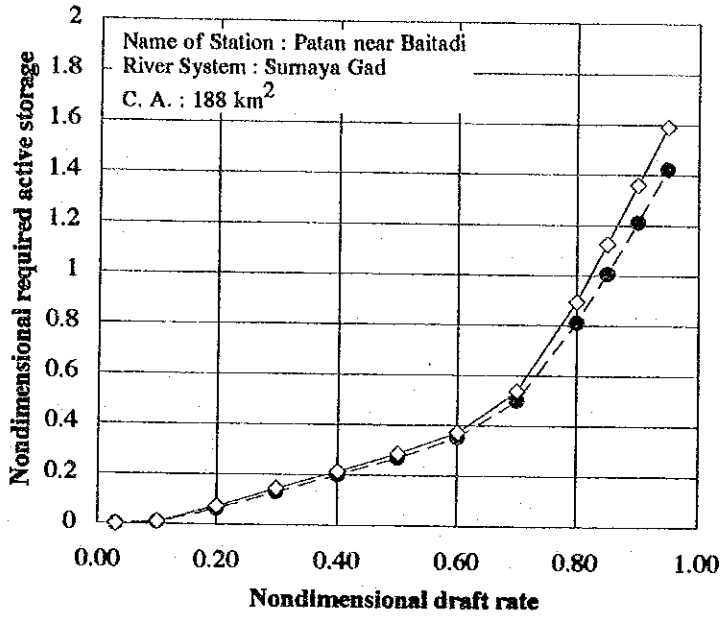
STATON 170



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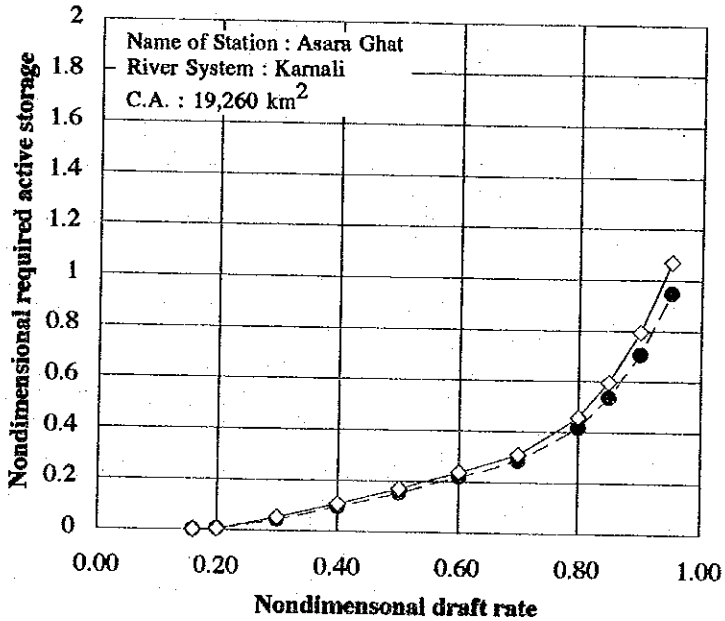

Figure 3.4.2 Storage-Draft Curves (2/7)

HIS MAJESTY'S GOVERNMENT OF NEPAL
WATER RESOURCES DEVELOPMENT OF
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
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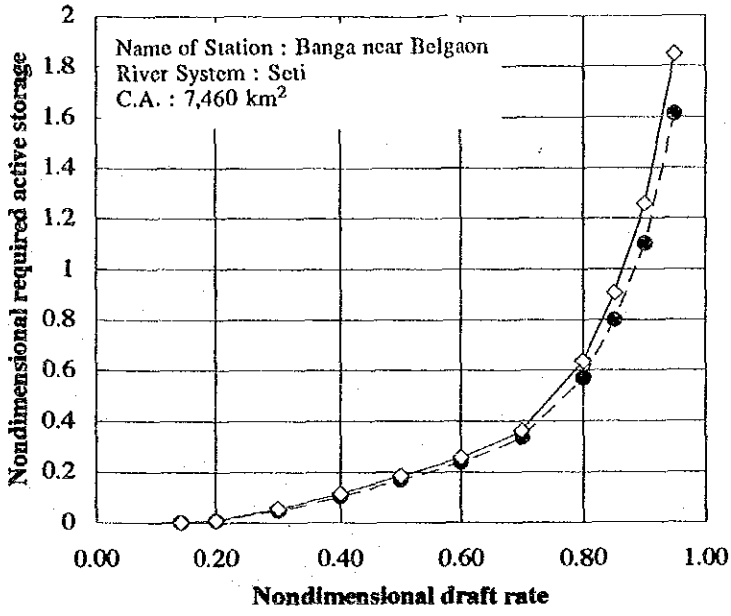
STATION 260



STATION 262

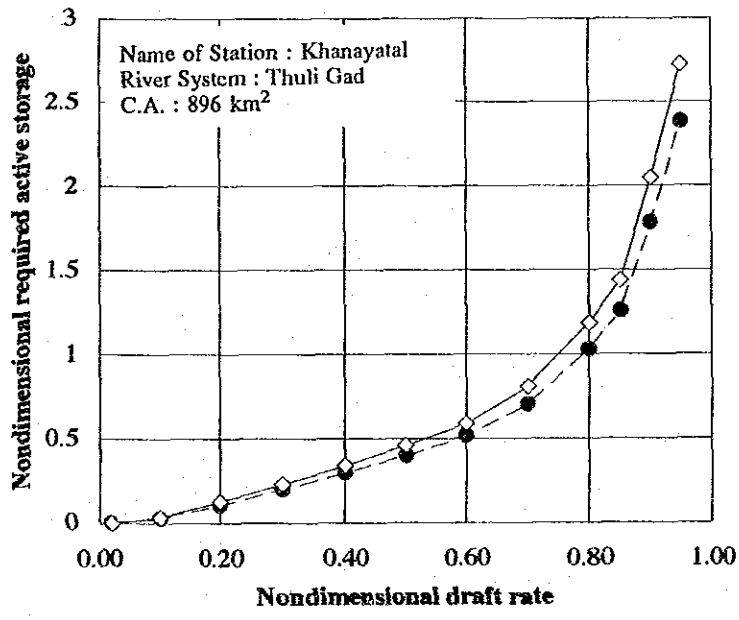


Figure 3.4.2 Storage-Draft Curves (3/7)

HIS MAJESTY'S GOVERNMENT OF NEPAL
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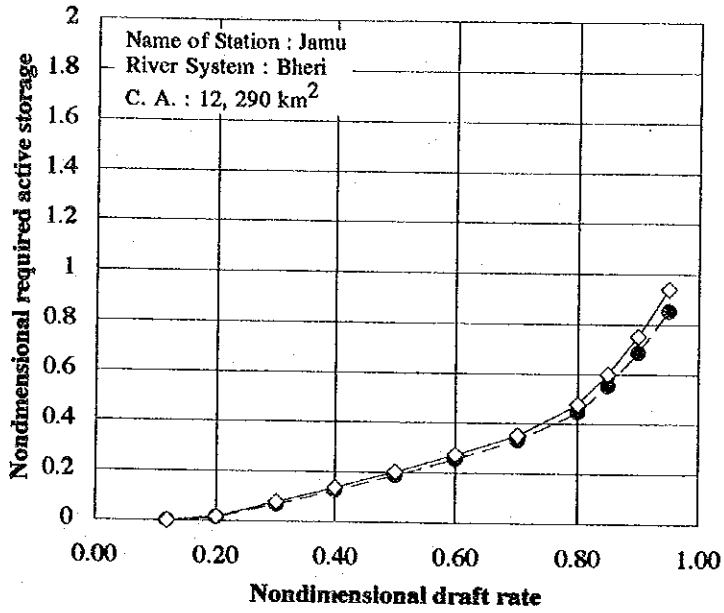
STATION 270



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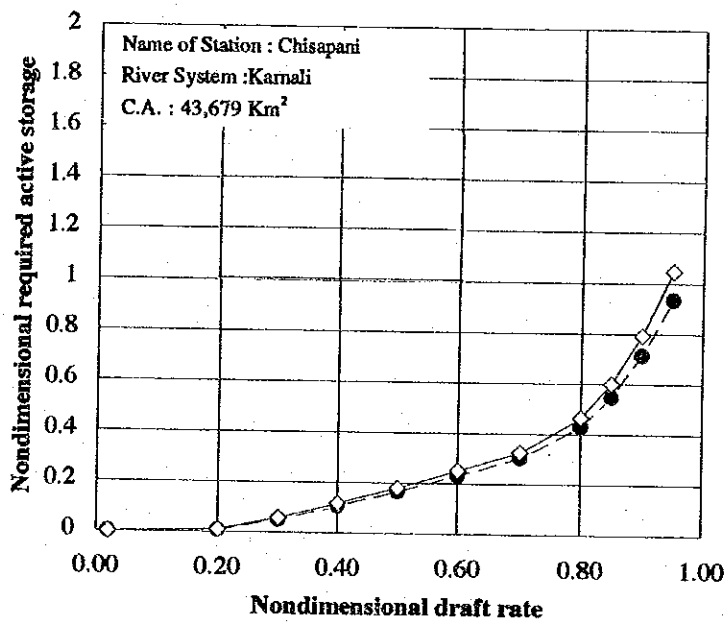

Figure 3.4.2 Storage-Draft Curves **(4/7)**

HIS MAJESTY'S GOVERNMENT OF NEPAL
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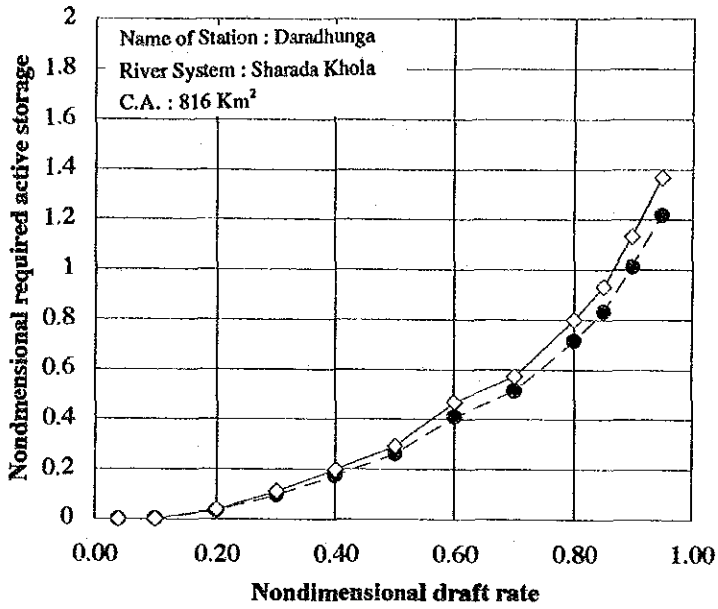
STATION 286



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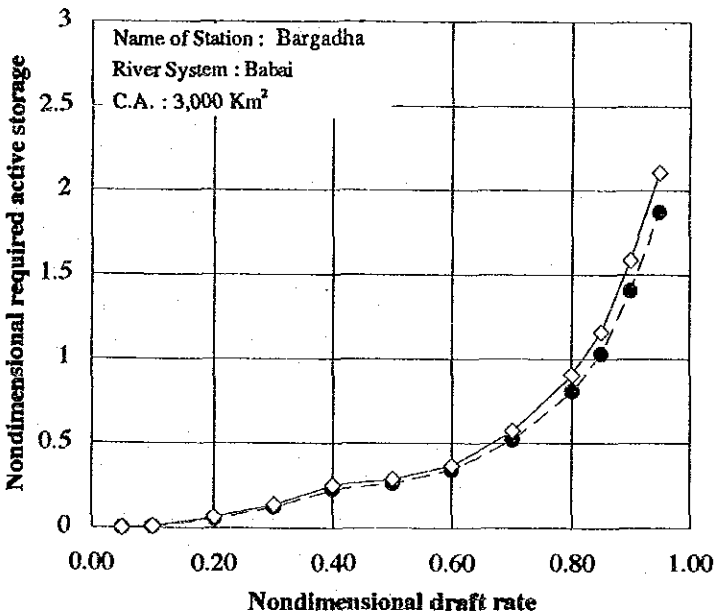

Figure 3.4.2 Storage-Draft Curves (5/7)

HIS MAJESTY'S GOVERNMENT OF NEPAL
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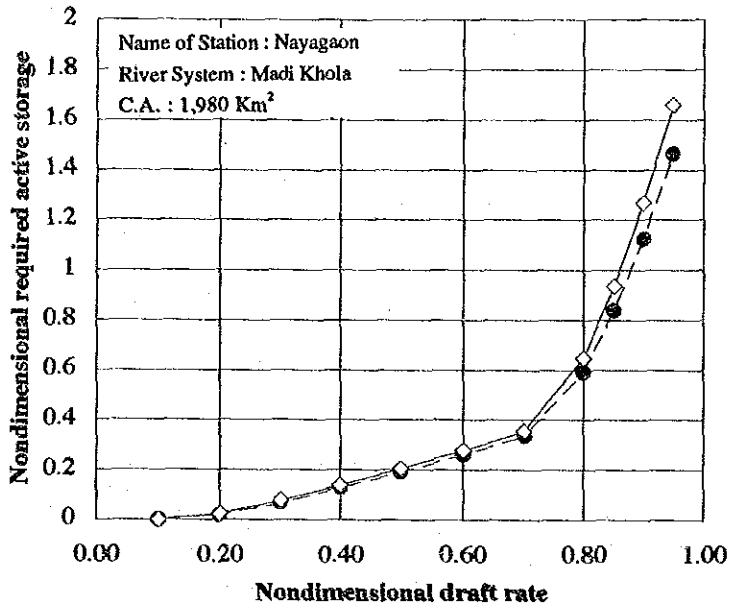
THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

STATION 330



STATION 350

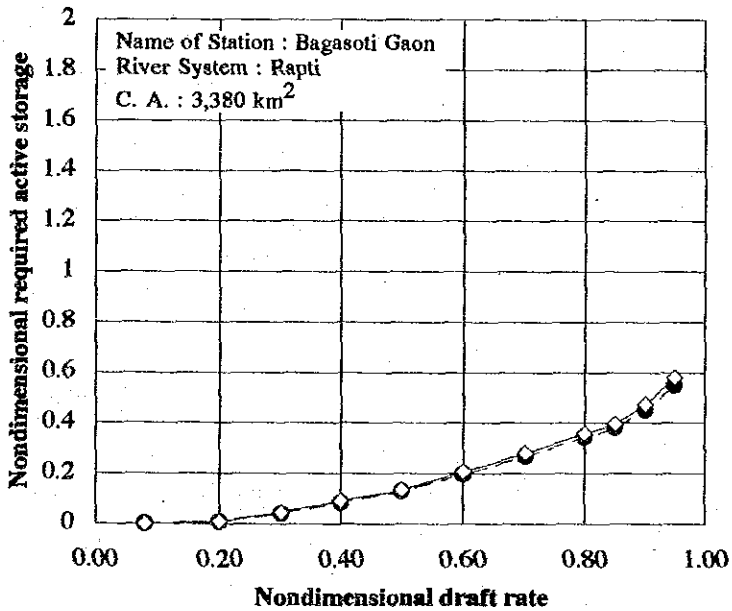


Figure 3.4.2 Storage-Draft Curves (6/7)

HIS MAJESTY'S GOVERNMENT OF NEPAL
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STATION 360

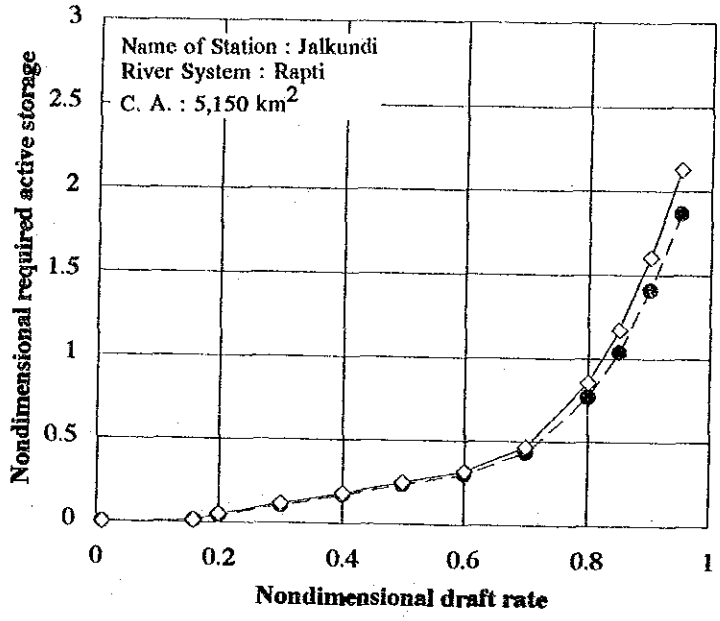

Figure 3.4.2 Storage-Draft Curves (7/7)

HIS MAJESTY'S GOVERNMENT OF NEPAL
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THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
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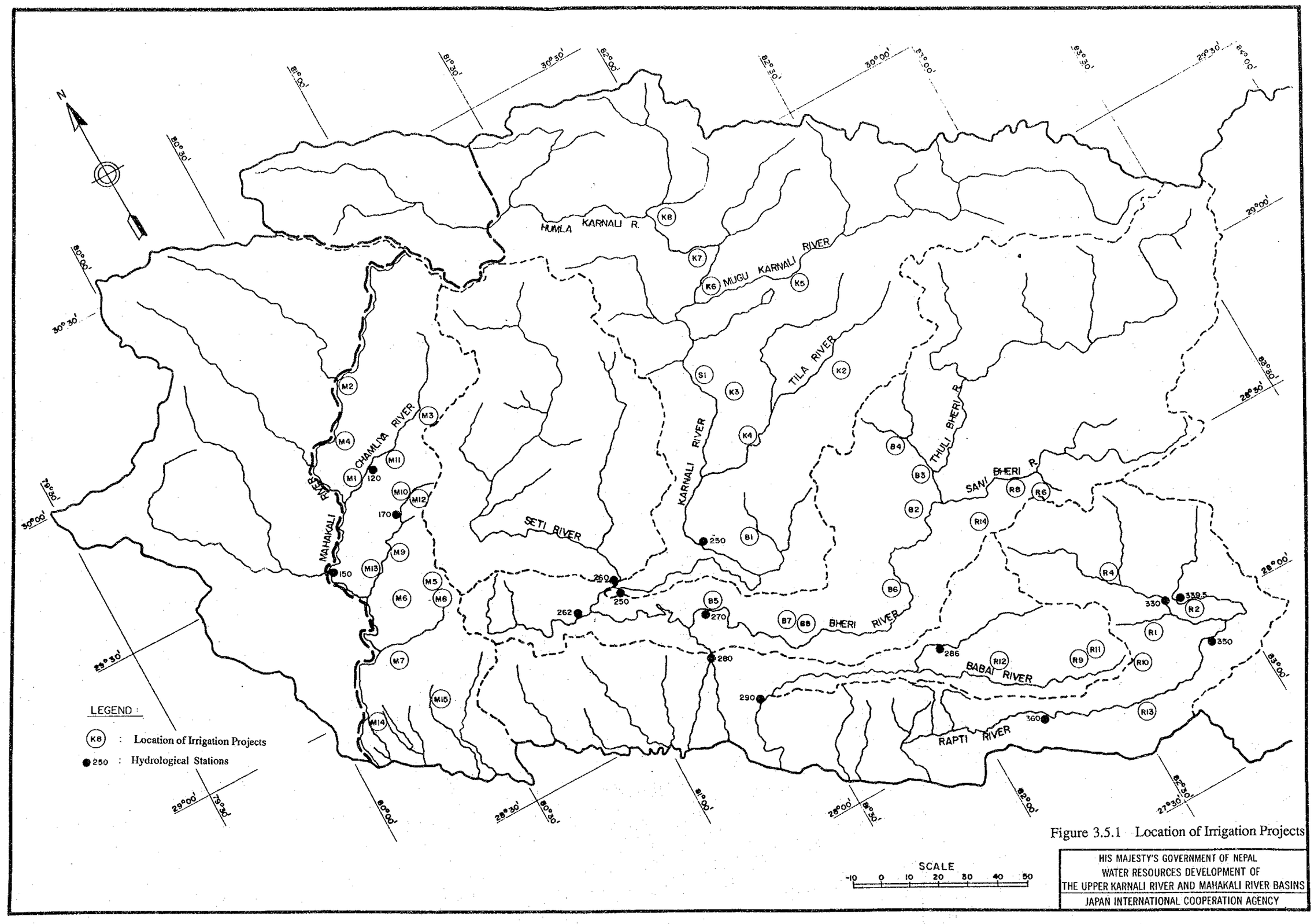

Figure 3.5.1 Location of Irrigation Projects

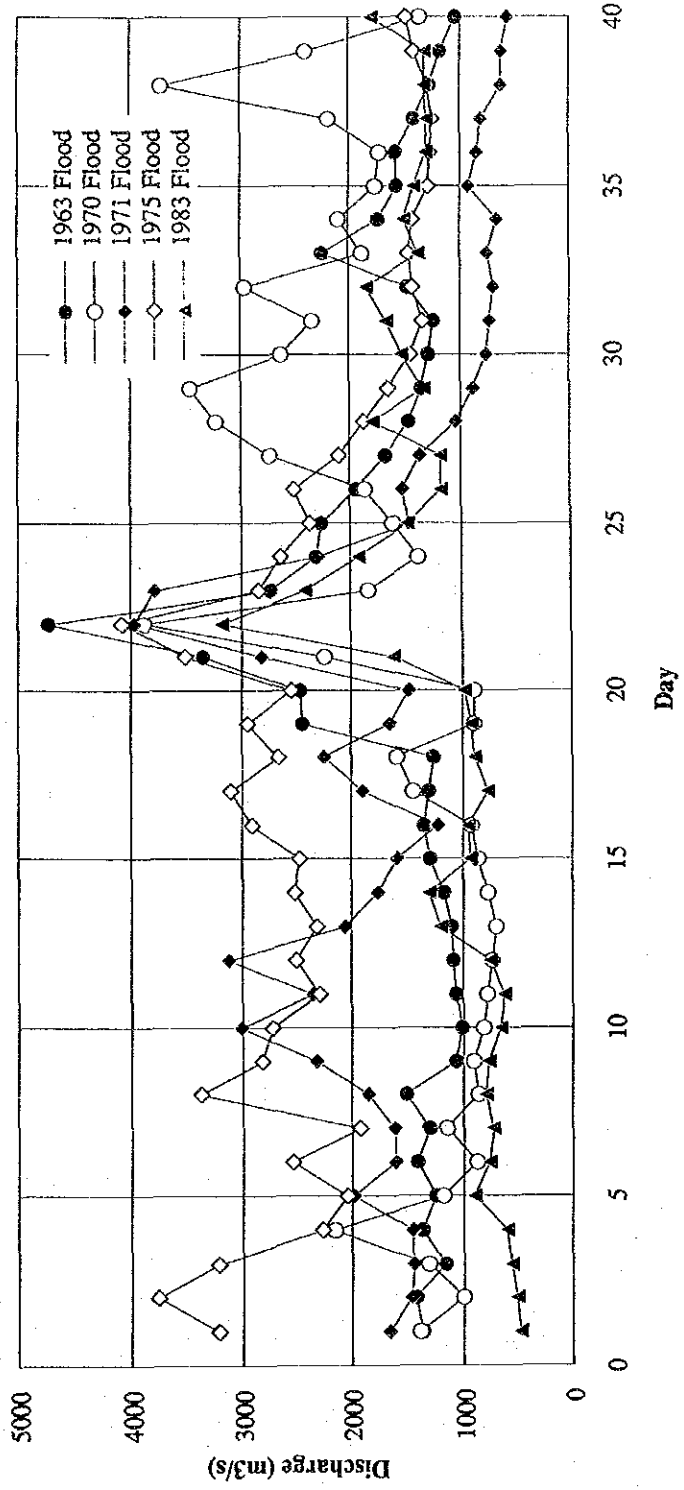

Figure 4.4.1 Flood Hydrographs Recorded at Station 150

HIS MAJESTY'S GOVERNMENT OF NEPAL WATER RESOURCES DEVELOPMENT OF THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
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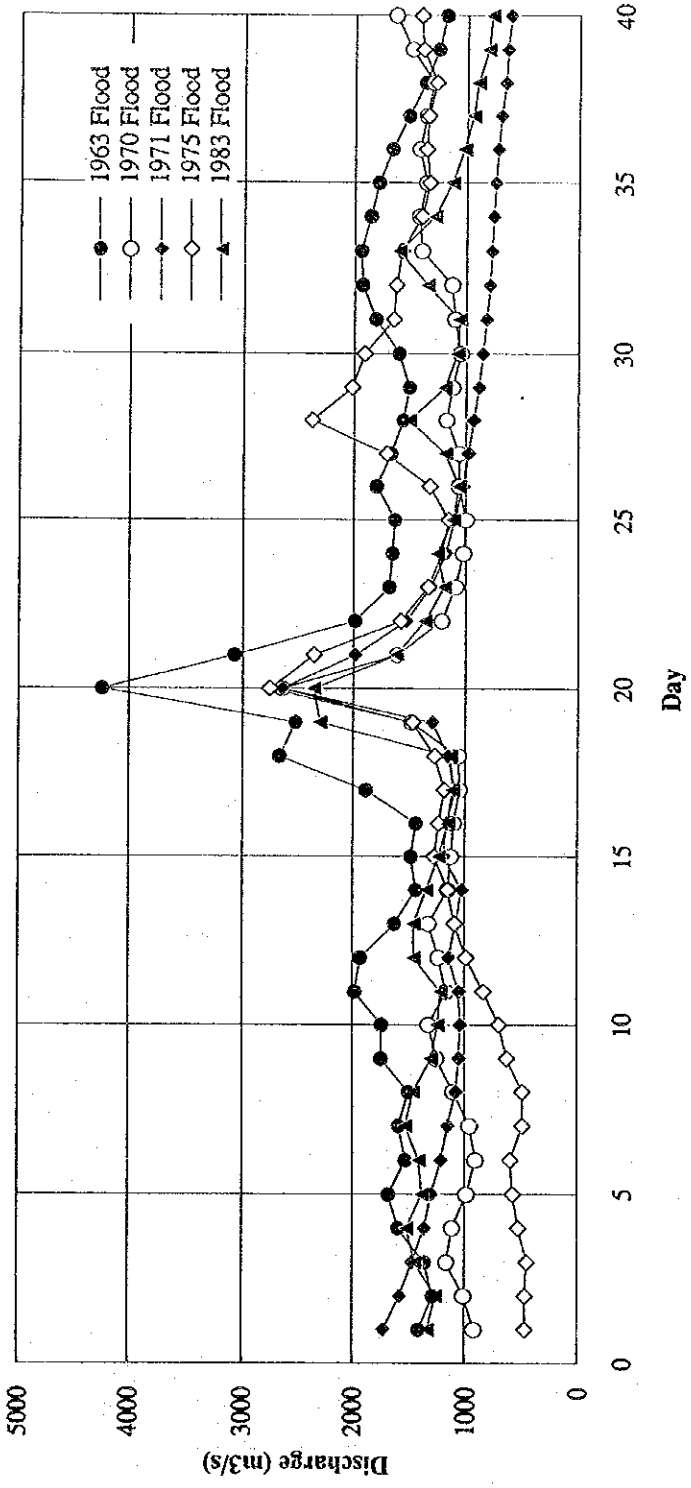

Figure 4.4.2 Flood Hydrographs Recorded at Station 240

HIS MAJESTY'S GOVERNMENT OF NEPAL WATER RESOURCES DEVELOPMENT OF THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
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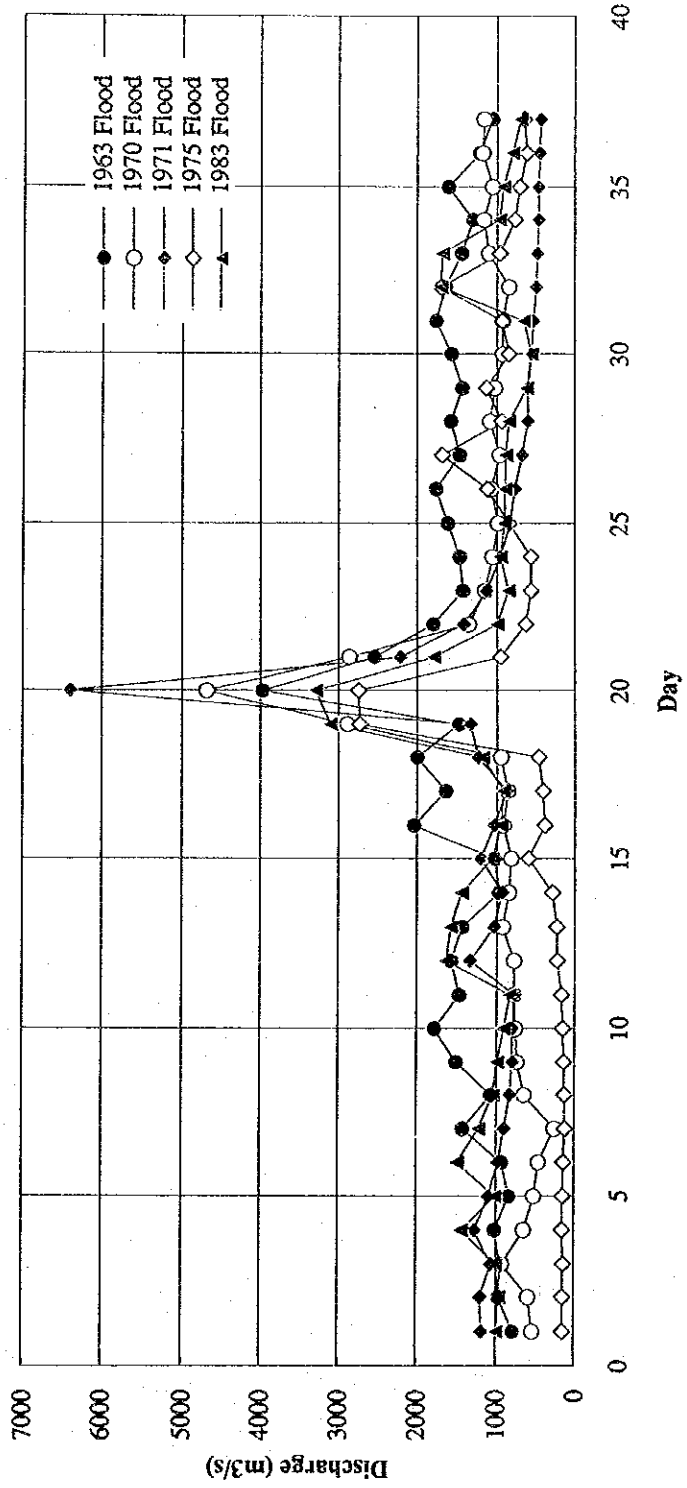

Figure 4.4.3 Flood Hydrographs Recorded at Station 260

HIS MAJESTY'S GOVERNMENT OF NEPAL WATER RESOURCES DEVELOPMENT OF THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
JAPAN INTERNATIONAL COOPERATION AGENCY

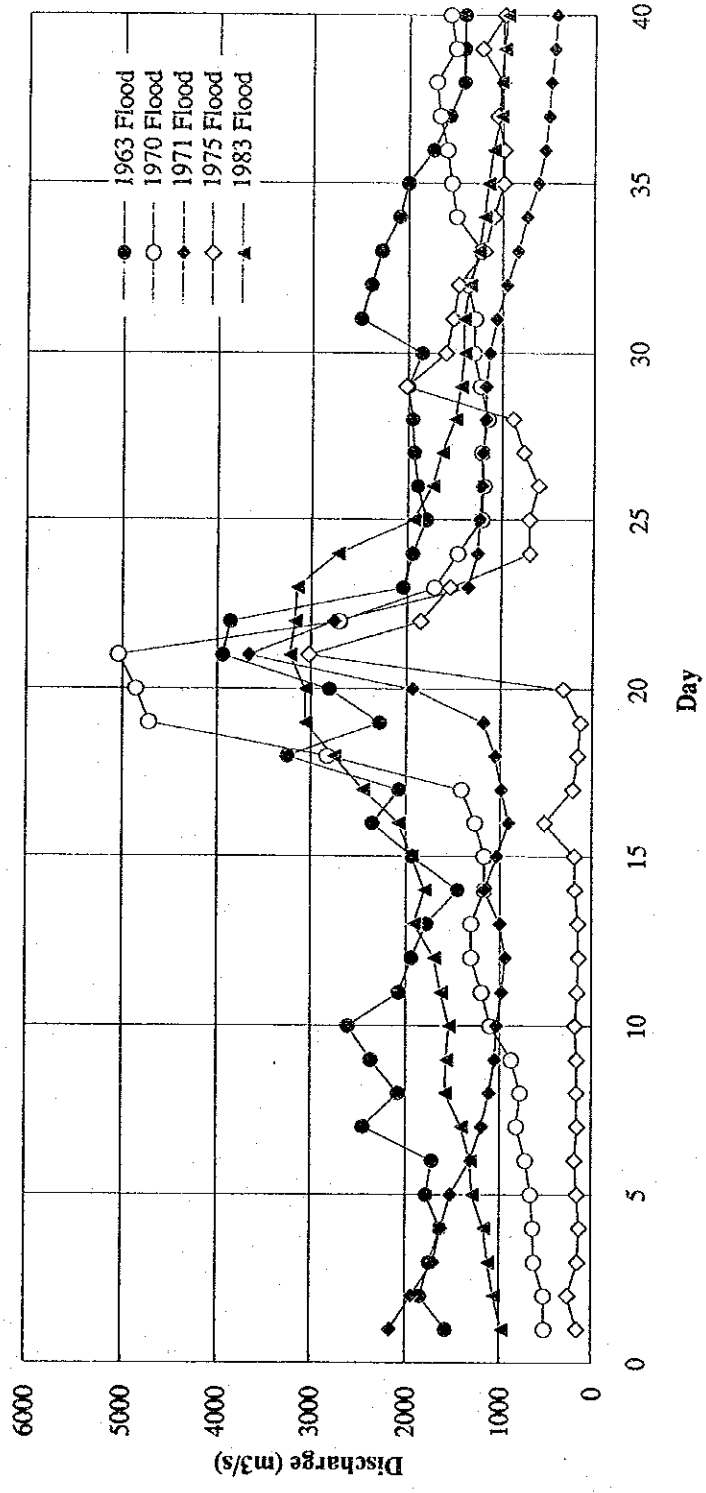

Figure 4.4.4 Flood Hydrographs Recorded at Station 270

HIS MAJESTY'S GOVERNMENT OF NEPAL
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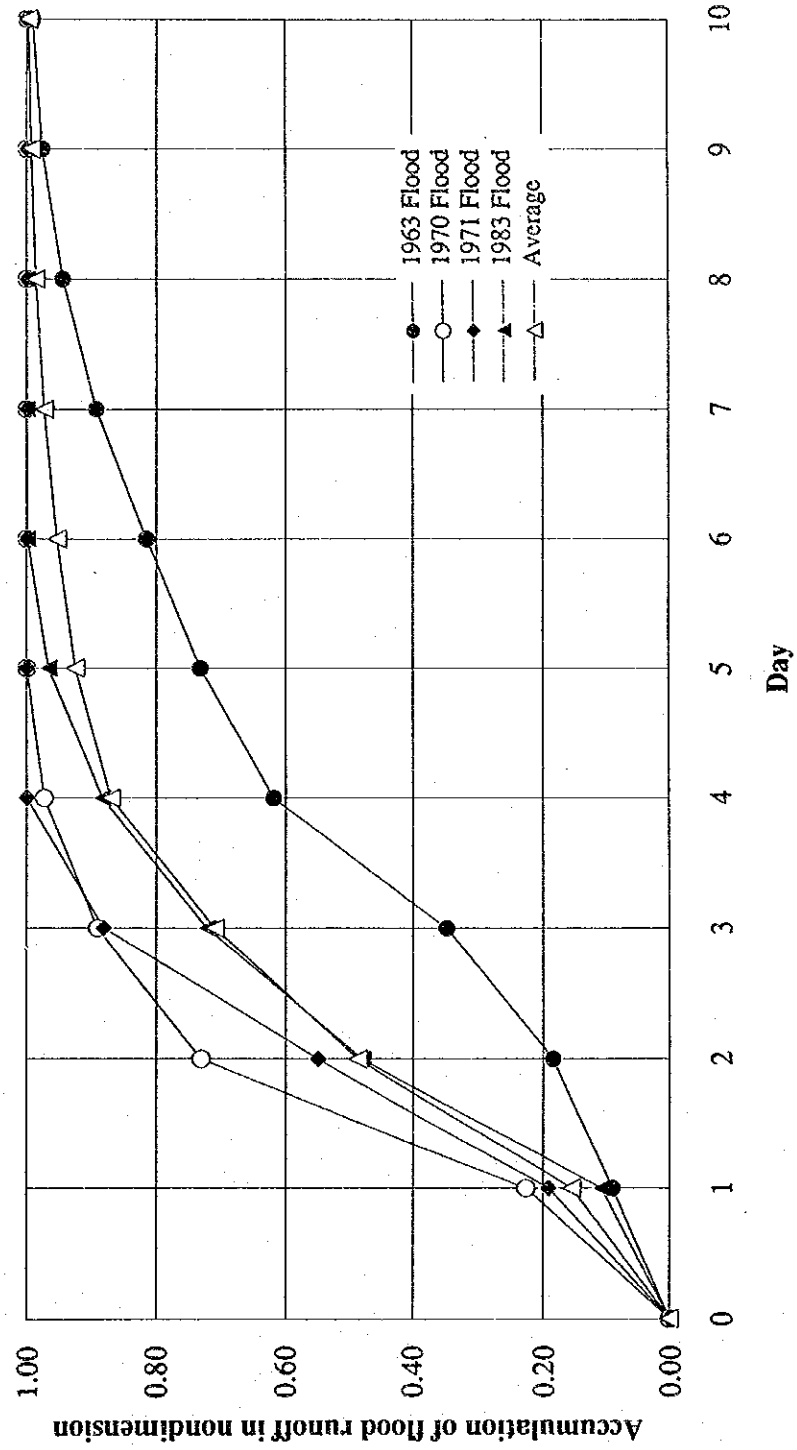

Figure 4.4.5 Accumulated Flood Hydrographs at Statoin 150

HIS MAJESTY'S GOVERNMENT OF NEPAL
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THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
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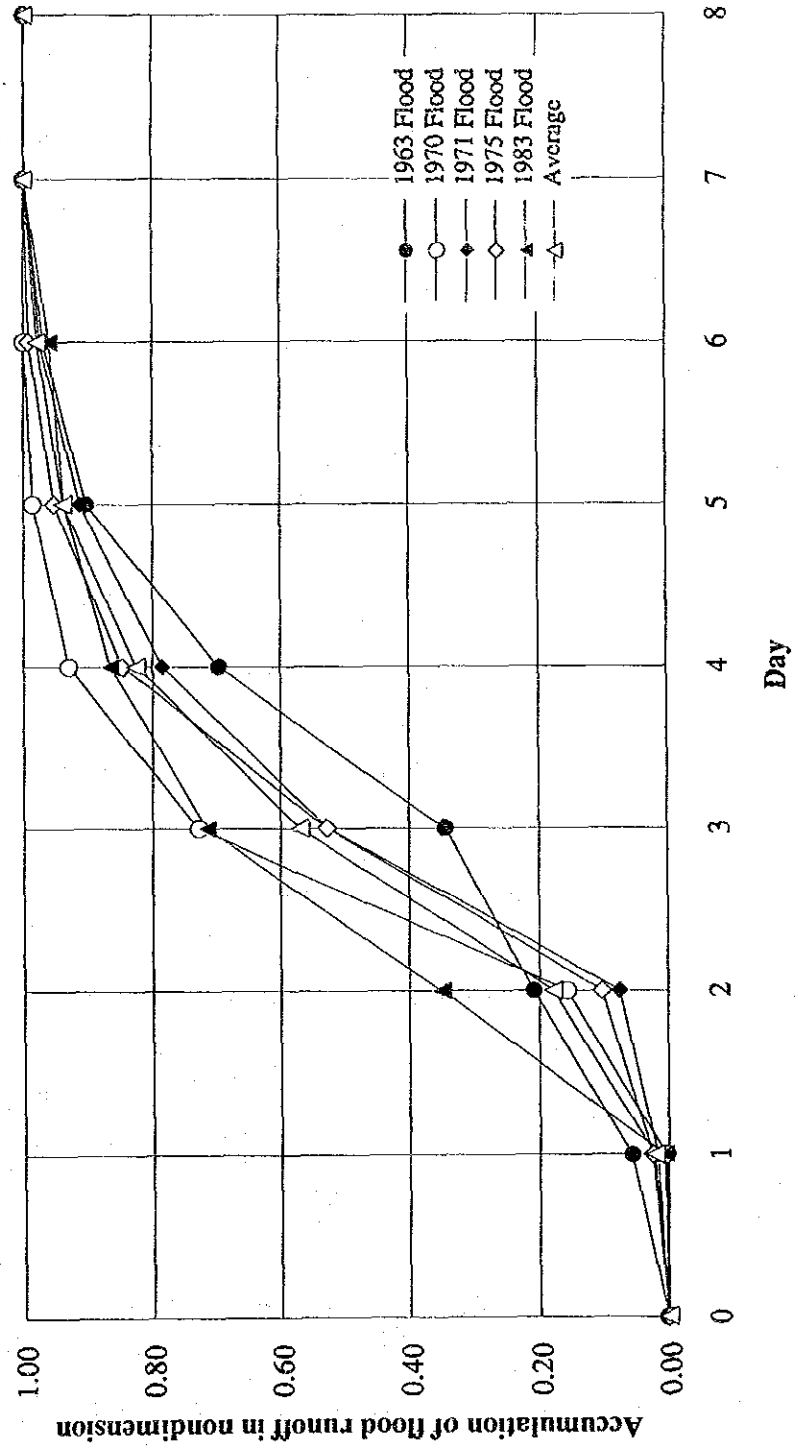

Figure 4.4.6 Accumulated Flood Hydrographs at Station 240

HIS MAJESTY'S GOVERNMENT OF NEPAL WATER RESOURCES DEVELOPMENT OF THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
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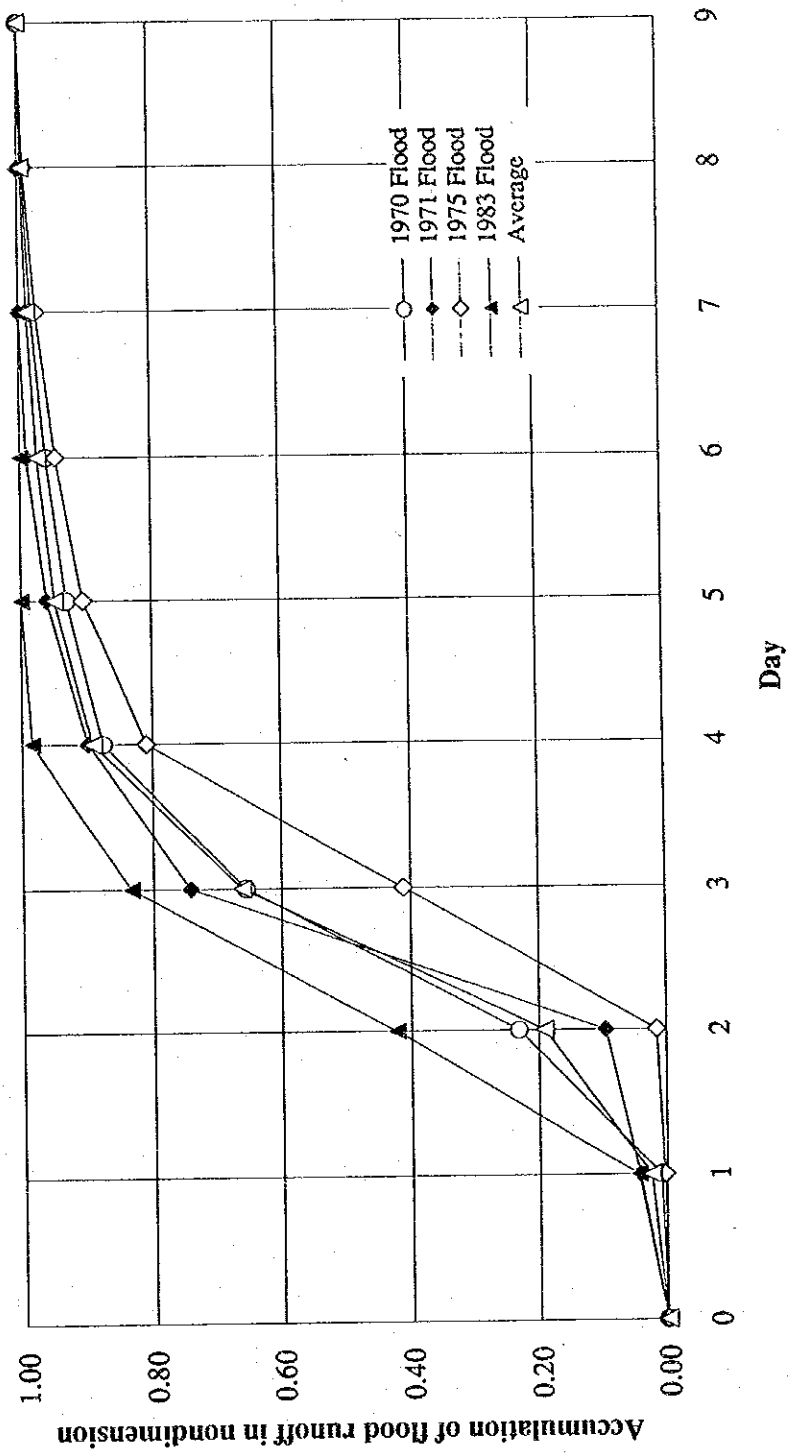

Figure 4.4.7 Accumulated Flood Hydrographs at Station 260

HIS MAJESTY'S GOVERNMENT OF NEPAL WATER RESOURCES DEVELOPMENT OF THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
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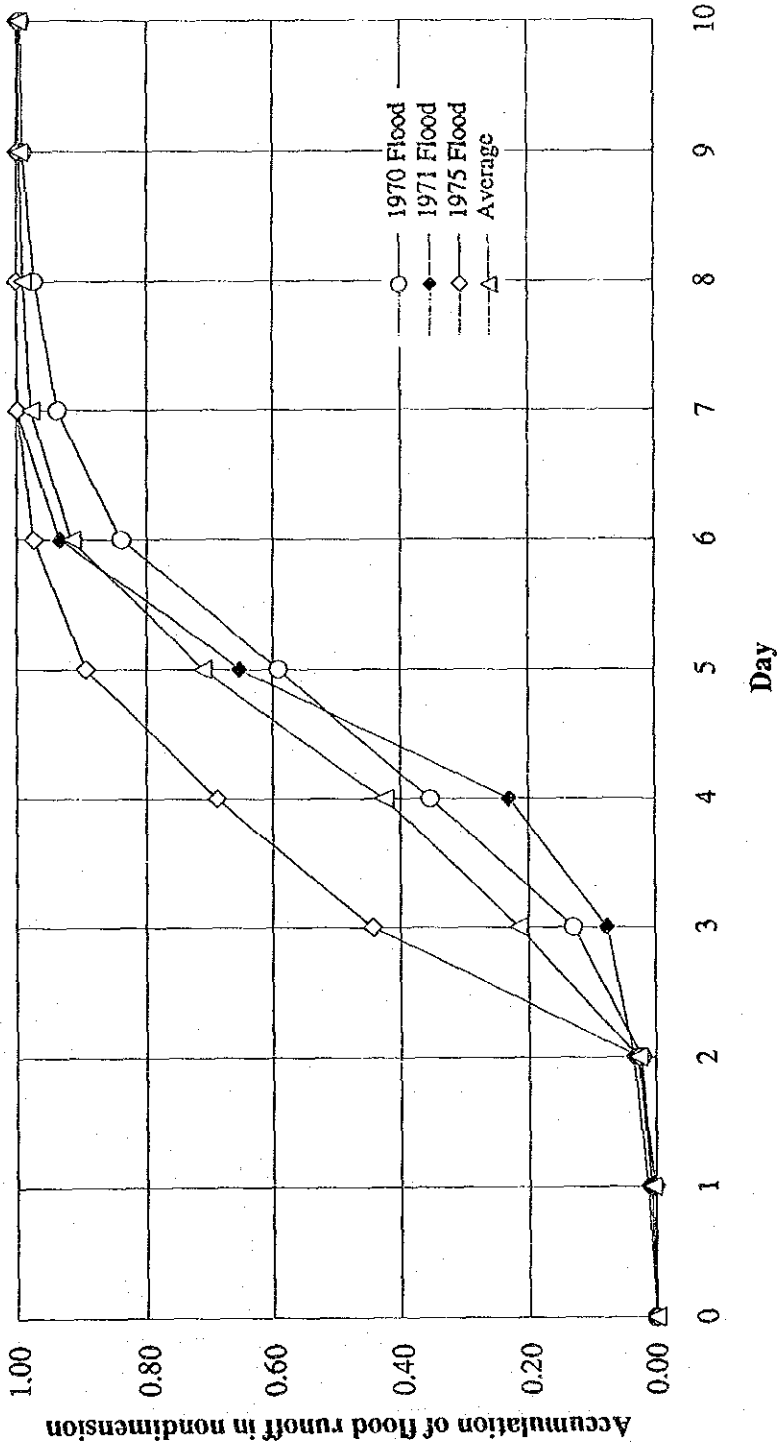

Figure 4.4.8 Accumulated Flood Hydrographs at Station 270

HIS MAJESTY'S GOVERNMENT OF NEPAL WATER RESOURCES DEVELOPMENT OF THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
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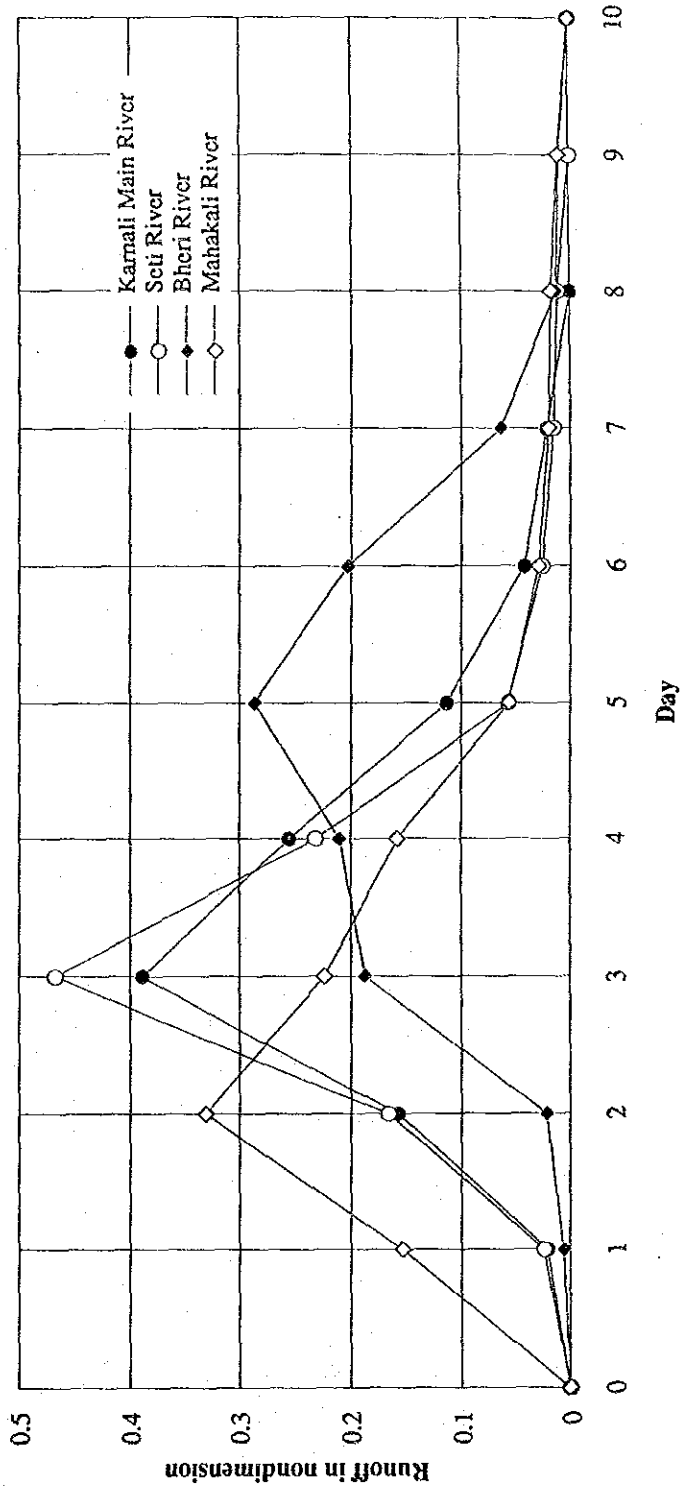

Figure 4.4.9 Proposed Flood Patterns

HIS MAJESTY'S GOVERNMENT OF NEPAL
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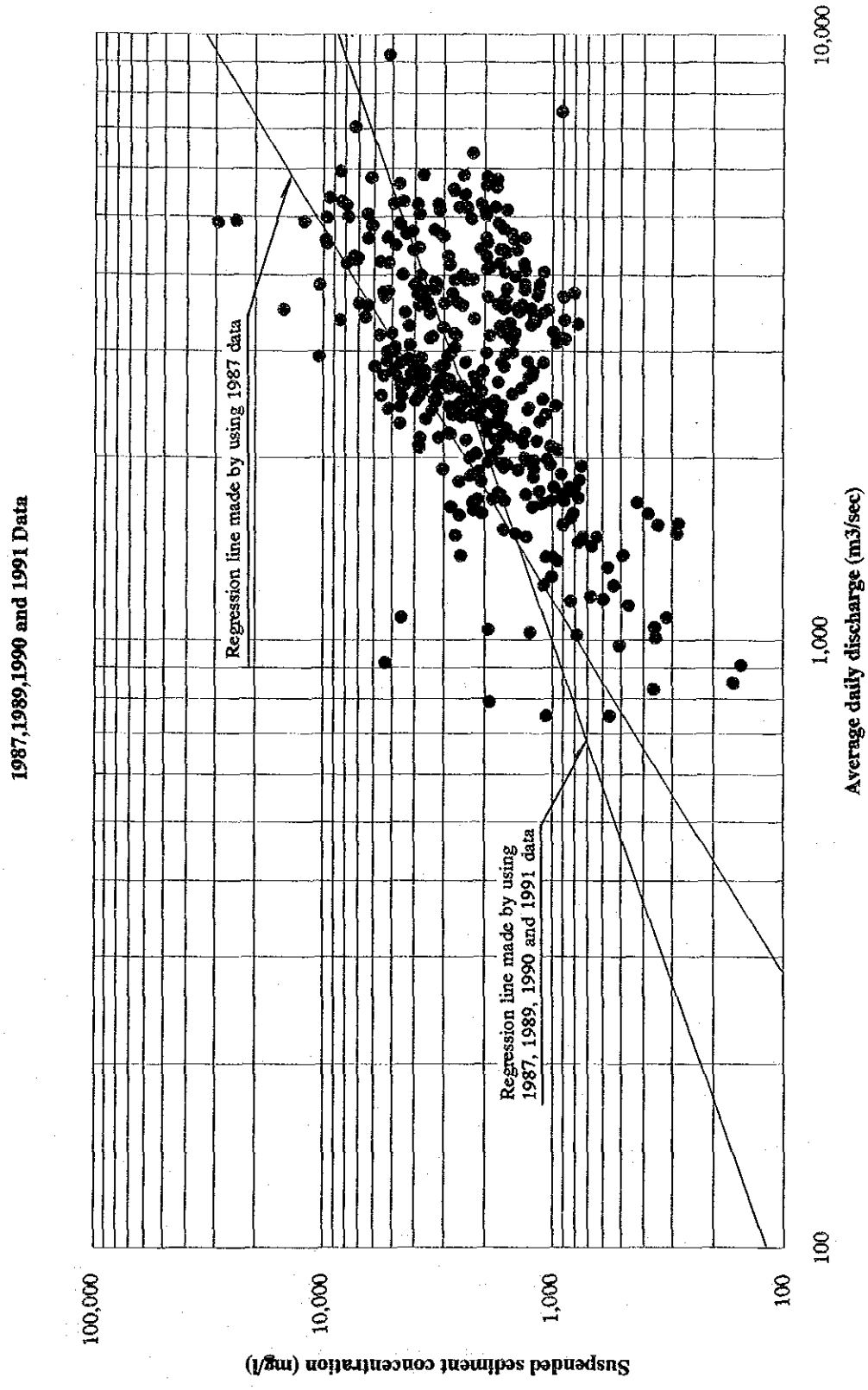

Figure 5.4.1 Average Daily Sediment Concentration Versus Discharge at Station 280

HIS MAJESTY'S GOVERNMENT OF NEPAL
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THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
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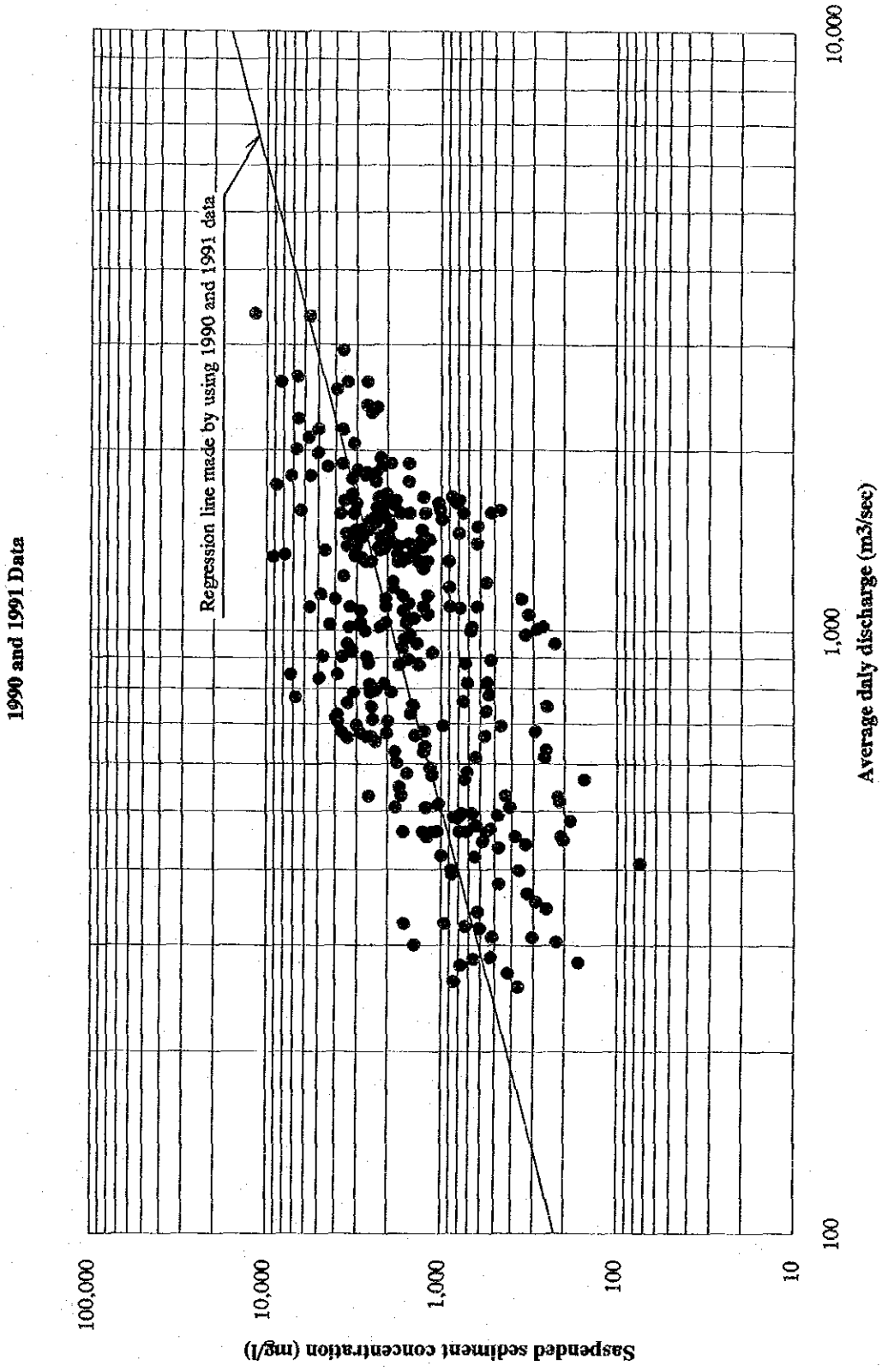

Figure 5.4.2 Average Daily Sediment Concentration Versus Discharge at Station 150

HIS MAJESTY'S GOVERNMENT OF NEPAL
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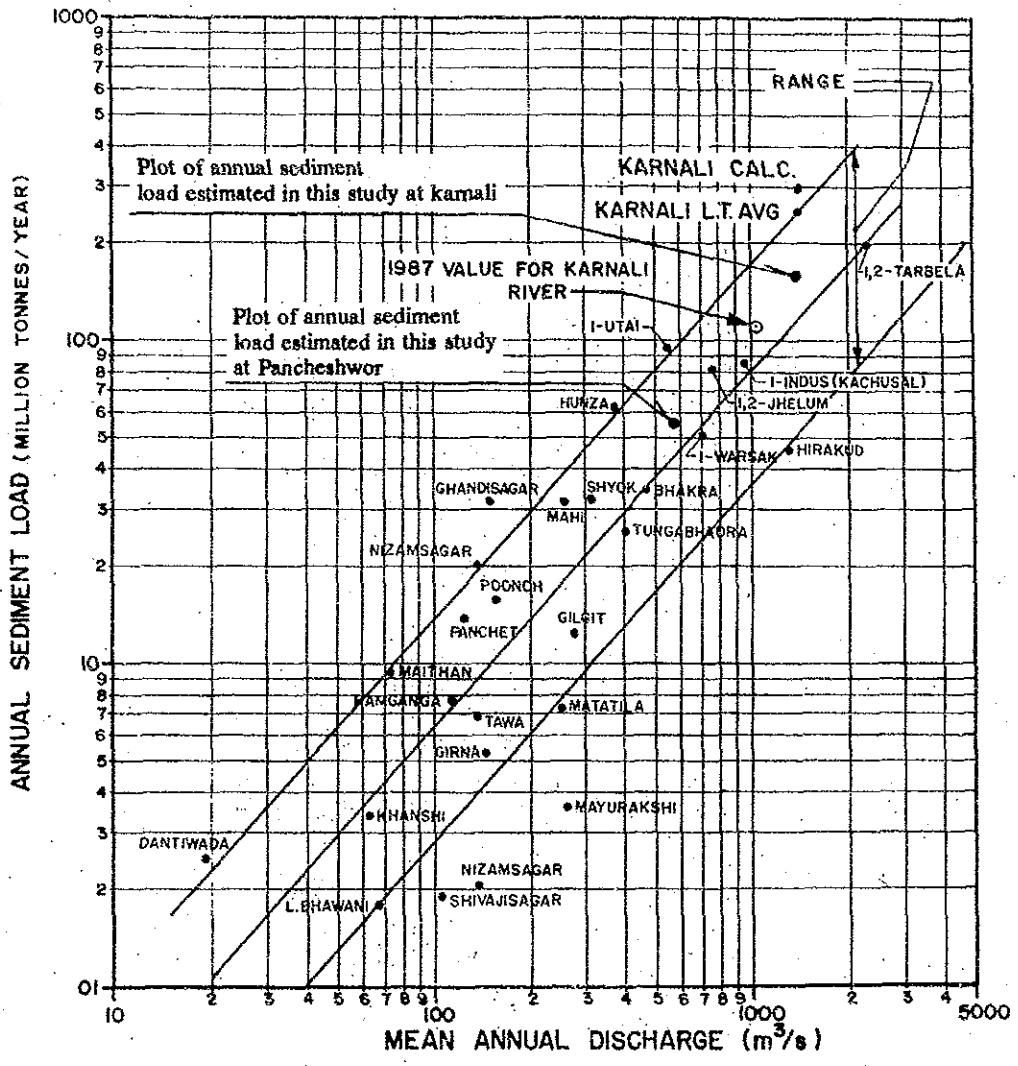

Source : Karnali Multipurpose Project
Annex E Sedimentation (1989)

Figure 5.4.3 Annual Sediment Deposition Rates in India Sabcontinental Reservoirs

HIS MAJESTY'S GOVERNMENT OF NEPAL
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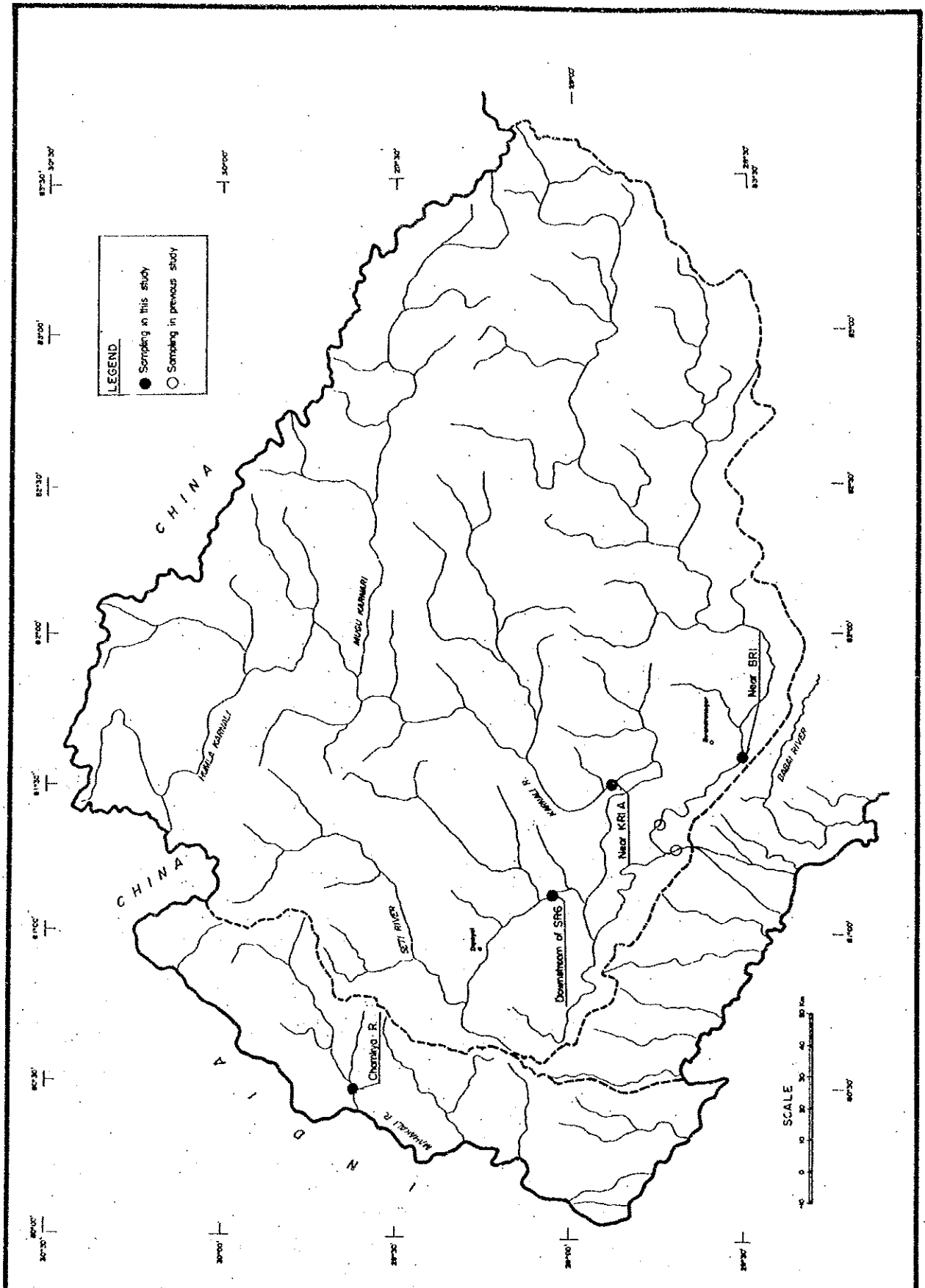

Figure 5.5.1 Sampling Places of River Bed Materials

HIS MAJESTY'S GOVERNMENT OF NEPAL
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THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
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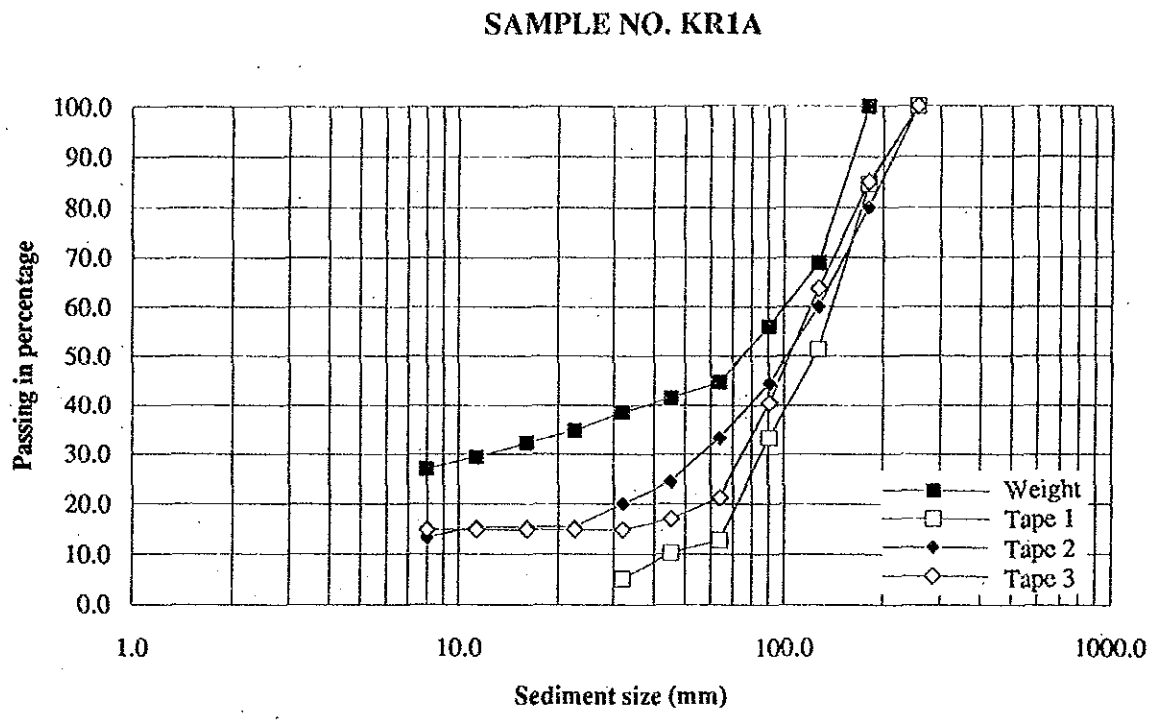

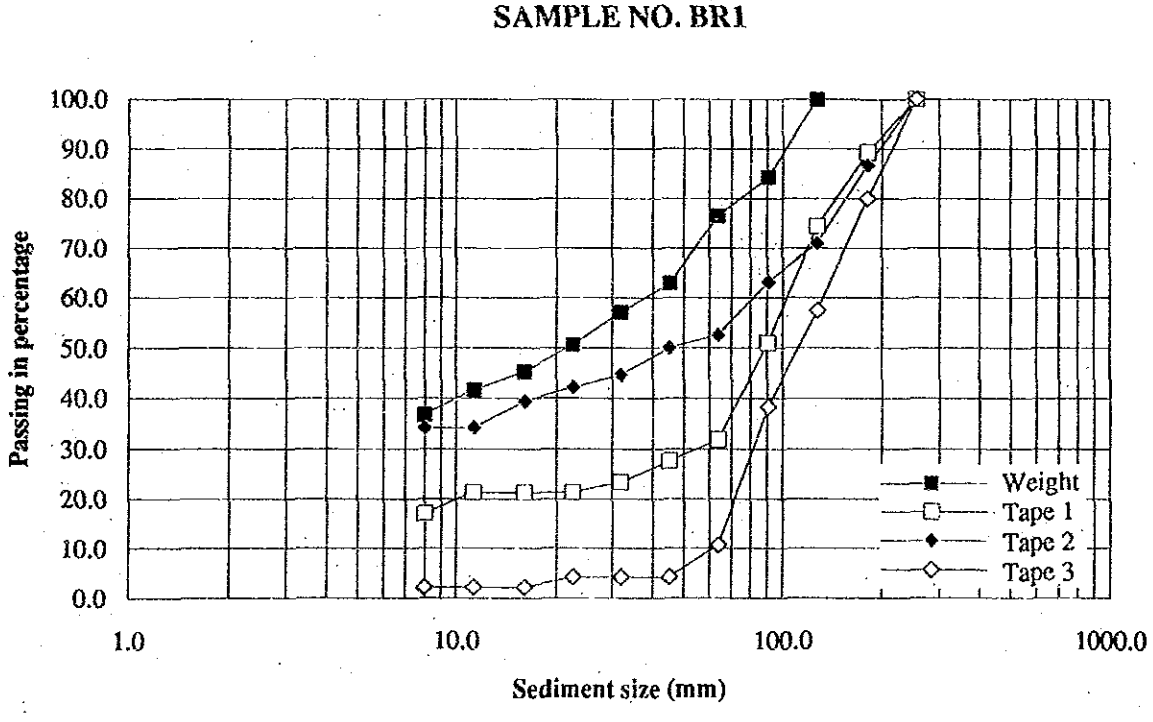

Figure 5.5.2 Distribution Curves of River Bed Materials at KR1A and BR1

HIS MAJESTY'S GOVERNMENT OF NEPAL
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THE UPPER KARNALI RIVER AND MAHAKALI RIVER BASINS
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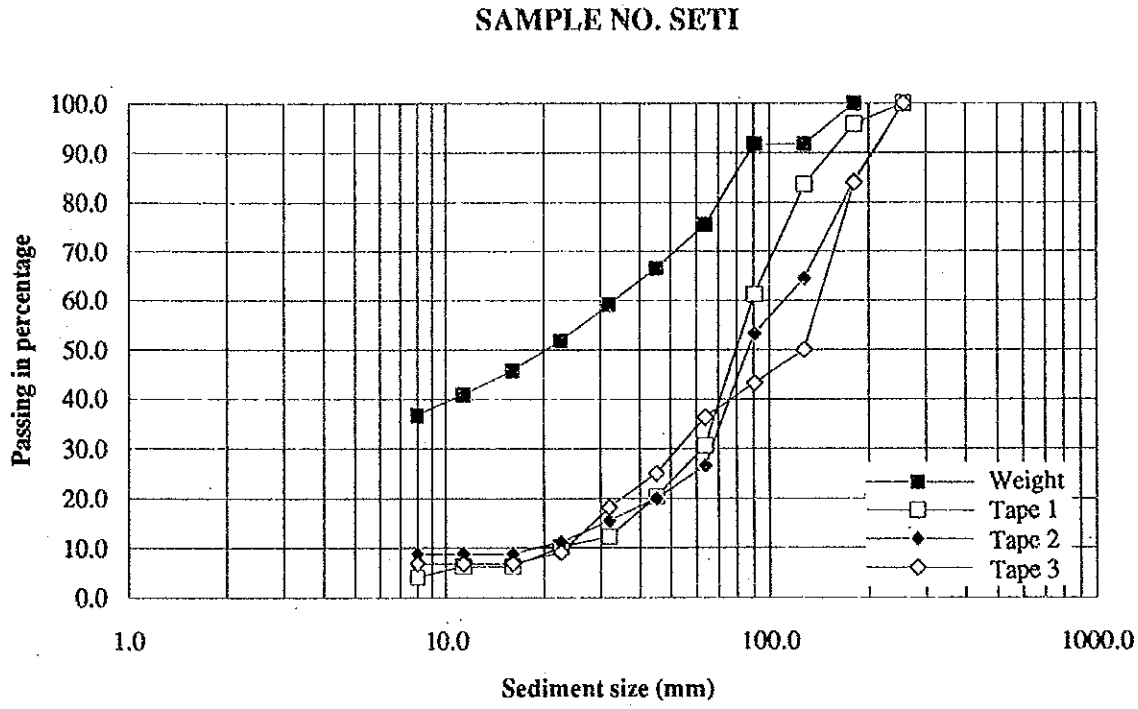

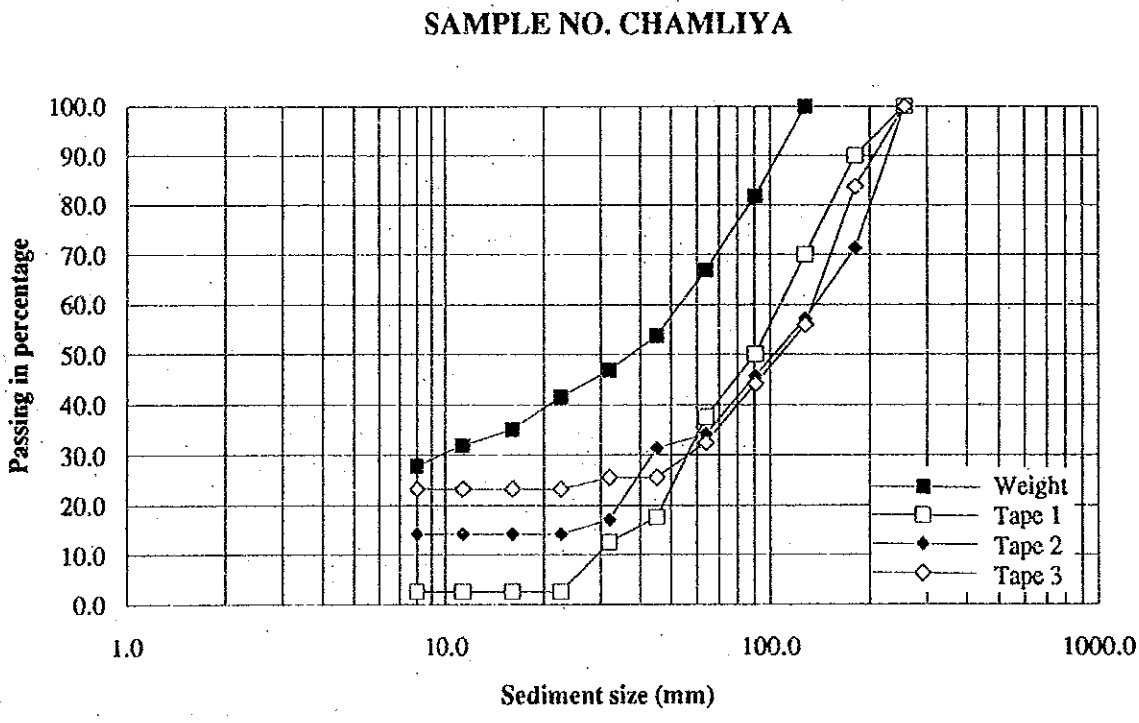

Figure 5.5.3 Distribution Curves of River Bed Materials at Seti and Chamliya

APPENDIX III

LAND USE, ENVIRONMENT AND WATERSHED

APPENDIX III
LAND USE, ENVIRONMENT AND WATERSHED

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1. THE STUDY AREA

1.1 Physical Environment

1.1.1 Soil and Land System

The soil of Nepal is, in general, poor in fertility, although soil type varies extremely with location and physiographic changes. Soil conditions are naturally better in lowlands than hills and mountains, since fertile top soils and organic matters are eroded from uplands and deposited in lowlands.

In the Terai area, the soil type is mainly alluvial, and the texture is fine to medium. The soil layer is generally deep, and thus the water-holding capacity is high. The soil pH ranges from moderately alkaline to moderately acidic, and the contents of organic matters vary in a wide range.

The main soil type of the Siwaliks area is fine loamy or sandy with pebbles. The drainage capability widely varies, and the water-holding capacity is low. The soil development is generally little, and the soil is shallow and acidic.

In the mountainous areas, the major soil types, which are composed of sand and gravels, show light to medium texture. The soil pH is generally acidic, and the soil fertility is low to medium. The typical characteristic of the soil in this area is its high erodibility mainly because of the light texture and steep slopes.

The soil types commonly observed in Nepal are taxonomically Entisols, Inceptisols, Mollisols and Altisols according to the soil order classified by Land Resource Mapping Project (LRMP) in 1986 (Ref. III-1). Their characteristics, such as parent materials, associated climate, slopes, dominant vegetation, development period required and major factors of pedogenetic development, are tabulated in Table 1.1.1. The soil's great groups of 2-Fluvents, 3-Aquepts, 6-Ocrepts, 8-Ustolls and 10-Ustalfs show increasing stability of alluvial landscape as the assigned number becomes higher. On the other hand the stability of mountainous landscape increases in the order of bare rock and non-soil, 1-Orthents, and 4,5,6 and 7-Ochrepts as shown in Figure 1.1.1.

On the basis of the soil survey above and other landscape features, i.e. location, slope, degree of dissection and flooding frequency, LRMP established seventeen land system classes as shown in Table 1.1.2. The extent of the land systems of the Study Area by development region is shown in Table 1.1.3.

High agricultural productivity in general relies on flat land, deep soil and flood-free area. On the basis of this and the land system criteria, the land units 2, 3a, 4c, 5a, 6a, 6b, 6c, 9b, 9c, 13b, 13c, 13Com, 13d and 14a are likely to have high agricultural potential. The area belonging to these land units is 666,724 ha and accounts for only 10.7% of the Study Area, while the area of high agricultural potential occupies 15% of the whole of Nepal (refer to Table 1.1.3). On the other hand, areas of low agricultural potential (Land Unit: 3b, 3c, 4b, 5b, 5c, 5Com, 9Com, 10a, 11 and 15a) and non-agricultural potential (Land Unit: 1, 3d, 4a, 4Com, 5d, 6d, 7, 8, 9a, 10b, 10Com, 12, 13a, 14b, 15b, 16, 17 and 18) account for 14.6% and 74.7% of the Study Area, while accounting for 18.7% and 66.4% of the whole of Nepal, respectively.

1.1.2 Vegetation

The vegetation of Nepal is a complicated mosaic of flora because of the wide variety of climate from sub-tropic to polar, soil types mentioned in Section 1.1.1 and moisture conditions. The flora of Nepal is, therefore, very rich and forest type has been classified into 35 categories. The general vegetation pattern is illustrated vertically in Figure 1.1.2 in relation to climatic zones, temperature and land use by LRMP (Ref. III-2).

Table 1.1.4 shows the sub-divisions of land use by physiographic region of Nepal. Hardwoods, which are represented by sisso, sal and oak, are dominant in the lower three physiographic regions. In the High Mountain, forests occupy half of the land with a balanced combination of three types of forest.

In the sub-tropical zone of the Karnali River basin, the dominant tree species are Dalbergia sisso (Sisso) and Acacia catechu along river banks. Another dominant tree species in this zone is Shorea robusta (Sal). At higher altitude, the sub-tropical forests are mainly Castanopsis indica and Quercus lanuginosa (kind of oak) according to New Era, 1987 (Ref. III-3). As the elevation increases, Pinus roxurghii (Chir-pine), Quercus incana and Quercus lanuginosa become dominant. At altitude of 2,000 to 3,000 meters, Pinus wallichiana (blue pine), Picea smithiana (spruce), Cedrus deodara (ceder), Abies pindrow (kind of fir) and Quercus semecarpifolia (khasru oak) are common. Above 4,000 meters in altitude, the dominant tree species are Pinus wallichiana, Quercus semecarpifolia, Tsuga dumosa, Abies

spectabilis(kind of fir), Betula utilis (birch) and Juniperus wallichiona. There are no trees in the alpine zone, but rhododendrons and junipers grow at up to 4,500 meters in altitude.

Forested areas are shrinking gradually. Many forests on steep slopes have been degraded, and eroded especially in the high altitude areas. When the population density was low, Terai, Siwaliks and Mountain areas were covered with forest. Once the population density exceeded a certain critical level, at which the demand and supply of forest resources are balanced, the demand for fodder, fuelwood and the land occupied by forest itself for cultivation increased at a rapid speed, causing shrinkage of forest land. It is presumed that this shrinkage of forest land started to become evident in the 1940's.

LRMP estimated that 62% of the Terai tropical hardwood forests had been cleared and used for cultivation in the last twenty years. The Siwaliks Zone remains relatively well covered with forest, although forest degradation continues. In the Middle Mountain areas where the largest population lives and the most intensive land use is practiced, forest remains only on non-arable land.

Forest is essential for human beings as a source of fodder, fuelwood and construction material in the short-run and for soil and watershed conservation in the long-run. These two aspects of long-run and short-run functions often conflict with the participation by human beings in the utilization of forest resources, and the current trend is the degradation of forest land.

1.1.3 Present Land Use

The land use according to LRMP (1986) has been classified into five categories, i.e. cultivated land, grazing land, forest land, shrub land and others. In the Study Area, the proportional extent of these land uses is 17.49% for cultivated land, 15.20% for grazing land, 42.35% for forest land, 2.21% for shrub and 22.75% for others respectively. The major differences in land use between the Study Area and the national average are (a) that the proportional extent of the cultivated area is nearly 10% lower than that of the national average, and (b) that the proportional extent of the forest land to the Study Area is higher than that of the national level. Details are shown in Table 1.1.5.

1.2 Socio-Cultural Environments

1.2.1 Ethnic Group

A detailed country-wide survey on ethnic groups has not been conducted yet. On the basis of mother tongue statistics, major ethnic groups are classified into 13 (Ref. III-4): Brahman, Chhetri, Thakuri, Bhojpuri, Tamang, Tharu, Newer, Awadhi, Magar, Rai, Gurung, Limbu and Sherpa. The core areas occupied by these major ethnic groups are depicted in Figure 1.2.1. The first three groups, i.e. Brahman, Chhetri and Thakuri, are Nepali-speaking groups and account for over 58% of the total population.

A dominant ethnic group living in the Study Area is the Chhetri, which is distributed in the area except for the Terai and the High Himal. Other Nepali speaking groups such as the Thakuri and the Brahman inhabit the Far Western Development Region.

The Bhotiya, which speaks the Tibet-Burma language and has customs similar to the Sherpa, lives in the High Himal Zone extending along the Humla and Mugu Karnali rivers. The Magar, which has a social culture based on Buddhism, inhabit the valley of the Thuli Bheri River.

The Surkhet valley, where flat terrain extends, is inhabited by the Tharu, which is a dominant ethnic group living in the Terai Zone. The Newar, which occupies such town area as Dipayal and Silgadhi, is mainly engaged in commercial activities.

In the Dailekh District where one reservoir type project is located, nearly 97% of the population is Nepali speaking (refer to Table 1.2.1). Therefore, if involuntary resettlement is conducted within the district, the problem of friction among ethnic groups is not likely to occur.

If the involuntary resettlement is implemented from LR-1, which is one of priority schemes selected in the hydropower sector, in Dailekh to Terai area, careful consideration about the relation between the resettlers and host groups is essential. Since Nepal is composed of many different ethnic groups for many years and HMG/N never experienced the friction of ethnic groups with involuntary resettlement programmes, this sort of problem is no likely to occur as far as fair treatment to both resettlers and host groups is made.