

Table C2.1 HYDROLOGICAL GAUGING STATIONS IN THE STUDY AREA

Rainfall Gauging Stations

Station	Management	Data		Observation Period
		Daily	Hourly	
Lang (Meteorological)	GDOMH	X 19:00 - 19:00	X	1955 - (daily) 1957 - (hourly)
Lien Mac Ha Dong	MOWR	X 19:00 - 19:00	-	1957 -

Legend : X : exist, - : no exist

note : Several stations in Hanoi had succeeded to observe daily rainfall from 1890 to 1954 but the data are intermittent and not complete.

Water Level Gauging Stations

	Station	River	Management	Data		Observation Period				
				Daily	Hourly					
1	Cong Vi	To Lich River	SDC	X 7:00	-	1987 - (rainy season only Apr.(May)-Oct.(Nov.))				
2	Trung Kinh									
3	Cong Moc									
4	Cau Moi									
5	Thanh Liet									
6	Tau Bay									
7	Dai La	Lu River	SDC	X 7:00	-	1987 - (rainy season only Apr.(May)-Oct.(Nov.))				
8	Lo Duc	Set River								
9	Minh Khai	Kim Nguu River								
10	Yen Duyen									
1	Xuan La	West Lake					SDC	X 7:00	-	1987 - (rainy season only Apr.(May)-Oct.(Nov.))
2	Truc Bach	Truc Bach Lake								
3	Hoan Kiem	Hoan Kiem Lake								
4	Giang Vo	Giang Vo Lake								
5	Nam Khang	Bay Mau Lake								
	Hanoi	Red River	MOWR	X	X	1902 - (daily) 1993 - (hourly)				
	Lien Mac Ha Dong	Nhue River	MOWR	X	7,13,19h	1957 -				

Legend : X : exist, - : no exist

Table C3.1 METEOROLOGICAL CONDITION IN HANOI

- LANG STATION -

Monthly Rainfall

unit : mm

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Max.	75.7	91.8	259.5	268.3	550.7	522.7	491.7	756.7	562.0	407.4	614.4	103.7	2252.3
Avg.	20.9	28.1	41.4	107.3	172.0	245.9	252.9	297.9	255.0	165.2	72.7	15.1	1674.4
Min.	0.8	3.7	9.0	10.3	28.9	39.8	101.7	39.4	41.5	10.4	0.0	0.0	1033.1

period : 1960 - 1990

Monthly Evaporation

unit : mm

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Max.	107.5	89.5	83.1	88.0	127.5	148.6	126.3	119.4	114.3	123.4	144.6	115.4	1126.7
Avg.	70.8	57.8	58.9	66.0	97.1	97.9	100.1	83.9	85.8	93.7	87.7	84.0	983.7
Min.	42.7	39.7	39.4	47.2	74.7	72.5	81.2	58.5	55.1	57.8	59.7	62.7	889.2

period : 1960 - 1990

Monthly Average Temperature

unit : °C

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Max.	19.3	19.9	22.8	27.0	31.5	32.6	32.9	31.9	30.9	28.6	25.2	21.8	27.0
Avg.	16.4	17.0	20.2	23.7	27.3	28.8	28.9	28.2	27.2	24.6	21.4	18.2	23.5
Min.	13.7	15.0	18.1	21.4	24.3	25.8	26.1	25.7	24.7	21.9	18.5	15.3	20.9

period : 1898 - 1985

Monthly Average Relative Humidity

unit : %

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
Max.	100	100	100	100	100	100	100	100	100	100	100	100	100
Avg.	83	85	87	87	84	83	84	86	85	82	81	81	84
Min.	64	70	74	72	64	64	64	68	65	60	59	60	65

period : 1925 - 1985

Table C3.2 MONTHLY RAINFALL IN HANOI (LANG STATION)

unit : mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1960	22.7	3.7	40.5	10.3	79.7	122.9	438.9	384.5	269.3	69.6	44.2	1.9	1488.2
1961	5.3	28.4	27.6	116.3	145.6	104.1	219.9	372.7	367.5	189.9	129.9	51.0	1758.2
1962	2.4	7.7	36.5	134.5	171.7	262.2	139.7	173.8	273.6	25.8	48.1	0.7	1276.7
1963	1.0	12.6	48.9	25.5	80.4	171.2	245.1	281.9	301.0	220.2	181.0	103.7	1672.5
1964	23.2	12.0	26.5	146.1	92.6	393.8	314.3	297.9	268.8	342.9	13.3	19.7	1951.1
1965	4.2	14.9	42.9	99.7	248.8	419.2	410.0	63.4	171.1	86.4	42.7	54.3	1657.6
1966	35.4	8.4	34.5	58.5	214.4	427.9	101.7	110.4	41.5	326.4	58.9	15.6	1433.6
1967	16.5	42.6	17.1	85.4	120.0	193.9	408.3	76.6	186.9	10.4	84.9	6.8	1249.4
1968	15.7	61.9	72.0	68.0	186.4	247.5	151.4	522.2	356.0	155.0	55.2	5.1	1896.4
1969	38.9	13.1	20.9	92.0	116.3	228.5	233.2	158.7	279.4	46.8	54.9	1.6	1284.3
1970	11.1	12.7	33.6	124.9	99.0	271.6	286.6	252.7	176.8	81.6	23.8	16.1	1390.5
1971	8.8	17.2	22.2	89.6	265.3	175.1	392.3	443.8	311.6	200.6	2.4	6.3	1935.2
1972	0.8	25.0	16.8	95.7	214.1	122.6	274.6	756.7	189.9	86.4	53.0	4.0	1839.6
1973	5.0	10.5	40.7	242.6	175.1	252.2	307.8	307.9	472.4	122.7	5.8	1.8	1944.5
1974	44.2	11.0	30.0	118.6	110.9	199.7	187.6	190.2	254.4	272.8	69.2	38.6	1527.2
1975	75.7	7.2	53.0	142.9	299.0	234.0	166.3	446.3	341.8	59.9	139.2	20.6	1985.9
1976	9.9	77.6	21.3	136.7	141.3	129.1	142.8	239.5	187.3	199.9	6.4	0.3	1292.1
1977	56.7	5.8	20.1	89.2	28.9	233.2	491.7	231.4	172.7	131.9	15.2	37.6	1514.4
1978	12.6	12.7	19.0	106.9	247.4	322.9	163.1	282.7	562.0	238.7	145.8	1.3	2115.1
1979	28.4	83.6	21.9	100.6	244.5	230.9	212.4	449.9	295.8	19.5	0.0	0.0	1687.5
1980	6.4	43.5	44.3	135.6	131.3	262.6	344.1	509.6	277.4	263.1	1.0	14.4	2033.3
1981	7.1	24.4	35.0	138.8	164.1	342.9	132.0	294.7	129.3	339.1	37.6	0.0	1645.0
1982	14.3	46.9	29.9	96.9	98.4	168.6	330.9	408.5	385.7	52.3	128.1	5.8	1766.3
1983	57.3	28.4	32.5	96.3	104.9	128.2	219.0	283.0	205.2	407.4	69.6	14.9	1646.7
1984	2.2	23.6	27.8	129.8	205.4	399.1	107.4	319.3	237.0	146.0	614.4	13.1	2225.1
1985	37.3	38.4	74.1	179.6	48.1	213.6	169.4	302.9	369.4	119.3	41.2	2.8	1596.1
1986	7.8	23.6	9.0	268.3	550.7	450.4	275.3	231.1	276.5	96.4	41.1	22.1	2252.3
1987	5.0	25.0	22.4	56.9	194.1	195.7	220.2	436.2	159.7	125.0	70.5	0.0	1510.7
1988	19.3	49.9	25.2	16.5	148.0	39.8	181.0	220.3	46.3	278.8	8.0	0.0	1033.1
1989	52.2	7.4	76.5	33.5	241.9	522.7	220.5	145.2	152.4	299.1	7.1	2.1	1760.6
1990	21.4	91.8	259.5	90.7	163.4	156.5	351.5	39.4	186.6	108.7	61.4	7.2	1538.1
Max	75.7	91.8	259.5	268.3	550.7	522.7	491.7	756.7	562.0	407.4	614.4	103.7	2252.3
Avg	20.9	28.1	41.4	107.3	172.0	245.9	252.9	297.9	255.0	165.2	72.7	15.1	1674.4
Min	0.8	3.7	9.0	10.3	28.9	39.8	101.7	39.4	41.5	10.4	0.0	0.0	1033.1

Table C3.3 MONTHLY EVAPORATION IN HANOI (LANG STATION)

unit : mm

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1960	98.1	89.5	61.3	88.0	127.5	148.6	101.0	75.9	61.2	84.2	65.0	79.3	1079.6
1961	87.7	54.9	49	73.6	97	97.4	113	91.9	68.5	85.0	83.2	67.6	968.8
1962	90.9	81.4	69.3	56.6	102.5	93.6	105.1	83.8	85.2	109.2	91.7	88.8	1058.1
1963	107.5	56.2	55.7	59.5	91.5	99.8	96.4	81.9	75.6	78.3	64.9	80.1	947.4
1964	77.4	60.2	58.5	64.0	106.8	94.3	109.9	80.6	66.0	57.8	104.2	85.2	964.9
1965	80.7	66.2	53.2	60.3	91.2	74.5	101.4	100.5	88.6	89.4	107.8	67.4	981.2
1966	51.1	63.2	67.1	71.3	106.4	77.5	104.2	81.8	105.5	78.8	86.3	64.4	957.6
1967	99.7	58.3	59.8	72.5	112.1	131.9	110.3	98.0	75.2	112.1	72.2	72.1	1074.2
1968	58.0	49.5	46.2	64.0	94.1	74.0	94.1	80.7	94.3	92.2	59.7	82.4	889.2
1969	58.9	62.0	55.8	68.6	103.8	92.5	95.2	81.4	86.2	98.8	78.3	93.3	974.8
1970	67.4	46.6	47.3	54.7	92.0	85.9	95.6	72.3	72.0	116.8	83.4	64.4	898.4
1971	76.5	53.8	62.2	60.6	92.3	104.3	94.5	64.8	92.8	103.5	103.7	78.7	987.7
1972	79.1	57.4	67.3	61.7	85.0	111.2	91.8	58.5	82.1	83.3	65.9	87.8	931.1
1973	67.9	53.0	64.0	72.5	98.0	91.1	81.2	73.4	55.1	102.9	98.1	92.8	950.0
1974	48.4	77.9	50.4	64.8	98.1	92.8	90.0	77.3	75.9	97.2	82.1	69.8	924.7
1975	44.8	51.6	44.8	61.2	83.9	82.1	106.1	80.5	74.0	108.5	85.4	100.8	923.7
1976	72.3	52.6	59.7	54.6	85.8	100.8	119.3	76.1	93.2	72.1	103.4	77.1	967.0
1977	49.4	80.2	83.1	65.1	122.6	111.0	82.1	100.6	114.3	88.4	112.1	62.7	1071.6
1978	74.8	66.2	49.9	57.9	74.7	73.1	95.1	82.6	89.7	105.9	67.6	78.1	915.6
1979	47.7	61.2	48.4	59.6	87.6	75.5	97.2	77.0	83.9	123.4	144.6	99.9	1006.0
1980	81.6	48.4	53.5	72.3	89.6	72.5	81.9	75.1	93.5	85.6	86.3	78.4	918.7
1981	61.2	43.9	60.1	70.3	95.9	109.7	105.4	91.7	103.6	86.4	67.7	115.4	1011.3
1982	66.0	45.4	39.4	72.5	102.8	108.7	90.5	71.9	67.8	84.6	88.7	103.7	942.0
1983	70.9	52.8	70.0	64.6	104.7	126.3	126.3	79.9	83.7	77.6	83.8	92.6	1033.2
1984	72.3	47.6	53.9	47.2	93.4	89.8	119.7	98.0	91.1	96.9	84.6	78.9	973.4
1985	42.7	43.1	61.2	67.0	95.4	102.3	106.0	85.6	97.1	104.8	80.2	97.5	982.9
1986	79.5	49.0	73.0	55.8	76.9	90.4	96.5	99.7	94.8	96.9	101.4	82.9	996.8
1987	91.5	68.3	78.2	79.8	116.7	121.6	94.4	99.0	100.6	90.0	72.7	113.9	1126.7
1988	59.9	39.7	54.9	77.6	97.4	118.7	105.0	72.2	99.1	91.4	117.4	87.7	1021.0
1989	66.5	65.1	72.8	67.5	97.6	88.7	104.9	88.3	92.0	110.5	99.1	73.7	1026.7
1990	63.2	47.5	56.5	79.2	87.6	95.8	88.0	119.4	98.1	91.7	78.2	86.6	991.8
Max	107.5	89.5	83.1	88.0	127.5	148.6	126.3	119.4	114.3	123.4	144.6	115.4	1126.7
Avg	70.8	57.8	58.9	66.0	97.1	97.9	100.1	83.9	85.8	93.7	87.7	84.0	983.7
Min	42.7	39.7	39.4	47.2	74.7	72.5	81.2	58.5	55.1	57.8	59.7	62.7	889.2

Table C3.4 NUMBER OF RAINY DAYS ACCORDING TO RAINFALL DEPTH IN HANOI

unit : day

Rainfall Depth (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1<=5	29.9	26.6	29.7	25.5	26.1	22.3	22.2	22.8	23.0	24.7	28.5	30.6	311.9
5<10	0.5	0.9	0.9	1.1	0.9	2.0	1.7	1.4	0.9	1.6	0.5	0.2	12.6
10<20	0.5	0.5	0.4	1.6	1.9	2.4	3.1	2.1	0.9	1.6	0.6	0.2	15.8
20<50	0.1	0.2	0.0	1.6	1.5	2.2	2.6	2.8	3.7	2.2	0.2	0.0	17.1
50<100	0.0	0.1	0.0	0.2	0.2	0.9	0.9	1.8	1.2	0.9	0.2	0.0	6.4
100<150	0.0	0.0	0.0	0.0	0.4	0.2	0.5	0.1	0.2	0.0	0.0	0.0	1.4
150<1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1

Data period : 1886 - 1985

Table C3.5 MONTHLY AVERAGE WATER LEVELS OF RED RIVER AT HANOI

unit ; m,MSL												
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1956	2.59	2.32	2.01	2.26	4.64	7.56	8.06	9.73	7.27	5.05	3.92	3.13
1957	2.71	2.40	2.43	3.05	2.97	6.88	8.48	6.69	5.64	5.35	3.66	3.00
1958	2.46	2.69	2.13	1.97	2.36	4.40	7.69	8.90	7.29	5.20	3.75	2.94
1959	2.65	2.39	2.86	3.09	3.98	6.56	7.28	8.92	7.27	5.69	4.24	3.31
1960	2.94	2.76	2.43	2.07	2.52	5.29	7.59	8.67	7.70	5.55	4.09	3.70
1961	2.98	2.96	3.00	3.33	3.21	6.32	6.47	9.40	7.66	6.66	5.37	4.16
1962	3.88	3.07	2.62	2.73	3.47	7.03	8.41	8.14	6.17	5.23	3.72	2.93
1963	2.43	2.26	2.26	2.14	2.32	3.87	7.06	8.04	6.23	5.53	6.33	3.98
1964	3.09	2.72	2.48	2.80	3.68	6.35	8.92	8.47	7.43	6.96	4.95	3.96
1965	3.22	2.87	2.58	3.21	3.33	6.74	8.13	7.20	5.62	5.82	6.17	4.37
1966	3.46	2.97	2.45	2.64	2.80	7.05	9.79	8.63	8.15	6.38	5.00	3.73
1967	3.19	2.86	2.54	2.66	3.31	4.72	6.34	8.34	7.07	5.45	4.42	3.73
1968	3.26	2.93	2.86	3.32	3.89	5.93	8.89	9.06	8.57	6.80	5.69	3.85
1969	3.12	2.66	2.37	2.43	3.19	4.84	7.31	10.48	7.17	5.11	4.71	3.34
1970	2.95	2.85	2.40	2.73	4.61	6.21	9.67	8.97	7.84	5.46	4.18	4.76
1971	3.32	3.18	2.65	3.06	4.24	6.96	9.50	11.44	8.93	6.36	4.88	3.75
1972	3.38	3.05	2.76	3.10	3.87	5.45	7.55	8.20	7.64	6.48	5.25	4.92
1973	3.67	3.38	3.55	3.50	4.99	6.98	8.69	9.44	9.36	6.51	5.30	3.87
1974	3.21	2.90	2.55	2.73	3.54	6.19	8.07	7.98	8.30	6.37	4.55	3.50
1975	3.32	2.70	2.48	3.41	4.56	8.24	7.66	7.36	7.57	5.62	4.81	3.68
1976	3.08	3.33	2.74	3.12	4.92	6.11	7.00	9.02	7.04	5.28	5.24	3.64
1977	3.24	2.99	2.64	3.04	3.47	3.84	8.51	8.39	6.17	5.51	4.45	3.38
1978	3.35	2.67	2.59	2.50	4.80	7.77	8.07	8.51	8.80	7.01	4.94	3.81
1979	3.49	3.34	2.89	2.89	3.90	6.47	7.68	8.77	9.62	5.77	4.21	3.39
1980	3.07	3.04	2.59	2.62	3.51	4.23	8.09	9.12	8.09	5.41	3.75	3.18
1981	3.11	2.88	2.73	3.82	5.28	7.06	8.06	9.32	8.12	6.70	6.09	4.42
1982	3.59	3.33	2.79	3.49	3.01	5.24	7.17	9.49	8.14	6.93	5.24	4.35
1983	3.63	3.28	3.54	2.76	3.36	4.59	5.20	8.61	8.49	6.88	6.32	4.52
1984	4.00	3.25	2.74	2.87	4.55	7.38	9.00	7.54	7.38	6.95	4.98	3.66
1985	3.25	3.03	2.97	3.27	3.63	6.17	7.24	7.78	9.16	5.81	5.97	4.41
1986	3.35	2.85	2.49	3.58	5.19	6.70	8.74	9.05	7.85	6.70	4.84	3.74
1987	3.33	2.96	2.49	2.53	2.94	4.08	6.68	7.87	7.32	6.24	4.88	3.65
1988	3.03	2.89	2.52	2.22	3.97	3.97	7.38	7.80	7.94	5.86	3.46	2.68
1989	2.59	2.49	2.63	2.82	3.50	7.48	8.24	6.04	5.63	6.01	4.32	3.29
1990	2.96	3.05	4.18	4.45	5.40	8.67	10.63	7.81	5.56	5.88	4.58	3.74
Max	4.00	3.38	4.18	4.45	5.40	8.67	10.63	11.44	9.62	7.01	6.33	4.92
Avg	3.17	2.89	2.68	2.92	3.80	6.10	7.98	8.55	7.55	6.01	4.81	3.73
Min	2.43	2.26	2.01	1.97	2.32	3.84	5.20	6.04	5.56	5.05	3.46	2.68

Table C3.6 MONTHLY AVERAGE WATER LEVELS OF WEST LAKE AND RED RIVER

Year	Month	Water Level (m,MSL)		Monthly Rainfall(mm) (Lang Sta.)	Year	Month	Water Level (m,MSL)		Monthly Rainfall(mm) (Lang Sta.)
		West Lake	Red River				West Lake	Red River	
1988	1	-	3.03	19.3	1991	1	-	3.56	57.1
	2	-	2.89	49.9		2	-	3.56	2.7
	3	-	2.52	25.2		3	-	3.38	76.4
	4	-	2.22	16.5		4	5.66	3.76	91.1
	5	-	3.97	148.0		5	5.75	4.12	275.6
	6	-	3.97	39.8		6	6.07	9.30	424.2
	7	5.67	7.38	181.0		7	6.18	11.16	246.9
	8	-	7.80	220.3		8	5.80	11.49	207.0
	9	5.72	7.94	46.3		9	5.78	7.26	83.4
	10	-	5.86	278.8		10	5.74	7.00	7.2
	11	-	3.46	8.0		11	-	5.96	112.6
	12	-	2.68	0.0		12	-	4.82	15.9
1989	1	-	2.59	52.2	1992	1	-	-	97.4
	2	-	2.49	7.4		2	-	-	27.6
	3	-	2.63	76.5		3	-	-	29.0
	4	-	2.82	33.5		4	5.50	-	46.0
	5	-	3.50	241.9		5	5.51	5.76	117.4
	6	5.63	7.48	522.7		6	5.53	9.24	396.2
	7	5.71	8.24	220.5		7	6.29	11.46	369.2
	8	-	6.04	145.2		8	6.28	9.62	37.8
	9	5.30	5.63	152.4		9	6.15	5.02	161.7
	10	5.20	6.01	299.1		10	6.10	4.56	20.0
	11	-	4.32	7.1		11	-	-	32.5
	12	-	3.29	2.1		12	-	-	36.4
1990	1	-	2.96	21.4	1993	1	-	-	3.3
	2	-	3.05	91.8		2	-	-	48.4
	3	-	4.18	259.5		3	-	-	38.9
	4	5.72	4.45	90.7		4	-	-	99.8
	5	5.70	5.40	163.4		5	5.96	4.78	247.9
	6	5.69	8.67	156.5		6	5.99	6.07	178.3
	7	5.65	10.63	351.5		7	5.94	9.22	186.5
	8	5.85	7.81	39.4		8	5.96	9.62	322.0
	9	5.89	5.56	186.6		9	5.96	8.66	260.5
	10	5.85	5.88	108.7		10	6.14	5.58	31.3
	11	-	4.58	61.4		11	6.05	-	16.3
	12	-	3.74	7.2		12	-	-	8.6

Table C4.1 DAILY RAINFALLS OF MAJOR PAST FLOODS (LANG STATION)

unit : mm

Year	Mon.	Date	Rainfall	Ratio
1984	11	9	165.5	total 604.7
		10	394.9	1-day 394.9
		11	0.0	2-day 560.4
		12	1.2	
		13	16.8	
1986	6	18	164.0	total 310.7
		19	128.4	1-day 164.0
		20	18.3	2-day 292.4
		21	2.7	
		22	2.7	
1989	6	10	41.9	total 348.4
		11	66.1	1-day 220.6
		12	220.6	2-day 286.7
		13	18.8	
		14	1.0	
1989	10	13	10.1	total 229.3
		14	161.6	1-day 161.6
		15	57.6	2-day 219.2
		16	0.0	
		17	0.0	
1992	6	29	68.4	total 233.7
		30	165.3	1-day 165.3
		31	0.0	2-day 233.7
		1	0.0	
		2	0.0	
1994	5	17	25.0	total 312.0
		18	41.0	1-day 169.0
		19	57.0	2-day 226.0
		20	169.0	
		21	20.0	
1994	8	29	170.4	total 319.3
		30	130.6	1-day 170.4
		31	16.1	2-day 301.0
		1	2.2	
		2	0.0	

1-day rainfall / total rainfall	=	73% (average)
2-day rainfall / total rainfall	=	91% (average)

Year	Mon.	Date	Rainfall	Ratio
1955	9	25	5.6	total 310.1
		26	224.4	1-day 224.4
		27	80.1	2-day 304.5
1958	6	15	0.6	total 184.6
		16	184.0	1-day 184.0
		17	0.0	2-day 184.6
1959	7	25	17.8	total 288.7
		26	29.3	1-day 199.8
		27	19.3	2-day 201.7
		28	20.6	
		29	1.9	
1967	6	7	5.9	total 162.0
		8	156.1	1-day 156.1
		9	0.0	2-day 162.0
		10	0.0	
		11	0.0	
1967	7	22	11.6	total 253.4
		23	6.2	1-day 175.7
		24	23.5	2-day 199.2
		25	175.7	
		26	6.6	
1968	8	13	18.3	total 205.6
		14	182.5	1-day 182.5
		15	4.8	2-day 200.8
		16	0.0	
		17	0.0	
1972	8	20	9.3	total 345.8
		21	3.6	1-day 205.7
		22	54.8	2-day 260.5
		23	205.7	
		24	43.0	
1975	9	20	5.6	total 182.4
		21	176.2	1-day 176.2
		22	0.6	2-day 181.8
		23	0.0	
		24	0.0	
1978	9	21	41.6	total 226.6
		22	185.0	1-day 185.0
		23	0.0	2-day 226.6





Table C4.3 WATER LEVELS OF MAJOR PAST FLOODS AT WEIRS ON NHUE RIVER (1/3)

unit : m,MSL

Year	Month	Day	hour	Lien Mac		Ha Dong		Dong Quan		Nhat Tau		Luong Co		
				Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	
1978	9	21	7	8.27	3.25	3.22	3.20	2.87	2.67	2.40	2.37	2.20	2.20	
			13	8.22	3.35	3.37	3.33	2.85	2.70	2.49	2.44	2.40	2.40	
			19	8.15	3.62	3.58	3.54	3.07	2.92	2.55	2.52	2.47	2.47	
		22	7	8.33	5.20	5.10	4.90	3.93	3.70	3.50	3.48	3.45	3.45	
			13	8.53	5.35	5.30	5.08	4.20	4.05	3.90	3.88	3.87	3.87	
			19	8.76	5.50	5.30	5.15	4.35	4.21	4.03	4.01	4.00	4.00	
		23	7	9.73	5.50	5.35	5.19	4.45	4.37	4.20	4.18	4.23	4.23	
			13	9.85	5.49	5.37	5.21	4.49	4.41	4.30	4.29	4.29	4.29	
			19	9.91	5.48	5.40	5.21	4.53	4.47	4.38	4.36	4.32	4.32	
		24	7	9.83	5.43	5.35	5.19	4.53	4.49	4.40	4.37	4.34	4.34	
			13	9.70	5.40	5.32	5.17	4.53	4.50	4.41	4.38	4.34	4.34	
			19	9.64	5.40	5.30	5.15	4.53	4.50	4.42	4.41	4.35	4.35	
		25	7	9.37	5.39	5.25	5.10	4.51	4.49	4.38	4.35	4.32	4.32	
			13	9.21	5.33	5.25	5.10	4.50	4.48	4.36	4.34	4.29	4.29	
			19	9.10	5.30	5.20	5.05	4.50	4.48	4.35	4.32	4.27	4.27	
		26	7	8.90	5.27	5.20	5.05	4.46	4.44	4.30	4.28	4.22	4.22	
			13	8.81	5.22	5.18	5.02	4.43	4.38	4.27	4.24	4.15	4.15	
			19	8.76	5.12	5.14	5.00	4.43	4.38	4.25	4.23	4.12	4.12	
		27	7	8.63	5.11	5.08	4.98	4.36	4.33	4.15	4.12	4.06	4.06	
			13	8.57	5.08	5.06	4.98	4.32	4.29	4.11	4.08	4.00	4.00	
			19	8.50	5.05	5.00	4.96	4.32	4.29	4.10	4.07	3.99	3.99	
		28	7	8.44	4.98	4.98	4.92	4.33	4.29	4.08	4.06	3.95	3.95	
			13	8.42	4.96	4.96	4.92	4.34	4.29	4.07	4.05	3.91	3.91	
			19	8.49	4.94	4.94	4.90	4.33	4.28	4.05	4.03	3.88	3.88	
	29	7	8.60	4.87	4.87	4.83	4.30	4.25	4.00	3.98	3.77	3.77		
		13	8.62	4.85	4.83	4.79	4.23	4.16	3.95	3.92	3.75	3.75		
		19	8.62	4.82	4.81	4.77	4.20	4.13	3.93	3.91	3.74	3.74		
	30	7	8.40	4.72	4.73	4.69	4.20	4.16	3.90	3.88	3.71	3.71		
		13	8.40	4.72	4.71	4.67	4.18	4.12	3.85	3.83	3.66	3.66		
		19	8.35	4.65	4.66	4.63	4.17	4.11	3.84	3.82	3.63	3.63		
	10	1	7	8.11	4.59	4.59	4.56	4.14	4.08	3.81	3.79	3.60	3.60	
				13	8.05	4.52	4.56	4.53	4.11	4.05	3.79	3.77	3.58	3.58
				19	8.06	4.57	4.52	4.50	4.08	4.02	3.75	3.73	3.56	3.56
			2	7	7.80	4.41	4.43	4.41	4.06	4.01	3.74	3.72	3.52	3.52
				13	7.72	4.36	4.41	4.39	4.05	4.00	3.71	3.69	3.51	3.51
				19	7.72	4.32	4.32	4.30	4.03	3.98	3.69	3.63	3.44	3.44
			3	7	7.50	4.28	4.31	4.29	3.98	3.93	3.67	3.61	3.40	3.40
				13	7.50	4.40	4.42	4.40	4.02	3.96	3.64	3.62	3.40	3.40
				19	7.50	4.65	4.52	4.50	4.04	3.98	3.62	3.60	3.39	3.39
			4	7	7.75	5.16	4.95	4.80	4.07	4.02	3.62	3.60	3.35	3.35
				13	7.90	5.39	5.25	4.98	4.10	4.03	3.70	3.67	3.50	3.50
				19	7.98	5.45	5.30	5.10	4.16	4.09	3.74	3.73	3.50	3.50
			5	7	9.58	5.43	5.35	5.10	4.15	4.08	3.75	3.71	3.50	3.50
				13	9.95	5.42	5.35	5.10	4.15	4.08	3.75	3.72	3.52	3.52
				19	9.97	5.41	5.30	5.05	4.17	4.09	3.75	3.72	3.51	3.51
			6	7	10.77	5.38	5.25	5.00	4.18	4.10	3.75	3.74	3.51	3.51
				13	10.83	5.35	5.25	5.00	4.18	4.10	3.78	3.75	3.52	3.52
				19	10.8	5.33	5.23	4.98	4.15	4.09	3.78	3.75	3.54	3.54
7			7	10.63	5.29	5.16	4.94	4.15	4.10	3.76	3.70	3.52	3.52	
			13	10.49	5.26	5.13	4.94	4.15	4.09	3.76	3.70	3.54	3.54	
			19	10.48	5.23	5.09	4.90	4.17	4.11	3.76	3.71	3.54	3.54	
8			7	9.98	5.19	5.08	4.90	4.15	4.09	3.74	3.70	3.53	3.53	
			13	9.80	5.16	5.08	4.89	4.15	4.09	3.74	3.70	3.52	3.52	
			19	9.82	5.13	5.03	4.88	4.15	4.09	3.74	3.70	3.50	3.50	
9		7	9.36	5.12	5.04	4.89	4.13	4.06	3.67	3.62	3.67	3.67		
		13	9.20	5.10	5.04	4.89	4.12	4.05	3.67	3.62	3.66	3.66		
		19	9.23	5.06	5.00	4.87	4.11	4.05	3.67	3.64	3.67	3.67		
10		7	8.94	4.99	4.94	4.82	4.07	3.99	3.61	3.58	3.61	3.61		
		13	8.85	4.95	4.90	4.75	4.05	3.98	3.54	3.50	3.54	3.54		
		19	8.82	4.92	4.82	4.70	4.05	3.97	3.59	3.54	3.59	3.59		

Table C4.3

## WATER LEVELS OF MAJOR PAST FLOODS AT WEIRS ON NHUE RIVER (2/3)

unit ; m,MSL

Year	Month	Day	hour	Lien Mac		Ha Dong		Dong Quan		Nhat Tuu		Luong Co	
				Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
1984	11	9	7	5.58	2.05	1.50	1.47	1.18	1.17	1.18	1.15	1.10	1.10
			13	5.87	2.40	1.55	1.51	1.28	1.26	1.34	1.10	1.10	1.10
			19	6.00	3.22	3.02	2.95	1.68	1.64	1.50	1.15	1.08	1.08
		10	7	6.50	5.70	5.60	5.30	3.50	3.25	2.83	2.54	2.30	2.25
			13	6.50	5.72	5.68	5.37	3.80	3.55	3.00	2.95	2.80	2.75
			19	6.55	5.82	5.70	5.40	3.97	3.74	3.20	3.15	3.10	3.05
		11	7	6.70	5.80	5.77	5.40	4.26	4.07	3.73	3.70	3.62	3.60
			13	6.75	5.83	5.75	5.40	4.36	4.20	3.91	3.87	3.82	3.76
			19	6.80	5.87	5.75	5.41	4.44	4.27	3.95	3.92	3.90	3.85
		12	7	6.90	5.87	5.75	5.41	4.50	4.35	4.08	4.05	3.90	3.85
			13	6.90	5.87	5.74	5.42	4.50	4.40	4.10	4.07	3.92	3.87
			19	6.88	5.87	5.74	5.42	4.55	4.41	4.12	4.09	3.94	3.90
		13	7	6.70	5.86	5.71	5.40	4.53	4.39	4.08	3.96	3.85	3.80
			13	6.63	5.81	5.71	5.40	4.55	4.40	4.10	3.99	3.85	3.82
			19	6.53	5.80	5.70	5.37	4.39	4.24	4.05	3.95	3.85	3.82
		14	7	6.38	5.80	5.69	5.32	4.30	4.20	3.95	3.85	3.70	3.67
			13	6.30	5.78	5.69	5.31	4.26	4.12	3.90	3.80	3.69	3.66
			19	6.30	5.78	5.68	5.25	4.25	4.10	3.88	3.80	3.69	3.66
		15	7	6.05	5.75	5.63	5.20	4.19	4.05	3.75	3.70	3.57	3.54
			13	6.00	5.73	5.62	5.20	4.23	4.07	3.78	3.70	3.52	3.50
			19	5.92	5.73	5.60	5.19	4.26	4.10	3.80	3.70	3.46	3.44
		16	7	5.80	5.60	5.50	5.20	4.22	4.07	3.73	3.61	3.46	3.44
			13	5.78	5.59	5.46	5.20	4.24	4.05	3.71	3.60	3.46	3.44
			19	5.73	5.58	5.38	5.20	4.24	4.04	3.72	3.61	3.46	3.44
		17	7	5.62	5.49	5.35	5.18	4.26	4.06	3.66	3.54	3.35	3.33
			13	5.60	5.48	5.31	5.16	4.28	4.09	3.65	3.53	3.35	3.33
			19	5.59	5.45	5.28	5.15	4.26	4.06	3.63	3.52	3.35	3.33
		18	7	5.55	5.35	5.22	5.14	4.19	3.98	3.55	3.43	3.25	3.23
			13	5.50	5.30	5.20	5.12	4.18	3.98	3.53	3.41	3.21	3.19
			19	5.47	5.26	5.14	5.07	4.16	3.94	3.51	3.40	3.19	3.17
		19	7	5.41	5.18	5.10	5.03	4.08	3.89	3.42	3.31	3.10	3.08
			13	5.40	5.15	5.08	5.01	4.09	3.89	3.44	3.29	3.05	3.03
			19	5.40	5.13	5.06	5.00	4.09	3.89	3.41	3.28	3.04	3.01
		20	7	5.39	5.00	4.95	4.90	3.95	3.78	3.26	3.17	2.95	2.93
			13	5.39	4.97	4.85	4.80	3.87	3.70	3.24	3.13	2.94	2.92
			19	5.38	4.95	4.60	4.75	3.88	3.71	3.20	3.10	2.90	2.88
		21	7	5.35	4.80	4.75	4.69	3.84	3.64	3.10	3.04	2.84	2.82
			13	5.34	4.78	4.70	4.64	3.83	3.65	3.12	3.03	2.81	2.79
			19	5.34	4.75	4.65	4.60	3.80	3.63	3.11	3.02	2.79	2.77
		22	7	5.31	4.65	4.56	4.53	3.71	3.53	3.00	2.95	2.75	2.73
			13	5.31	4.58	4.50	4.46	3.70	3.55	3.01	2.94	2.72	2.72
			19	5.31	4.55	4.46	4.43	3.60	3.50	3.00	2.92	2.70	2.68
		23	7	5.28	4.38	4.30	4.27	3.58	3.42	2.89	2.82	2.65	2.63
			13	5.25	4.32	4.25	4.23	3.57	3.49	2.90	2.83	2.64	2.62
			19	5.25	4.29	4.21	4.19	3.55	3.46	2.90	2.82	2.62	2.60
		24	7	5.22	4.15	4.11	4.08	3.45	3.36	2.78	2.71	2.55	2.53
			13	5.20	4.10	4.11	4.00	3.46	3.38	2.81	2.75	2.57	2.55
			19	5.20	4.09	3.98	3.95	3.46	3.36	2.80	2.75	2.55	2.53
25	7	5.20	3.90	3.95	3.92	3.36	3.27	2.66	2.61	2.42	2.40		
	13	5.20	3.90	3.90	3.86	3.35	3.26	2.72	2.66	2.46	2.44		
	19	5.20	3.84	3.86	3.83	3.32	3.26	2.71	2.65	2.45	2.43		
26	7	5.18	3.73	3.80	3.77	3.21	3.14	2.56	2.50	2.33	2.31		
	13	5.18	3.69	3.73	3.70	3.19	3.14	2.60	2.58	2.35	2.33		
	19	5.17	3.67	3.67	3.65	3.18	3.15	2.60	2.58	2.37	2.35		
27	7	5.06	3.57	3.60	3.58	3.09	3.04	2.47	2.42	2.24	2.22		
	13	5.00	3.52	3.57	3.55	3.08	3.02	2.53	2.50	2.34	2.32		
	19	4.95	3.50	3.55	3.53	3.08	3.03	2.55	2.51	2.34	2.32		

Table C4.3

## WATER LEVELS OF MAJOR PAST FLOODS AT WEIRS ON NHUE RIVER (3/3)

unit ; m,MSL

Year	Month	Day	hour	Lien Mac		Ha Dong		Dong Quan		Nhat Tuu		Luong Co	
				Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
1989	6	10	7	7.60	3.15	3.15	3.10	2.51	2.49	2.10	2.09	1.99	1.98
			13	7.70	3.45	3.30	3.25	2.50	2.48	2.03	2.02	1.92	1.91
			19	7.72	3.52	3.44	3.39	2.52	2.50	2.01	2.00	1.80	1.79
	11	7	7	7.90	3.98	3.82	3.76	2.60	2.57	2.04	2.03	1.81	1.80
			13	8.00	3.98	3.85	3.80	2.62	2.59	2.00	1.99	1.78	1.77
			19	8.10	4.00	4.02	3.97	2.80	2.76	2.10	2.08	1.98	1.97
	12	7	7	8.30	5.40	5.00	4.98	3.34	3.28	2.77	2.76	2.63	2.62
			13	8.43	5.50	5.21	5.15	3.50	3.44	2.94	2.93	2.80	2.79
			19	8.70	5.52	5.25	5.18	3.60	3.56	3.05	3.04	2.95	2.94
	13	7	7	9.48	5.52	5.36	5.26	3.88	3.82	3.39	3.38	3.14	3.13
			13	9.70	5.55	5.39	5.29	4.00	3.94	3.49	3.48	3.36	3.35
			19	10.00	5.57	5.39	5.29	4.09	4.02	3.60	3.59	3.42	3.40
	14	7	7	10.60	5.52	5.40	5.33	4.23	4.17	3.78	3.76	3.50	3.49
			13	10.80	5.52	5.40	5.33	4.31	4.26	3.84	3.82	3.60	3.59
			19	10.90	5.51	5.38	5.32	4.34	4.29	3.90	3.88	3.67	3.66
	15	7	7	10.88	5.48	5.34	5.28	4.34	4.29	3.89	3.87	3.64	3.63
			13	10.70	5.41	5.32	5.26	4.30	4.25	3.88	3.86	3.64	3.63
			19	10.60	5.40	5.30	5.25	4.30	4.25	3.84	3.82	3.65	3.64
	16	7	7	10.25	5.38	5.27	5.22	4.25	4.20	3.80	3.78	3.62	3.62
			13	9.90	5.30	5.23	5.18	4.20	4.15	3.78	3.76	3.50	3.49
			19	9.70	5.30	5.19	5.14	4.19	4.15	3.70	3.68	3.48	3.47
	17	7	7	9.35	5.18	5.10	5.05	4.10	4.05	3.62	3.60	3.40	3.39
			13	9.18	5.15	5.05	5.00	4.06	4.01	3.60	3.58	3.33	3.32
			19	9.05	5.05	4.96	4.89	4.00	3.95	3.55	3.52	3.27	3.26
	18	7	7	8.70	4.95	4.87	4.82	3.90	3.85	3.48	3.38	3.17	3.16
			13	8.60	4.98	4.82	4.77	3.85	3.80	3.40	3.38	3.10	3.08
			19	8.48	4.80	4.77	4.72	3.80	3.75	3.30	3.27	3.00	2.99
	19	7	7	8.05	4.67	4.62	4.57	3.62	3.58	3.25	3.23	2.90	2.89
			13	7.82	4.55	4.52	4.47	3.56	3.51	3.13	3.10	2.82	2.81
			19	7.65	4.25	4.40	4.35	3.49	3.44	3.05	3.00	2.74	2.73
	20	7	7	7.20	4.20	4.23	4.18	3.25	3.21	2.90	2.87	2.64	2.63
			13	7.10	4.15	4.15	4.10	3.28	3.24	2.80	2.77	2.53	2.52
			19	7.00	4.05	4.03	3.98	3.20	3.16	2.70	2.68	2.50	2.49
	21	7	7	6.97	3.38	3.84	3.79	3.10	3.06	2.63	2.60	2.45	2.44
			13	6.85	3.70	3.73	3.68	3.05	3.01	2.58	2.55	2.30	2.29
			19	6.80	3.60	3.60	3.55	2.95	2.90	2.50	2.48	2.30	2.29
	22	7	7	6.68	3.45	3.45	3.40	2.90	2.86	2.45	2.43	2.29	2.28
			13	6.67	3.35	3.37	3.32	2.85	2.81	2.36	2.34	2.19	2.18
			19	6.67	3.15	3.15	3.10	2.80	2.76	2.30	2.28	2.15	2.14
	23	7	7	6.67	3.10	3.15	3.10	2.70	2.66	2.32	2.30	2.18	2.17
			13	6.67	3.00	3.05	3.00	2.68	2.64	2.24	2.20	2.05	2.04
			19	6.75	2.98	3.00	2.89	2.64	2.60	2.18	2.16	2.10	2.09
	24	7	7	6.88	3.45	3.50	3.00	2.60	2.56	2.14	2.18	2.04	2.03
			13	7.20	3.65	3.65	3.10	2.62	2.58	2.10	2.08	2.02	2.01
			19	7.48	3.75	3.70	3.10	2.65	2.61	2.07	2.05	1.97	1.96
	25	7	7	7.90	3.85	3.85	3.10	2.64	2.60	2.02	2.00	1.95	1.95
			13	7.95	3.75	3.78	3.17	2.63	2.60	2.00	1.98	1.99	1.99
			19	7.98	3.50	3.65	3.20	2.62	2.59	1.98	1.96	1.97	1.97
26	7	7	8.00	3.30	3.40	3.00	2.56	2.53	2.15	2.14	2.05	2.04	
		13	8.00	3.30	3.38	2.89	2.53	2.50	2.08	2.07	2.00	1.99	
		19	8.00	3.30	3.35	2.82	2.47	2.44	2.04	2.03	1.93	1.92	
27	7	7	8.05	3.90	3.92	2.80	2.45	2.42	2.08	2.07	2.02	2.01	
		13	8.05	4.20	4.20	2.80	2.46	2.43	2.13	2.12	2.00	1.99	
		19	8.05	4.22	4.23	2.86	2.50	2.47	2.15	2.14	2.08	2.07	
28	7	7	8.10	4.10	4.10	3.15	2.60	2.57	2.22	2.21	2.10	2.09	
		13	8.30	4.10	4.07	3.18	2.65	2.62	2.27	2.26	2.15	2.14	
		19	8.25	4.00	3.98	3.25	2.69	2.66	2.30	2.29	2.18	2.17	

Table C4.4 RELATION BETWEEN RAINFALL AND WATER LEVELS (1/3)  
- Jun. 12, 1989 Flood -

unit : m,MSL

Year	Month	Day	Lake			River				One Day Rainfall at Lang Station (mm)	
			West Lake	Hoan Kiem	Giang Vo	To Lich Thanh Liet	Kim Nguu Yen Duyen	Ha Dong down	Nhue Dong Quan up		
1989	6	8	5.60		4.80	3.45	3.35	4.10			
	6	9	5.60		4.70	3.75	3.60	3.90			
	6	10	5.60	7.85	4.80	3.45	3.35	3.80	3.10	2.51	41.9
	6	11							3.76	2.60	66.1
	6	12	5.60		6.50	5.20	5.00	5.50	4.98	3.34	220.6
	6	13	5.60		6.20	5.30	5.25	5.40	5.26	3.88	18.8
	6	14	5.60		6.07	5.37	5.32	5.50	5.33	4.23	1.0
	6	15	5.70		5.84	5.28	5.24	5.40	5.28	4.34	-
	6	16			5.82	5.20	5.16	5.30	5.22	4.25	24.4
	6	17	5.75		5.70	5.08	5.03	4.90	5.05	4.10	-
	6	18	5.70						4.82	3.90	-
	6	19	5.70						4.57	3.62	-
	6	20	5.70						4.18	3.25	2.6
	6	21	5.70		5.47	4.05	3.90	4.10	3.79	3.10	0.6
	6	22	5.70		5.45	3.85	3.70	3.80	3.40	2.90	-
	6	23	5.65		5.43	3.70	3.60	3.70	3.10	2.70	0.0
	6	24	5.60		5.40	3.80	3.65	4.30	3.00	2.60	32.4

Table C4.4 RELATION BETWEEN RAINFALL AND WATER LEVELS (2/3)  
- May. 20, 1994 Flood -

unit : m,MSL

Year	Month	Day	Lake			River				One Day Rainfall at Lang station (mm)		
			West Lake	Hoan Kiem	Giang Vo	Bay Mau up down	To Lich Thanh Liet up down	Kim Nguu Yen Duyen	Ha Dong down		Nhue Dong Quan up	
1994	5	14	6.00	7.55	5.45	5.20	3.90	3.50	4.10	4.33	3.21	-
	5	15								4.33	3.24	-
	5	16	6.00	7.55	5.45	5.20	3.95	3.95	4.10	4.45	3.28	8.4
	5	17	6.10	7.56	5.45	5.22	4.00	4.00	4.25	4.40	3.39	13.5
	5	18	6.12	7.56	5.46	5.20	3.40	3.33	4.25	3.33	2.81	39.5
	5	19	6.10	7.55	5.57	5.25	3.40	3.33	4.27	3.16	2.52	69.2
	5	20	6.30	7.90	6.32	5.80	4.55	4.30	5.90	4.03	2.90	179.6
	5	21	6.35	7.80	5.91	5.60	5.15	5.10	5.70	4.93	3.45	7.20
	5	22								4.80	3.58	0.1
	5	23	6.25	7.75	5.67	5.10	4.60	4.55	5.35	4.60	3.45	0.00
	5	24	6.20	7.70	5.60	4.95	4.20	4.05	4.80	4.22	3.22	0.00
	5	25	6.20	7.68	5.60	4.90	3.97	3.91	4.75	3.90	3.01	0.10
	5	26	6.20	7.68	5.58	4.88	3.85	3.80	4.70	3.62	2.8	0.1
	5	27	6.25	7.80	5.81	5.12	4.05	4.00	5.00	3.66	2.78	66.9
	5	28	6.25	7.60	5.62	5.00	4.00	3.95	4.70	3.85	3.00	-
	5	29		7.65						3.59	2.91	-
	5	30	6.20	7.65	5.55	4.90	3.30	3.25	4.50	3.30	2.70	0.7
	5	31	6.2	7.65	5.55	4.9	3.05	3	4.35	3.30	2.70	0.2

Table C4.4 RELATION BETWEEN RAINFALL AND WATER LEVELS (3/3)  
- Aug. 29, 1994 Flood -

unit : m,MSL

Year	Month	Day	Lake				River				One Day Rainfall at Lang station (mm)			
			Hoan Kiem	Giang Vo	Bay Mau		To Lich		Kim Nguu Yen Duyen	Nhue				
					Up	Down	Thanh Liet	Down		Ha Dong down		Dong Quan up		
1994	8	26	6.25	7.70	5.65	4.95	4.52	3.50	2.60	5.08	2.7	2.37	0.5 170.4 130.6 16.1 2.2	
	8	27	6.25	7.70	5.65	4.95	4.52	3.80	2.60	5.08	2.55	2.30		
	8	28			5.87			3.30	2.60					
	8	29	6.50	8.00	5.87	5.20	5.15	4.40	3.90	5.25	3.35	2.62		
	8	30	6.60	8.18	5.93	5.67	5.62	5.20	5.18	5.73	5.30	4.01		
	8	31	6.78	8.20	6.00	5.90	5.88	5.70	5.70	5.90	5.60	4.67		
	9	1	6.75	8.00	5.90	5.77	5.77	5.70	5.70	5.79	5.60	4.87		
	9	2									5.56	4.70		
	9	3									5.54	4.72		
	9	4	6.65	7.89	5.85	5.55	5.53	5.40	5.35	5.55	5.43	4.68		
	9	5	6.65	7.85	5.85	5.46	5.43	5.20	5.15	5.49	5.29	4.64		
9	6	6.63	7.85	5.85	5.46	5.43	5.20	5.15	5.49					
9	7	6.58	7.85	5.92	5.38	5.35	5.05	5.00	5.41					
9	8	6.85	8.05	6.02	5.89	5.86	5.55	5.50	6.09					
9	9	6.72	8.00	5.90	5.70	5.69	5.58	5.50	5.70					
9	10	6.68	7.90	5.83	5.70	5.69	5.40	5.35	5.20					
9	11												42.9 128.2 1.10	

Table C5.1

## LOW FLOW MEASUREMENT ON DECEMBER 1993

(1) To Lich River <Dec. 16>  
(Cau Moi Bridge)

Section	Area (m <sup>2</sup> )	Velocity (m/s)	Discharge (m <sup>3</sup> /s)	Water Level (m,MSL)
1	2.90	0.04	0.12	-
2	3.60	0.07	0.25	
3	3.05	0.06	0.18	
4	3.05	0.09	0.27	
5	3.20	0.06	0.19	
SUM	15.80		1.02	

(4) Lu River <Dec. 15>  
(Tau Bay Bridge)

Section	Area (m <sup>2</sup> )	Velocity (m/s)	Discharge (m <sup>3</sup> /s)	Water Level (m,MSL)
1	1.65	0.25	0.41	-
2	1.38	0.19	0.26	
SUM	3.03		0.67	

(5) Kim Nguu River <Dec. 15>  
(Cau Xa Hoang Van Thu Bridge)

Section	Area (m <sup>2</sup> )	Velocity (m/s)	Discharge (m <sup>3</sup> /s)	Water Level (m,MSL)
1	0.54	0.15	0.08	4.3
2	1.64	0.14	0.23	
3	0.82	0.11	0.09	
SUM	3.00		0.40	

(2) To Lich River <Dec. 16>  
(Cau Dau Bridge)

Section	Area (m <sup>2</sup> )	Velocity (m/s)	Discharge (m <sup>3</sup> /s)	Water Level (m,MSL)
1	12.98	0.00	0.00	4.30
2	9.79	0.03	0.29	
3	7.83	0.05	0.39	
4	17.70	0.05	0.89	
SUM	48.31		1.57	

(6) Kim Nguu River <Dec. 15>  
(Confluence with Kim Nguu and Set River)

Section	Area (m <sup>2</sup> )	Velocity (m/s)	Discharge (m <sup>3</sup> /s)	Water Level (m,MSL)
1	8.23	0.08	0.66	4.3
2	5.12	0.06	0.31	
3	10.03	0.05	0.50	
4	5.82	0.00	0.00	
5	1.90	0.00	0.00	
SUM	31.09		1.47	

(3) To Lich River <Dec. 16>  
(Thanh Liet Flood Gate Upstream)

Section	Area (m <sup>2</sup> )	Velocity (m/s)	Discharge (m <sup>3</sup> /s)	Water Level (m,MSL)
1	4.31	0.15	0.65	4.30
2	7.60	0.17	1.29	
3	7.61	0.20	1.52	



Table C5.2 LOW FLOW CONDITION IN THE STUDY AREA

Measurement Point	Area (km <sup>2</sup> )	Date in 1993												
		Jul. 8	Jul. 29	Jul. 30	Aug. 5	Aug. 6	Aug. 12	Aug. 13	Dec. 15	Dec. 16				
(1) To Lich River (Cau Moi Bridge)	16.9 Q(m <sup>3</sup> /s) q(m <sup>3</sup> /s/km <sup>2</sup> )	-	-	-	-	-	-	-	-	-	-	-	-	1.02 0.060
(2) To Lich River (Cau Dau Bridge)	29.4 Q(m <sup>3</sup> /s) q(m <sup>3</sup> /s/km <sup>2</sup> )	-	6.37 0.217	-	4.19 0.143	-	1.27 0.043	-	-	-	-	-	-	1.57 0.053
(3) To Lich River (Thanh Liet Flood Gate Upstream)	68.2 Q(m <sup>3</sup> /s) q(m <sup>3</sup> /s/km <sup>2</sup> )	4.70 0.069	19.37 0.284	-	*18.15 0.266	-	5.25 0.077	-	-	-	-	-	-	5.83 0.085
(4) Lu River (Tau Bay Bridge)	4.6 Q(m <sup>3</sup> /s) q(m <sup>3</sup> /s/km <sup>2</sup> )	-	-	-	-	-	-	-	-	-	-	-	0.67 0.146	-
(5) Kim Nguu River (Cau Xa Hoang Van Thu Bridge)	19.6 Q(m <sup>3</sup> /s) q(m <sup>3</sup> /s/km <sup>2</sup> )	-	-	1.08 0.055	-	1.14 0.058	-	1.21 0.062	-	-	-	-	0.40 0.020	-
(6) Kim Nguu River (conf. with Kim Nguu and Set rivers)	28.5 Q(m <sup>3</sup> /s) q(m <sup>3</sup> /s/km <sup>2</sup> )	-	-	4.52 0.159	-	3.43 0.120	-	2.70 0.095	-	-	-	-	1.47 0.052	-
Daily Rainfall at Lang Station (mm)	the day before	24.9	44.5	4.9	0.0	-	-	-	-	-	-	-	0.0	-
	the day	5.1	4.9	0.3	-	0.1	-	18.2	-	-	-	-	-	-

\* : This value was influenced by the gate operation

Table C6.1

## ANNUAL MAXIMUM ONE DAY AND 2 DAYS RAINFALLS

- Lang Station -

## - One Day Rainfalls -

## - 2 Days Rainfalls -

Order	Year	Month	Date	R(mm)	Order	Year	Month	Date	R(mm)
1	1984	11	10	394.9	1	1984	11	9	560.4
2	1955	9	26	224.4	2	1955	9	26	304.5
3	1989	6	12	220.6	3	1986	6	18	292.4
4	1972	8	23	205.7	4	1989	6	11	286.7
5	1959	7	30	199.8	5	1972	8	22	260.5
6	1978	9	22	185.0	6	1980	8	19	245.5
7	1958	6	16	184.0	7	1992	6	29	233.7
8	1968	8	14	182.5	8	1979	8	3	228.3
9	1975	9	21	176.2	9	1978	9	21	226.6
10	1967	7	25	175.7	10	1985	9	11	219.3
11	1992	6	30	165.3	11	1964	6	3	202.8
12	1986	6	18	164.0	12	1959	7	29	201.7
13	1974	9	7	146.6	13	1968	8	13	200.8
14	1993	9	30	143.4	14	1991	6	11	199.8
15	1983	10	4	142.1	15	1967	7	24	199.2
16	1979	8	4	139.5	16	1958	6	15	184.6
17	1981	6	12	137.8	17	1975	9	20	181.8
18	1964	7	3	135.5	18	1993	9	29	180.1
19	1965	7	24	134.1	19	1965	7	24	171.6
20	1963	8	17	130.8	20	1983	10	4	169.1
21	1966	10	28	129.9	21	1963	9	9	162.8
22	1990	9	20	128.0	22	1971	8	19	162.5
23	1980	8	19	125.4	23	1966	10	27	160.5
24	1971	5	12	125.1	24	1977	7	15	153.7
25	1961	10	21	123.5	25	1987	8	30	153.6
26	1991	6	11	120.5	26	1961	10	20	152.6
27	1985	9	12	112.4	27	1974	9	7	147.8
28	1956	9	16	108.7	28	1982	8	19	143.7
29	1977	7	15	105.7	29	1956	9	15	143.5
30	1960	7	1	104.8	30	1981	6	12	137.8
31	1973	7	24	104.4	31	1990	9	20	136.5
32	1987	8	30	99.6	32	1960	6	30	135.0
33	1969	6	11	87.5	33	1973	9	2	132.8
34	1970	7	25	79.2	34	1976	9	17	114.9
35	1982	7	10	78.4	35	1957	5	26	100.5
36	1976	9	17	76.2	36	1969	9	4	91.4
37	1988	10	23	73.6	37	1988	10	3	88.2
38	1962	5	9	68.7	38	1970	7	24	81.0
39	1957	8	28	65.8	39	1962	9	22	69.3

Table C6.2 PROBABLE ONE DAY AND 2 DAYS RAINFALLS

- Lang Station -

One Day				2 Days			
unit : mm				unit : mm			
Return Period (year)	Method			Return Period (year)	Method		
	Gumbel	Weibull-Plot	Hazen-Plot		Gumbel	Weibull-Plot	Hazen-Plot
1000	469	466	427	1000	650	663	602
500	433	427	394	500	599	604	552
400	422	415	384	400	583	585	537
300	407	399	370	300	562	562	516
250	398	389	362	250	548	547	504
200	386	378	351	200	532	529	488
150	371	362	338	150	511	506	469
100	350	341	320	100	481	474	441
80	339	329	309	80	465	457	426
60	324	314	296	60	444	435	407
50	314	305	288	50	430	421	395
40	303	294	278	40	414	404	380
30	288	279	265	30	393	382	361
25	278	270	257	25	379	368	349
20	267	258	247	20	363	352	334
15	251	243	233	15	341	330	315
10	230	223	215	10	310	300	288
8	217	211	204	8	293	283	273
5	191	186	182	5	255	247	241
4	178	174	171	4	237	230	225
3	160	157	155	3	212	207	204
2	133	132	132	2	173	171	171
1.5	104	110	112	1.5	139	142	144
1.2	83	89	91	1.2	103	111	115
1.03	47	63	59	1.03	51	73	77

Period : 1955 - 1993 (39 years)

Table C6.3

ANNUAL MAXIMUM 10 AND 60  
MINUTES RAINFALLS

- Lang Station -

- 10 Minutes Rainfalls -			- 60 Minutes Rainfalls -		
Order	Year	R(mm)	Order	Year	R(mm)
1	1968	35.2	1	1984	136.3
2	1973	34.7	2	1986	111.8
3	1986	32.4	3	1967	93.9
4	1982	31.5	4	1980	90.3
5	1984	30.2	5	1977	79.4
6	1971	29.0	6	1966	73.8
7	1964	27.9	7	1978	70.7
8	1957	27.3	8	1973	69.5
9	1985	26.4	9	1963	67.7
10	1961	25.0	10	1975	67.4
11	1980	24.2	11	1968	67.0
12	1977	23.6	12	1987	67.0
13	1974	23.5	13	1969	64.8
14	1978	23.2	14	1982	64.8
15	1975	23.1	15	1989	63.6
16	1976	22.9	16	1976	63.3
17	1972	22.8	17	1981	61.4
18	1963	22.6	18	1974	60.9
19	1962	22.4	19	1972	60.9
20	1990	22.4	20	1983	60.1
21	1969	22.0	21	1964	59.1
22	1987	21.8	22	1961	58.9
23	1967	21.4	23	1971	53.0
24	1965	21.3	24	1965	51.3
25	1983	20.6	25	1979	47.7
26	1979	20.3	26	1962	47.6
27	1966	20.0	27	1985	46.6
28	1988	19.9	28	1991	45.6
29	1981	19.7	29	1957	45.4
30	1991	19.6	30	1960	42.0
31	1970	19.3	31	1990	41.3
32	1989	18.0	32	1970	40.8
33	1959	17.8	33	1959	34.5
34	1960	17.6	34	1992	33.9
35	1992	11.7	35	1988	31.9
36	1958	11.0	36	1958	23.4

period : 1957 -1992 (36 years)

Table C6.4 PROBABLE 10 AND 60 MINUTES RAINFALLS

- Lang Station -

10 Minutes				60 Minutes			
unit : mm				unit : mm			
Return Period (year)	Method			Return Period (year)	Method		
	Gumbel	Weibull-Plot	Hazen-Plot		Gumbel	Weibull-Plot	Hazen-Plot
1000	54	54	50	1000	184	190	174
500	50	51	48	500	171	175	161
400	49	50	47	400	167	171	157
300	48	48	46	300	161	164	152
250	47	48	45	250	158	161	149
200	46	47	44	200	153	156	145
150	45	45	43	150	148	150	140
100	43	44	41	100	140	142	133
80	42	43	41	80	135	137	129
60	40	41	39	60	130	131	124
50	39	40	39	50	126	128	120
40	38	39	38	40	122	123	116
30	37	38	37	30	116	117	111
25	36	37	36	25	113	114	108
20	35	36	35	20	108	109	104
15	34	35	34	15	103	103	99
10	32	33	32	10	94	95	91
8	31	31	31	8	90	90	87
5	28	29	28	5	80	80	78
4	27	28	27	4	75	75	74
3	25	26	26	3	69	68	68
2	23	23	23	2	58	58	58

Period : 1957 - 1992 (36 years)

Table C7.1 SELECTION OF OBJECTIVE FLOOD FOR DRAINAGE PLAN

Flood Type	Rainfall at Lang station (mm)		Cause of Rainfall	Data Availability			Remarks	
	2 days	Storm Total		Return Period (2 days)	Hourly Rainfall	Rivers in Hanoi		Water Level
					Inner Water	Nhue River		
Aug. 23, 1972	260.5 (1.190)	345.8	6-year	Low pressure	X Imperfect	-	X	There exist few information about flooding
Sep. 22, 1978	226.6 (1.368)	226.6	4-year	Typhoon (No.7 and 8)	X	-	X	There exist few information about flooding
Nov. 10, 1984	560.4 (0.553)	604.7	Less than 200-year	Typhoon (No.9)	X	-	X	Extremely big flood Flooding caused heavy damage
Jun. 12, 1989 (Objective Flood)	286.7 (1.081)	348.4	8-year	Typhoon (No.3)	X	X * 5.37 m	X	Rainfall is nearly 10-year Flooding caused heavy damage Intensive hyetograph pattern
May 20, 1994	226.0 (1.372)	312.0	4-year	Typhoon	X	X * 5.15 m	X	
Aug 29, 1994	301.0 (1.030)	317.1	9-year	Typhoon	X	X * 5.70 m	X	Rainfall is nearly 10-year Flooding caused heavy damage Scattering hyetograph pattern

Data Availability : X ; exist, - ; no exist

( ) : enlarging factor for making design hourly hyetograph of 10-year (310 mm, 2 days)

\* : peak water level at downstream side of Thanh Liet floodgate

Table C7.2 CONSTANTS OF SUB-BASINS (1/2) - To Lich River Basin -

Basin Nos.	Area (km <sup>2</sup> )	Length of Basin L (m)	Height of Channel H (m)	Slope of Basin I	Ratio of Future Land Use				Constants														
					Urban Area		Park & Green		Paddy Field (%)	Pond & Lake (%)	N	K	P	II (hr)	Qb (m <sup>3</sup> /s)	fi	Rsa (mm)						
					High Density (km <sup>2</sup> )	General (km <sup>2</sup> )	General (%)	General (%)															
1 T1	1.30	2,200	10.1	7.4	2.7	1/810	0.67	52	0.39	30	0.24	18	0.00	0	0.00	0	0.039	12.6	0.6	0.0	0.10	0.9	55
2 T2	4.36	3,300	7.6	6.2	1.4	1/2360	0.48	11	3.25	75	0.50	11	0.00	0	0.13	3	0.051	25.9	0.6	0.0	0.32	0.9	55
3 T3	3.12	1,700	6.2	5.8	0.4	1/4250	0.36	12	2.17	70	0.50	16	0.00	0	0.09	3	0.053	21.3	0.6	0.0	0.23	0.9	55
4 T4	1.22	1,600	6.3	5.8	0.5	1/3200	0.00	0	0.97	80	0.25	20	0.00	0	0.00	0	0.060	20.3	0.6	0.0	0.09	0.9	55
5 T5	3.30	5,000	8.8	5.8	3.0	1/1670	0.75	23	2.14	65	0.20	6	0.00	0	0.21	6	0.044	27.4	0.6	0.0	0.24	0.9	55
6 T6	2.50	3,900	7.3	5.9	1.4	1/2790	0.21	8	1.98	79	0.10	4	0.00	0	0.21	8	0.049	29.4	0.6	0.0	0.18	0.9	55
7 T7	1.06	900	6.2	5.9	0.3	1/3000	0.11	10	0.87	82	0.08	8	0.00	0	0.00	0	0.050	12.6	0.6	0.0	0.08	0.9	55
8 T8	2.34	1,400	6.1	5.8	0.3	1/4670	0.03	1	1.68	72	0.53	23	0.00	0	0.10	4	0.061	21.2	0.6	0.0	0.17	0.9	55
9 T9	0.80	400	5.3	5.2	0.1	1/4000	0.00	0	0.21	26	0.26	33	0.31	39	0.02	3	0.434	30.9	0.6	0.0	0.06	0.9	55
10 L1	2.15	2,600	6.9	5.9	1.0	1/2600	0.31	14	1.62	75	0.06	3	0.00	0	0.16	7	0.046	21.7	0.6	0.0	0.16	0.9	55
11 L2	1.75	1,900	6.4	5.7	0.7	1/2710	0.10	6	1.51	86	0.14	8	0.00	0	0.00	0	0.052	19.6	0.6	0.0	0.13	0.9	55
12 L3	0.92	800	6.0	5.7	0.3	1/2670	0.00	0	0.88	96	0.02	2	0.00	0	0.02	2	0.051	11.5	0.6	0.0	0.07	0.9	55
13 L4	1.05	800	6.1	5.7	0.4	1/2000	0.00	0	0.78	74	0.19	18	0.00	0	0.08	8	0.059	11.5	0.6	0.0	0.08	0.9	55
14 L5	0.75	2,200	6.1	5.0	1.1	1/2000	0.00	0	0.59	79	0.16	21	0.00	0	0.00	0	0.061	21.5	0.6	0.0	0.05	0.9	55
15 L6	3.58	2,700	6.0	4.9	1.1	1/2450	0.00	0	1.84	51	0.97	27	0.00	0	0.77	22	0.064	26.6	0.6	0.0	0.26	0.9	55
16 K1	3.47	3,300	9.2	8.1	1.1	1/3000	2.70	78	0.52	15	0.12	3	0.00	0	0.13	4	0.021	16.4	0.6	0.0	0.25	0.9	55
17 K2	1.22	800	5.7	5.4	0.3	1/2670	0.15	12	0.56	46	0.51	42	0.00	0	0.13	8	0.066	13.4	0.6	0.0	0.09	0.9	55
18 K3	1.59	1,600	6.2	5.6	0.6	1/2670	0.25	16	0.91	57	0.30	19	0.00	0	0.13	8	0.053	17.8	0.6	0.0	0.12	0.9	55
19 K4	1.26	1,400	5.7	5.0	0.7	1/2000	0.00	0	0.75	60	0.51	40	0.00	0	0.00	0	0.070	17.8	0.6	0.0	0.09	0.9	55
20 K5	2.77	2,800	5.7	4.7	1.0	1/2800	0.00	0	2.16	78	0.51	18	0.10	4	0.00	0	0.094	35.7	0.6	0.0	0.20	0.9	55
21 K6	6.99	3,800	6.0	4.6	1.4	1/2710	0.00	0	1.54	22	2.17	31	1.00	14	2.28	33	0.201	67.0	0.6	0.0	0.51	0.9	55
22 S1	2.17	2,300	7.0	5.9	1.1	1/2090	0.87	40	0.72	33	0.30	14	0.00	0	0.28	13	0.041	17.7	0.6	0.0	0.16	0.9	55
23 S2	1.99	800	6.4	6.2	0.2	1/4000	0.00	0	1.76	88	0.18	9	0.00	0	0.05	3	0.055	13.6	0.6	0.0	0.15	0.9	55
24 S3	1.50	1,000	5.2	4.8	0.4	1/2500	0.21	14	0.85	57	0.38	25	0.00	0	0.06	4	0.057	13.8	0.6	0.0	0.11	0.9	55
25 S4	1.44	2,800	6.0	4.6	1.4	1/2000	0.02	1	1.26	88	0.10	7	0.00	0	0.06	4	0.053	22.9	0.6	0.0	0.11	0.9	55
26 H1	5.62	1,800	5.0	4.2	0.8	1/2250	0.09	2	1.60	28	0.66	12	2.11	38	1.16	21	0.412	62.2	0.6	0.0	0.41	0.9	55
27 H2	2.48	1,500	4.6	4.1	0.5	1/3000	0.00	0	1.26	51	0.30	12	0.45	18	0.47	19	0.228	42.6	0.6	0.0	0.18	0.9	55
28 Y1	5.50	2,800	4.8	4.4	0.4	1/7000	0.00	0	0.15	3	0.23	4	0.00	0	5.12	93	0.052	32.9	0.6	0.0	0.40	0.9	55

$$K = 1000 / (3.6 * 10^6)^{0.5} * (L * N / 1)^{0.35}$$

- Equivalent Roughness (N)
- High density urban area : 0.010
  - General urban area : 0.050
  - Park and green : 0.100
  - Paddy field : 1.000
  - Water Surface : 0.050

Table C7.2 CONSTANTS OF SUB-BASINS (2/2) - Nhue River Basin -

Basin Nos. Name	Area (km <sup>2</sup> )	Length of Basin L (m)	Height of Channel H(max) (m)	Slope of Basin I	Ratio of Future Land Use					Constants													
					Urban Area		Park & Green		Paddy Field		Pond & Lake		N	K	P	Tl	Qb	Rsa					
					High Density (km <sup>2</sup> )	General (km <sup>2</sup> )	(%)	(%)	(%)	(%)	(%)	(%)							(hr)	(m <sup>2</sup> /s)	(mm)		
C1	1.48	1600	7.0	6.2	0.8	1/2000	0.00	0.76	51	0.40	27	0.22	15	0.10	7	0.205	36.8	0.6	0.0	0.11	0.9	55	
C2	2.32	3200	7.0	6.2	0.8	1/4000	0.00	1.92	83	0.32	14	0.08	3	0.00	0	0.090	41.9	0.6	0.0	0.17	0.9	55	
C3	3.00	1000	5.6	5.5	0.1	1/###	0.00	0.49	16	2.29	76	0.21	7	0.01	0	0.155	38.1	0.6	0.0	0.22	0.9	55	
C4	3.08	4400	7.9	5.6	2.3	1/1910	0.00	1.11	36	1.50	49	0.44	14	0.03	1	0.210	67.6	0.6	0.0	0.23	0.9	55	
C5	2.06	2400	7.0	5.6	1.4	1/1710	0.00	1.60	78	0.20	10	0.26	13	0.00	0	0.175	40.7	0.6	0.0	0.15	0.9	55	
C6	2.74	3000	5.9	5.6	0.3	1/###	0.23	8	1.91	70	0.60	22	0.00	0	0.00	0	0.058	40.8	0.6	0.0	0.20	0.9	55
C7	0.75	2000	7.4	6.0	1.4	1/1430	0.00	0.17	23	0.45	60	0.13	17	0.00	0	0.245	42.4	0.6	0.0	0.05	0.9	55	
C8	0.95	700	6.0	5.9	0.1	1/7000	0.00	0.77	81	0.18	19	0.00	0	0.00	0	0.059	15.5	0.6	0.0	0.07	0.9	55	
C9	2.35	3800	7.4	6.0	1.4	1/2710	0.00	1.67	71	0.23	10	0.45	19	0.00	0	0.237	73.9	0.6	0.0	0.17	0.9	55	
C10	0.97	1900	6.3	6.0	0.3	1/6330	0.11	11	0.80	82	0.00	0	0.06	0	6	0.045	23.2	0.6	0.0	0.07	0.9	55	
D1	4.57	3600	6.5	4.7	1.8	1/2000	0.26	6	3.32	73	0.54	12	0.30	7	0.15	3	0.116	42.6	0.6	0.0	0.34	0.9	55
D2	3.26	3500	6.5	4.6	1.9	1/1840	0.13	4	1.99	61	0.53	16	0.54	17	0.07	2	0.214	58.9	0.6	0.0	0.24	0.9	55
D3	1.12	800	6.2	5.0	1.2	1/670	0.00	0	1.11	10	0.26	23	0.75	67	0.00	0	0.698	36.5	0.6	0.0	0.08	0.9	55
D4	1.68	2600	6.5	5.0	1.5	1/1730	0.00	0	0.29	17	0.29	17	1.10	65	0.00	0	0.681	96.9	0.6	0.0	0.12	0.9	55
D5	2.97	3200	6.5	4.9	1.6	1/2000	0.15	5	0.58	20	0.00	0	2.24	75	0.00	0	0.764	122.9	0.6	0.0	0.22	0.9	55
M1	2.91	2000	5.3	5.0	0.3	1/6670	0.04	3	2.32	80	0.48	16	0.00	0	0.07	2	0.058	28.3	0.6	0.0	0.21	0.9	55
M2	2.61	1800	5.5	5.0	0.5	1/3600	0.00	0	1.42	54	0.32	12	0.55	21	0.32	12	0.256	53.9	0.6	0.0	0.19	0.9	55
M3	2.39	2000	5.5	5.0	0.4	1/4000	0.00	0	1.68	70	0.35	15	0.36	15	0.00	0	0.200	51.1	0.6	0.0	0.18	0.9	55
M4	4.73	2000	5.6	5.2	0.4	1/5000	0.00	0	0.51	11	0.58	12	3.44	73	0.20	4	0.747	120.4	0.6	0.0	0.35	0.9	55
M5	2.06	2600	5.3	5.0	0.3	1/8670	0.29	14	1.43	69	0.34	17	0.00	0	0.00	0	0.053	34.0	0.6	0.0	0.15	0.9	55
B1	2.18	2600	6.3	4.6	1.7	1/1530	0.00	0	1.01	46	0.15	7	0.85	39	0.17	8	0.424	70.3	0.6	0.0	0.16	0.9	55
B2	3.63	3000	6.3	4.6	1.7	1/1760	0.07	2	1.97	54	0.39	11	1.18	33	0.02	1	0.363	72.8	0.6	0.0	0.27	0.9	55
B3	4.09	3300	6.3	4.6	1.7	1/1940	0.14	3	2.25	55	0.42	10	0.89	22	0.39	10	0.260	65.0	0.6	0.0	0.30	0.9	55

$K = 1000 / (3.6 * 10^6)^{0.25} * (L * N / I)^{0.25}$

- Equivalent Roughness (N)
  - High density urban area : 0.010
  - General urban area : 0.050
  - Park and green : 0.100
  - Paddy field : 1.000
  - Water Surface : 0.050



Table C7.3      CONSTANTS OF CHANNELS

River	Name	Constants		
		K	P	Tl (hr)
- TO LICH RIVER BASIN -				
To Lich	A	2.96	0.707	0.30
To Lich	B	4.92	0.677	0.22
To Lich	C	3.61	0.677	0.16
To Lich	D	6.56	0.677	0.29
To Lich	E	3.72	0.668	0.15
Lu	F	1.49	0.706	0.08
Lu	G	1.29	0.685	0.06
Lu	H	4.14	0.685	0.19
Kim Nguu	I	2.04	0.685	0.09
Kim Nguu	J	3.09	0.660	0.12
Set	K	2.82	0.679	0.13
Set	L	3.46	0.653	0.13
Kim Nguu	M	11.10	0.657	0.48
- NHUE RIVER BASIN -				
Co Nhue	A	-	-	0.31
Co Nhue	B	-	-	0.12
My Dinh	A	-	-	0.15
My Dinh	B	-	-	0.10
Me Tri	A	-	-	0.21

note ;      K,P were estimated by uniform flow

$$Tl = 7.36 * 10^{-4} * L * I^{-0.5}$$

whrer,      L : Channel length (km)

I : Slope of channel

Table C7.4 DESIGN HYDROGRAPHS OF ALTERNATIVE 6 (1/2)

- Jun. 1989 Flood Type (10-year, Alternative 6) -

Date	h	Discharge (m <sup>3</sup> /s)					Hourly Rainfall (mm)	
		Yen So	To Lich	Set	Kim Nguu	Hoan Liet	Observed	Enlarged
10	19	5.0	1.7	1.0	1.7	0.7	0	0.00
10	20	5.1	1.8	1.0	1.7	0.7		
10	21	5.1	1.7	1.0	1.7	0.7		
10	22	5.1	1.7	1.0	1.7	0.7		
10	23	5.1	1.7	1.0	1.7	0.7	0.8	0.89
11	0	5.1	1.7	1.0	1.7	0.7	0.7	0.78
11	1	5.2	1.7	1.0	1.7	0.8	0.9	1.00
11	2	5.2	1.7	1.0	1.7	0.8		
11	3	5.3	1.7	1.1	1.7	0.8		
11	4	5.3	1.7	1.1	1.8	0.8		
11	5	5.3	1.7	1.1	1.8	0.8		
11	6	5.3	1.7	1.1	1.8	0.8		
11	7	5.3	1.7	1.1	1.8	0.8	0	0.00
11	8	5.3	1.7	1.1	1.8	0.8	0	0.00
11	9	6.1	1.8	1.3	2.1	1.0	6.3	7.01
11	10	6.8	1.8	1.6	2.3	1.1	2.1	2.34
11	11	7.3	1.8	1.9	2.5	1.1	0	0.00
11	12	7.7	1.9	2.1	2.7	1.1	0	0.00
11	13	7.9	1.9	2.2	2.8	1.1	0	0.00
11	14	8.3	2.0	2.3	2.9	1.2	1.6	1.78
11	15	10.3	2.2	2.8	3.7	1.7	7.5	8.34
11	16	12.5	2.3	3.7	4.5	2.0	3.7	4.11
11	17	14.7	2.5	4.7	5.4	2.2	2.8	3.11
11	18	19.9	2.9	6.3	7.5	3.3	10.1	11.23
11	19	37.6	4.0	11.9	14.5	7.2	27	30.02
11	20	58.2	5.3	22.0	23.0	7.9	17.6	19.57
11	21	96.7	9.0	39.0	40.8	7.9	61.4	68.28
11	22	128.9	12.4	51.4	57.2	7.9	26.7	29.69
11	23	142.0	19.3	54.0	60.8	7.9	15.7	17.46
12	0	149.9	30.2	52.5	59.3	7.9	12	13.34
12	1	159.4	44.2	50.4	56.9	7.9	9.5	10.56
12	2	168.1	57.8	48.3	54.1	7.9	5.2	5.78
12	3	172.5	67.3	46.2	51.1	7.9	2	2.22
12	4	172.2	72.1	43.1	49.1	7.9	6	6.67
12	5	161.1	73.2	35.5	44.5	7.9	5.5	6.12
12	6	151.5	70.8	33.5	39.3	7.9	5.3	5.89
12	7	152.0	68.1	35.8	40.2	7.9	24.2	26.91
12	8	153.9	66.7	37.3	42.0	7.9	3.9	4.34
12	9	149.9	66.0	35.5	40.6	7.9	4.4	4.89
12	10	145.1	65.1	33.7	38.4	7.9	5.1	5.67
12	11	139.7	64.0	31.8	36.1	7.9	1.7	1.89
12	12	133.4	62.4	29.6	33.5	7.9	0.6	0.67
12	13	126.9	60.2	27.8	31.0	7.9	0.9	1.00
12	14	120.9	57.5	26.4	29.1	7.9	1.4	1.56
12	15	115.7	54.8	25.4	27.6	7.9	1.5	1.67
12	16	111.0	52.0	24.6	26.5	7.9	2.1	2.34
12	17	103.7	49.1	21.1	25.6	7.9	1.2	1.33
12	18	98.3	46.0	19.8	24.7	7.9	0.6	0.67
12	19	93.6	43.0	18.9	23.8	7.9	0.7	0.78
12	20	89.3	40.3	18.1	23.0	7.9		
12	21	83.9	37.9	15.9	22.2	7.9		
12	22	79.7	35.8	14.5	21.5	7.9		

Table C7.4 DESIGN HYDROGRAPHS OF ALTERNATIVE 6 (2/2)

- Jun. 1989 Flood Type (10-year, Alternative 6) -

Date h	Discharge (m3/s)					Hourly Rainfall (mm)	
	Yen So	To Lich	Set	Kim Nguu	Hoan Liet	Observed	Enlarged
12 23	76.4	34.0	13.7	20.8	7.9		
13 0	73.8	32.4	13.2	20.3	7.9		
13 1	71.5	31.0	12.7	19.8	7.9		
13 2	69.4	29.8	12.4	19.4	7.9		
13 3	66.0	28.6	11.1	18.4	7.9		
13 4	61.8	27.6	9.3	16.9	7.9		
13 5	58.7	26.7	8.2	15.9	7.9		
13 6	56.5	25.9	7.5	15.2	7.9		
13 7	54.8	25.1	7.1	14.8	7.9		
13 8	53.5	24.5	6.8	14.4	7.9		
13 9	49.0	20.4	6.5	14.2	7.9		
13 10	47.2	19.0	6.3	13.9	7.9		
13 11	45.4	17.6	6.2	13.8	7.9		
13 12	43.8	16.3	6.0	13.6	7.9		
13 13	42.4	15.1	5.9	13.4	7.9		
13 14	41.2	14.2	5.8	13.3	7.9		
13 15	40.2	13.4	5.7	13.2	7.9		
13 16	39.3	12.8	5.6	13.1	7.9		
13 17	38.6	12.2	5.5	13.0	7.9		
13 18	37.9	11.7	5.5	12.9	7.9		
13 19	37.3	11.3	5.4	12.8	7.9		
13 20	36.6	10.6	5.3	12.7	7.9		
13 21	35.7	9.9	5.3	12.6	7.9		
13 22	34.9	9.2	5.2	12.6	7.9		
13 23	34.0	8.6	5.0	12.5	7.9		
13 0	32.4	8.0	4.2	12.4	7.9		
14 1	31.1	7.4	3.4	12.4	7.9		
14 2	30.0	7.0	2.8	12.3	7.9		
14 3	29.2	6.6	2.5	12.3	7.9		
14 4	28.6	6.2	2.2	12.2	7.9		
14 5	28.0	5.9	2.0	12.2	7.9		
14 6	27.6	5.6	1.9	12.1	7.9		
14 7	27.2	5.4	1.8	12.1	7.9		
14 8	26.9	5.2	1.7	12.1	7.9		
14 9	26.6	5.0	1.7	12.0	7.9		
14 10	26.4	4.8	1.6	12.0	7.9		
14 11	26.1	4.7	1.6	12.0	7.9		
14 12	25.9	4.5	1.6	11.9	7.9		
14 13	25.8	4.4	1.5	11.9	7.9		
14 14	25.6	4.3	1.5	11.9	7.9		
14 15	25.4	4.2	1.5	11.9	7.9		
14 16	25.3	4.1	1.5	11.8	7.9		
14 17	25.1	4.0	1.4	11.8	7.9		
14 18	25.0	3.9	1.4	11.8	7.9		
Qp	173.4	73.3	54.0	60.8	7.9		

note : Enlarged rainfall

$1.081[\text{Enlarging factor}] * (286.7\text{mm}[2 \text{ days rainfall}]/278.7\text{mm}[\text{Total of hourly rainfall}])$

Table C7.5 FLOOD CONTROL VOLUME OF LAKES (1/2) - To Lich River Basin -

Basin No.	Name	Bottom EL. of Basin (m,MSL)	As they are				Dredged				
			Future Lake Area (ha)	Regulation Water Level (m,MSL)	Water Depth (m)	Volume (10 <sup>3</sup> m <sup>3</sup> )	Future Lake Area (ha)	Regulation Water Level (m,MSL)	Water Depth (m)	Volume (10 <sup>3</sup> m <sup>3</sup> )	
2	T2	5.9	As they are Dredged Total	13.0 0.0 13.0	4.9 - 5.9	1.0	130 0 130	As they are Dredged Total	13.0 0.0 13.0	- - -	- - -
3	T3	5.8	As they are Dredged Total	5.0 0.0 5.0	4.8 - 5.8	1.0	50 0 50	As they are Dredged Total	0.0 5.0 5.0	- 3.5 - 5.8	0 2.3 115
5	T5	5.8	As they are Dredged Total	21.0 0.0 21.0	4.8 - 5.8	1.0	210 0 210	As they are Dredged Total	0.0 21.0 21.0	- 3.5 - 5.8	0 2.3 483
6	T6	5.9	As they are Dredged Total	21.0 0.0 21.0	4.9 - 5.9	1.0	210 0 210	As they are Dredged Total	2.0 19.0 21.0	4.9 - 5.9	1.0 2.4 476
8	T8	4.0	As they are Dredged Total	10.0 0.0 10.0	4.0 - 4.5	0.5	50 0 50	As they are Dredged Total	10.0 0.0 10.0	- -	- -
10	L1	5.9	As they are Dredged Total	16.0 0.0 16.0	4.9 - 5.9	1.0	160 0 160	As they are Dredged Total	5.0 11.0 16.0	4.9 - 5.9	1.0 2.4 314
13	L4	5.7	As they are Dredged Total	8.0 0.0 8.0	4.7 - 5.7	1.0	80 0 80	As they are Dredged Total	0.0 8.0 8.0	- 3.5 - 5.7	0 2.2 176
15	L6	4.0	As they are Dredged Total	77.0 0.0 77.0	4.0 - 4.5	0.5	385 0 385	As they are Dredged Total	51.7 25.3 77.0	4.0 - 4.5	0.5 1.0 512
16	K1	6.4	As they are Dredged Total	13.0 0.0 13.0	5.4 - 6.4	1.0	130 0 130	As they are Dredged Total	13.0 0.0 13.0	- -	- -
18	K3	5.6	As they are Dredged Total	13.0 0.0 13.0	4.6 - 5.6	1.0	130 0 130	As they are Dredged Total	0.0 13.0 13.0	- 3.5 - 5.6	0 2.1 273
21	K6	4.6	As they are Dredged Total	228.0 0.0 228.0	4.0 - 4.6	0.6	1368 0 1368	As they are Dredged Total	228.0 0.0 228.0	- -	- -
22	S1	5.9	As they are Dredged Total	28.0 0.0 28.0	4.9 - 5.9	1.0	280 0 280	As they are Dredged Total	5.0 23.0 28.0	4.9 - 5.9	1.0 2.4 602
23	S2	5.3	As they are Dredged Total	5.0 0.0 5.0	4.3 - 5.3	1.0	50 0 50	As they are Dredged Total	0.0 5.0 5.0	- 3.5 - 5.3	0 1.8 90
24	S3	4.6	As they are Dredged Total	19.0 0.0 19.0	4.0 - 4.6	0.6	114 0 114	As they are Dredged Total	0.0 19.0 19.0	- 3.5 - 4.6	0 1.1 209
25	S4	4.0	As they are Dredged Total	6.0 0.0 6.0	4.0 - 4.5	0.5	30 0 30	As they are Dredged Total	6.0 0.0 6.0	- -	- -
26	H1	4.0	As they are Dredged Total	116.0 0.0 116.0	4.0 - 4.5	0.5	580 0 580	As they are Dredged Total	0.0 116.0 116.0	- 3.5 - 4.5	0 1.0 1160
27	H2	4.0	As they are Dredged Total	47.0 0.0 47.0	4.0 - 4.5	0.5	235 0 235	As they are Dredged Total	47.0 0.0 47.0	- -	- -
28	Y	4.0	As they are Dredged Total	312.0 0.0 312.0	4.0 - 4.5	0.5	1560 0 1560	As they are Dredged Total	312.0 0.0 312.0	- -	- -

Normal Water Level : EL. 3.5 m      Water Level of Fish Pond : EL. 4.0 m

Table C7.5 FLOOD CONTROL VOLUME OF LAKES (2/2) - Nhue River Basin -

Basin No. Name	Bottom EL. of Basin (m,MSL)	As they are				Dredged			
		Future Lake Area (ha)	Regulation Water Level (m,MSL)	Water Depth (m)	Volume (10 <sup>3</sup> m <sup>3</sup> )	Future Lake Area (ha)	Regulation Water Level (m,MSL)	Water Depth (m)	Volume (10 <sup>3</sup> m <sup>3</sup> )
C1	6.0	As they are	10.0	5.0 - 6.0	1.0	100	As they are	10.0	-
		Dredged	0.0	-	-	0	Dredged	0.0	-
		Total	10.0	-	-	100	Total	10.0	-
C3	5.2	As they are	1.0	4.2 - 5.2	1.0	10	As they are	1.0	-
		Dredged	0.0	-	-	0	Dredged	0.0	-
		Total	1.0	-	-	10	Total	1.0	-
C4	5.9	As they are	3.0	4.9 - 5.9	1.0	30	As they are	3.0	-
		Dredged	0.0	-	-	0	Dredged	0.0	-
		Total	3.0	-	-	30	Total	3.0	-
C10	5.6	As they are	6.0	4.6 - 5.6	1.0	60	As they are	6.0	-
		Dredged	0.0	-	-	0	Dredged	0.0	-
		Total	6.0	-	-	60	Total	6.0	-
D1	4.7	As they are	15.0	3.7 - 4.7	1.0	150	As they are	15.0	-
		Dredged	0.0	-	-	0	Dredged	0.0	-
		Total	15.0	-	-	150	Total	15.0	-
D2	4.7	As they are	7.0	3.7 - 4.7	1.0	70	As they are	7.0	-
		Dredged	0.0	-	-	0	Dredged	0.0	-
		Total	7.0	-	-	70	Total	7.0	-
M1	5.4	As they are	7.0	4.4 - 5.4	1.0	70	As they are	7.0	-
		Dredged	0.0	-	-	0	Dredged	0.0	-
		Total	7.0	-	-	70	Total	7.0	-
M2	4.9	As they are	32.0	3.9 - 4.9	1.0	320	As they are	32.0	-
		Dredged	0.0	-	-	0	Dredged	0.0	-
		Total	32.0	-	-	320	Total	32.0	-
M4	4.7	As they are	20.0	3.7 - 4.7	1.0	200	As they are	20.0	-
		Dredged	0.0	-	-	0	Dredged	0.0	-
		Total	20.0	-	-	200	Total	20.0	-
B1	4.6	As they are	17.0	3.6 - 4.6	1.0	170	As they are	17.0	-
		Dredged	0.0	-	-	0	Dredged	0.0	-
		Total	17.0	-	-	170	Total	17.0	-
B2	4.6	As they are	2.0	3.6 - 4.6	1.0	20	As they are	2.0	-
		Dredged	0.0	-	-	0	Dredged	0.0	-
		Total	2.0	-	-	20	Total	2.0	-
B3	4.5	As they are	39.0	3.5 - 4.5	1.0	390	As they are	39.0	-
		Dredged	0.0	-	-	0	Dredged	0.0	-
		Total	39.0	-	-	390	Total	39.0	-

Table C7.6 COMPARISON OF RUNOFF CALCULATIONS

Items	JICA Study	Existing Plan
1 Objective area	68.2km <sup>2</sup> (excluding West Lake basin) 10-year return period	77.53km <sup>2</sup> (excluding West Lake basin, including some portion of Nhue River basin) 10-year return period
2 Design scale	310mm / 2 days	226mm / 1 day
3 Duration and depth of design rainfall	21,140,000m <sup>3</sup> (310mm*68.2km <sup>2</sup> )	17,520,000m <sup>3</sup> (226mm*77.53km <sup>2</sup> )
4 Total volume of design rainfall	Storage function method	Limited intensity rainfall formula method
5 Method of runoff calculation	Hanoi master plan land use, 2010	(unknown, probably present land use)
6 Land use condition in calculation	Jun. 1989 flood type	Sep. 1978 flood type (?) (unknown)
7 Design hourly hyetograph	Primary runoff ratio (f1) = 0.9	Runoff ratio = 0.51
8 Runoff ratio	Saturation rainfall (Rsa) = 55mm Saturated runoff ratio (f2) = 1.0	(throughout the flood period)
9 Total runoff volume	20,770,000m <sup>3</sup>	8,810,000m <sup>3</sup> (about 77.53km <sup>2</sup> *226mm*0.51)
10 Regulation method at lakes and ponds	Natural control method (ungated) (Regulation water depth assumed is about 1.0m)	Total flood storage up to maximum volume (Regulation water depth assumed is 1.0m)
11 Regulation volume	1,940,000m <sup>3</sup>	800,000m <sup>3</sup>
-River channel		
-Lakes including Linh Dam and Dinh	3,620,000m <sup>3</sup>	1,970,000m <sup>3</sup>
Cong Lakes	6,830,000m <sup>3</sup> (Pump=60m <sup>3</sup> /s)	1,200,000m <sup>3</sup> (Yen So and Thanh Liet)
-Yen So regulating reservoir	3,870,000m <sup>3</sup> (Pump=90m <sup>3</sup> /s)	(Pump=60m <sup>3</sup> /s)
12 Peak discharge	329m <sup>3</sup> /s	229m <sup>3</sup> /s
-without lakes and river channel	256m <sup>3</sup> /s (Alternative 0)	around 140m <sup>3</sup> /s
-without lakes	174m <sup>3</sup> /s (Alternative 6 as an example)	around 90m <sup>3</sup> /s
-with lakes		

Table C9.1 LANDSIDE WATER LEVELS OF TO LICH RIVER BASIN (1/2)  
 - under Present Condition (Pond ; Alternative 1) -

unit : m,MSL

Basin No.	Name	Area (km <sup>2</sup> )	EL. min. (m,MSL)	Return Period (year)						
				1.2	2	5	10	20	30	50
1	T1	1.30	7.40	-	7.43	7.51	7.80	8.02	8.05	8.09
2	T2	4.36	5.90	-	6.01	6.20	6.35	6.50	6.59	6.70
3	T3	3.12	5.80	-	5.83	6.02	6.08	6.15	6.19	6.23
4	T4	1.22	5.80	-	-	6.01	6.07	6.15	6.20	6.27
5	T5	3.30	5.80	-	5.86	6.04	6.11	6.18	6.23	6.28
6	T6	2.50	5.90	-	6.00	6.08	6.14	6.21	6.24	6.29
7	T7	1.06	5.80	-	5.82	5.91	5.99	6.03	6.06	6.09
8	T8	2.34	4.00	4.12	4.46	4.85	5.11	5.36	5.50	5.68
9	T9	0.80	4.00	4.12	4.46	4.85	5.11	5.36	5.50	5.68
10	L1	2.15	5.90	-	5.95	6.06	6.12	6.18	6.22	6.26
11	L2	1.75	5.70	5.71	5.83	6.01	6.07	6.12	6.16	6.20
12	L3	0.92	5.70	-	5.71	5.78	5.84	5.91	5.96	6.01
13	L4	1.05	5.70	-	5.80	5.97	6.04	6.10	6.13	6.16
14	L5	0.75	4.90	-	5.00	5.09	5.16	5.36	5.50	5.68
15	L6	3.58	4.00	4.12	4.46	4.85	5.11	5.36	5.50	5.68
16	K1	3.47	6.40	-	7.01	7.23	7.40	7.57	7.66	7.78
17	K2	1.22	5.40	-	5.45	5.55	5.75	5.95	6.02	6.06
18	K3	1.59	5.60	-	5.71	5.87	5.98	6.04	6.08	6.11
19	K4	1.26	4.60	-	4.64	4.85	5.11	5.36	5.50	5.68
20	K5	2.77	4.70	-	4.70	4.87	5.11	5.36	5.50	5.68
21	K6	6.99	4.60	-	-	4.85	5.11	5.36	5.50	5.68
22	S1	2.17	5.90	5.99	6.09	6.22	6.31	6.41	6.46	6.52
23	S2	1.99	5.30	-	5.35	5.50	5.82	6.03	6.07	6.12
24	S3	1.50	4.60	4.63	4.81	5.03	5.11	5.36	5.50	5.68
25	S4	1.44	4.00	4.12	4.46	4.85	5.11	5.36	5.50	5.68
26	H1	5.62	4.00	4.12	4.46	4.85	5.11	5.36	5.50	5.68
27	H2	2.48	4.00	4.12	4.46	4.85	5.11	5.36	5.50	5.68
28	Y	5.50	4.00	4.12	4.46	4.85	5.11	5.36	5.50	5.68

Table C9.1 LANDSIDE WATER LEVELS OF TO LICH RIVER BASIN (2/2)  
- under Future Condition (Alternative 6) -

unit : m,MSL

Basin		Area (km <sup>2</sup> )	EL. min. (m,MSL)	Return Period (year)						
No.	Name			1.2	2	5	10	20	30	50
1	T1	1.30	7.40	-	-	-	-	7.41	7.42	7.44
2	T2	4.36	5.90	-	-	-	-	6.05	6.10	6.16
3	T3	3.12	5.80	-	-	-	-	5.94	6.01	6.05
4	T4	1.22	5.80	-	-	-	-	5.94	6.02	6.05
5	T5	3.30	5.80	-	-	-	-	5.93	6.01	6.06
6	T6	2.50	5.90	-	-	-	-	6.00	6.03	6.07
7	T7	1.06	5.80	-	-	-	-	5.82	5.84	5.87
8	T8	2.34	4.00	-	-	-	-	4.57	5.00	5.06
9	T9	0.80	4.00	-	-	-	-	4.01	4.07	4.17
10	L1	2.15	5.90	-	-	-	-	6.03	6.06	6.11
11	L2	1.75	5.70	-	-	-	-	5.72	5.75	5.79
12	L3	0.92	5.70	-	-	-	-	5.71	5.72	5.74
13	L4	1.05	5.70	-	-	-	-	5.76	5.82	5.90
14	L5	0.75	4.90	-	-	-	-	4.94	5.01	5.03
15	L6	3.58	4.00	-	-	-	-	4.17	4.30	4.46
16	K1	3.47	6.40	-	-	-	-	7.00	7.05	7.12
17	K2	1.22	5.40	-	-	-	-	5.41	5.41	5.42
18	K3	1.59	5.60	-	-	-	-	5.69	5.75	5.82
19	K4	1.26	4.60	-	-	-	-	4.63	4.67	4.72
20	K5	2.77	4.70	-	-	-	-	4.75	4.80	4.89
21	K6	6.99	4.60	-	-	-	-	4.76	4.88	5.00
22	S1	2.17	5.90	-	-	-	-	6.04	6.08	6.14
23	S2	1.99	5.30	-	-	-	-	5.37	5.42	5.49
24	S3	1.50	4.60	-	-	-	-	4.70	4.78	4.89
25	S4	1.44	4.00	-	-	-	-	4.06	4.11	4.17
26	H1	5.62	4.00	-	-	-	-	4.11	4.18	4.27
27	H2	2.48	4.00	-	-	-	-	4.07	4.12	4.18
28	Y	5.50	4.00	-	-	-	-	4.08	4.14	4.20



Table C9.2 ELEVATION - AREA - VOLUME OF TO LICH RIVER BASIN (1/2)

No.	Name	Area (km <sup>2</sup> )	Σ Area (km <sup>2</sup> )	EL. min. (m,MSL)	Elevation (m,MSL)					
					4.0	5.0	6.0	7.0	8.0	9.0
1	T1	1.30	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	7.4	0.00 0	0.00 0	0.00 0	0.00 0	0.65 195	1.30 1170
2	T2	4.36	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	5.9	0.00 0	0.00 0	0.13 13	2.32 1238	4.36 4578	4.36 8938
3	T3	3.12	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	5.8	0.00 0	0.00 0	1.00 100	3.12 2160	3.12 5280	3.12 8400
4	T4	1.22	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	5.8	0.00 0	0.00 0	0.14 14	0.83 499	1.22 1524	1.22 2744
5	T5	3.30	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	5.8	0.00 0	0.00 0	1.55 155	2.50 2180	3.30 5080	3.30 8380
6	T6	2.50	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	5.9	0.00 0	0.00 0	1.42 71	2.38 1971	2.50 4411	2.50 6911
7	T7	1.06	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	5.8	0.00 0	0.00 0	0.81 81	1.06 1016	1.06 2076	1.06 3136
8	T8	2.34	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	4.0	0.00 0	0.14 70	1.23 755	2.34 2540	2.34 4880	2.34 7220
9	T9	0.80	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	4.0	0.00 0	0.21 105	0.80 610	0.80 1410	0.80 2210	0.80 3010
10	L1	2.15	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	5.9	0.00 0	0.00 0	0.81 40	2.08 1486	2.15 3601	2.15 5751
11	L2	1.75	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	5.7	0.00 0	0.00 0	1.21 182	1.75 1662	1.75 3412	1.75 5162
12	L3	0.92	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	5.7	0.00 0	0.00 0	0.83 125	0.92 1000	0.92 1920	0.92 2840
13	L4	1.05	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	5.7	0.00 0	0.00 0	0.68 102	1.05 967	1.05 2017	1.05 3067
14	L5	0.75	Σ Area (km <sup>2</sup> ) Σ Volum (10 <sup>3</sup> m <sup>3</sup> )	4.9	0.00 0	0.15 7	0.75 458	0.75 1208	0.75 1958	0.75 2708

Table C9.2 ELEVATION - AREA - VOLUME OF TO LICH RIVER BASIN (2/2)

No.	Name	Area (km <sup>2</sup> )		EL. min. (m,MSL)	Elevation (m,MSL)					
					4.0	5.0	6.0	7.0	8.0	9.0
15	L6	3.58	Σ Area (km <sup>2</sup> )	4.0	0.00	1.23	2.90	3.58	3.58	3.58
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	615	2680	5920	9500	13080
16	K1	3.47	Σ Area (km <sup>2</sup> )	6.4	0.00	0.00	0.00	0.24	1.62	3.47
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	0	0	72	1000	3542
17	K2	1.22	Σ Area (km <sup>2</sup> )	5.4	0.00	0.00	0.97	1.06	1.22	1.22
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	0	291	1306	2446	3666
18	K3	1.59	Σ Area (km <sup>2</sup> )	5.6	0.00	0.00	1.29	1.59	1.59	1.59
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	0	258	1698	3288	4878
19	K4	1.26	Σ Area (km <sup>2</sup> )	4.6	0.00	0.70	1.21	1.26	1.26	1.26
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	140	1095	2330	3590	4850
20	K5	2.77	Σ Area (km <sup>2</sup> )	4.7	0.00	1.51	2.77	2.77	2.77	2.77
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	227	2367	5137	7907	10677
21	K6	6.99	Σ Area (km <sup>2</sup> )	4.6	0.00	3.28	6.58	6.99	6.99	6.99
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	656	5586	12371	19361	26351
22	S1	2.17	Σ Area (km <sup>2</sup> )	5.9	0.00	0.00	0.55	1.79	2.17	2.17
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	0	27	1198	3178	5348
23	S2	1.99	Σ Area (km <sup>2</sup> )	5.3	0.00	0.00	0.69	1.99	1.99	1.99
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	0	242	1582	3572	5562
24	S3	1.50	Σ Area (km <sup>2</sup> )	4.6	0.00	0.67	1.50	1.50	1.50	1.50
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	134	1219	2719	4219	5719
25	S4	1.44	Σ Area (km <sup>2</sup> )	4.0	0.00	0.78	1.31	1.44	1.44	1.44
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	390	1435	2810	4250	5690
26	H1	5.62	Σ Area (km <sup>2</sup> )	4.0	0.00	3.46	5.62	5.62	5.62	5.62
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	1730	6270	11890	17510	23130
27	H2	2.48	Σ Area (km <sup>2</sup> )	4.0	0.00	2.17	2.48	2.48	2.48	2.48
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	1085	3410	5890	8370	10850
28	Y1	5.50	Σ Area (km <sup>2</sup> )	4.0	0.00	5.27	5.50	5.50	5.50	5.50
			Σ Volum (10 <sup>3</sup> m <sup>3</sup> )		0	2635	8020	13520	19020	24520

Table C9.3

**LANDSIDE WATER LEVELS OF NHUE RIVER BASIN**  
- under Future Condition (Alternative 1)-

unit : m,MSL

Basin Name	Area (km <sup>2</sup> )	EL.min. (m,MSL)	Return Period (year)						
			1.2	2	5	10	20	30	50
Co Nhue	19.7	5.2	-	-	-	-	5.62	5.85	6.04
My Dinh	13.6	4.7	-	-	-	-	5.02	5.08	5.14
Me Tri	14.7	4.7	-	-	-	-	5.02	5.07	5.13
Ba Xa	9.9	4.5	-	-	-	-	4.72	4.85	5.00

Table C9.4 ELEVATION - AREA - VOLUME OF NHUE RIVER BASIN

Name	Area (km <sup>2</sup> )	EL. min. (m,MSL)	Elevation (m,MSL)				
			4.0	5.0	6.0	7.0	8.0
Co Nhue	19.70	5.2	0.00	0.00	4.46	12.82	19.70
	$\Sigma$ Area (km <sup>2</sup> )		0	0	1784	10424	26684
	$\Sigma$ Volum (10 <sup>3</sup> m <sup>3</sup> )						
My Dinh	13.60	4.7	0.00	2.84	10.09	13.60	13.60
	$\Sigma$ Area (km <sup>2</sup> )		0	426	6891	18736	32336
	$\Sigma$ Volum (10 <sup>3</sup> m <sup>3</sup> )						
Me Tri	14.70	4.7	0.00	3.01	12.01	14.70	14.70
	$\Sigma$ Area (km <sup>2</sup> )		0	452	7962	21317	36017
	$\Sigma$ Volum (10 <sup>3</sup> m <sup>3</sup> )						
Ba Xa	9.90	4.5	0.00	3.99	8.95	9.90	9.90
	$\Sigma$ Area (km <sup>2</sup> )		0	998	7468	16893	26793
	$\Sigma$ Volum (10 <sup>3</sup> m <sup>3</sup> )						

Table C10.1 AVERAGE FLOW REGIMES

**NHUE RIVER**

Regimes		Ha Dong (downstream) 15.2k H (m,MSL)	Dong Quan (upstream) 41.0k H (m,MSL)	Thanh Liet Floodgate 19.9k H (m,MSL)	Estimated Discharge by Discharge Rating Curve Q (m <sup>3</sup> /s)
High	(95-days)	3.55	2.94	3.44	28
Normal	(185-days)	3.10	2.58	3.01	21
Low	(275-days)	2.53	2.06	2.45	13
Lowest Low	(355-days)	1.81	1.23	1.70	6

Data Period : 1989-1993 (5 years)

**RED RIVER**

Regimes		Hanoi Station <Long Bien Bridge> (m,MSL)	Yen So Site (m,MSL)
<b>Annually(365 days)</b>			
High	(95-days)	5.93	5.51
Normal	(185-days)	4.03	3.74
Low	(275-days)	3.22	3.00
Lowest Low	(355-days)	2.81	2.62
<b>Rainy Season ( May - October)</b>			
High	(46-days)	8.02	7.46
Normal	(92-days)	5.96	5.54
Low	(138-days)	4.84	4.50
Lowest Low	(174-days)	3.37	3.13
<b>Dry Season (November - April)</b>			
High	(46-days)	3.65	3.39
Normal	(91-days)	3.26	3.03
Low	(136-days)	3.01	2.80
Lowest Low	(171-days)	2.82	2.62

Data Period : 1989-1993 (5 years)

Table C10.2 ANNUAL MAXIMUM WATER LEVELS OF NHUE RIVER

<u>Ha Dong (downstream)</u>					<u>Dong Quan (upstream)</u>				
unit : m,MSL					unit : m,MSL				
Order	Year	Month	Date	Water Level	Order	Year	Month	Date	Water Level
1	1984	11	11	5.42	1	1985	9	13	4.78
2	1985	9	14	5.40	2	1983	10	7	4.57
3	1989	6	14	5.33	3	1980	8	24	4.55
4	1983	10	6	5.28	4	1984	11	12	4.55
5	1978	9	23	5.21	5	1978	9	23	4.53
6	1980	8	22	5.20	6	1989	6	15	4.35
7	1992	7	29	5.03	7	1992	7	30	4.30
8	1975	9	2	4.96	8	1975	9	3	4.22
9	1966	10	8	4.92	9	1973	9	6	4.21
10	1979	8	6	4.90	10	1971	8	31	4.20
11	1973	9	4	4.85	11	1986	6	20	4.10
12	1986	6	19	4.85	12	1979	8	6	4.06
13	1972	8	25	4.84	13	1961	7	28	3.86
14	1967	7	13	4.75	14	1963	7	26	3.84
15	1987	7	4	4.75	15	1967	7	10	3.80
16	1990	9	21	4.75	16	1962	1	9	3.80
17	1968	8	15	4.65	17	1960	6	1	3.75
18	1991	7	7	4.65	18	1972	9	2	3.75
19	1960	5	31	4.60	19	1964	10	5	3.72
20	1988	7	8	4.60	20	1965	7	25	3.71
21	1963	7	26	4.57	21	1968	8	15	3.70
22	1993	7	9	4.57	22	1966	10	8	3.69
23	1977	7	23	4.55	23	1970	6	21	3.65
24	1981	6	12	4.53	24	1987	7	4	3.64
25	1971	8	20	4.48	25	1982	8	22	3.61
26	1965	7	27	4.46	26	1977	7	24	3.60
27	1969	7	2	4.41	27	1958	10	11	3.57
28	1974	8	4	4.41	28	1974	8	4	3.57
29	1982	8	20	4.40	29	1976	10	5	3.55
30	1976	10	5	4.38	30	1990	9	22	3.54
31	1964	10	4	4.27	31	1993	7	9	3.52
32	1962	1	8	4.22	32	1991	7	10	3.51
33	1970	6	20	4.20	33	1969	7	3	3.50
34	1959	10	15	4.15	34	1988	7	8	3.43
35	1958	10	11	4.12	35	1957	9	18	3.42
36	1961	7	29	4.07	36	1981	6	10	3.40
37	1957	9	19	3.74	37	1959	10	16	3.35

Table C10.3 ANNUAL MAXIMUM WATER LEVELS OF RED RIVER AT HANOI

unit : m,MSL

Order	Year	Month	Date	Water Level	Order	Year	Month	Date	Water Level
1	1971	8	22	14.13	51	1933	7	6	10.63
2	1945	8	20	13.90	52	1953	7	7	10.60
3	1969	8	18	13.22	53	1921	9	1	10.59
4	1915	7	12	12.54	54	1935	8	13	10.49
5	1904	8	14	12.54	55	1934	7	31	10.48
6	1986	7	29	12.35	56	1984	7	16	10.48
7	1940	8	8	12.30	57	1949	7	16	10.47
8	1947	7	30	12.24	58	1958	8	19	10.42
9	1968	8	16	12.23	59	1938	7	13	10.41
10	1913	8	22	12.10	60	1959	8	3	10.38
11	1983	8	6	12.07	61	1919	7	24	10.34
12	1970	7	28	12.05	62	1902	7	17	10.33
13	1985	9	13	11.96	63	1946	8	4	10.31
14	1990	7	31	11.94	64	1951	8	7	10.28
15	1926	7	29	11.93	65	1927	8	6	10.26
16	1932	8	8	11.90	66	1960	8	17	10.23
17	1980	7	25	11.81	67	1989	6	14	10.23
18	1966	7	31	11.78	68	1975	6	19	10.22
19	1979	9	13	11.69	69	1957	7	24	10.20
20	1917	8	5	11.63	70	1914	7	23	10.20
21	1964	7	9	11.58	71	1987	8	25	10.18
22	1911	7	25	11.54	72	1922	8	15	10.15
23	1943	8	22	11.51	73	1988	9	10	10.15
24	1991	8	16	11.49	74	1920	9	20	10.13
25	1992	7	27	11.46	75	1955	8	24	10.05
26	1954	8	30	11.45	76	1912	8	25	10.03
27	1928	8	15	11.42	77	1962	7	6	9.97
28	1978	9	11	11.42	78	1972	7	29	9.97
29	1923	8	22	11.35	79	1930	8	9	9.93
30	1918	8	16	11.29	80	1974	8	8	9.92
31	1977	8	1	11.23	81	1907	10	11	9.91
32	1982	8	23	11.22	82	1910	8	18	9.90
33	1936	8	11	11.21	83	1952	8	21	9.85
34	1942	7	31	11.17	84	1906	9	27	9.84
35	1973	9	5	11.16	85	1908	6	23	9.78
36	1924	7	27	11.14	86	1925	7	29	9.75
37	1929	8	10	11.10	87	1963	8	4	9.67
38	1937	9	7	11.09	88	1965	10	29	9.63
39	1909	9	1	11.06	89	1993	8	26	9.62
40	1981	8	1	11.06	90	1903	7	14	9.60
41	1950	8	13	11.01	91	1916	10	1	9.27
42	1961	8	10	10.97	92	1931	7	31	8.80
43	1976	8	18	10.89					
44	1944	8	30	10.82					
45	1967	8	21	10.80					
46	1948	8	4	10.73					
47	1905	8	15	10.73					
48	1956	8	24	10.68					
49	1939	7	28	10.65					
50	1941	8	10	10.65					

Data Period : 1902-1993 (92 years)

Table C10.4 PROBABLE MAXIMUM WATER LEVELS

NHUE RIVER

Return Period (year)	Ha Dong (downstream) 15.2k H (m,MSL)	Dong Quan (upstream) 41.0k H (m,MSL)	Thanh Liet Floodgate 19.9k H (m,MSL)	stimated Discharge by Discharge Rating Curve Q (m3/s)
100	6.07	5.25	5.92	91
50	5.83	5.01	5.68	83
30	5.65	4.84	5.50	78
20	5.50	4.69	5.36	74
10	5.25	4.45	5.11	66
5	4.99	4.19	4.85	59
2	4.60	3.80	4.46	50
1.2	4.27	3.47	4.12	42

Data Period : 1957-1993 (37 years)

RED RIVER

Return Period (year)	Hanoi Station Long Bien Bridge> (m,MSL)	Yen So Site (m,MSL)
100	14.17	13.18
50	13.61	12.65
30	13.19	12.27
20	12.86	11.96
10	12.28	11.42
5	11.67	10.85
2	10.76	10.00
1.2	9.99	9.29

Data Period : 1902-1993 (92 years)

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