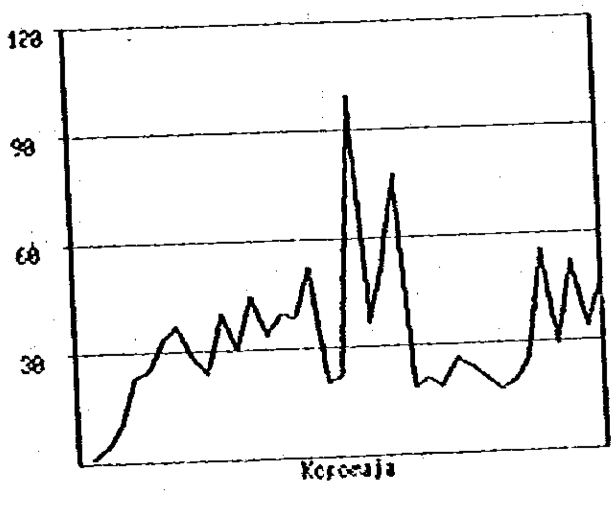
Table I-20 Estimated Discharge (Tank Model) (1 /15)

Place Kopoeaja

Year 1964

MONTH	RAIN	I	H1	H2	I	H1	H2	Q	Est.Q
OCT-1	4.6	4.6	14.6	11.6	2.9	22.9	20.6	0.3	1.08
OCT-2	6.6	6.6	18.2	13.6	3.6	24.3	21.9	1.2	4.12
OCT-3	9.2	9.2	22.8	16.1	4.6	26.4	23.3	2.9	10.24
NOV-1	16.0	16.0	32.0	21.0	6.4	29.7	25.1	6.5	23.01
NOV-2	10.4	10.4	31.4	20.6	6.3	31.4	26.0	7.0	24.52
NOV-3	13.7	13.7	34.3	21.0	6.9	32.9	26.9	9.5	33.55
DEC-1	13.8	13.8	34.8	20.8	7.0	33.8	27.4	10.4	36.75
DEC-2	11.1	11.1	31.8	20.9	6.4	33.7	27.3	7.9	27.95
DEC-3	7.4	7.4	28.3	19.0	5.7	33.0	26.9	6.7	23.75
JAN-1	16.4	16.4	35.4	20.5	7.1	34.0	27.5	11.3	39.77
JAN-2	12.6	12.6	33.1	21.5	6.6	34.1	27.5	8.5	29.79
JAN-3	14.8	14.8	36.3	20.2	7.3	34.8	27.9	12.7	44.51
FEB-1	13.8	13.8	33.9	21.1	6.8	34.7	27.8	9.7	34.21
FEB-2	13.9	13.9	35.1	20.7	7.0	34.9	27.9	11.2	39.25
FEB-3	14.2	14.2	34.8	20.8	7.0	34.9	28.0	10.9	38.41
MAR-1	17.0	17.0	37.8	19.5	7.6	35.5	28.3	14.7	51.82
MAR-2	5.3	5.3	24.8	17.2	5.0	33.3	27.1	5.9	20.83
MAR-3	10.2	10.2	27.4	18.5	5.5	32.5	26.7	6.3	22.26
APR-1	30.1	30.1	48.6	15.0	9.7	36.4	28.8	28.2	99.28
APR-2	19.1	19.1	34.2	21.0	6.8	35.6	28.4	10.3	36.34
APR-3	16.8	16.8	37.8	19.5	7.6	35.9	28.5	14.9	52.35
MAY-1	23.8	23.8	43.3	17.2	8.7	37.2	27.2	22.0	77.57
MAY-2	4.5	4.5	21.8	15.5	4.4	33.6	27.2	5.2	18.37
MAY-3	10.6	10.6	26.1	17.8	5.2	32.5	26.6	6.0	20.96
JUN-1	6.8	6.8	24.6	17.0	4.9	31.5	26.1	5.2	18.42
JUN-2	14.5	14.5	31.5	20.7	6.3	32.4	26.6	7.4	25.98
JUN-3	8.3	8.3	29.0	19.4	5.8	32.4	26.6	6.7	23.67
JUL-1	6.9	6.9	26.3	18.0	5.3	31.9	26.3	5.8	20.44
JUL-2	5.9	5.9	23.9	16.6	4.8	31.1	25.9	4.9	17.12
JUL-3	9.8	9.8	26.4	18.0	5.3	31.1	25.9	5.6	19.60
AUG-1	13.5	13.5	31.5	20.7	6.3	32.2	26.5	7.3	25.63
AUG-2	18.3	18.3	39.0	19.0	7.8	34.3	27.6	15.8	55.46
AUG-3	13.5	13.5	32.5	21.3	6.5	34.1	27.5	8.3	29.09
SEP-1	16.6	16.6	37.9	19.5	7.6	35.1	28.1	14.7	51.80
SEP-2	14.4	14.4	33.8	21.7	6.8	34.9	27.9	9.7	34.05
SEP-3	15.3	15.3	36.5	20.1	7.3	35.2	28.2	13.0	45.78

Rainfall= 4543 Discharge= 3374



Place Kopomaja

Year 1965

MONTH	RAIN	E	H1	H2	E	H1	H2	Q	Est.Q
OCT-1	15.4	15.4	35.5	20.5	7.1	35.3	28.2	11.8	41.61
OCT-2	20.8	20.8	41.3	18.1	8.3	36.4	28.8	19.3	67.83
OCT-3	11.9	11.9	33.0	21.5	6.6	35.4	28.2	8.8	31.13
NOV-1	6.8	6.8	28.4	19.0	5.7	33.9	27.4	7.1	24.92
NOV-2	13.1	13.1	32.2	21.1	6.4	33.9	27.4	8.1	28.40
NOV-3	13.2	13.2	34.3	21.0	6.9	34.3	27.6	10.0	35.31
DEC-1	9.0	9.0	29.9	19.9	6.0	33.6	27.2	7.4	26.00
DEC-2	16.4	16.4	36.3	20.1	7.3	34.5	27.8	12.6	44.24
DEC-3	7.6	7.6	27.7	18.7	5.5	33.3	27.1	6.7	23.56
JAN-1	22.3	22.3	41.0	18.2	8.2	35.3	28.2	18.5	65.11
JAN-2	8.6	8.6	26.8	18.2	5.4	33.5	27.2	6.5	23.01
JAN-3	10.1	10.1	28.4	19.0	5.7	32.9	26.9	6.7	23.63
FEB-1	8.1	8.1	27.2	18.4	5.4	32.3	26.5	6.2	21.75
FEB-2	21.3	21.3	39.7	18.7	7.9	34.5	27.7	16.7	58.70
FEB-3	19.4	19.4	38.1	19.8	7.6	35.4	28.2	15.1	53.01
MAR-1	9.1	9.1	28.5	19.1	5.7	33.9	27.4	7.1	25.10
MAR-2	10.0	10.0	29.1	19.4	5.8	33.2	27.1	7.0	24.77
MAR-3	3.0	3.0	22.5	15.9	4.5	31.6	26.1	4.7	16.44
APR-1	14.0	14.0	29.9	19.9	6.0	32.1	26.4	6.8	24.04
APR-2	6.9	6.9	26.7	18.2	5.3	31.8	26.2	5.9	20.69
APR-3	6.4	6.4	24.6	17.9	4.9	31.2	25.9	5.1	17.93
MAY-1	23.2	23.2	40.2	18.5	8.0	33.9	27.4	17.1	60.02
MAY-2	13.5	13.5	32.1	21.0	6.4	33.9	27.4	8.1	28.33
MAY-3	18.5	18.5	39.6	18.8	7.9	35.3	28.2	16.8	59.06
JUN-1	17.1	17.1	35.9	20.3	7.2	35.4	28.2	12.4	43.50
JUN-2	9.1	9.1	29.4	19.6	5.9	34.1	27.5	7.4	26.11
JUN-3	15.6	15.6	35.2	20.6	7.0	34.6	27.8	11.2	39.52
JUL-1	10.4	10.4	31.0	20.5	6.2	34.0	27.5	7.8	27.53
JUL-2	3.2	3.2	23.7	16.5	4.7	32.2	26.5	5.2	18.42
JUL-3	3.3	3.3	19.9	14.5	4.0	30.5	25.5	3.6	12.64
AUG-1	3.0	3.0	17.5	13.2	3.5	29.0	24.7	2.4	8.61
AUG-2	5.8	5.8	19.0	14.1	3.8	28.5	24.5	2.7	9.42
AUG-3	2.1	2.1	16.1	12.5	3.2	27.7	24.0	1.6	5.64
SEP-1	1.1	1.1	13.6	10.8	2.7	26.7	23.5	0.9	3.28
SEP-2	5.9	5.9	16.7	12.8	3.3	26.8	23.5	1.4	5.05
SEP-3	2.5	2.5	15.3	12.1	3.1	26.6	23.4	1.0	3.45

Rainfall= 3930 Discharge= 2997

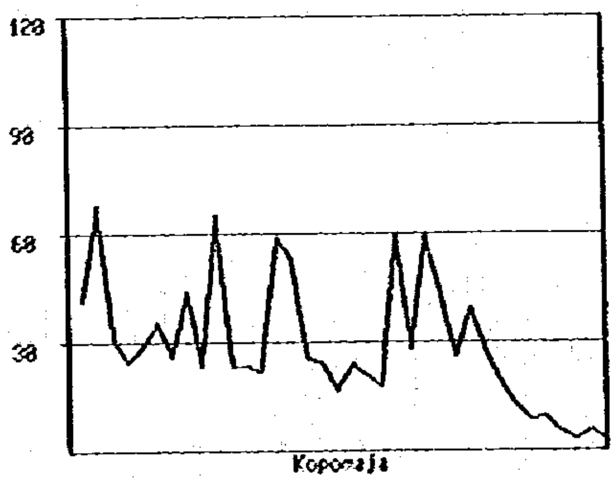


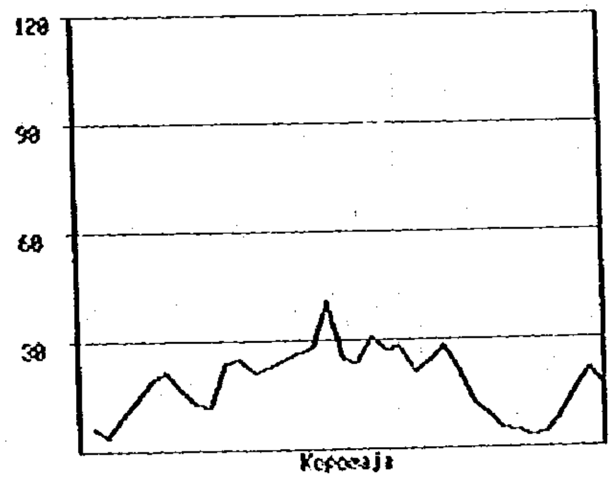
Table I-20 Estimated Discharge (Tank Model)(3/15)

Place Koponaja

Year 1966

MONTH	RAIN	1	H1	H2	1	H1	H2	Q	Est.Q
OCT-1	5.7	5.7	17.8	13.4	3.6	27.0	23.6	1.8	6.27
OCT-2	2.4	2.4	15.8	12.3	3.2	26.8	23.5	1.2	4.19
OCT-3	8.0	8.0	20.4	14.8	4.1	27.6	23.9	2.7	9.44
NOV-1	9.2	9.2	23.9	16.7	4.8	28.7	24.6	4.0	14.22
NOV-2	10.9	10.9	27.6	18.6	5.5	30.1	25.3	5.5	19.38
NOV-3	10.0	10.0	28.7	19.2	5.7	31.1	25.9	6.1	21.61
DEC-1	4.7	4.7	23.9	16.6	4.8	30.6	25.6	4.7	16.58
DEC-2	4.2	4.2	20.8	15.0	4.2	29.8	25.2	3.6	12.69
DEC-3	5.9	5.9	20.9	15.0	4.2	29.3	24.9	3.4	12.14
JAN-1	16.1	16.1	31.2	20.5	6.2	31.1	25.9	6.8	24.01
JAN-2	10.2	10.2	30.7	20.3	6.1	32.0	26.4	7.0	24.72
JAN-3	6.9	6.9	27.1	18.4	5.4	31.8	26.3	6.0	21.14
FEB-1	10.3	10.3	28.7	19.2	5.7	32.0	26.4	6.5	22.80
FEB-2	10.7	10.7	29.9	19.9	6.0	32.4	26.6	6.9	24.37
FEB-3	11.9	11.9	31.8	20.9	6.4	32.9	26.9	7.6	26.86
MAR-1	11.8	11.8	32.7	21.4	6.5	33.4	27.1	8.0	28.31
MAR-2	14.2	14.2	35.6	20.5	7.1	34.3	27.6	11.5	40.69
MAR-3	8.1	8.1	28.6	19.2	5.7	33.3	27.1	6.9	24.38
APR-1	9.7	9.7	28.9	19.3	5.8	32.9	26.9	6.8	24.09
APR-2	14.2	14.2	33.5	21.3	6.7	33.5	27.2	8.8	30.84
APR-3	9.9	9.9	31.2	20.6	6.2	33.5	27.2	7.7	27.06
MAY-1	11.3	11.3	31.9	20.9	6.4	33.6	27.2	7.9	27.74
MAY-2	5.7	5.7	26.6	18.1	5.3	32.5	26.7	6.1	21.52
MAY-3	11.4	11.4	29.5	19.6	5.9	32.6	26.7	6.9	24.25
JUN-1	12.9	12.9	32.5	21.3	6.5	33.2	27.0	7.9	27.88
JUN-2	6.0	6.0	27.3	18.5	5.5	32.5	26.6	6.3	22.13
JUN-3	1.4	1.4	19.9	14.5	4.0	30.6	25.6	3.7	12.88
JUL-1	3.4	3.4	17.9	13.4	3.6	29.2	24.8	2.6	9.17
JUL-2	1.9	1.9	15.4	12.1	3.1	27.9	24.1	1.5	5.18
JUL-3	3.4	3.4	15.5	12.2	3.1	27.2	23.7	1.3	4.45
AUG-1	1.7	1.7	13.9	11.0	2.8	26.5	23.4	0.9	3.04
AUG-2	4.7	4.7	15.7	12.3	3.1	26.5	23.3	1.1	3.70
AUG-3	7.4	7.4	19.7	14.4	3.9	27.3	23.8	2.4	8.44
SEP-1	11.2	11.2	25.6	17.6	5.1	28.9	24.7	4.5	15.98
SEP-2	11.6	11.6	29.2	19.5	5.8	30.5	25.5	6.1	21.34
SEP-3	5.6	5.6	25.1	17.3	5.0	30.6	25.6	5.0	17.43

Rainfall= 2973 Discharge= 1693



Place Kopomaja

Year 1987

MONTH	RAIN	I	H1	H2	I	H1	H2	Q	Est.Q
OCT-1	13.3	13.3	30.6	20.7	6.1	31.7	26.2	4.9	24.19
OCT-2	11.0	11.0	31.2	20.6	6.2	32.5	26.6	7.3	25.77
OCT-3	16.7	16.7	37.3	19.7	7.5	34.1	27.5	13.6	47.81
NOV-1	10.2	10.2	30.0	19.9	6.0	33.5	27.2	7.4	25.93
NOV-2	9.7	9.7	29.6	19.7	5.9	33.1	27.0	7.1	25.04
NOV-3	3.5	3.5	23.2	16.3	4.6	31.6	26.2	4.9	17.16
DEC-1	12.3	12.3	28.6	19.1	5.7	31.9	26.3	6.4	22.52
DEC-2	5.5	5.5	24.6	17.0	4.9	31.2	25.9	5.1	18.04
DEC-3	3.1	3.1	20.1	14.6	4.0	30.0	25.2	3.5	12.22
JAN-1	6.7	6.7	21.3	15.3	4.3	29.5	25.0	3.6	12.77
JAN-2	8.8	8.8	24.0	16.7	4.8	29.8	25.2	4.5	15.69
JAN-3	11.8	11.8	28.5	19.1	5.7	30.9	25.7	6.0	21.22
FEB-1	18.4	18.4	37.6	19.6	7.5	33.3	27.1	13.6	47.97
FEB-2	4.9	4.9	24.5	17.0	4.9	32.0	26.4	5.4	18.87
FEB-3	9.4	9.4	26.4	18.0	5.3	31.6	26.2	5.7	20.16
MAR-1	16.2	16.2	34.2	21.0	6.8	33.0	26.9	9.4	33.10
MAR-2	0.1	0.1	21.7	15.2	4.2	31.2	25.9	4.2	14.76
MAR-3	18.5	18.5	33.7	21.2	6.7	32.6	26.7	8.7	30.52
APR-1	9.8	9.8	31.1	20.5	6.2	32.9	26.9	7.4	26.23
APR-2	22.9	22.9	43.4	17.2	8.7	35.6	28.3	21.6	75.94
APR-3	12.0	12.0	29.2	19.5	5.8	34.2	27.6	7.4	26.08
MAY-1	7.4	7.4	26.9	18.2	5.4	32.9	26.9	6.3	22.31
MAY-2	12.9	12.9	31.1	20.5	6.7	33.1	27.0	7.5	26.49
MAY-3	5.3	5.3	25.8	17.7	5.2	32.1	26.5	5.8	20.31
JUN-1	1.7	1.7	19.4	14.2	3.9	30.3	25.4	3.4	11.99
JUN-2	0.0	0.0	14.3	11.3	2.9	28.3	24.3	1.5	5.32
JUN-3	5.8	5.8	17.1	13.0	3.4	27.8	24.0	1.9	6.69
JUL-1	1.3	1.3	14.3	11.3	2.9	26.9	23.6	1.0	3.54
JUL-2	1.5	1.5	12.8	10.2	2.6	26.1	23.1	0.7	2.49
JUL-3	2.1	2.1	12.3	9.7	2.5	25.6	22.8	0.5	1.78
AUG-1	0.1	0.1	9.9	7.9	2.0	24.8	22.4	0.3	0.99
AUG-2	3.5	3.5	11.4	9.1	2.3	24.6	22.2	0.3	0.97
AUG-3	1.3	1.3	10.4	8.3	2.1	24.3	21.9	0.3	0.91
SEP-1	0.6	0.6	8.9	7.1	1.8	23.6	21.3	0.2	0.81
SEP-2	0.5	0.5	7.6	6.1	1.5	22.8	20.6	0.2	0.73
SEP-3	9.1	9.1	15.2	12.0	3.0	23.6	21.3	0.4	1.31

Rainfall= 2818 Discharge= 1926

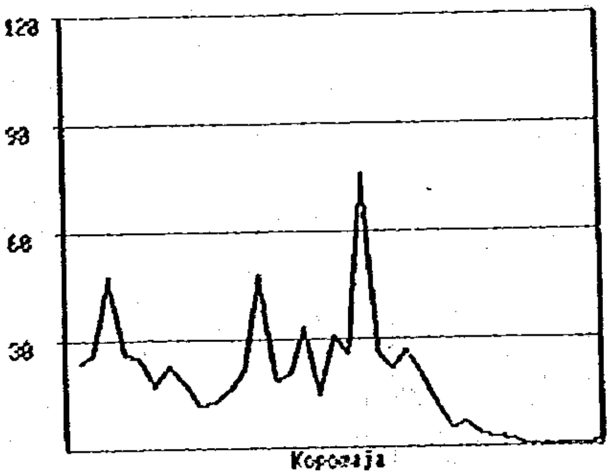


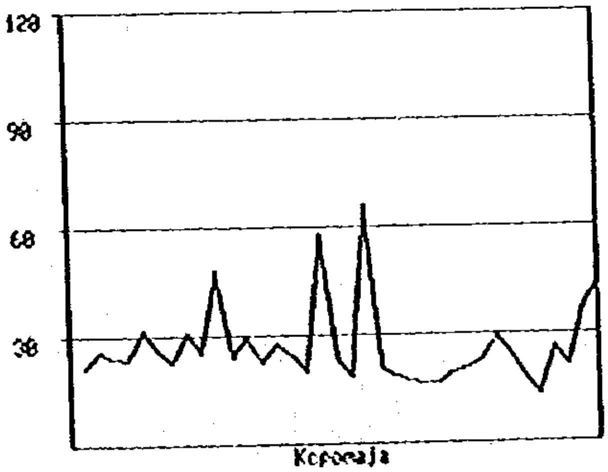
Table I-20 Estimated Discharge (Tank Model)(5/15)

Place Kopoaja

Year 1968

MONTH	RAIN	S	H1	H2	S	H1	H2	Q	Est.Q
OCT-1	20.6	20.6	32.6	21.3	6.5	27.8	24.1	6.0	21.21
OCT-2	11.6	11.6	32.9	21.5	6.6	30.7	25.6	7.1	25.02
OCT-3	8.9	8.9	30.4	20.1	6.1	31.7	26.2	6.8	24.01
NOV-1	9.1	9.1	29.2	19.5	5.8	32.0	26.4	6.6	23.35
NOV-2	14.3	14.3	33.8	21.2	6.8	33.1	27.0	9.0	31.50
NOV-3	9.2	9.2	30.4	20.1	6.1	33.1	27.0	7.3	25.79
DEC-1	7.9	7.9	28.1	18.9	5.6	32.6	26.7	6.5	22.98
DEC-2	14.6	14.6	33.5	21.3	6.7	33.4	27.1	8.7	30.61
DEC-3	8.4	8.4	29.7	19.8	5.9	33.1	27.0	7.2	25.16
JAN-1	17.5	17.5	37.3	19.7	7.5	34.4	27.7	13.7	48.30
JAN-2	8.6	8.6	28.4	19.0	5.7	33.4	27.1	6.9	24.24
JAN-3	13.9	13.9	33.0	21.5	6.6	33.7	27.3	8.2	29.09
FEB-1	6.0	6.0	27.6	18.6	5.5	32.8	26.8	6.5	22.81
FEB-2	13.6	13.6	32.2	21.1	6.4	33.3	27.1	7.9	27.88
FEB-3	8.1	8.1	29.2	19.5	5.8	32.9	26.9	6.9	24.44
MAR-1	6.1	6.1	25.6	17.6	5.1	32.0	26.4	5.7	19.96
MAR-2	22.1	22.1	39.7	18.8	7.9	34.3	27.6	16.6	58.33
MAR-3	8.7	8.7	27.5	18.6	5.5	33.1	27.0	6.6	23.09
APR-1	6.0	6.0	24.6	17.0	4.9	31.9	26.3	5.4	18.84
APR-2	24.4	24.4	41.4	18.0	8.3	34.6	27.8	18.8	65.98
APR-3	7.3	7.3	25.3	17.4	5.1	32.9	26.8	5.9	20.79
MAY-1	7.3	7.3	24.7	17.1	4.9	31.8	26.3	5.4	18.88
MAY-2	7.2	7.2	24.3	16.9	4.9	31.1	25.9	5.0	17.59
MAY-3	7.1	7.1	24.0	16.7	4.8	30.7	25.6	4.8	16.72
JUN-1	7.5	7.5	24.2	16.8	4.8	30.5	25.5	4.7	16.66
JUN-2	9.5	9.5	26.3	18.0	5.3	30.8	25.7	5.4	19.07
JUN-3	9.6	9.6	27.5	18.6	5.5	31.2	25.9	5.9	20.71
JUL-1	10.3	10.3	28.9	19.3	5.8	31.7	26.2	6.4	22.63
JUL-2	14.0	14.0	33.3	21.4	6.7	32.9	26.9	8.4	29.42
JUL-3	8.5	8.5	29.9	19.9	6.0	32.8	26.8	7.1	24.96
AUG-1	3.9	3.9	23.8	16.6	4.8	31.6	26.1	5.0	17.72
AUG-2	4.3	4.3	20.9	15.1	4.2	30.3	25.4	3.8	13.42
AUG-3	17.2	17.2	32.2	21.1	6.4	31.9	26.3	7.4	25.98
SEP-1	6.5	6.5	27.6	18.6	5.5	31.8	26.3	6.1	21.57
SEP-2	16.7	16.7	35.3	20.6	7.1	33.3	27.1	10.9	38.32
SEP-3	15.6	15.6	36.2	20.2	7.2	34.3	27.7	12.4	43.54

Rainfall= 3978 Discharge= 2763



Kopoaja

Table I-20 Estimated Discharge (Tank Model)(6/15)

Place Kopcmaja

Year 1969

MONTH	RAIN	E	H1	H2	E	H1	H2	Q	Est.Q
OCT-1	11.8	11.8	31.9	20.9	6.4	34.1	27.5	8.1	28.44
OCT-2	10.8	10.8	31.7	20.8	6.3	33.9	27.4	7.9	27.96
OCT-3	15.8	15.8	36.7	20.0	7.3	34.7	27.9	13.1	45.94
NOV-1	12.8	12.8	32.8	21.4	6.6	34.4	27.7	8.4	29.72
NOV-2	11.1	11.1	32.5	21.2	6.5	34.2	27.6	8.3	29.13
NOV-3	10.1	10.1	31.4	20.7	6.3	33.9	27.4	7.9	27.65
DEC-1	21.4	21.4	47.1	17.8	8.4	35.8	28.5	20.0	70.34
DEC-2	9.6	9.6	27.3	18.5	5.5	33.9	27.4	6.8	23.98
DEC-3	14.3	14.3	32.8	21.4	6.6	34.0	27.5	8.3	29.14
JAN-1	3.0	3.0	24.4	16.9	4.9	32.3	26.6	5.5	19.25
JAN-2	17.1	17.1	34.1	21.1	6.8	33.4	27.1	9.4	33.13
JAN-3	12.0	12.0	33.1	21.5	6.6	33.7	27.3	8.4	29.47
FEB-1	6.5	6.5	28.0	18.9	5.6	32.9	26.9	6.6	23.37
FEB-2	10.4	10.4	29.3	19.5	5.9	32.7	26.8	6.9	24.28
FEB-3	3.4	3.4	22.9	16.1	4.6	31.4	26.0	4.7	16.60
MAR-1	2.3	2.3	18.4	13.7	3.7	29.7	25.1	2.9	10.30
MAR-2	18.2	18.2	31.9	21.0	6.4	31.5	26.1	7.2	25.19
MAR-3	11.1	11.1	32.0	21.0	6.4	32.5	26.6	7.5	26.53
APR-1	21.2	21.2	47.2	17.7	8.4	35.1	28.1	20.0	70.22
APR-2	13.7	13.7	31.4	20.7	6.3	34.3	27.7	8.0	28.30
APR-3	14.1	14.1	34.8	20.8	7.0	34.6	27.8	10.7	37.68
MAY-1	21.2	21.2	42.0	17.8	8.4	36.2	28.7	20.1	70.69
MAY-2	17.7	17.7	35.5	20.5	7.1	35.8	28.5	12.1	42.42
MAY-3	8.7	8.7	29.2	19.5	5.8	34.3	27.6	7.4	26.20
JUN-1	9.1	9.1	28.6	19.2	5.7	33.3	27.1	6.9	24.41
JUN-2	3.5	3.5	22.7	16.0	4.5	31.6	26.2	4.8	16.73
JUN-3	2.5	2.5	18.5	13.8	3.7	29.9	25.2	3.0	10.58
JUL-1	18.1	18.1	31.8	20.9	6.4	31.6	26.1	7.2	25.16
JUL-2	5.8	5.8	26.7	18.1	5.3	31.5	26.1	5.8	20.24
JUL-3	1.4	1.4	19.5	14.3	3.9	30.0	25.3	3.3	11.68
AUG-1	0.1	0.1	14.4	11.4	2.9	28.1	24.2	1.5	5.11
AUG-2	4.0	4.0	15.4	12.1	3.1	27.3	23.8	1.3	4.46
AUG-3	3.9	3.9	16.0	12.5	3.2	27.0	23.6	1.3	4.68
SEP-1	11.6	11.6	24.1	16.7	4.8	28.4	24.4	4.0	13.96
SEP-2	15.1	15.1	31.9	20.9	6.4	30.8	25.7	6.9	24.22
SEP-3	5.0	5.0	25.9	17.7	5.2	30.9	25.8	5.3	18.80

Rainfall= 3814 Discharge= 2814

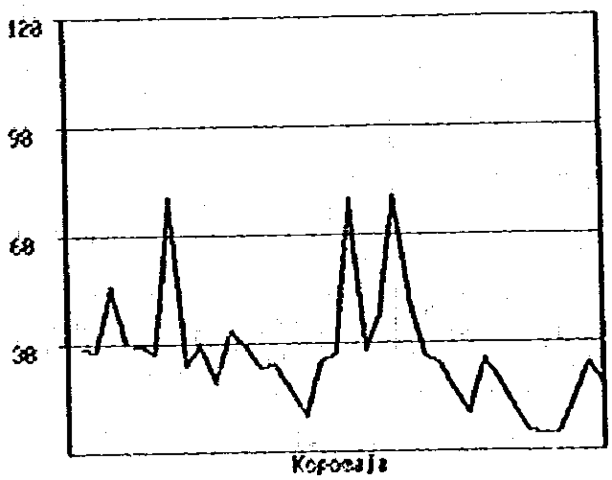


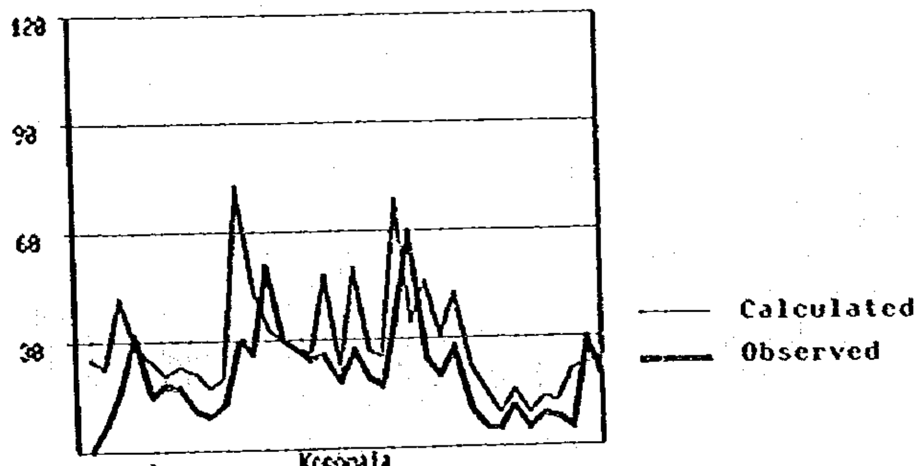
Table I-20 Estimated Discharge (Tank Model)(7/15)

Place Kopcnaja
Year 1970

INPUT FACTOR---------
Watershed 304 Km2
Percolation Ratio 1 0.200 2 0.030
First Water Depth 1 17.7 2 25.8
Hole Depth (1 1) 33.00 (1 2) 15.00 (1 3) 8.00 (2 1) 25.00 (2 2) 2.00
Hole Ratio (1 1) 0.9500 (1 2) 0.2500 (1 3) 0.0150 (2 1) 0.3500 (2 2) 0.0100

NO	RAIN	I	H1	H2	I	H1	H2	Q	Est.Q	Obs.Q
1	13.0	13.0	30.7	20.3	6.1	31.9	26.3	7.0	21.58	0.00
2	8.0	8.0	28.3	19.0	5.7	32.0	26.4	6.4	22.40	6.83
3	17.1	17.1	36.0	20.3	7.2	33.6	27.2	11.9	41.84	16.47
4	12.4	12.4	32.6	21.3	6.5	33.8	27.3	8.2	28.70	31.68
5	7.6	7.6	28.9	19.3	5.8	33.1	27.0	6.9	24.42	15.16
6	6.8	6.8	26.2	17.9	5.2	32.2	26.5	5.9	20.72	17.72
7	10.7	10.7	28.5	19.1	5.7	32.2	26.5	6.5	22.90	17.39
8	8.0	8.0	27.2	18.4	5.4	31.9	26.3	6.0	21.28	10.92
9	5.5	5.5	23.9	16.7	4.8	31.1	25.9	4.9	17.20	9.17
10	9.3	9.3	25.9	17.7	5.2	31.1	25.9	5.4	19.65	11.93
11	25.3	25.3	43.0	17.4	8.6	34.5	27.7	20.7	72.71	29.83
12	19.0	19.0	36.4	20.1	7.3	35.0	28.0	12.8	45.21	25.82
13	13.5	13.5	33.7	21.3	6.7	34.8	27.9	9.4	33.09	51.00
14	11.5	11.5	32.8	21.4	6.6	34.4	27.7	8.4	29.71	29.35
15	9.8	9.8	31.2	20.6	6.2	34.0	27.4	7.9	27.66	27.06
16	10.1	10.1	30.7	20.3	6.1	33.6	27.2	7.6	26.69	25.00
17	16.8	16.8	37.1	19.8	7.4	34.7	27.8	13.6	47.83	25.14
18	5.8	5.8	25.6	17.6	5.1	33.0	26.9	6.0	21.20	17.83
19	20.1	20.1	37.7	19.6	7.5	34.4	27.7	14.3	50.15	27.65
20	10.8	10.8	30.3	20.1	6.1	33.8	27.3	7.6	26.59	18.41
21	9.4	9.4	29.5	19.6	5.9	33.2	27.1	7.1	25.14	16.78
22	22.1	22.1	41.8	17.9	8.4	35.4	28.2	19.5	68.63	36.08
23	16.0	16.0	33.9	21.1	6.8	35.0	28.0	9.8	34.63	59.31
24	15.4	15.4	36.5	20.1	7.3	35.3	28.2	13.1	45.12	24.75
25	13.0	13.0	33.1	21.5	6.6	34.8	27.9	8.8	30.65	19.14
26	14.4	14.4	35.8	20.3	7.2	35.1	28.1	12.2	42.93	28.23
27	6.4	6.4	26.7	18.2	5.3	33.4	27.1	6.5	22.77	10.23
28	3.2	3.2	21.4	15.3	4.3	31.4	26.1	4.3	15.28	5.66
29	2.4	2.4	17.7	13.3	3.5	29.6	25.0	2.7	9.53	5.31
30	10.2	10.2	23.6	16.5	4.7	29.8	25.1	4.3	15.20	11.27
31	2.0	2.0	18.5	13.8	3.7	28.8	24.6	2.7	9.32	5.20
32	8.9	8.9	22.7	16.0	4.5	29.2	24.8	3.9	13.64	8.48
33	5.7	5.7	21.7	15.5	4.3	29.2	24.8	3.6	12.74	7.76
34	13.3	13.3	28.8	19.3	5.8	30.6	25.6	6.0	21.06	5.96
35	10.1	10.1	29.4	19.6	5.9	31.5	26.1	6.5	22.74	29.69
36	10.1	10.1	29.7	19.8	5.9	32.0	26.4	6.8	23.76	19.93

Rainfall= 4098 Discharge= 2692



TableⅠ-20 Estimated Discharge (Tank Model)(8/15)

Place Kopcmaja
Year 1971

INPUT FACTOR---------
Watershed 304 Km2
Percolation Ratio 1 0.200 2 0.090
First Water Depth 1 19.8 2 26.4
Hole Depth (1 1) 33.00 (1 2) 15.00 (1 3) 8.00 (2 1) 25.00 (2 2) 2.00
Hole Ratio (1 1) 0.9500 (1 2) 0.2500 (1 3) 0.0150 (2 1) 0.3500 (2 2) 0.0100

NO	RAIN	I	H1	H2	I	H1	H2	Q	Est.Q	Obs.Q
1	11.3	11.3	31.1	20.5	6.2	32.6	26.7	7.3	25.80	7.35
2	3.9	3.9	24.4	16.9	4.9	31.6	26.1	5.2	18.27	5.98
3	13.3	13.3	30.2	20.0	6.0	32.2	26.5	7.0	24.48	8.59
4	18.8	18.8	38.9	19.1	7.8	34.2	27.6	15.6	54.82	21.75
5	23.1	23.1	42.1	17.7	8.4	36.0	28.6	20.2	71.03	34.63
6	12.6	12.6	30.3	20.1	6.1	34.7	27.8	7.9	27.70	29.98
7	3.2	3.2	23.3	16.3	4.7	32.5	26.6	5.2	18.43	9.12
8	5.7	5.7	22.0	15.6	4.4	31.0	25.8	4.4	15.36	6.71
9	15.3	15.3	31.0	20.4	6.2	32.0	26.4	7.1	24.96	25.99
10	6.8	6.8	21.3	18.5	5.5	31.8	26.3	6.0	21.29	15.13
11	14.7	14.7	33.1	21.5	6.6	32.9	26.9	8.1	28.58	31.97
12	5.7	5.7	27.1	18.4	5.4	32.3	26.5	6.2	21.74	17.31
13	18.7	18.7	37.1	19.8	7.4	34.0	27.4	13.3	45.88	54.68
14	15.0	15.0	34.8	20.8	7.9	34.4	27.7	10.7	37.57	69.51
15	6.0	6.0	26.8	18.2	5.4	33.1	26.9	6.4	22.39	16.93
16	5.9	5.9	24.1	16.8	4.8	31.8	26.2	5.2	18.27	12.41
17	13.0	13.0	29.8	19.8	6.0	32.2	26.5	6.9	24.11	37.07
18	7.9	7.9	27.7	18.7	5.5	32.0	26.4	6.2	21.92	23.55
19	8.8	8.8	27.5	18.6	5.5	31.9	26.3	6.1	21.57	27.46
20	4.4	4.4	22.9	16.1	4.6	30.9	25.8	4.6	16.06	29.70
21	6.4	6.4	22.5	15.9	4.5	30.3	25.4	4.2	14.89	28.65
22	3.0	3.0	18.9	14.0	3.8	29.2	24.8	2.9	10.15	20.70
23	8.9	8.9	22.9	16.1	4.6	29.4	24.9	4.0	14.12	13.56
24	7.8	7.8	23.9	16.7	4.8	29.7	25.1	4.4	15.49	15.41
25	7.8	7.8	24.5	17.0	4.9	30.0	25.3	4.6	16.35	14.95
26	8.8	8.8	25.7	17.6	5.1	30.4	25.5	5.1	18.04	18.17
27	9.3	9.3	26.9	18.3	5.4	30.9	25.8	5.6	19.71	21.74
28	4.1	4.1	22.4	15.9	4.5	30.2	25.4	4.2	14.70	15.28
29	3.0	3.0	18.8	13.9	3.8	29.2	24.8	2.8	10.03	19.16
30	0.8	0.8	14.7	11.7	2.9	27.8	24.0	1.3	4.65	6.53
31	7.9	7.9	19.6	14.4	3.9	28.0	24.1	2.6	9.24	11.00
32	10.1	10.1	24.5	17.0	4.9	29.0	24.7	4.3	15.15	18.62
33	11.1	11.1	28.1	18.9	5.6	30.4	25.5	5.7	20.21	13.07
34	8.1	8.1	27.0	18.3	5.4	30.9	25.8	5.6	19.84	8.55
35	7.6	7.6	25.9	17.7	5.2	30.9	25.8	5.4	18.87	4.17
36	4.2	4.2	22.0	15.6	4.4	30.2	25.4	4.0	14.22	6.24

Rainfall= 3280 Discharge= 2290

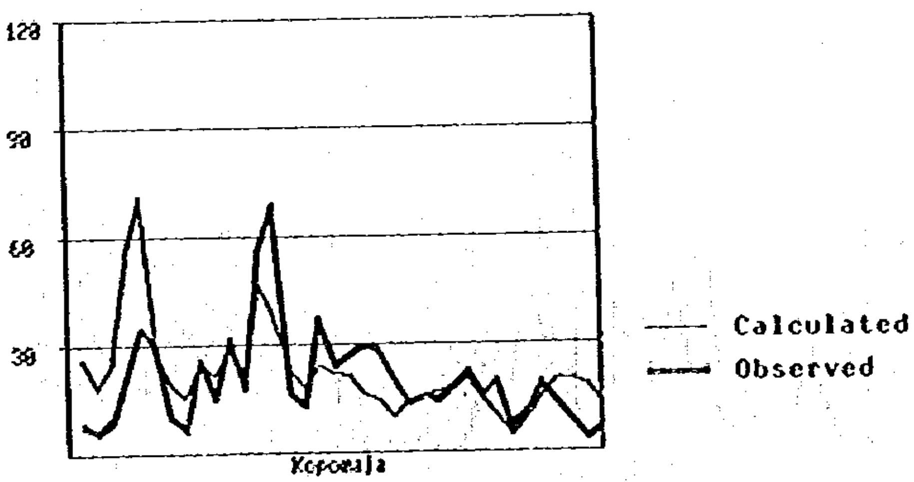


Table I-20 Estimated Discharge (Tank Model)(9/15)

Place Kopcaaja
Year 1972

INPUT FACTOR---------

Watershed	304	Km2									
Percolation Ratio	1	0.200	2	0.030							
First Water Depth	1	10.0	2	20.0							
Hole Depth	(1 1)	33.00	(1 2)	15.00	(1 3)	8.00	(2 1)	25.00	(2 2)	2.00	
Hole Ratio	(1 1)	0.9500	(1 2)	0.2500	(1 3)	0.0150	(2 1)	0.3500	(2 2)	0.0100	

NO	RAIN	I	H1	H2	E	H1	H2	Q	Est.Q	Obs.Q
1	6.5	6.5	16.5	12.7	3.3	23.3	21.0	0.7	2.56	9.10
2	19.4	19.4	37.2	21.1	6.4	27.4	23.9	5.8	20.25	13.70
3	17.7	17.7	38.8	19.1	7.8	31.6	26.2	14.5	51.07	54.64
4	9.2	9.2	28.3	19.0	5.7	31.8	26.3	6.3	22.22	12.60
5	12.1	12.1	31.1	20.5	6.2	32.5	26.6	7.3	25.69	17.40
6	6.5	6.5	27.0	18.3	5.4	32.0	26.4	6.1	21.30	12.10
7	11.8	11.8	30.1	20.0	6.0	32.4	26.6	7.0	24.68	23.70
8	9.3	9.3	29.2	19.5	5.8	32.4	26.6	6.8	23.99	13.50
9	12.6	12.6	32.1	21.0	6.4	33.0	26.9	7.8	27.30	20.55
10	16.2	16.2	37.2	19.8	7.4	34.4	27.7	13.6	47.99	47.50
11	20.9	20.9	40.6	18.4	8.1	35.8	28.5	18.3	64.34	67.10
12	20.5	20.5	38.9	19.1	7.8	36.2	28.7	16.3	57.34	70.27
13	9.2	9.2	28.3	19.0	5.7	34.4	27.7	7.2	25.40	45.60
14	10.6	10.6	29.6	19.7	5.9	33.6	27.2	7.3	25.71	30.30
15	6.5	6.5	26.2	17.9	5.2	32.5	26.6	6.0	21.10	17.75
16	19.4	19.4	37.3	19.7	7.5	34.1	27.5	13.6	47.80	59.50
17	16.0	16.0	35.8	20.4	7.2	34.7	27.8	12.0	42.13	43.90
18	19.2	19.2	39.5	18.8	7.9	35.7	28.4	16.9	59.50	38.07
19	6.1	6.1	25.0	17.2	5.0	33.4	27.2	6.0	21.13	19.60
20	16.5	16.5	33.7	21.2	6.7	33.9	27.4	9.2	32.31	28.80
21	13.9	13.9	35.1	20.6	7.0	34.4	27.7	11.1	39.10	34.60
22	12.1	12.1	32.8	21.4	6.6	34.3	27.6	8.4	29.47	39.20
23	8.0	8.0	29.4	19.6	5.9	33.5	27.2	7.2	25.33	28.30
24	8.3	8.3	27.9	18.8	5.6	32.8	26.8	6.6	23.66	30.61
25	9.0	0.0	18.8	13.9	3.8	30.6	25.6	3.3	11.76	18.40
26	4.8	4.8	18.7	13.9	3.7	29.3	24.9	2.9	10.03	6.40
27	0.8	0.8	14.7	11.6	2.9	27.8	24.1	1.3	4.74	4.20
28	1.9	1.9	13.6	10.8	2.7	26.8	23.5	1.0	3.36	2.80
29	2.3	2.3	13.0	10.3	2.6	26.1	23.1	0.7	2.48	2.20
30	3.0	3.0	13.3	10.6	2.7	25.8	23.0	0.6	2.10	1.91
31	12.0	12.0	22.6	16.0	4.5	27.5	23.9	3.2	11.40	10.20
32	5.9	5.9	21.8	15.5	4.4	28.2	24.3	3.3	11.65	8.40
33	6.1	6.1	21.7	15.5	4.3	28.6	24.5	3.4	12.01	4.91
34	1.1	1.1	16.5	12.7	3.3	27.8	24.1	1.8	6.20	1.80
35	3.0	3.0	15.7	12.3	3.1	27.2	23.7	1.3	4.64	1.40
36	2.4	2.4	14.6	11.6	2.9	26.7	23.4	0.9	3.27	1.70

Rainfall= 3592 Discharge= 2511

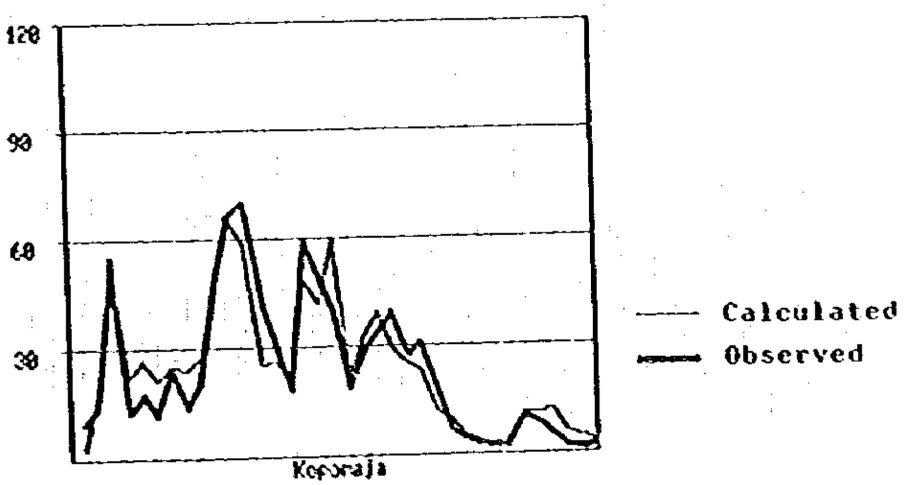


Table I-20 Estimated Discharge (Tank Model)(10/15)

Place Kopcasja
Year 1973

INPUT FACTOR---------
Watershed 304 Km2
Percolation Ratio 1 0.200 2 0.090
First Water Depth 1 11.6 2 23.4
Hole Depth (1 1) 35.00 (1 2) 15.00 (1 3) 8.00 (2 1) 25.00 (2 2) 2.00
Hole Ratio (1 1) 0.9500 (1 2) 0.2500 (1 3) 0.0150 (2 1) 0.3500 (2 2) 0.0100

NO	RAIN	I	H1	H2	I	H1	H2	Q	Est.Q	Obs.Q
1	1.6	1.6	13.2	10.5	2.6	26.0	23.1	0.7	2.40	0.90
2	7.5	7.5	17.9	13.5	3.6	26.7	23.4	1.7	6.05	1.70
3	16.3	16.3	29.7	19.8	5.9	29.4	24.9	5.8	20.49	10.75
4	6.2	6.2	26.0	17.8	5.2	30.1	25.3	5.1	17.90	8.70
5	22.3	22.3	40.1	18.6	8.0	33.4	27.1	16.7	58.90	15.20
6	9.6	9.6	28.2	18.9	5.6	32.8	26.8	6.6	23.29	13.20
7	12.8	12.8	31.7	20.8	6.3	33.1	27.0	7.7	27.05	17.70
8	8.5	8.5	29.4	19.6	5.9	32.9	26.8	7.0	24.54	28.00
9	15.4	15.4	35.0	20.7	7.0	33.8	27.4	10.7	37.64	31.36
10	17.8	17.8	38.5	19.2	7.7	35.1	28.1	15.4	51.34	36.60
11	10.0	10.0	29.2	19.5	5.8	33.9	27.4	7.3	25.69	19.40
12	9.8	9.8	29.3	19.5	5.9	33.3	27.1	7.1	24.96	27.27
13	17.3	17.3	36.8	20.0	7.4	34.4	27.7	13.1	46.10	61.70
14	14.2	14.2	34.1	21.1	6.8	34.5	27.8	9.9	34.79	40.00
15	10.5	10.5	31.6	20.8	6.3	34.1	27.5	8.0	28.14	39.50
16	11.9	11.9	32.7	21.3	6.5	34.0	27.5	8.3	29.11	31.60
17	11.6	11.6	32.9	21.5	6.6	34.1	27.5	8.4	29.40	34.80
18	8.1	8.1	29.6	19.7	5.9	33.4	27.2	7.2	25.43	26.69
19	15.0	15.0	34.7	20.8	6.9	34.1	27.5	10.5	36.77	37.50
20	26.7	26.7	47.5	15.5	9.5	37.0	29.1	27.0	95.17	57.00
21	16.6	16.6	32.1	21.0	6.4	35.5	28.3	8.7	30.45	59.10
22	13.4	13.4	34.4	20.9	6.9	35.2	28.1	10.5	36.81	32.70
23	26.7	26.7	47.6	15.5	9.5	37.7	29.5	27.4	96.53	34.30
24	13.3	13.3	28.8	19.3	5.8	35.2	28.2	7.7	27.02	31.69
25	10.9	10.9	30.2	20.9	6.0	34.2	27.6	7.7	26.97	33.50
26	7.0	7.0	27.1	18.4	5.4	33.0	26.9	6.4	22.55	13.10
27	20.0	20.0	38.3	19.3	7.7	34.6	27.8	15.0	52.88	24.30
28	8.4	8.4	27.7	18.7	5.5	33.3	27.1	6.7	23.59	14.10
29	14.1	14.1	32.8	21.4	6.6	33.7	27.3	8.2	28.74	21.60
30	2.7	2.7	24.1	16.8	4.8	32.1	26.4	5.3	18.67	10.82
31	16.5	16.5	33.3	21.4	6.7	33.1	27.0	8.4	29.52	15.40
32	12.6	12.6	34.0	21.1	6.8	33.8	27.3	9.5	33.33	19.00
33	8.9	8.9	30.0	19.9	6.0	33.3	27.1	7.3	25.73	18.27
34	19.4	19.4	39.4	18.9	7.9	35.0	28.0	16.4	57.89	43.70
35	18.4	18.4	37.2	19.8	7.4	35.5	28.3	14.0	49.36	27.50
36	15.4	15.4	35.1	20.6	7.0	35.3	28.2	11.4	40.03	37.69

Rainfall= 4325 Bischarge= 3583

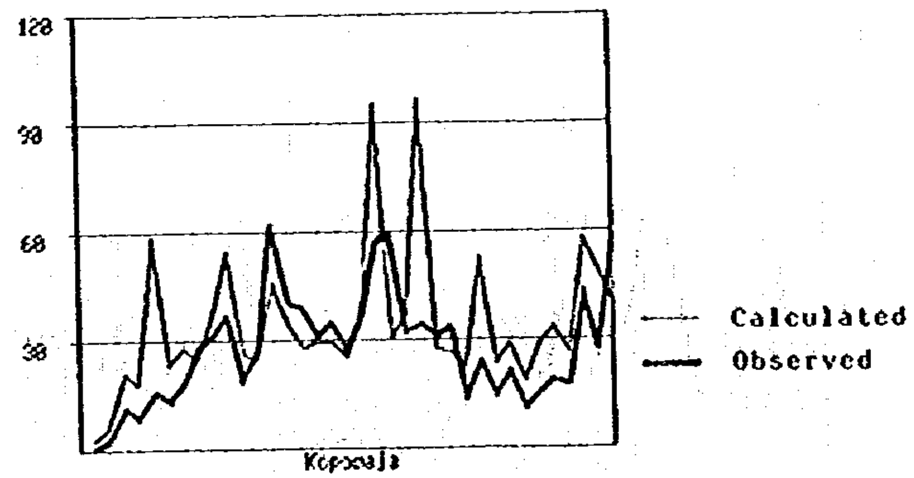


Table I-20 Estimated Discharge (Tank Model)(11/15)

Place Kopcuaja
Year 1974

INPUT FACTOR---------

Watershed 304 Km2

Percolation Ratio 1 0.200 2 0.090

First Water Depth 1 20.6 2 28.2

Hole Depth (1 1) 33.00 (1 2) 15.00 (1 3) 8.00 (2 1) 25.00 (2 2) 2.00

Hole Ratio (1 1) 0.9500 (1 2) 0.2500 (1 3) 0.0150 (2 1) 0.3500 (2 2) 0.0100

NO	RAIN	I	H1	H2	I	H1	H2	Q	Est.Q	Obs.Q
1	5.4	5.4	26.0	17.8	5.2	33.4	27.1	6.3	22.10	29.00
2	13.8	13.8	31.6	20.8	6.3	33.5	27.2	7.8	27.34	16.30
3	22.9	22.9	43.7	17.1	8.7	35.9	28.5	22.0	77.39	35.73
4	7.6	7.6	24.7	17.1	4.9	33.5	27.2	6.0	20.95	26.30
5	3.6	3.6	20.7	14.9	4.1	31.3	26.0	4.1	14.44	8.70
6	16.1	16.1	34.1	20.5	6.2	32.2	26.5	7.2	25.27	21.40
7	14.9	14.9	35.4	20.5	7.3	33.6	27.2	11.1	39.19	26.20
8	7.9	7.9	28.4	19.1	5.7	32.9	26.9	6.7	23.69	16.70
9	9.2	9.2	28.3	19.0	5.7	32.5	26.7	6.6	23.12	26.64
10	22.9	22.9	41.9	17.8	8.4	35.0	28.0	19.5	68.68	81.20
11	7.3	7.3	25.2	17.3	5.0	33.1	27.0	5.9	20.90	55.40
12	8.5	8.5	25.8	17.7	5.2	32.1	26.4	5.8	20.33	14.45
13	11.2	11.2	28.9	19.3	5.8	32.2	26.5	6.6	23.24	29.50
14	9.8	9.8	29.1	19.4	5.8	32.3	26.5	6.7	23.59	37.90
15	7.5	7.5	26.9	18.3	5.4	31.9	26.3	6.0	21.03	28.75
16	10.2	10.2	28.4	19.1	5.7	32.0	26.4	6.4	22.57	38.40
17	0.2	0.2	19.3	14.2	3.9	30.2	25.4	3.4	11.84	12.50
18	8.9	8.9	23.1	16.2	4.6	30.9	25.3	4.3	15.05	19.35
19	8.3	8.3	24.6	17.0	4.9	30.2	25.4	4.7	16.64	21.60
20	16.0	16.0	33.0	21.5	6.6	32.0	26.4	7.7	27.01	49.60
21	3.7	3.7	25.2	17.3	5.0	31.4	26.0	5.3	18.78	18.00
22	12.4	12.4	29.7	19.8	5.9	32.0	26.4	6.7	23.73	32.70
23	18.0	18.0	37.8	19.5	7.6	33.9	27.4	14.1	49.61	51.10
24	5.0	5.0	24.5	17.0	4.9	32.3	26.6	5.5	19.37	23.35
25	2.4	2.4	19.4	14.2	3.9	30.4	25.5	3.5	12.14	15.89
26	11.7	11.7	26.0	17.8	5.2	30.7	25.7	5.3	18.64	11.60
27	13.0	13.0	30.8	20.3	6.2	31.8	26.3	7.0	24.53	23.30
28	10.1	10.1	30.5	20.2	6.1	32.4	26.6	7.1	24.94	16.60
29	8.2	8.2	28.4	19.1	5.7	32.2	26.5	6.5	22.65	18.70
30	10.4	10.4	29.4	19.6	5.9	32.4	26.6	6.8	23.97	11.45
31	9.7	9.7	29.4	19.6	5.9	32.5	26.6	6.8	24.01	21.60
32	11.4	11.4	31.0	20.5	6.2	32.8	26.8	7.4	26.02	27.30
33	7.7	7.7	28.1	18.9	5.6	32.5	26.6	6.5	22.86	20.18
34	18.2	18.2	37.1	19.8	7.4	34.0	27.5	13.3	46.86	49.10
35	22.2	22.2	42.1	17.8	8.4	35.9	28.5	20.0	70.45	59.60
36	18.9	18.9	36.7	20.0	7.3	35.8	28.5	13.5	47.39	59.30

Rainfall= 4011 Discharge= 2845

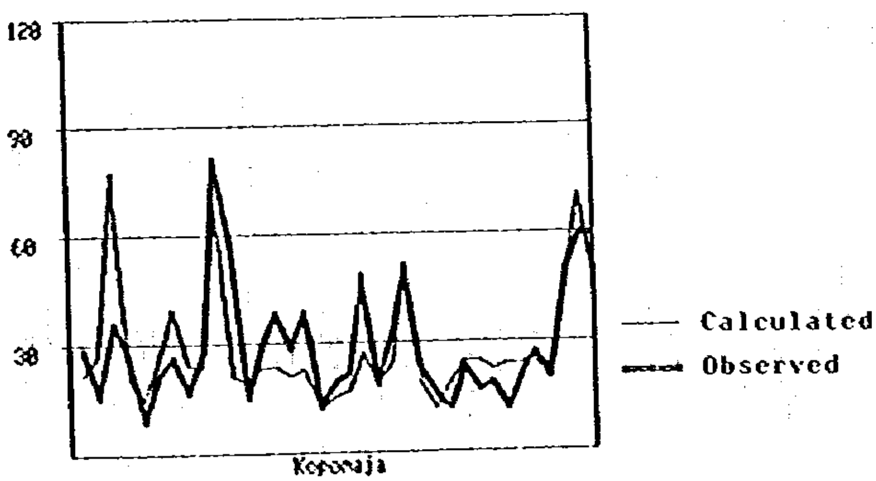


Table I-20 Estimated Discharge (Tank Model) (12/15)

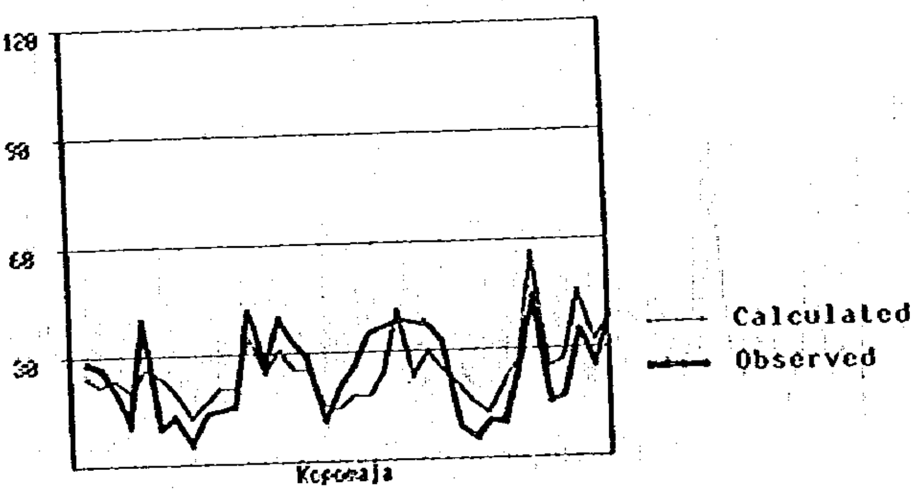
Place Kopcaaja
Year 1975

INPUT FACTOR---------

Watershed	304 Km2									
Percolation Ratio	1	0.200	2	0.090						
First Water Depth	1	20.0	2	28.5						
Hole Depth	(1 1)	33.00	(1 2)	15.00	(1 3)	8.00	(2 1)	25.00	(2 2)	2.00
Hole Ratio	(1 1)	0.9500	(1 2)	0.2500	(1 3)	0.0150	(2 1)	0.3500	(2 2)	0.0100

NO	RAIN	I	H1	H2	I	H1	H2	Q	Est.Q	Obs.Q
1	7.5	7.5	27.5	18.6	5.5	34.0	27.5	6.9	24.76	28.20
2	8.1	8.1	26.7	18.1	5.3	32.8	26.8	6.2	21.95	26.50
3	10.3	10.3	28.4	19.1	5.7	32.5	26.6	6.6	23.20	20.55
4	6.9	6.9	25.9	17.7	5.2	31.8	26.3	5.7	20.04	11.00
5	13.6	13.6	31.3	20.6	6.3	32.5	26.7	7.4	25.91	39.80
6	8.7	8.7	29.3	19.6	5.9	32.5	26.7	6.8	24.09	10.30
7	6.4	6.4	26.0	17.8	5.2	31.9	26.3	5.7	20.11	13.40
8	2.2	2.2	20.0	14.6	4.0	30.3	25.4	3.6	12.51	6.30
9	9.9	9.9	24.5	17.0	4.9	30.3	25.5	4.8	16.79	14.00
10	10.6	10.6	27.6	18.6	5.5	31.0	25.8	5.8	20.44	14.90
11	8.7	8.7	27.3	18.5	5.5	31.3	26.0	5.8	20.54	16.30
12	16.1	16.1	34.6	20.9	6.9	32.9	26.8	9.8	34.57	41.02
13	8.6	8.6	29.5	19.7	5.9	32.8	26.8	7.0	24.54	25.40
14	13.8	13.8	33.5	21.3	6.7	33.5	27.2	8.7	30.77	39.80
15	8.5	8.5	29.8	19.8	6.0	33.1	27.0	7.2	25.29	33.38
16	10.3	10.3	30.1	20.0	6.0	33.0	26.9	7.2	25.41	28.60
17	1.9	1.9	21.9	15.6	4.4	31.3	26.0	4.4	15.57	11.60
18	6.6	6.6	22.2	15.7	4.6	30.4	25.5	4.2	14.75	20.45
19	9.6	9.6	25.3	17.4	5.1	30.6	25.6	5.1	17.85	26.30
20	7.9	7.9	25.3	17.4	5.1	30.6	25.6	5.1	17.95	35.20
21	13.1	13.1	30.5	20.2	6.1	31.7	26.2	6.9	24.12	36.70
22	15.8	15.8	36.0	20.3	7.2	33.4	27.2	11.8	41.51	38.40
23	7.4	7.4	27.7	18.7	5.5	32.7	26.8	6.5	22.78	37.80
24	14.6	14.6	33.3	21.4	6.7	33.4	27.1	8.5	29.97	37.55
25	7.6	7.6	29.0	19.4	5.8	33.0	26.9	6.9	24.34	32.20
26	6.7	6.7	26.1	17.8	5.2	32.1	26.4	5.8	20.57	8.80
27	4.3	4.3	22.2	15.7	4.4	30.9	25.7	4.3	15.29	6.00
28	4.8	4.8	20.5	14.8	4.1	29.8	25.2	3.5	12.43	10.00
29	13.3	13.3	28.2	18.9	5.6	30.8	25.7	5.9	20.83	9.80
30	13.9	13.9	32.8	21.4	6.6	32.3	26.5	7.7	27.04	23.91
31	17.8	17.8	39.3	18.9	7.9	34.4	27.7	16.1	56.59	45.50
32	10.5	10.5	29.4	19.6	5.9	33.6	27.2	7.2	25.50	15.10
33	11.3	11.3	30.9	20.4	6.2	33.4	27.1	7.6	26.66	16.02
34	16.3	16.3	36.7	20.0	7.3	34.5	27.7	13.1	45.98	35.40
35	13.5	13.5	33.4	21.3	6.7	34.4	27.7	9.0	31.75	25.50
36	13.3	13.3	34.7	20.8	6.9	34.6	27.8	10.6	37.38	37.40

Rainfall= 3571 Discharge= 2591



Place Kopoaaja
Year 1976

INPUT FACTOR---------

Watershed 304 Km2
Percolation Ratio 1 0.200 2 0.090
First Water Depth 1 20.8 2 27.8
Hole Depth (1 1) 33.00 (1 2) 15.00 (1 3) 8.00 (2 1) 25.00 (2 2) 2.00
Hole Ratio (1 1) 0.9500 (1 2) 0.2500 (1 3) 0.0150 (2 1) 0.3500 (2 2) 0.0100

NO	RAIN	I	H1	H2	I	H1	H2	Q	Est.Q	Obs.Q
1	10.0	10.0	30.8	20.3	6.2	34.0	27.4	7.7	27.24	23.20
2	9.8	9.8	30.1	20.0	6.0	33.5	27.2	7.4	26.00	23.50
3	11.9	11.9	31.9	20.9	6.4	33.6	27.2	7.9	27.75	17.91
4	11.5	11.5	32.4	21.2	6.5	33.7	27.3	8.1	28.45	20.10
5	8.4	8.4	29.6	19.7	5.9	33.2	27.0	7.2	25.19	33.90
6	2.9	2.9	22.6	15.9	4.5	31.6	26.1	4.7	16.52	13.00
7	11.3	11.3	27.2	18.4	5.4	31.6	26.1	5.9	20.86	11.90
8	5.9	5.9	24.3	16.9	4.9	31.0	25.8	5.0	17.44	19.90
9	6.3	6.3	23.2	16.3	4.6	30.5	25.5	4.5	15.75	12.82
10	20.4	20.4	36.7	20.0	7.3	32.9	26.8	12.4	43.60	54.80
11	19.4	19.4	39.4	18.9	7.9	34.7	27.9	16.3	57.45	91.40
12	18.7	18.7	37.6	19.6	7.5	35.4	28.2	14.4	50.59	103.36
13	5.1	5.1	24.8	17.1	5.0	33.2	27.0	5.9	20.65	45.00
14	5.4	5.4	22.5	15.9	4.5	31.5	26.1	4.7	16.49	16.60
15	14.7	14.7	30.6	20.3	6.1	32.2	26.5	7.1	24.92	23.75
16	16.9	16.9	37.1	19.8	7.4	33.9	27.4	13.3	46.96	54.70
17	4.7	4.7	24.5	17.0	4.9	32.3	26.6	5.5	19.38	13.60
18	10.2	10.2	27.2	18.4	5.4	32.0	26.4	6.1	21.45	18.73
19	11.2	11.2	29.6	19.7	5.9	32.3	26.5	6.8	24.05	22.90
20	9.7	9.7	29.5	19.6	5.9	32.4	26.6	6.8	24.07	20.20
21	16.8	16.8	36.4	20.1	7.3	33.9	27.4	12.5	43.69	32.50
22	10.4	10.4	30.5	20.2	6.1	33.5	27.2	7.5	26.46	35.20
23	0.8	0.8	21.0	15.1	4.2	31.4	26.0	4.2	14.94	16.30
24	2.5	2.5	17.6	13.3	3.5	29.6	25.0	2.7	9.44	6.00
25	11.1	11.1	24.4	16.9	4.9	29.9	25.2	4.6	16.18	18.20
26	7.5	7.5	24.4	16.9	4.9	30.1	25.3	4.7	16.40	10.00
27	0.0	0.0	16.9	12.9	3.4	28.7	24.6	2.2	7.67	3.70
28	5.4	5.4	18.4	13.7	3.7	28.2	24.3	2.4	8.41	6.60
29	0.0	0.0	13.7	10.9	2.7	27.0	23.6	1.0	3.69	2.50
30	3.2	3.2	14.1	11.2	2.8	26.5	23.3	0.8	2.97	3.73
31	7.7	7.7	18.9	14.0	3.8	27.1	23.7	2.1	7.45	10.60
32	0.4	0.4	14.4	11.4	2.9	26.6	23.4	0.9	3.11	3.60
33	9.1	9.1	20.5	14.9	4.1	27.5	23.9	2.7	9.47	11.27
34	6.9	6.9	21.8	15.5	4.4	28.2	24.3	3.3	11.61	9.50
35	0.6	0.6	16.1	12.5	3.2	27.5	23.9	1.5	5.43	3.10
36	8.7	8.7	21.2	15.2	4.2	28.2	24.3	3.1	10.97	5.80

Rainfall= 3089 Discharge= 2165

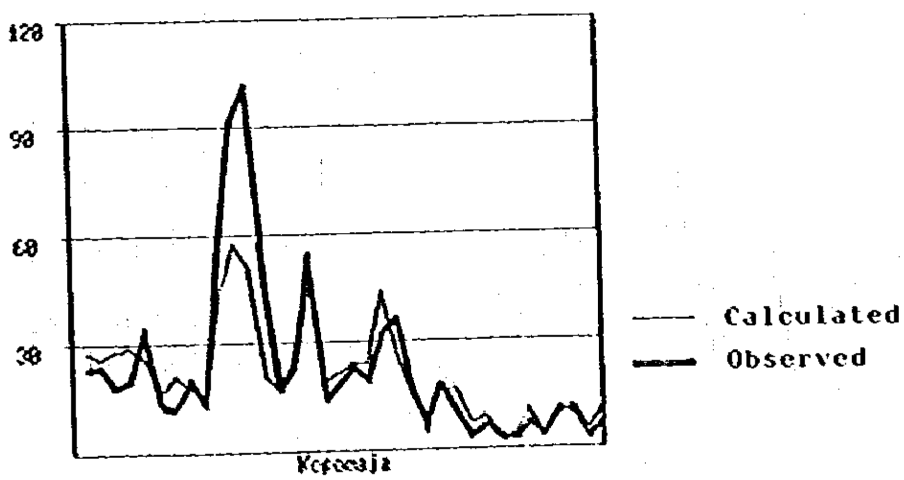


Table I-20 Estimated Discharge (Tank Model)(14/15)

Place Koponaja
Year 1977

INPUT FACTOR---------

Watershed	304	Km2									
Percolation Ratio	1	0.200	2	0.090							
First Water Depth	1	15.2	2	24.3							
Hole Depth	(1 1)	33.00	(1 2)	15.00	(1 3)	8.00	(2 1)	25.00	(2 2)	2.00	
Hole Ratio	(1 1)	0.9500	(1 2)	0.2500	(1 3)	0.0150	(2 1)	0.3500	(2 2)	0.0100	

NO	RAIN	I	H1	H2	I	H1	H2	Q	Est.Q	Obs.Q
1	22.3	22.3	37.5	19.6	7.5	31.8	26.3	13.0	45.90	27.40
2	10.2	10.2	29.9	19.9	6.0	32.2	26.5	6.9	24.23	24.10
3	5.1	5.1	25.0	17.2	5.0	31.5	26.1	5.3	18.68	8.73
4	14.1	14.1	31.4	20.6	6.3	32.4	26.6	7.3	25.76	12.69
5	20.8	20.8	41.4	18.0	8.3	34.9	27.9	18.9	65.47	38.89
6	4.7	4.7	22.7	14.0	4.5	32.5	26.6	5.1	17.69	15.90
7	7.5	7.5	23.5	16.5	4.7	31.3	26.0	4.9	17.16	8.30
8	12.3	12.3	28.7	19.2	5.7	31.8	26.2	6.4	22.52	14.60
9	11.5	11.5	30.7	20.3	6.1	32.4	26.6	7.2	25.21	12.82
10	18.8	18.8	39.1	19.0	7.8	34.4	27.7	15.9	55.93	30.20
11	12.6	12.6	31.6	20.8	6.3	34.0	27.5	8.0	28.02	31.10
12	17.6	17.6	38.4	19.3	7.7	35.1	28.1	15.3	53.77	87.55
13	9.6	9.6	28.9	19.4	5.8	33.9	27.4	7.2	25.43	22.20
14	10.2	10.2	29.6	19.7	5.9	33.3	27.4	7.2	25.33	47.10
15	16.6	16.6	34.3	20.2	7.3	34.3	27.7	12.4	43.70	32.25
16	15.6	15.6	35.8	20.4	7.2	34.8	27.9	12.9	42.26	40.90
17	5.4	5.4	25.8	17.7	5.2	33.1	27.0	6.1	21.47	24.30
18	17.7	17.7	35.4	20.5	7.1	34.0	27.5	11.2	39.58	34.82
19	20.0	20.0	40.5	18.4	8.1	35.6	28.3	18.1	63.52	49.50
20	16.8	16.8	35.2	20.6	7.0	35.4	28.2	11.5	40.55	40.00
21	15.7	15.7	36.3	20.2	7.3	35.5	28.3	12.9	45.41	47.00
22	18.8	18.8	39.0	19.0	7.8	36.1	28.6	16.4	57.53	67.20
23	7.8	7.8	26.8	18.2	5.4	34.0	27.5	6.7	23.56	22.00
24	6.5	6.5	24.7	17.1	4.9	32.4	26.6	5.6	19.64	39.45
25	16.1	16.1	33.2	21.5	6.6	33.2	27.0	8.3	29.01	33.80
26	5.3	5.3	26.8	18.2	5.4	32.4	26.6	6.1	21.53	19.50
27	9.0	9.0	27.2	18.4	5.4	32.0	26.4	6.1	21.43	13.50
28	7.5	7.5	25.9	17.8	5.2	31.6	26.1	5.6	19.71	17.10
29	6.8	6.8	24.5	17.0	4.9	31.0	25.8	5.0	17.72	7.70
30	6.3	6.3	23.3	16.3	4.7	30.5	25.5	4.5	15.65	11.00
31	3.2	3.2	19.5	14.3	3.9	29.4	25.0	3.1	11.60	4.70
32	0.7	0.7	15.0	11.9	3.0	28.0	24.1	1.4	4.92	3.10
33	5.2	5.2	17.1	13.0	3.4	27.6	23.9	1.8	6.39	5.27
34	1.7	1.7	14.7	11.6	2.9	26.9	23.5	1.0	3.53	3.80
35	9.4	9.4	21.1	15.1	4.2	27.8	24.0	2.9	10.33	14.40
36	3.5	3.5	18.6	13.8	3.7	27.8	24.0	2.3	8.07	4.50

Rainfall= 3965 Discharge= 2922

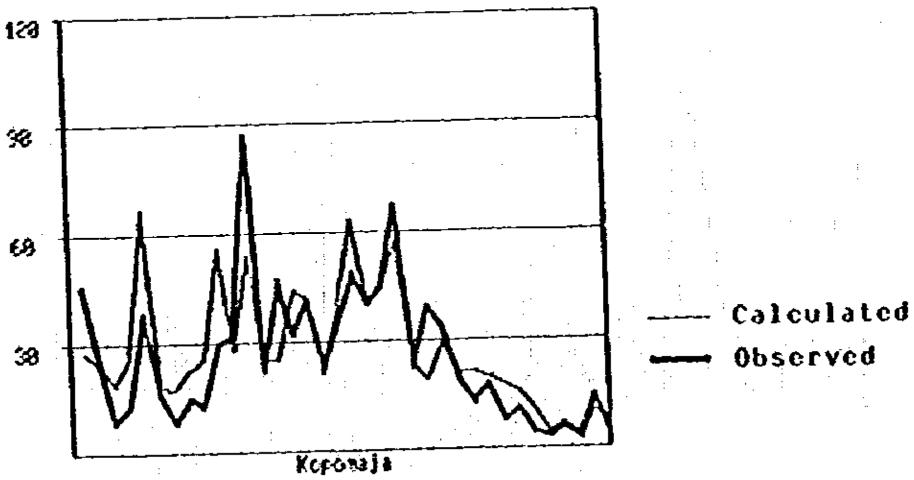


Table I-2010 Days Mean Discharge (m3/s) (15/15)
Station Gadeg
(Estimate by Tank Model)

	1964	1965	1966	1967	1968	1969
OCT-1	0.37	14.15	2.13	8.22	7.21	9.67
OCT-2	1.40	23.06	1.42	8.76	8.51	9.51
OCT-3	3.48	10.58	3.21	16.26	8.16	15.62
NOV-1	7.82	8.47	4.83	8.82	7.94	10.10
NOV-2	8.34	9.65	6.59	8.51	10.71	9.90
NOV-3	11.41	12.01	7.35	5.83	8.77	9.40
DEC-1	12.50	8.84	5.64	7.66	7.81	23.92
DEC-2	9.50	15.04	4.31	6.13	10.41	8.15
DEC-3	8.08	8.01	4.13	4.15	8.55	9.91
JAN-1	13.52	22.14	8.16	4.34	16.42	6.55
JAN-2	10.13	7.82	8.40	5.33	8.24	11.26
JAN-3	15.13	8.03	7.19	7.21	9.86	10.02
FEB-1	11.63	7.40	7.75	16.31	7.76	7.95
FEB-2	13.35	19.96	8.29	6.42	9.40	8.26
FEB-3	13.06	18.03	9.13	6.85	8.31	5.64
MAR-1	17.62	8.53	9.63	11.25	6.79	3.50
MAR-2	7.08	8.42	13.89	5.01	19.83	8.56
MAR-3	7.57	5.59	8.29	10.38	7.85	9.07
APR-1	33.76	8.17	8.19	8.91	6.41	23.87
APR-2	12.36	7.03	10.49	25.82	22.43	9.62
APR-3	17.80	6.10	9.20	8.87	7.07	12.81
MAY-1	26.37	20.41	9.43	7.59	6.42	24.03
MAY-2	6.25	9.63	7.32	9.01	5.98	14.42
MAY-3	7.13	20.08	8.25	6.91	5.68	8.91
JUN-1	6.26	14.79	9.48	4.08	5.66	8.30
JUN-2	8.83	8.83	7.52	1.81	6.43	5.69
JUN-3	8.05	13.44	4.38	2.24	7.04	3.60
JUL-1	6.95	9.36	3.12	1.20	7.69	8.55
JUL-2	5.82	6.26	1.76	0.85	10.00	6.83
JUL-3	6.66	4.30	1.51	0.61	8.49	3.97
AUG-1	8.71	2.93	1.03	0.31	6.02	1.74
AUG-2	18.86	3.20	1.26	0.33	4.56	1.52
AUG-3	9.87	1.92	2.87	0.31	8.83	1.59
SEP-1	17.61	1.12	5.43	0.28	7.33	4.75
SEP-2	11.58	1.72	7.26	0.25	13.03	8.23
SEP-3	15.57	1.17	5.99	0.45	14.60	6.39
TOTAL	400.4	356.2	224.8	227.3	326.5	331.8

Table I-21 Monthly Mean Discharge at Rangkasbitung

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
1972	260.00	141.00	187.00	80.00	105.00	24.20	13.50	20.90	6.20	9.30	34.10	62.20	943.40
1973	166.00	111.00	157.00	173.00	189.00	106.00	48.50	63.60	125.00	107.00	101.00	131.00	1480.10
1974	189.00	143.00	150.00	115.00	128.00	58.20	65.60	91.00	178.00	96.10	80.00	88.20	1382.10
1975	103.00	162.00	106.00	55.40	70.70	42.40	62.00	90.80	135.00	74.80	127.00	173.00	1202.10
1976	274.00	101.00	123.00	94.90	58.40	37.70	23.40	24.30	15.00	43.90	76.00	50.40	922.00
1977	189.40	111.00	156.00	145.00	126.60	75.10	29.80	15.70	15.50	29.00	28.00	46.50	967.60
1978	183.00	89.40	139.00	108.00	68.00	68.70	61.10	83.50	73.90	77.10	94.60	89.00	1135.30
1979	133.00	151.00	121.00	165.00	65.60	41.00	44.60	26.60	32.70	33.10	96.70	31.00	939.30
1980	183.20	127.80	66.20	100.20	91.50	45.10	51.20	88.10	89.30	69.70	96.00	124.90	1133.20
1981	200.00	127.40	132.90	106.70	123.20	149.70	127.80	90.10	108.20	103.30	120.90	111.80	1502.00
TOTAL	1830.60	1264.60	1338.10	1143.20	1024.00	648.10	527.50	594.60	778.80	645.30	854.30	908.00	11607.1
MEAN	183.06	126.46	133.81	114.32	102.40	64.81	52.75	59.46	77.88	64.53	85.43	90.80	96.73
MAX	274.00	162.00	187.00	173.00	189.00	149.70	127.80	91.00	178.00	107.00	127.00	173.00	
MIN	103.00	89.40	66.20	55.40	58.40	24.20	13.50	15.70	6.20	9.30	28.00	31.00	

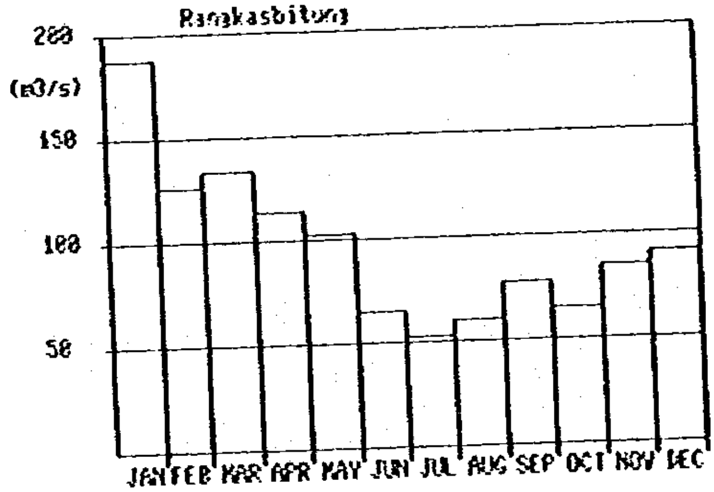


Table I-22 Regrresion Analysis of Droughty Discharge and Precipitation befor One Month

X=Monthly Rain
Y=Discharge

INPUT DATA:---------

X	Y	X	Y	X	Y	X	Y
381.0	8.7	194.0	6.3	313.0	6.0	59.0	2.1
107.0	3.1						

OUT PUT:-----------

VARIANCE= 336.885
CORRELATION COEFFICIENT= .937377
REGRESSION COEFFICIENT
A= 1.83307E-02
B= 1.37589
AVERAGE
X= 210.8
Y= 5.24

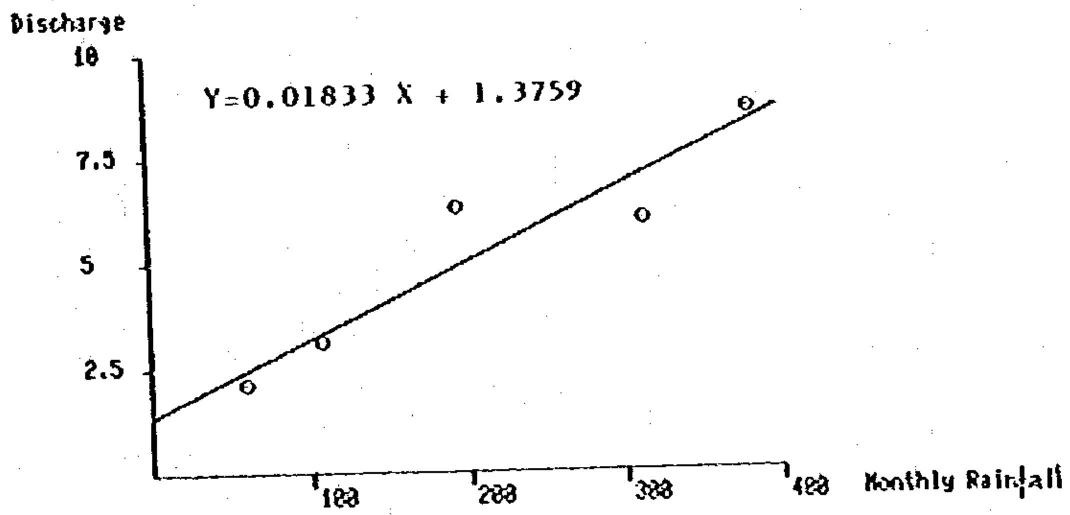


Table I-23 Regrresion Analysis of Specific Discharge (Kopomaja and Rangkasbitung)

X=Kopomaja
Y=Rankasbitung

INPUT DATA:--------

X	Y	X	Y	X	Y	X	Y
20.4	19.1	10.4	10.3	16.0	13.7	9.0	5.9
10.7	7.7	3.2	1.8	0.8	1.0	2.5	1.5
0.5	0.5	1.6	0.7	4.1	2.5	8.5	4.6
9.1	12.2	15.7	8.1	10.2	10.0	16.8	12.7
10.8	13.9	7.8	7.8	5.1	3.6	5.8	4.7
14.1	9.2	9.0	8.0	6.2	7.4	7.7	9.6
16.2	13.9	10.6	10.5	7.7	11.0	9.7	8.4
11.6	9.4	5.6	4.3	5.1	4.8	7.5	6.7
18.3	13.1	8.2	7.1	6.7	5.9	3.7	6.5
8.2	7.6	10.8	11.9	6.7	7.8	10.8	4.1
12.5	5.2	5.2	3.1	4.9	4.6	8.4	6.7
10.8	9.9	7.0	5.5	7.3	9.3	4.9	12.7
27.3	20.1	9.5	7.4	9.5	9.4	8.3	7.0
6.3	4.3	3.5	2.8	1.4	1.7	2.8	1.8
2.0	1.1	6.5	3.2	7.4	5.6	3.9	3.7
16.8	13.9	11.2	8.1	11.0	11.4	15.0	10.6
14.1	9.3	7.3	5.5	3.9	2.2	1.5	1.2
2.5	1.1	4.9	2.1	8.4	3.4	12.3	13.4
6.0	6.6	10.8	10.2	6.7	7.9	4.3	5.0
4.2	4.5	4.8	6.1	8.6	5.4	7.1	5.7
6.0	6.9	6.6	6.5	11.8	9.8	8.0	11.1
8.8	8.9	10.6	12.1	5.0	4.7	5.1	3.0
5.7	3.3	4.8	2.0	3.8	2.4	5.9	2.4
15.7	7.1	5.9	5.9				

OUT PUT:----------

VARIANCE= 15.8289
CORRELATION COEFFICIENT= .838173
REGRESSION COEFFICIENT
A= .742497
B= .888456
AVERAGE
X= 8.1633
Y= 6.94968

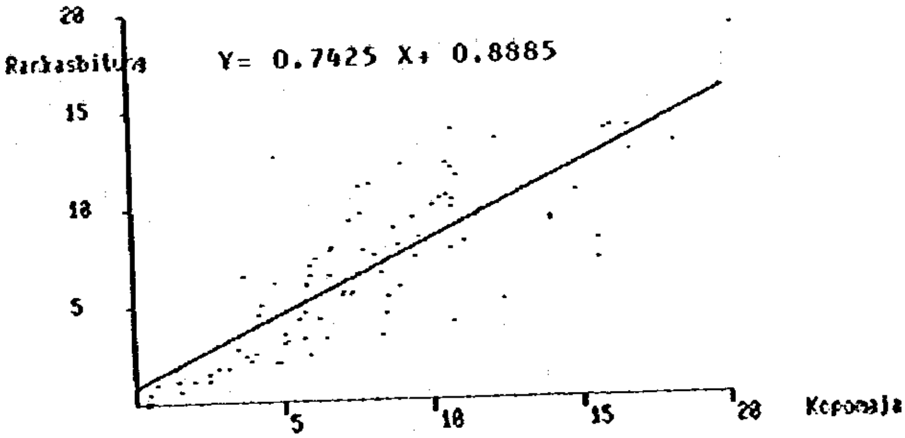


Table I -24 Water Quality

INSTITUTE OF HYDRAULIC ENGINEERING
ENVIRONMENTAL AND WATER QUALITY DIVISION
WATER QUALITY LABORATORY
Jalan Ir. H. Juanda No. 193 Bandung - Tlp. 84553 - 84554

Lab. No. : PKA 82/118
Location : Banten
Jawa Barat

RESULT OF WATER QUALITY ANALYSES

Substances		Units	Results of Analyses 1	2	3	4
PHYSICAL						
Temperature		°C				
Colour		Uan PtCo	10 k	10 k	10 k	10 k
Odour			-	-	-	-
Taste			-	-	-	-
Turbidity		Mg SiO2	29,5	33,0	25,5	18,5
Disolved solid		Mg	48	50	84	76
Conductivity		umho/cm	95	60	125	110
CHEMICAL						
pH			6,75	6,70	6,65	6,70
Calcium	(Ca)	Mg	8,82	4,17	16,27	11,86
Magnesium	(Mg)	"	3,28	1,22	1,46	1,95
Hardness			2,00	0,87	2,60	2,11
Sodium	(Na)	"	4,06	4,57	4,34	4,72
Potasium	(K)	"	1,64	1,81	2,15	1,54
Nickel	(Ni)	"	ud	ud	ud	ud
Iron	(Fe)	"	0,80	1,10	0,71	0,19
Mangan	(Mn)	"	ud	ud	ud	ud
Copper	(Cu)	"	ud	ud	ud	ud
Zink	(Zn)	"	ud	ud	ud	ud
Krom hexavalen	(Cr)	"	ud	ud	ud	ud
Kadmium	(Cd)	"	ud	ud	ud	ud
Mercury	(Hg)	"	-	-	-	-
Lead	(Pb)	"	ud	ud	ud	ud
Cyanide	(CN)	"	-	-	-	-
Sulfide	(S)	"	-	-	-	-
Fluoride	(F)	"	ud	ud	ud	ud
Chloride	(Cl)	"	4,81	4,65	4,90	4,73
Sulfate	(SO4)	"	3,90	4,50	3,20	2,40
Amonia	(NH4)	"	0,40	0,46	0,40	0,62
Nitrat	(NO3)	"	0,80	0,90	0,80	0,80
Nitrit	(NO2)	"	ud	ud	ud	ud
Bikarbonat	(HCO3)	"	41,5	23,2	58,0	48,8
% Na		%	19,4	35,7	16,1	21,0
SAR		-	0,30	0,51	0,28	0,34
RSC		-	0	0,07	0,02	0,05
Boron	(B)	ppm	ud	ud	ud	ud
Permanganat meter		Mg KMnO4	10,98	13,75	16,13	8,34
BAKTERIOLOGI :						
E.Coli		MPN/100 ml	-	-	-	-

Note: 1.Ciberang Karian
2.Cibeureum Gadel
3.Ciujung Cikeles
4.Cisireuk Leuwidamar.

ud = undetected.
k = koloid

i. Table I -25 Water Quality for Irrigation

GOLONGAN D :

AIR YANG BAIK UNTUK KEPERLUAN PERTANIAN
DAN DAPAT DIMANFAATKAN UNTUK USAHA PERKOTAAN
INDUSTRI, LISTRIK TENAGA AIR, LINTAS AIR,
DAN UNTUK KEPERLUAN LAINNYA,
TETAPI TIDAK SESUAI UNTUK KEPERLUAN GOLONGAN A, B, DAN C

P A R A M E T E R		SATUAN	KADAR MAKSIMUM	KETERANGAN
F i s i k a				
Temperatur		°C	Temperatur normal	Sesuai dengan kondisi setempat.
Residu terlarut		mg/l	1000 - 2000	
Daya hantar listrik		micro mho/cm (25°C)	1750 - 2250	1750 untuk tanaman peka. 2250 untuk tanaman yang agak tahan.
K i m i a				
pH			5 - 9	
Mangan	(Mn)	mg/l	2	
Tembaga	(Cu)	"	0,2	
Seng	(Zn)	"	5	
Krom heksavalen	(Cr)	"	5	
Kadmium	(Cd)	"	0,01	
Raksa total	(Hg)	"	0,005	
Timbal	(Pb)	"	5	
Arsen	(As)	"	1	
Selenium	(Se)	"	0,05	
Nikel	(Ni)	"	0,5	
Kobalt	(Co)	"	0,2	
Boron	(B)	"	1	
% Na (% garam alkali)			60	
Sodium Absorption Ratio (S A R)			10 - 18	Maksimum 10 untuk tanaman peka. Maksimum 18 untuk tanaman kurang peka.
Residual Sodium Carbonat (R S C)			1,25 - 2,5	Maksimum 1,25 untuk tanaman peka. Maksimum 2,5 untuk tanaman kurang peka.
Radioaktifitas				
Aktifitas beta total		Bq/l	1000*)	*) Aktifitas tanpa adanya Sr - 90 dan Ra-226.
Strontium - 90		"	10	
Radium - 226		"	3	

Table I-26 Daily Discharge Parigi

YEAR 1972

DATE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	10.20	72.60	18.40	32.50	71.60	22.30	3.20	13.80	2.90	0.70	6.18	13.40
2	16.20	80.20	46.50	34.60	62.20	76.80	5.34	12.20	2.84	0.72	2.90	8.38
3	61.80	94.40	110.00	47.50	31.00	37.10	4.71	3.20	2.60	0.70	3.29	10.70
4	120.00	50.90	63.60	31.30	20.70	20.20	3.47	3.02	2.48	0.68	2.32	8.74
5	116.00	72.60	36.20	18.90	48.90	11.60	2.96	2.44	2.44	0.68	2.04	7.40
6	90.50	68.30	29.20	12.40	25.00	7.08	2.84	2.32	2.32	0.68	2.28	12.60
7	68.00	41.60	49.20	9.10	19.70	5.76	2.72	7.40	2.20	0.64	2.36	18.20
8	98.00	31.90	113.00	25.30	47.20	4.32	2.52	20.00	2.12	0.62	1.96	10.70
9	62.60	27.50	100.00	15.10	94.10	3.92	2.56	6.76	2.00	0.64	1.80	36.30
10	67.20	32.20	74.50	8.92	49.90	3.65	2.48	2.78	1.96	0.62	11.80	46.50
	(71.05)	(57.22)	(64.06)	(23.56)	(47.33)	(19.27)	(3.28)	(7.39)	(2.39)	(0.67)	(3.69)	(17.29)
11	80.20	25.80	78.30	7.72	38.10	3.38	2.44	2.44	1.88	0.60	4.76	46.20
12	53.60	50.60	116.00	34.60	31.60	3.14	2.36	3.20	1.84	0.62	2.96	26.10
13	104.00	29.80	80.60	71.20	29.50	3.07	2.16	2.48	1.84	0.62	3.92	15.60
14	102.00	63.30	76.40	27.20	28.60	2.96	2.20	3.29	1.76	0.65	5.20	11.60
15	85.30	38.10	90.20	17.20	55.70	6.32	2.28	4.32	1.68	0.68	6.92	26.40
16	108.00	61.50	60.80	12.80	24.70	8.20	2.20	5.90	1.60	0.66	3.56	23.30
17	92.50	34.30	75.30	18.90	27.00	5.34	2.12	4.65	1.48	0.64	18.90	51.90
18	71.90	22.60	42.60	14.20	69.00	3.74	2.08	3.02	1.34	0.64	13.40	56.40
19	82.10	37.40	28.10	82.10	35.60	3.02	2.00	2.24	1.31	0.70	13.60	32.80
20	107.00	39.70	22.80	126.00	30.10	2.78	4.01	2.16	1.25	0.74	11.60	18.70
	(88.96)	(40.31)	(67.41)	(41.19)	(36.51)	(4.19)	(2.39)	(3.37)	(1.60)	(0.66)	(8.50)	(30.90)
21	139.00	23.10	45.10	91.30	22.60	2.60	2.08	2.00	1.16	0.68	8.04	17.40
22	147.00	33.70	30.70	54.00	56.10	2.60	2.00	2.12	1.13	0.65	8.20	16.20
23	95.20	60.00	33.10	55.70	19.70	1.52	2.04	2.65	1.13	2.08	6.04	21.50
24	89.40	39.00	69.70	73.40	53.00	2.40	14.20	2.08	1.10	3.20	5.20	27.00
25	70.80	21.30	24.60	35.20	50.90	2.48	9.82	2.12	1.04	2.08	5.76	17.40
26	57.90	14.00	55.40	25.80	96.80	2.40	14.00	2.08	0.92	1.16	6.18	33.70
27	48.20	11.60	65.50	22.60	49.60	2.52	14.20	4.65	0.89	2.20	3.74	28.60
28	55.40	17.20	54.00	16.70	33.40	2.40	14.50	14.20	0.80	2.08	6.92	37.80
29	119.00	11.40	73.80	29.20	20.60	2.28	14.20	14.00	1.07	1.68	21.00	41.00
30	152.00		35.80	101.00	13.40	2.24	14.20	14.20	0.74	1.52	25.00	46.20
31	77.20		69.40		11.60	-	12.00	13.80		3.56		35.80
	(95.55)	(28.91)	(50.65)	(50.79)	(38.83)	(2.34)	(10.29)	(6.72)	(1.00)	(1.90)	(9.61)	(29.33)
									ANNUAL = 9863.55			
TOTAL	2651.20	1206.60	1868.80	1155.44	1265.50	258.07	169.89	181.53	49.82	34.14	218.03	804.52
MEAN	85.52	41.61	60.28	38.51	40.82	8.60	5.48	5.85	1.66	1.10	7.27	25.95
MAX	152.00	94.40	116.00	126.00	96.80	76.80	14.50	20.00	2.90	3.56	25.00	56.40

Table I-27 Water Balance at Parigi

YEAR 1972

Month		Gadeg Q	Intake Q	Q.A	Parigi Q	Q.B
1971 OCT	1	3.09	1.69	1.40	13.86	12.17
	2	4.68	1.82	2.86	17.18	15.36
	3	18.64	1.24	17.40	92.49	91.25
NOV	1	4.30	2.00	2.31	21.15	19.15
	2	5.93	0.48	5.45	29.15	28.67
	3	4.12	3.87	0.25	19.48	15.61
DEC	1	8.09	2.95	5.14	39.00	36.05
	2	4.59	4.02	0.57	17.76	13.75
	3	7.01	2.84	4.17	27.30	24.46
1972 JAN	1	16.20	0.00	16.20	71.05	71.05
	2	22.92	0.00	22.92	88.96	88.96
	3	23.98	0.04	23.94	95.55	95.51
FEB	1	15.55	2.55	13.00	57.22	54.67
	2	10.35	0.00	10.35	40.31	40.31
	3	5.87	0.87	5.00	28.91	28.04
MAR	1	20.32	0.54	19.78	64.06	63.52
	2	16.68	0.59	16.09	67.11	66.52
	3	13.00	1.73	11.27	50.65	48.92
APR	1	6.49	1.40	5.09	23.56	22.16
	2	9.84	4.26	5.58	41.19	36.93
	3	11.62	5.27	6.35	50.79	45.52
MAY	1	13.37	0.00	13.37	47.33	47.33
	2	9.64	0.25	9.40	36.51	36.27
	3	10.46	3.12	7.34	38.83	35.71
JUN	1	6.28	2.01	4.27	19.27	17.26
	2	2.18	1.71	0.47	4.19	2.48
	3	1.42	1.12	0.30	2.34	1.22
JUL	1	0.95	0.57	0.38	3.28	2.71
	2	0.75	0.19	0.56	2.39	2.20
	3	0.65	0.00	0.65	10.29	10.29
AUG	1	3.49	0.03	3.46	7.39	7.36
	2	2.86	0.40	2.46	3.37	2.97
	3	1.66	0.49	1.17	6.27	5.78
SEP	1	0.60	0.45	0.15	2.39	1.94
	2	0.47	0.33	0.14	1.60	1.27
	3	0.59	0.22	0.37	1.00	0.78
OCT	1	0.30	0.24	0.06	0.67	0.43
	2	0.58	0.46	0.12	0.66	0.20
	3	3.67	1.82	1.85	1.90	0.08
NOV	1	2.97	2.24	0.73	3.69	1.45
	2	5.20	2.41	2.79	8.50	6.09
	3	4.50	1.38	3.12	9.61	8.23
DEC	1	6.03	3.77	2.26	17.29	13.52
	2	9.57	4.76	4.81	30.90	26.14
	3	10.71	0.77	9.94	29.33	28.56

Where:

Gadeg Q:Discharge at Gadeg (m3/s)
Intake Q:Intake Water at Gadeg (m3/s)
Q.A:Discharge after Intake (m3/s)
Parigi Q:Discharge at Parigi (m3/s)
Q.B:Discharge after Completion at Parigi (m3/s)

Table I-27 Water Balance at Parigi (2/2)

YEAR 1973

NO.	Gadeg Q	Intake Q	Q.A	Parigi Q	Q.B
OCT-1	0.30	0.24	0.06	(0.67)	(0.43)
OCT-2	0.58	0.46	0.12	(0.66)	(0.20)
OCT-3	3.67	2.94	0.73	(1.90)	(-1.04)
NOV-1	2.97	2.38	0.59	3.69	1.31
NOV-2	5.20	4.16	1.04	8.50	4.34
NOV-3	4.50	3.60	0.90	9.61	6.01
DEC-1	6.03	4.82	1.21	17.29	12.47
DEC-2	9.57	6.00	3.57	30.90	24.90
DEC-3	10.71	6.00	4.71	29.33	23.33
JAN-1	12.50	6.00	6.50	53.86	7.86
JAN-2	6.62	5.30	1.32	33.19	27.89
JAN-3	9.32	6.00	3.32	45.98	39.98
FEB-1	21.06	6.00	15.06	90.90	84.90
FEB-2	13.63	6.00	7.63	66.96	60.96
FEB-3	13.49	6.00	7.49	44.58	38.58
MAR-1	10.80	6.00	4.80	29.18	23.18
MAR-2	11.87	6.00	5.87	45.05	39.05
MAR-3	9.08	6.00	3.08	30.44	24.44
APR-1	12.80	6.00	6.80	40.43	34.43
APR-2	19.44	6.00	13.44	70.29	64.29
APR-3	20.18	6.00	14.18	100.84	94.84
MAY-1	11.16	6.00	5.16	65.20	59.20
MAY-2	11.72	6.00	5.72	54.52	48.52
MAY-3	10.80	6.00	4.80	45.45	39.45
JUN-1	11.45	6.00	5.45	60.33	54.33
JUN-2	4.46	3.57	0.89	19.53	15.96
JUN-3	8.28	6.00	2.28	30.91	24.91
JUL-1	4.81	3.85	0.96	12.91	9.06
JUL-2	7.35	5.88	1.47	21.34	15.46
JUL-3	3.70	2.96	0.74	8.54	5.58
AUG-1	5.26	4.21	1.05	10.42	6.21
AUG-2	6.47	5.18	1.29	14.69	9.51
AUG-3	6.25	5.00	1.25	16.85	11.85
SEP-1	14.89	6.00	8.89	42.91	36.91
SEP-2	9.38	6.00	3.38	44.53	8.53
SEP-3	19.65	6.00	13.65	96.28	90.28

Where:

Gadeg Q:Discharge at Gadeg (m3/s)
Intake Q:Intake Water(m3/s)
Q.A :Discharge after Intake(m3/s)
Parigi Q:Discharge at Parigi(m3/s)
Q.B :(Parigi Q)-Int.Q(m3/s)
( ) :Uncertain Data

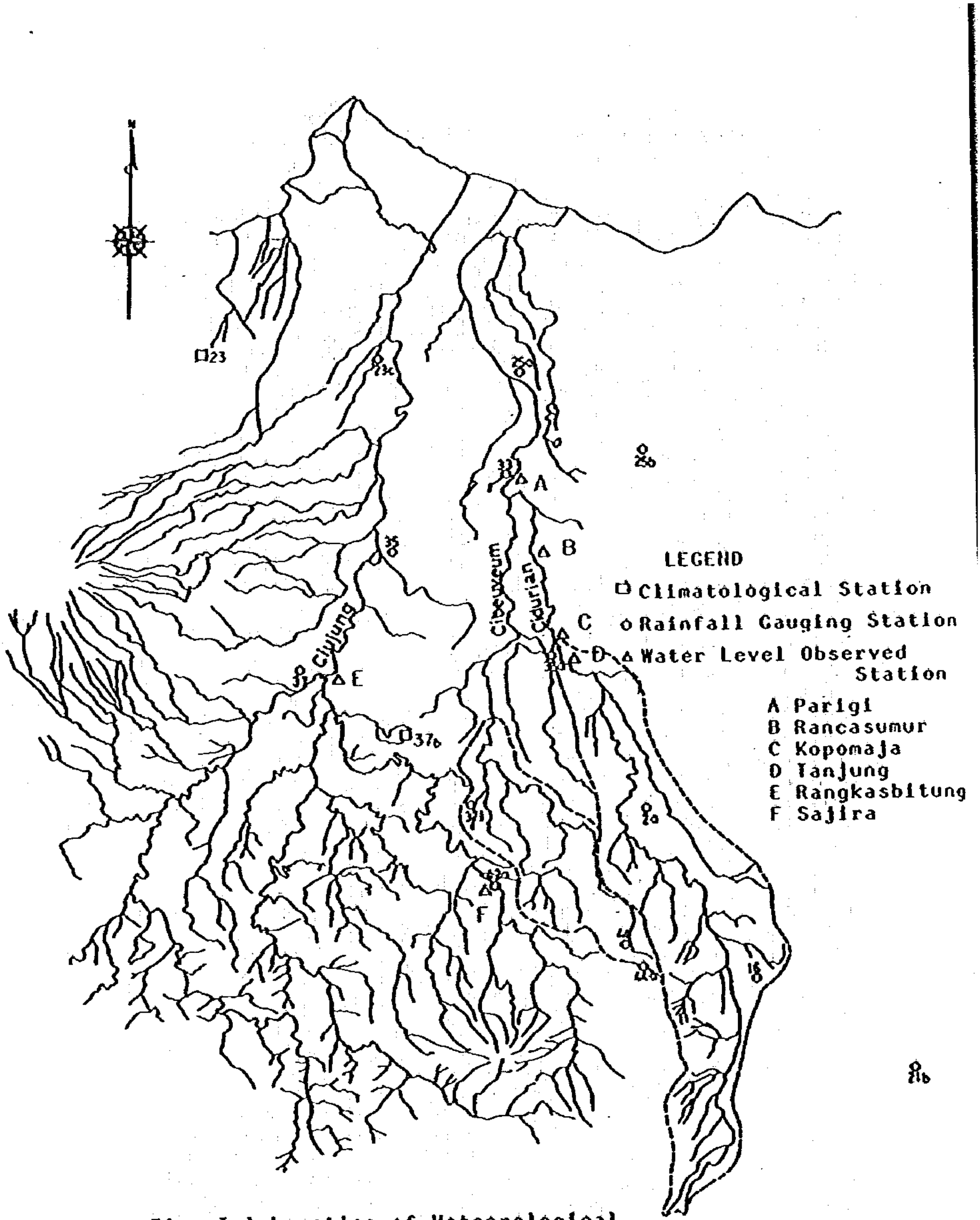


Fig. I-1 Location of Meteorological and Hydrological Station

Scale

5 0 5 10(Km)

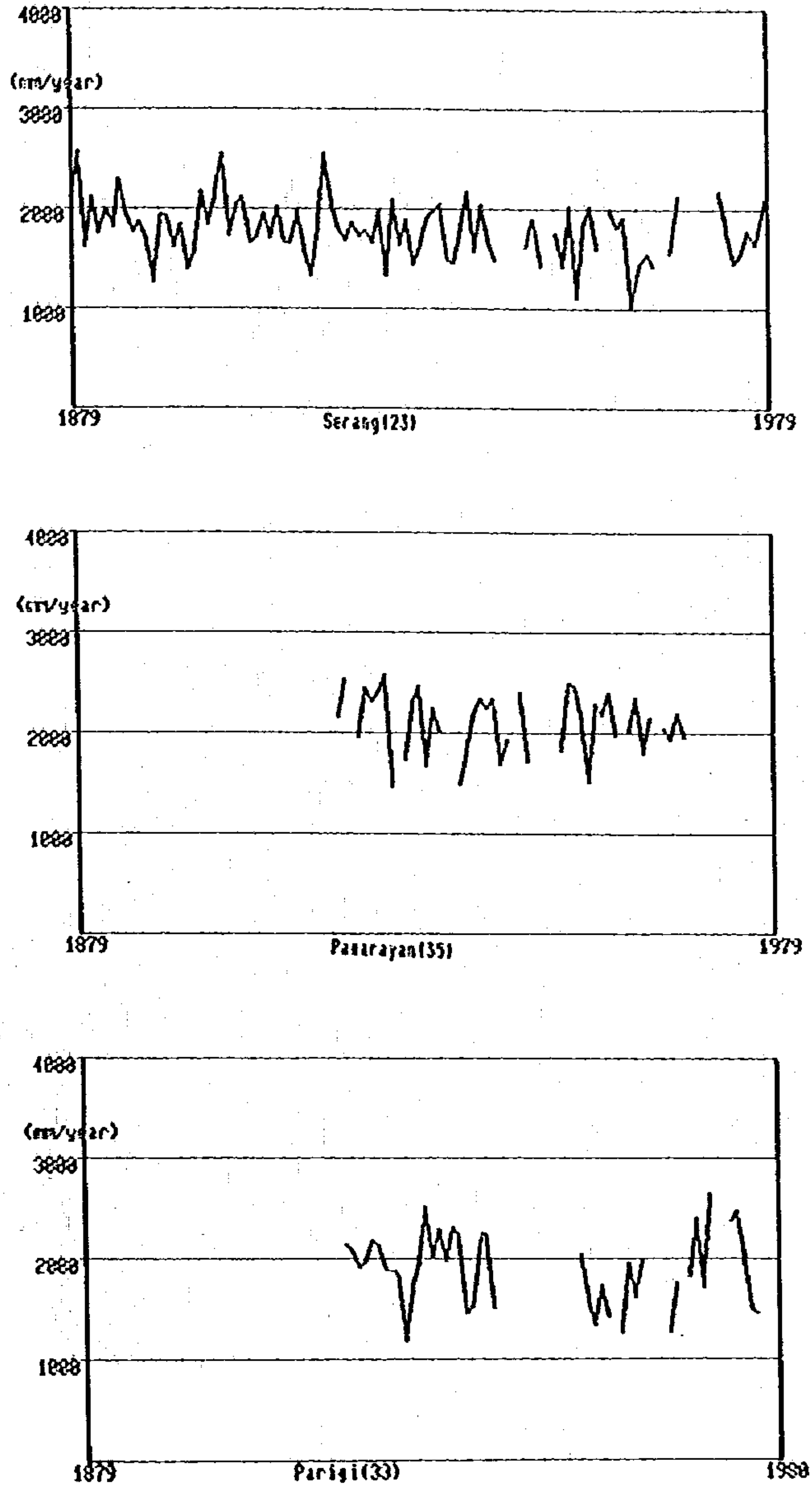


Fig.I-2 VARIATION ANNUAL RAINFALL

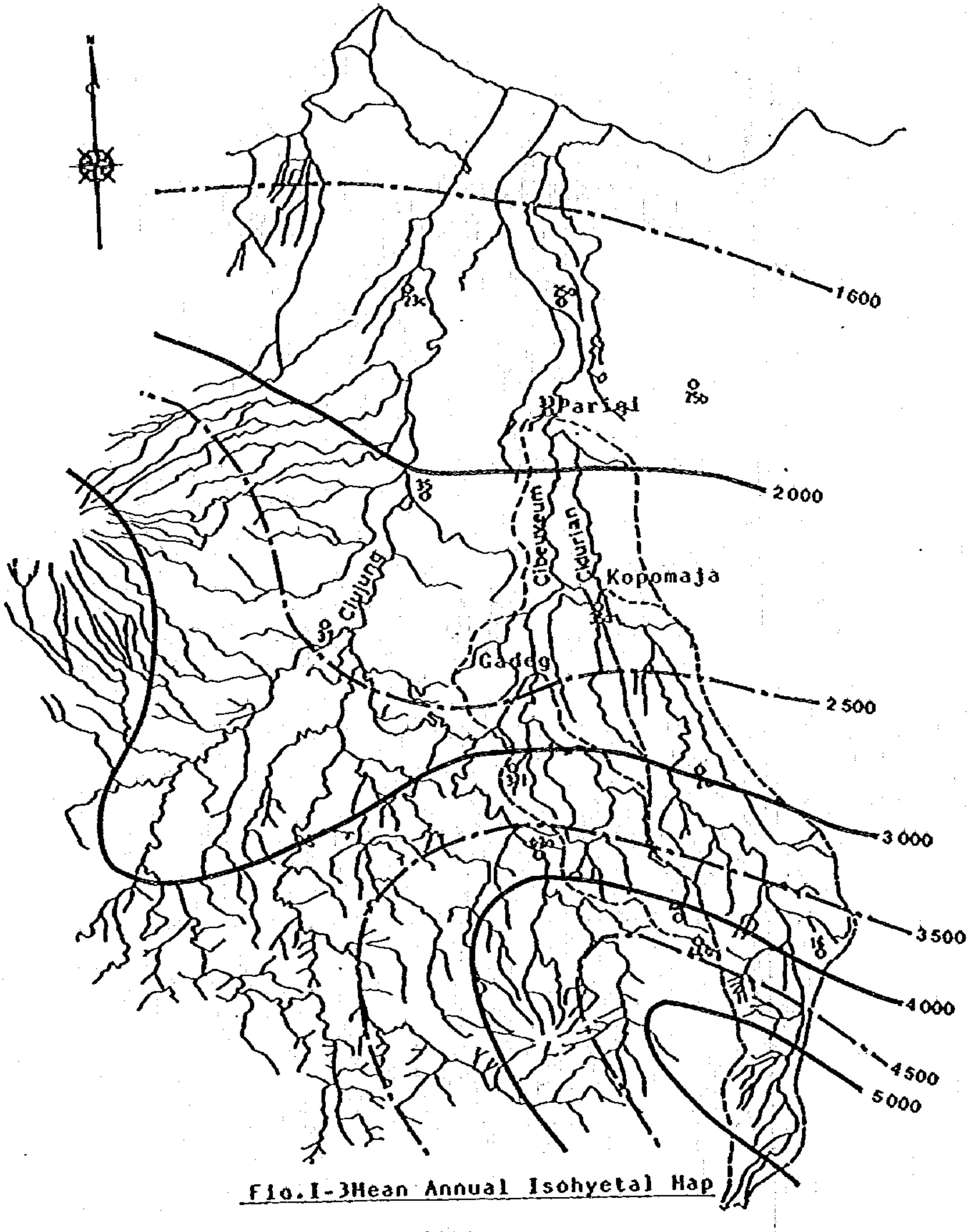
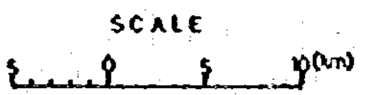
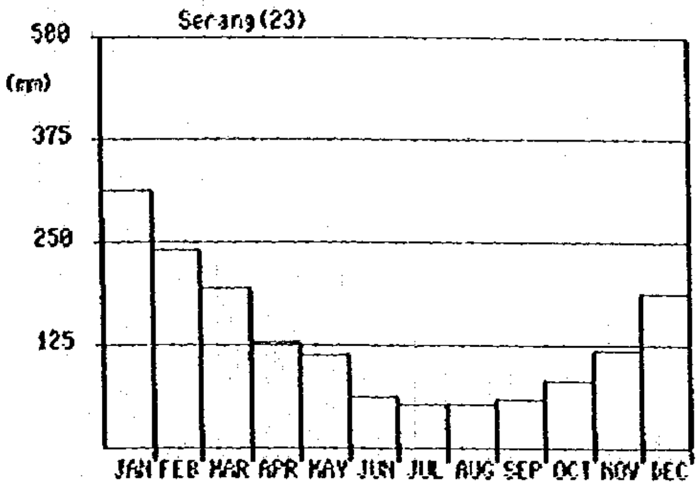
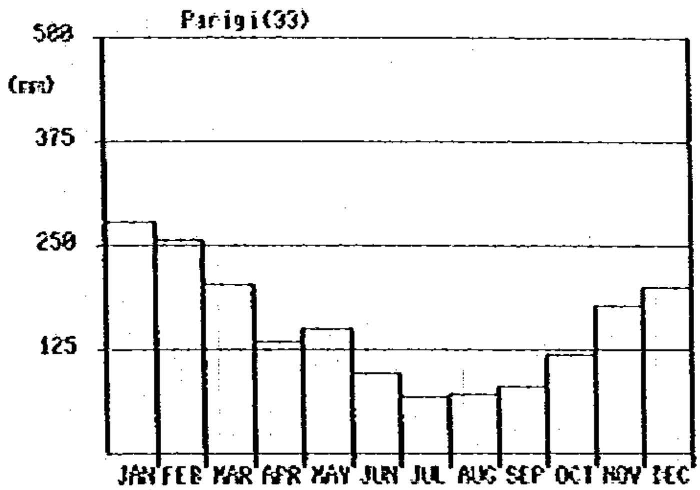


Fig.I-3Mean Annual Isohyetal Map



Source:BINNIE&PARTNERS(1979)
Banten Water Resources Development
Reconnaissance Study





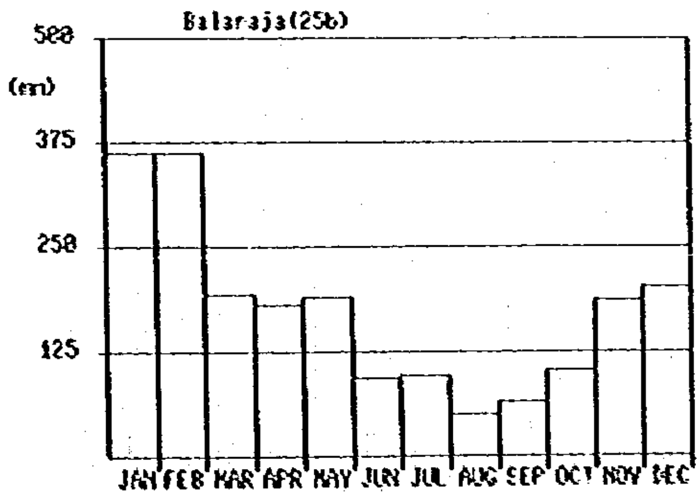
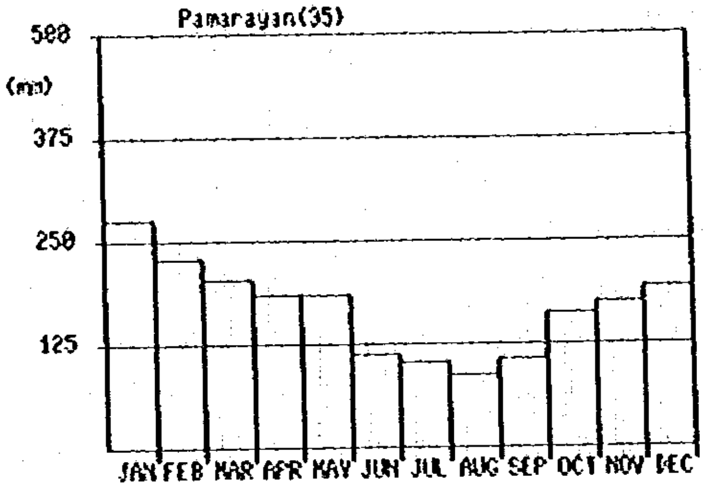
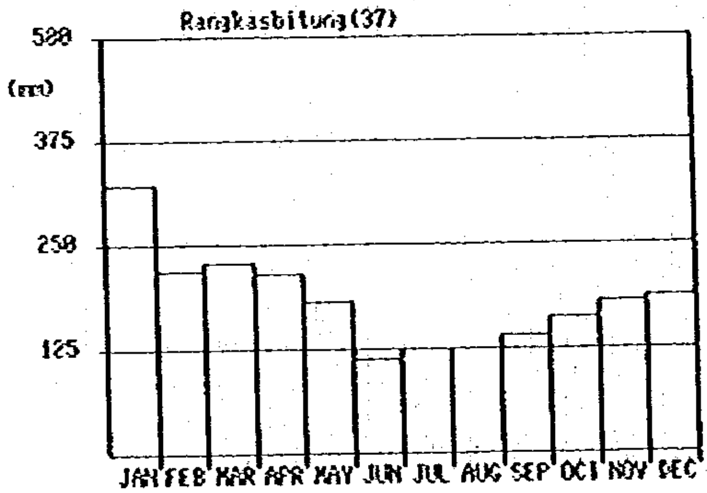


Fig.I-4 Monthly Rainfall Distribution(1/3)





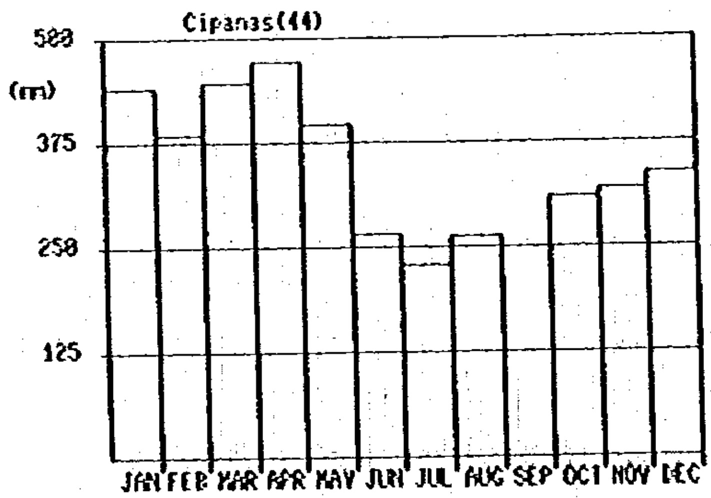
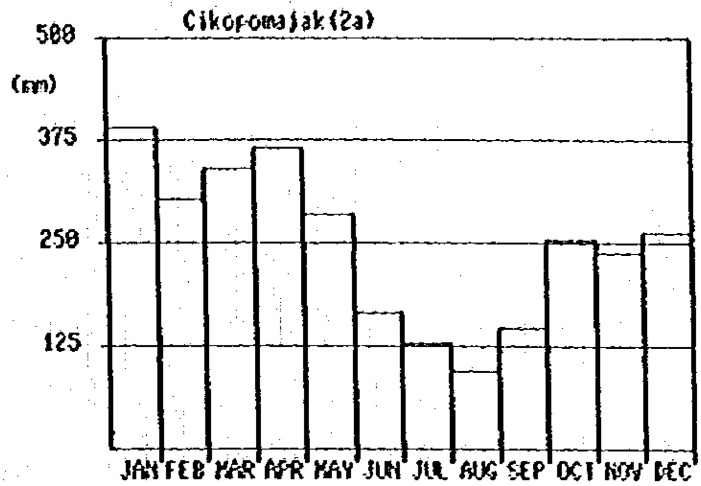


Fig.I-4 Monthly Rainfall Distribution(2/3)



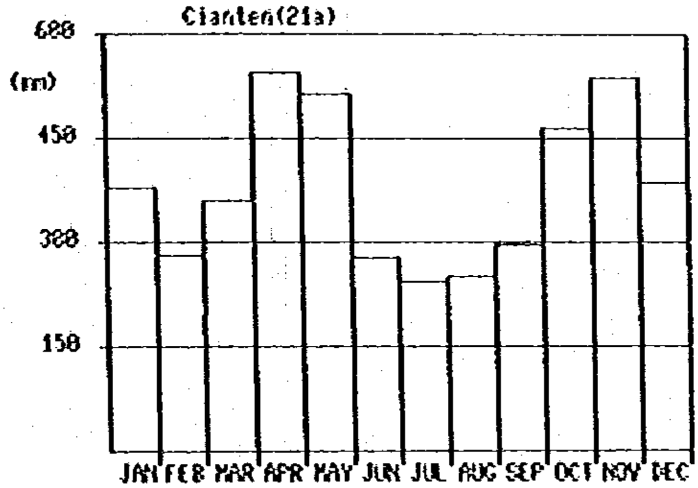


Fig.1-4 Monthly Rainfall Distribution(3/3)

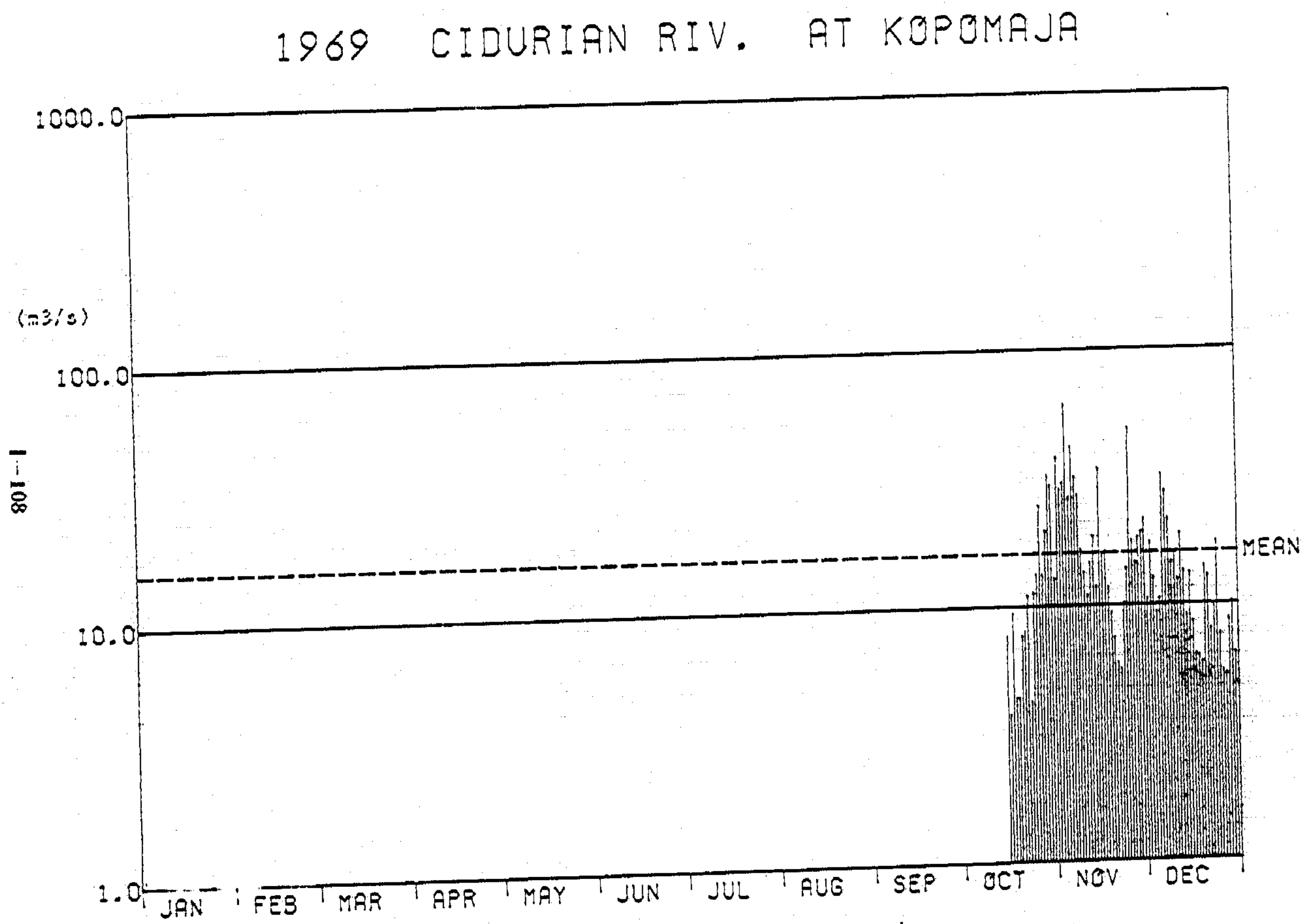


Fig. I-5 Daily Discharge at Kopomaja

1970 CIDURIAN RIV. AT KOPOMAJA

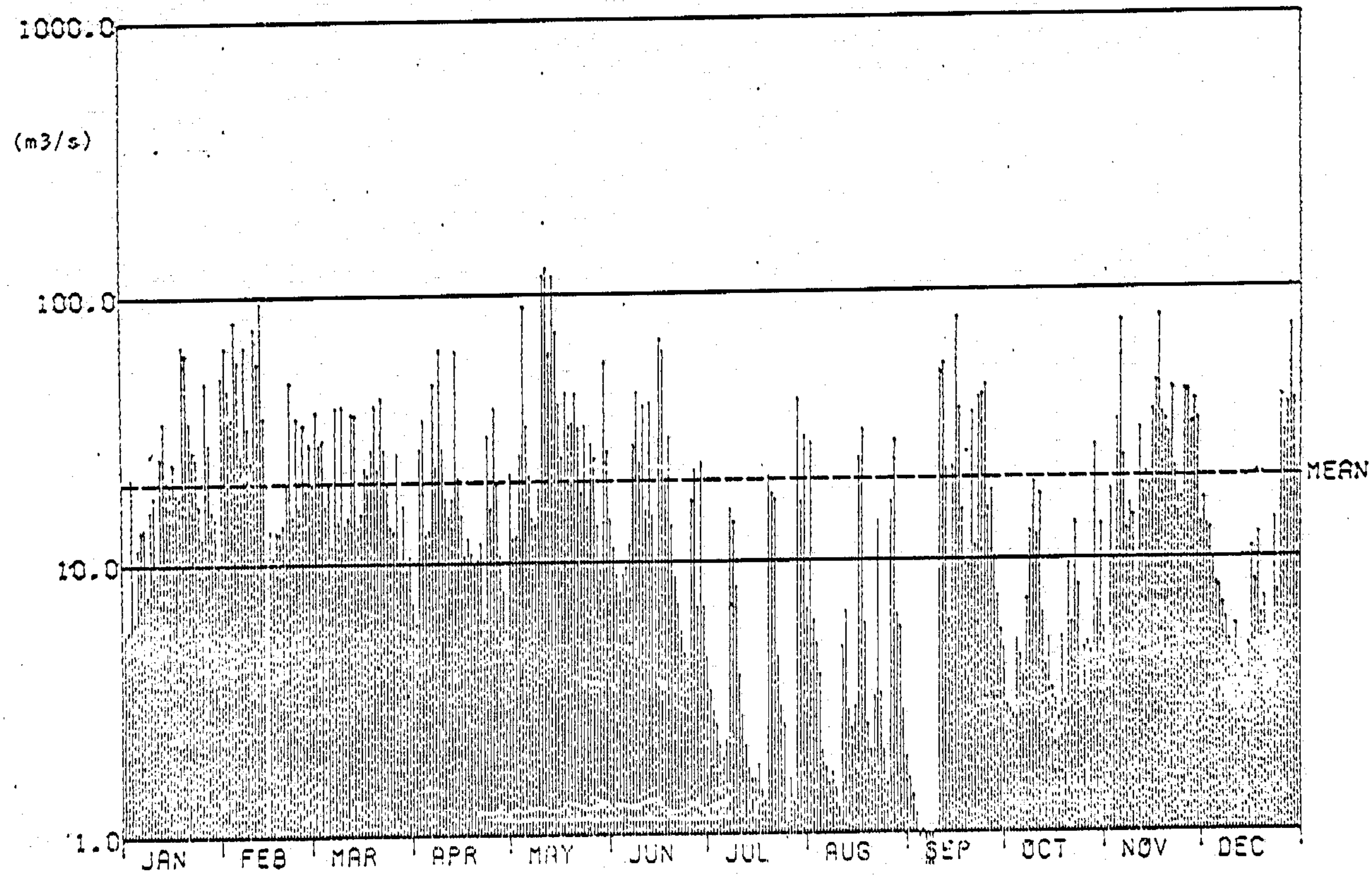


Fig. I-5 Daily Discharge at Kopomaja

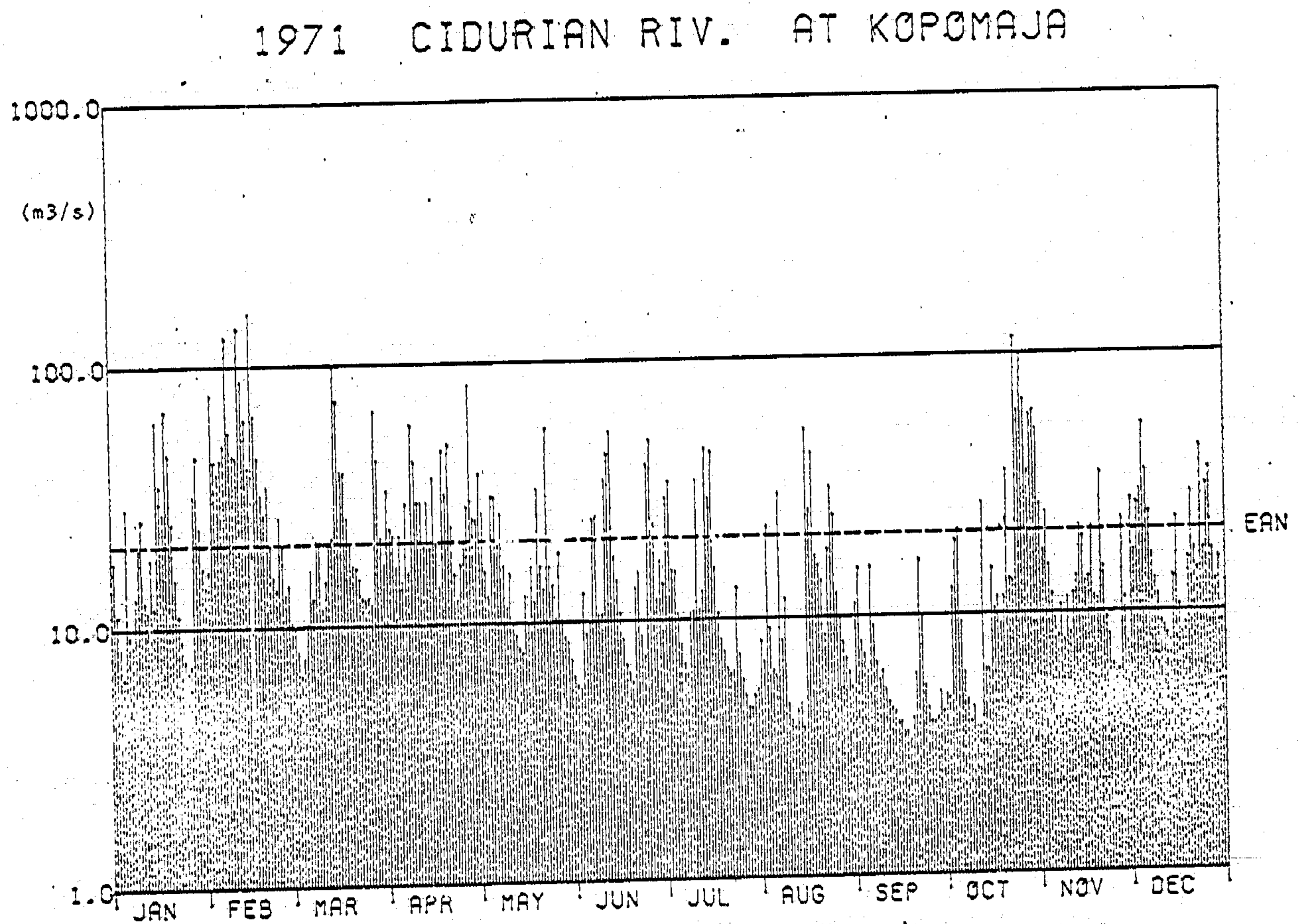


Fig. I-5 Daily Discharge at Kopomaja

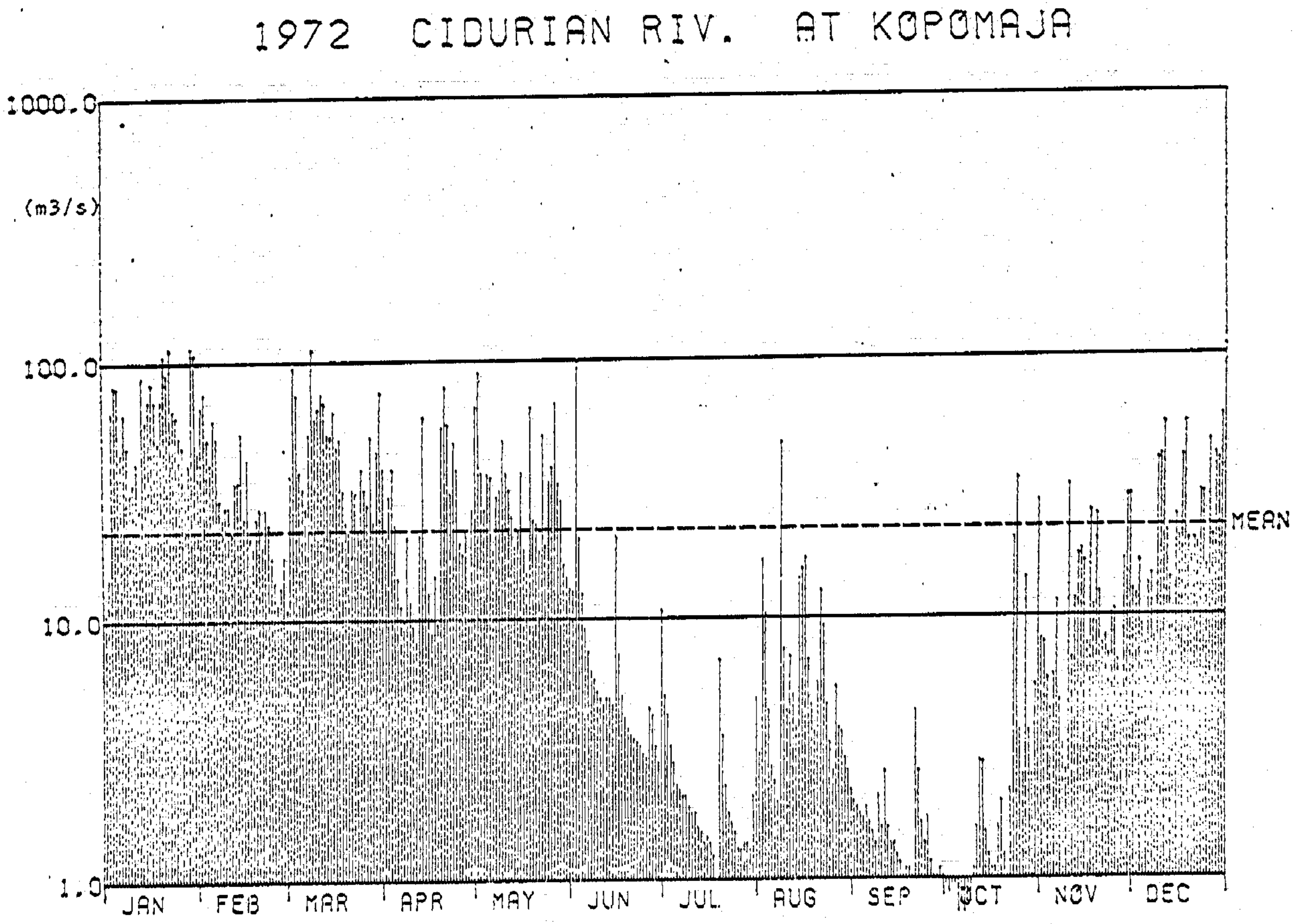


Fig. I-5 Daily Discharge at Kopomaja

1973 CIDURIAN RIV. AT KØPØMAJA

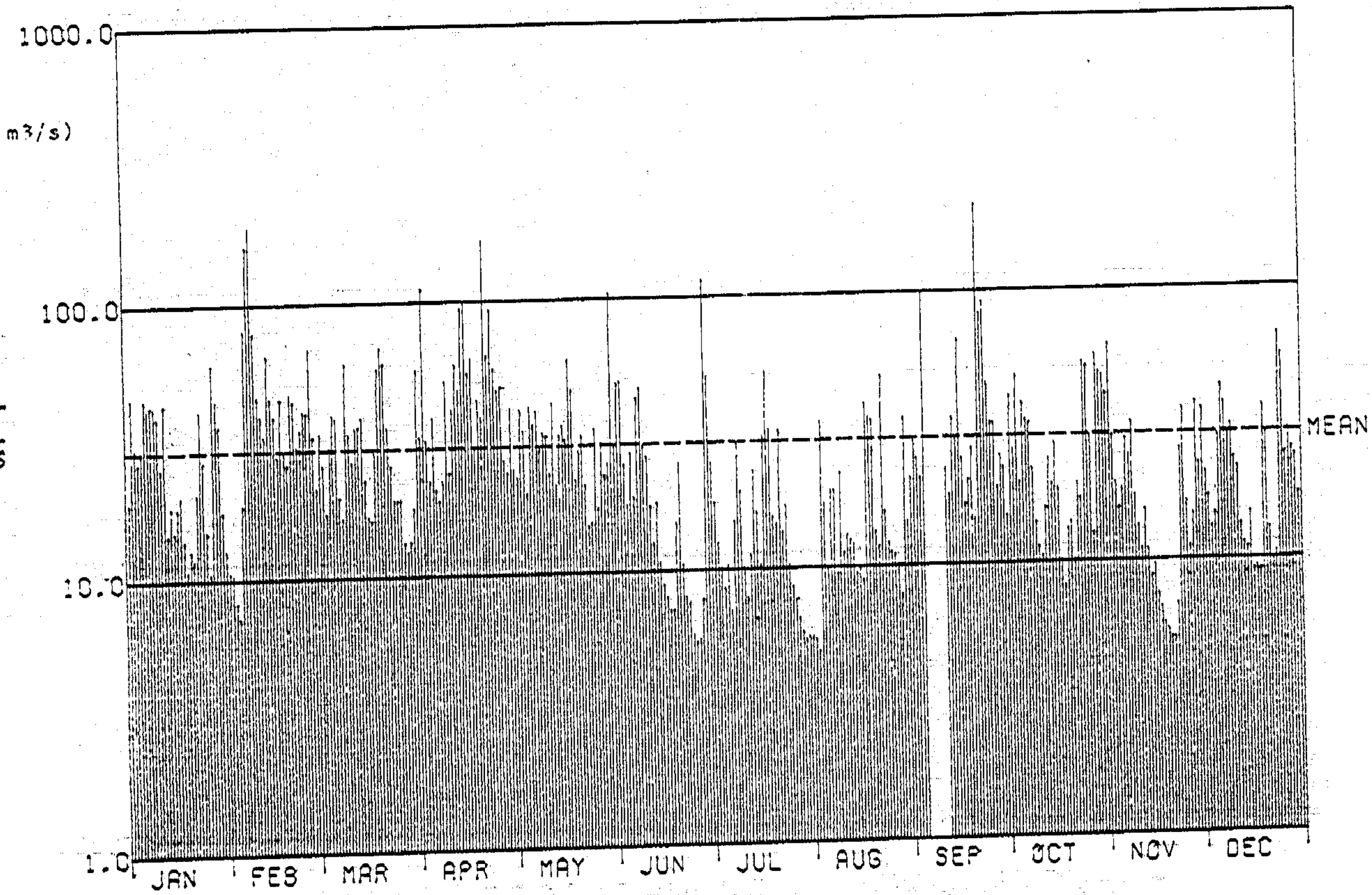


Fig. I-5 Daily Discharge at Kopomaja

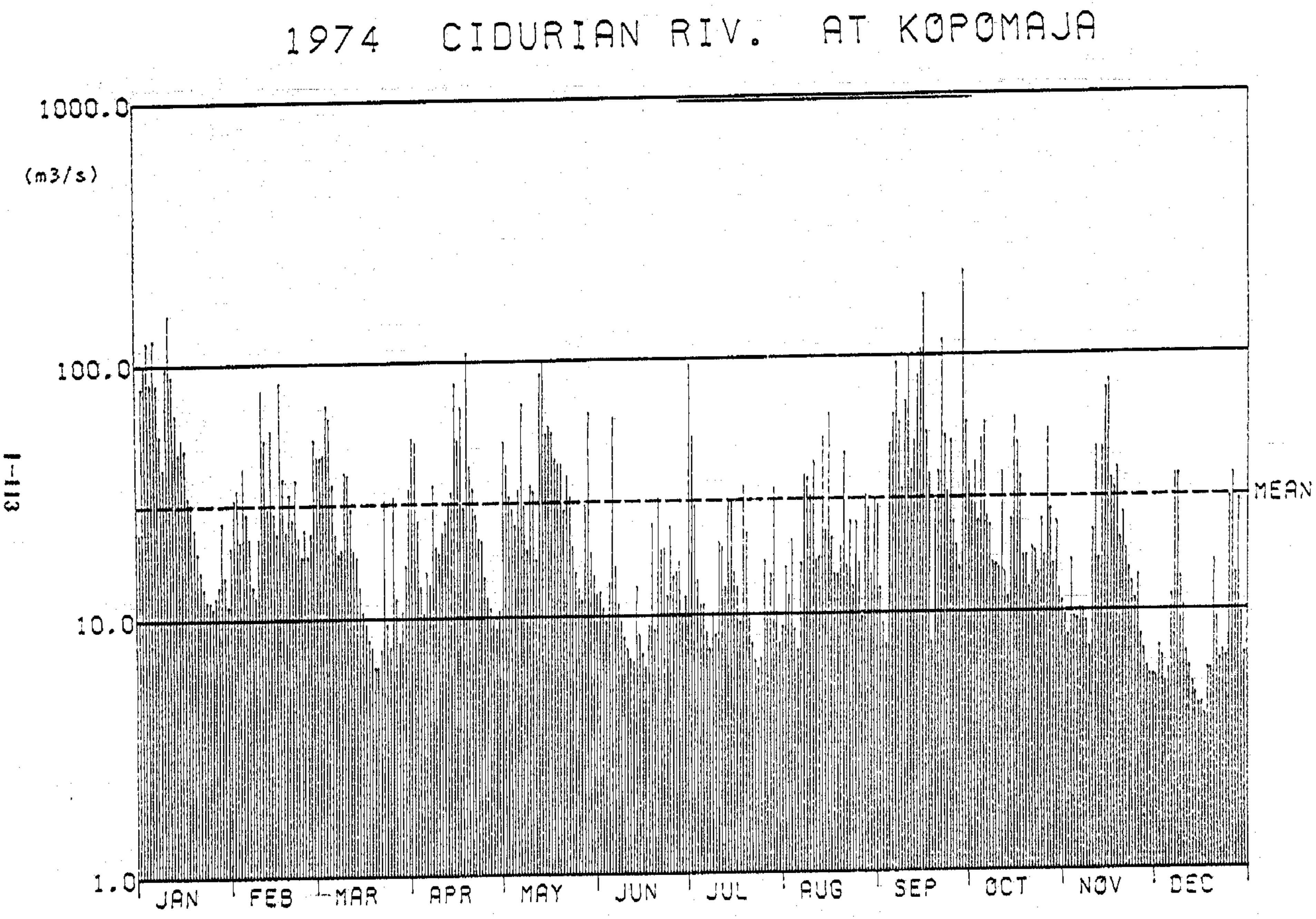


Fig. I-5 Daily Discharge at Kopomaja

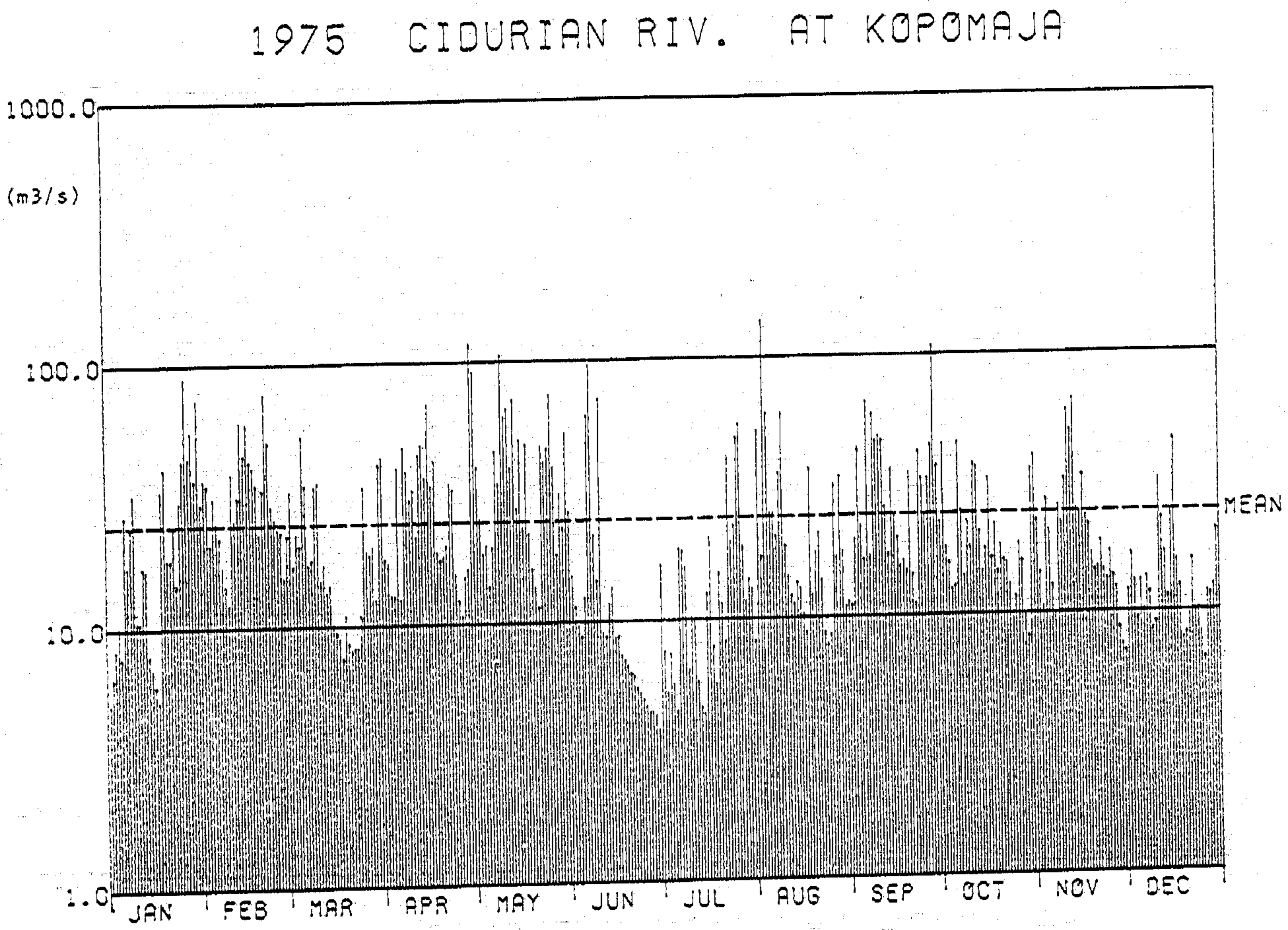


Fig. I-5 Daily Discharge at Kopomaja

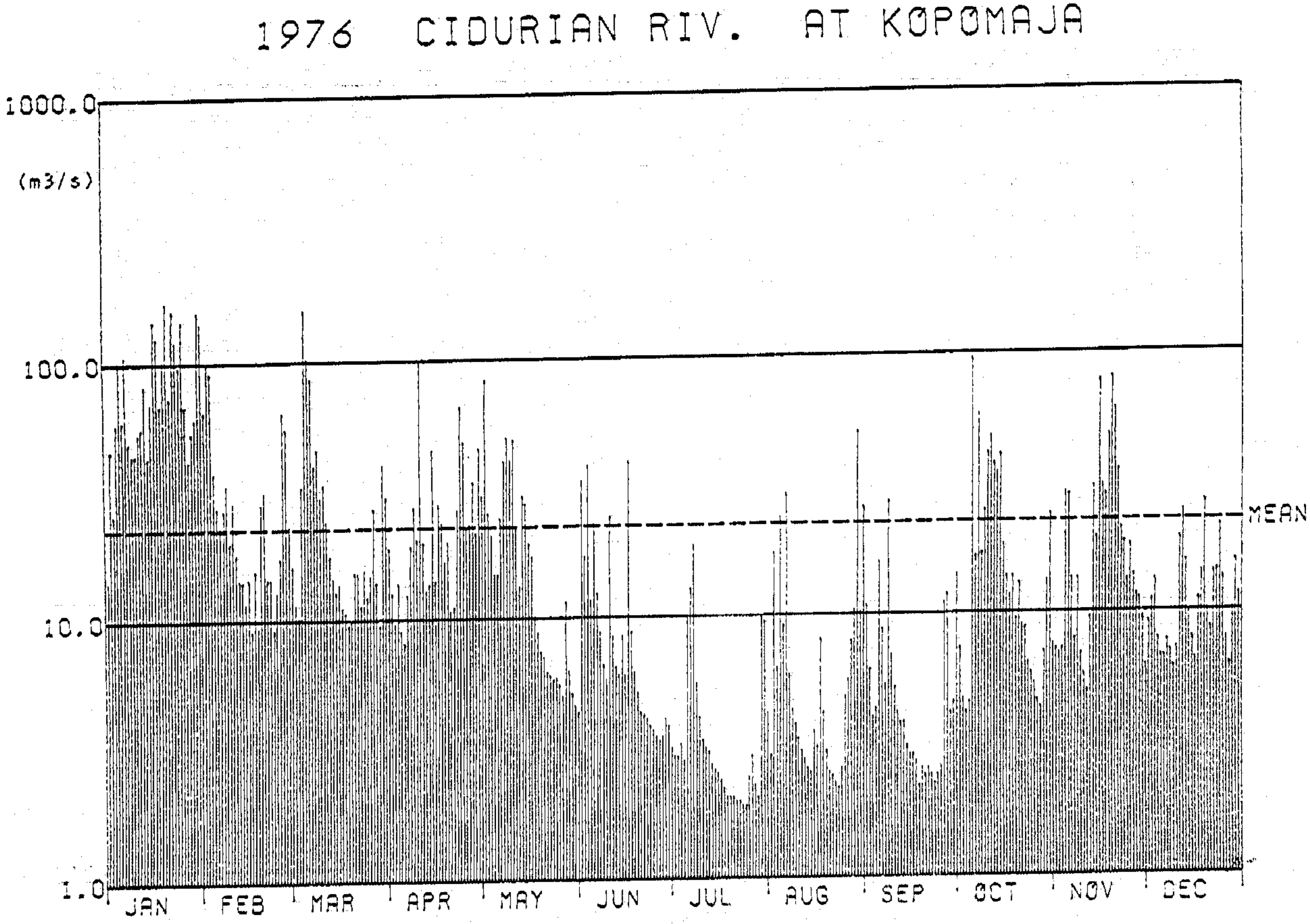


Fig. I-5 Daily Discharge at Kopomaja

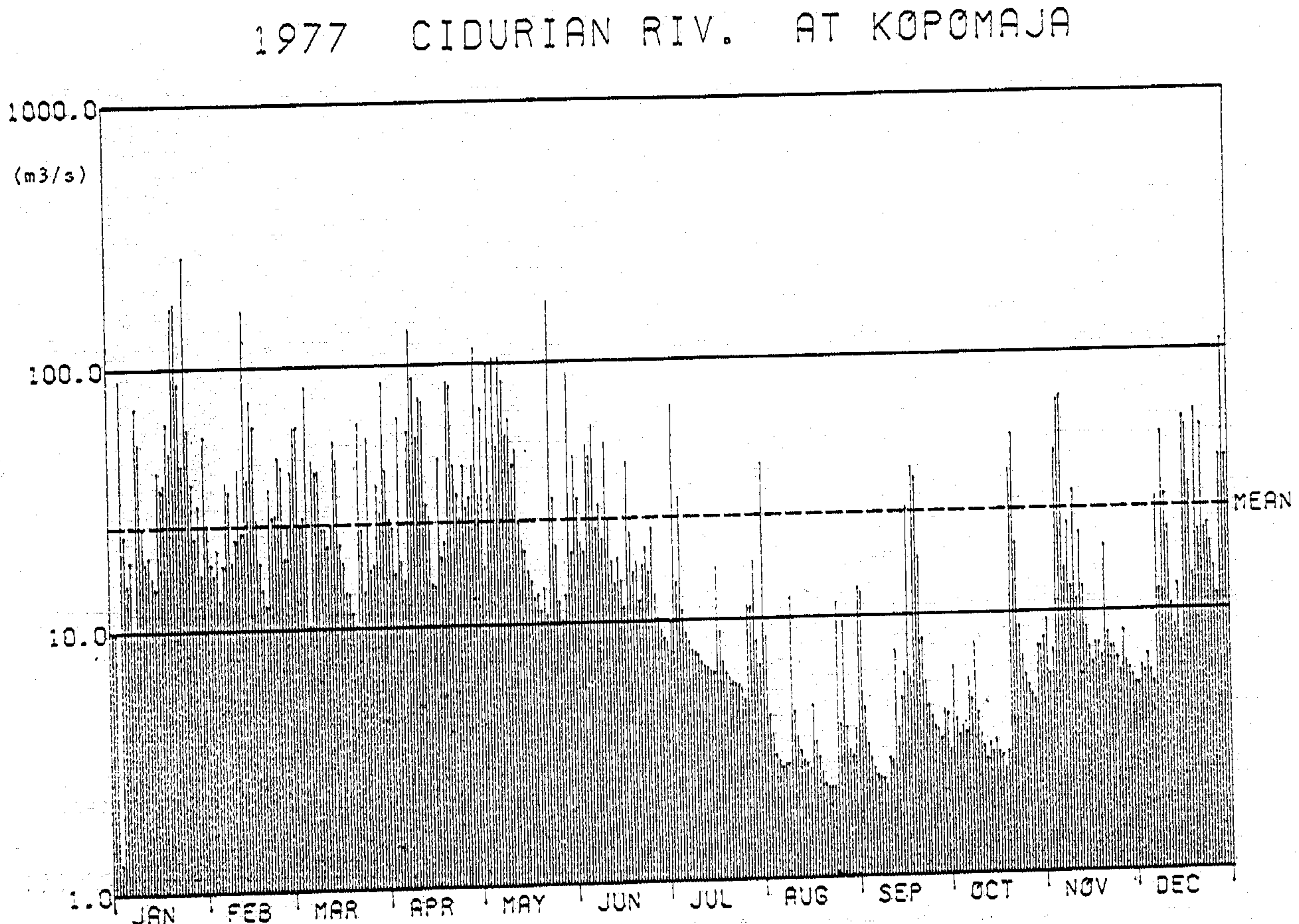


Fig. I-5 Daily Discharge at Kopomaja

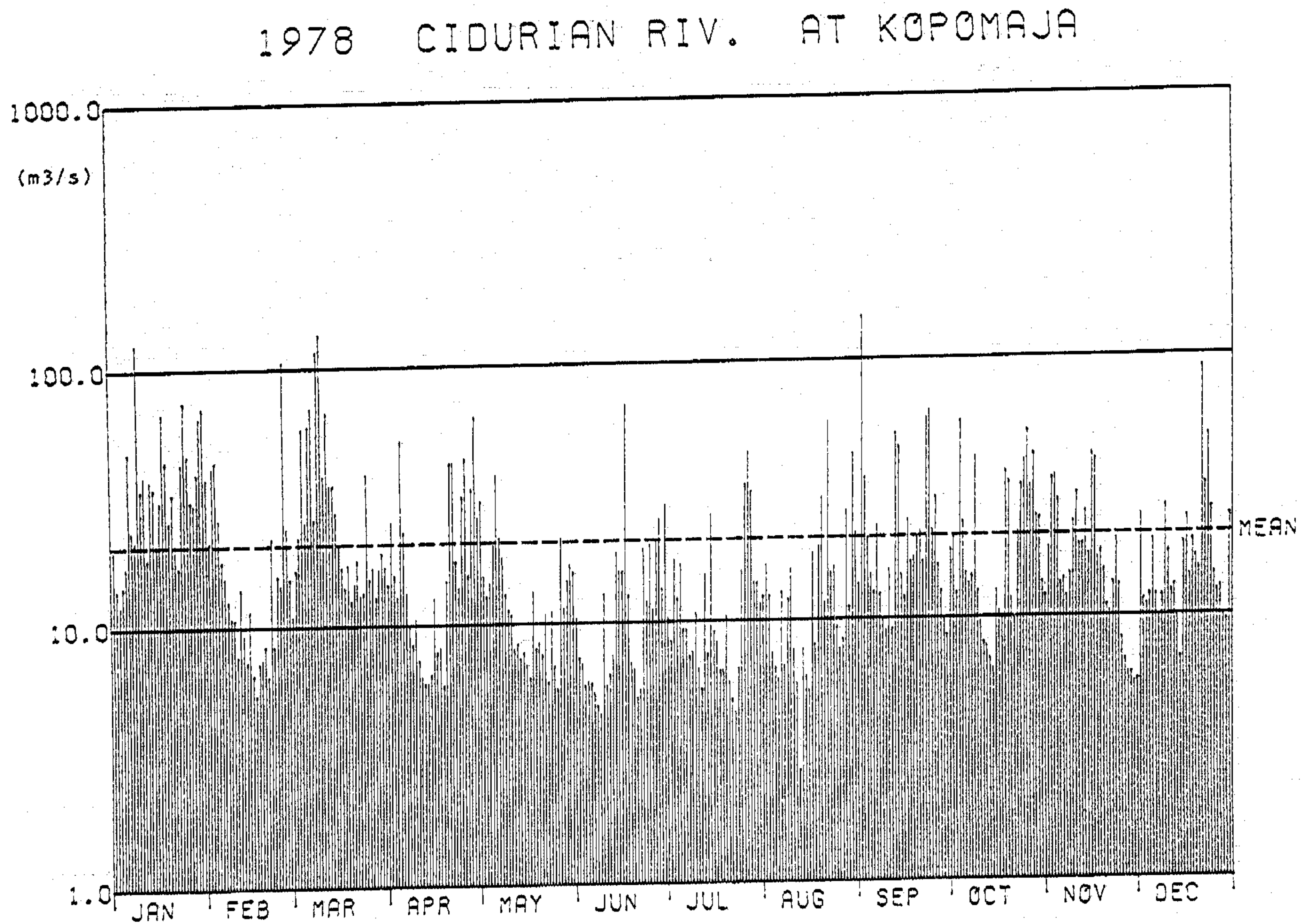


Fig. I-5 Daily Discharge at Kopomaja

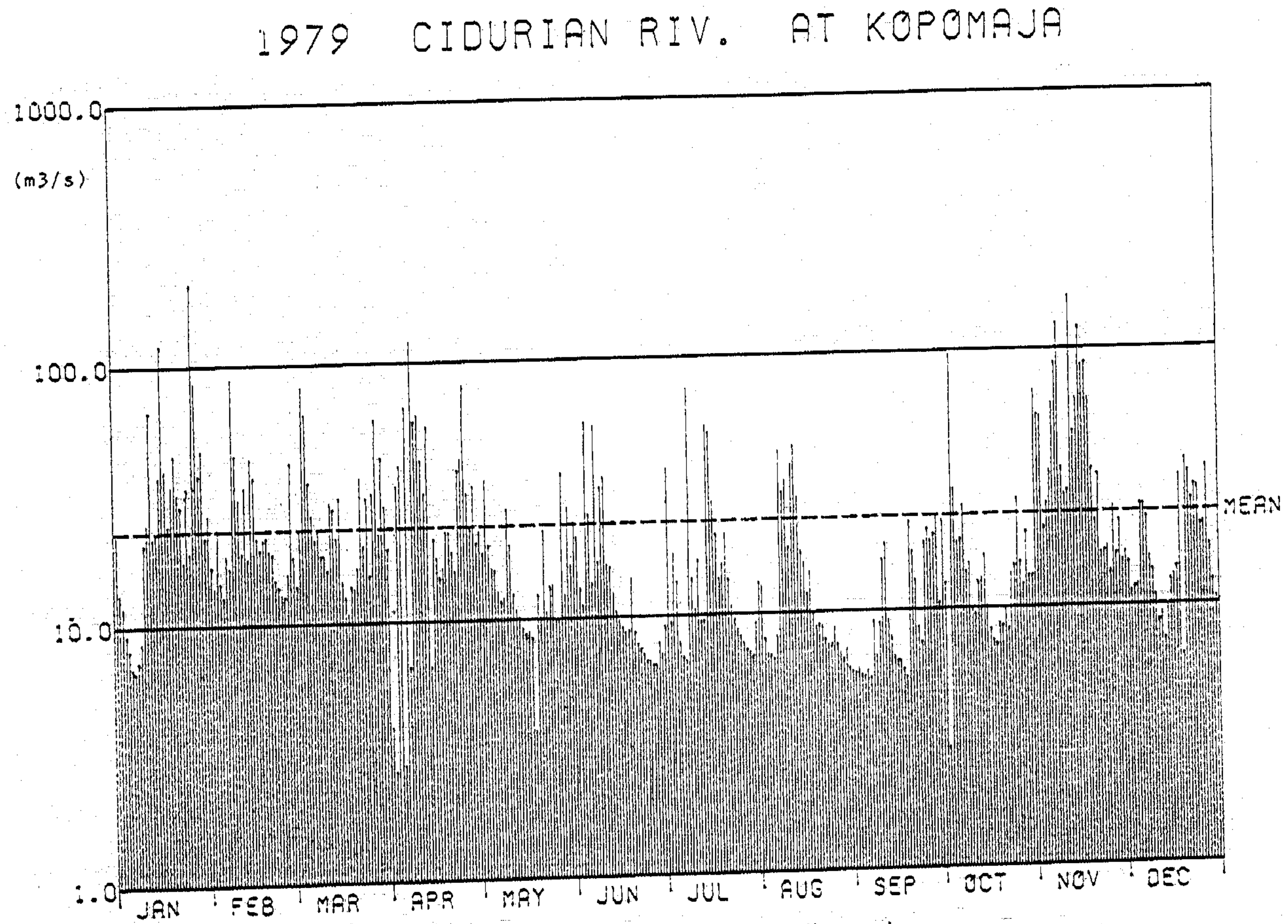


Fig. I-5 Daily Discharge at Kopomaja

1980 CIDURIAN RIV. AT KOPOMAJA

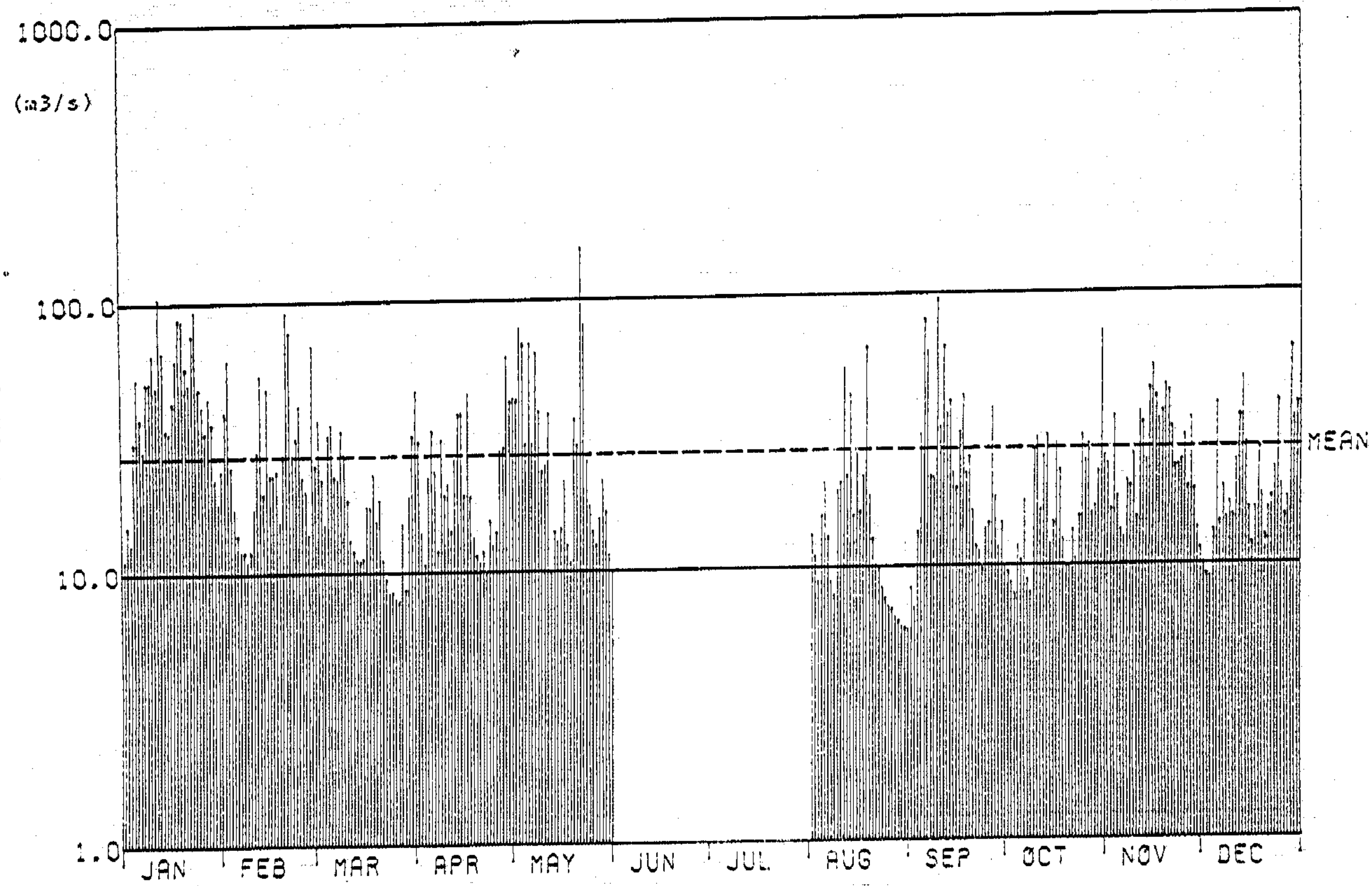


Fig. I-5 Daily Discharge at Kopomaja

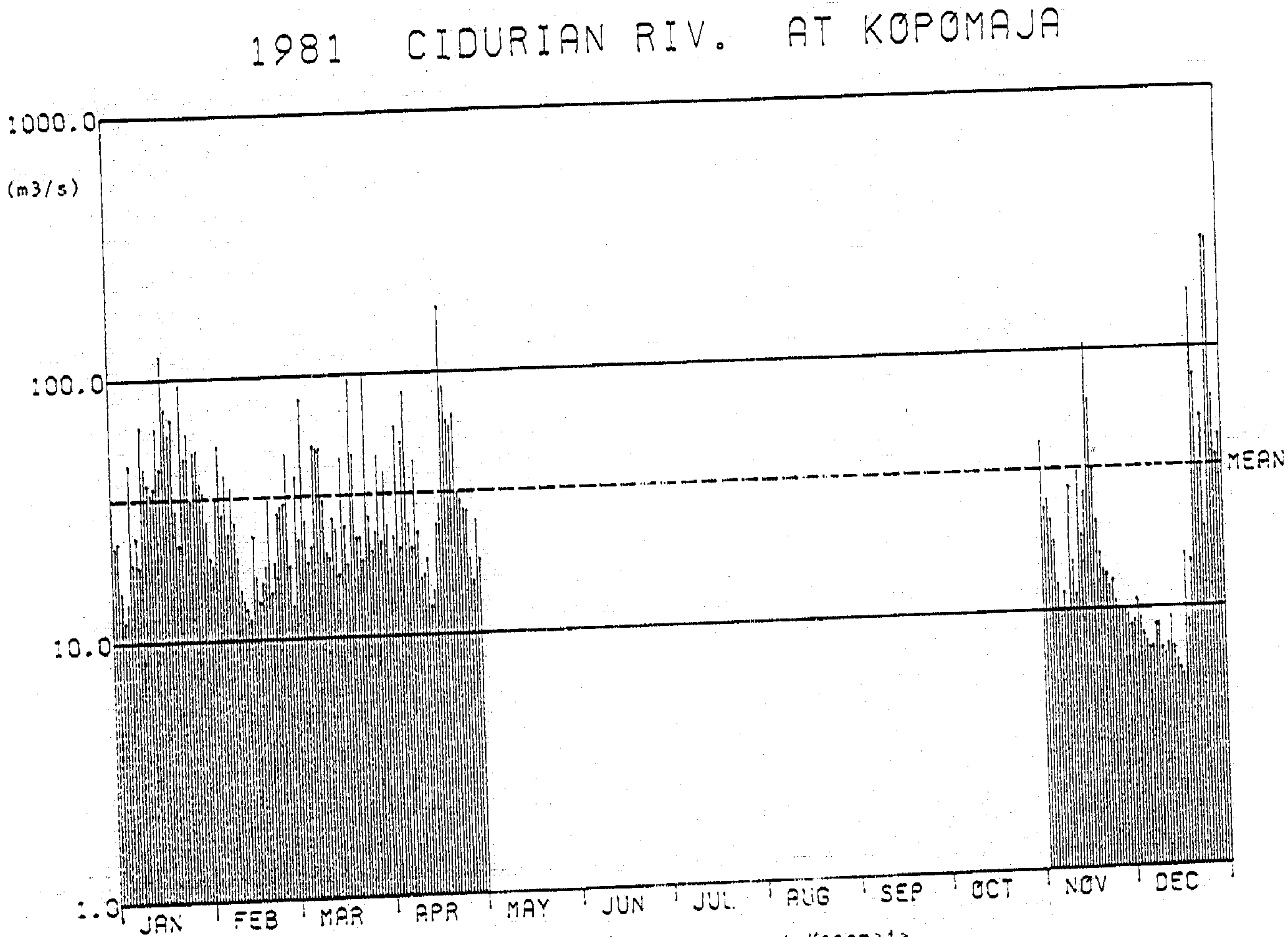


Fig. I-5 Daily Discharge at Kopomaja

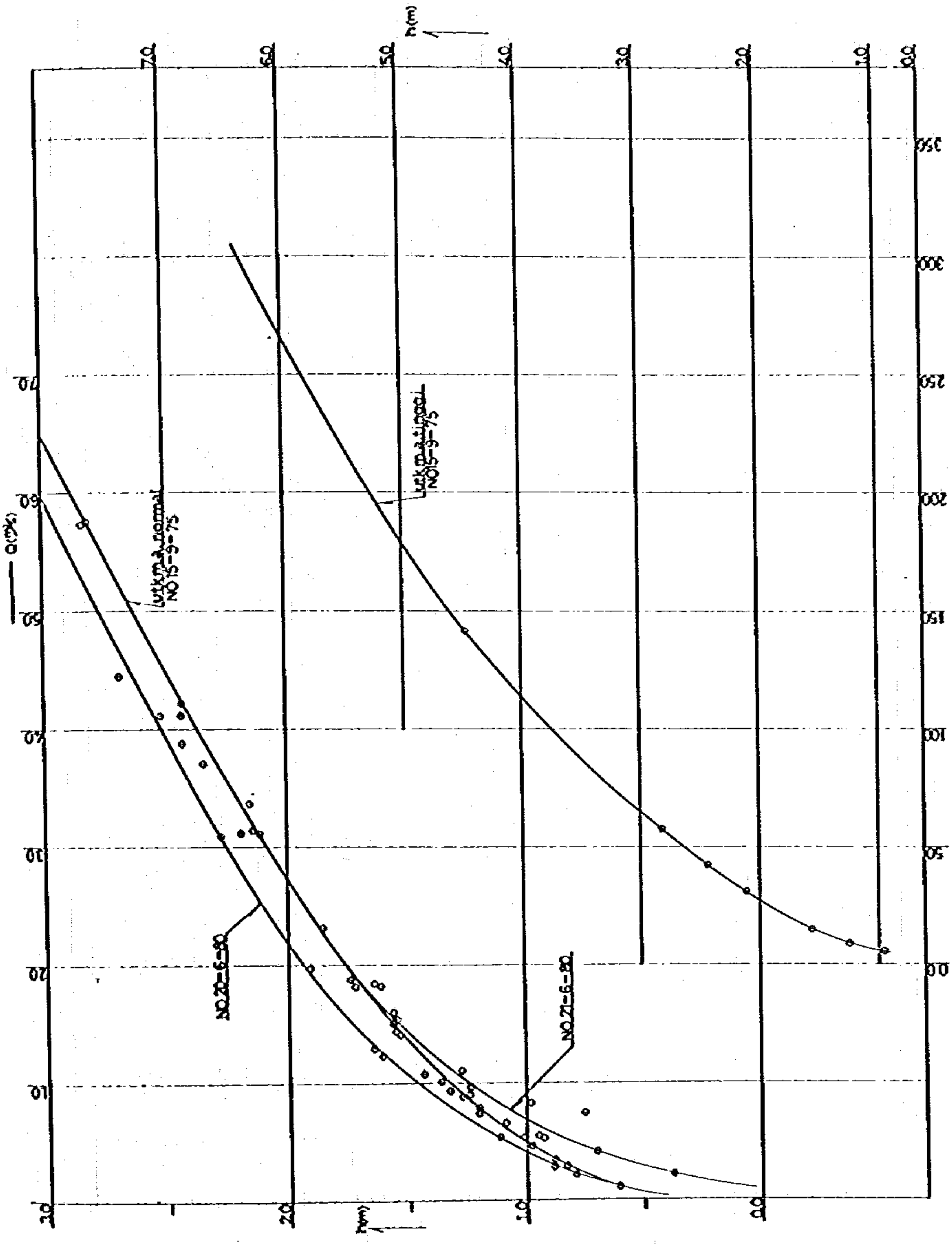
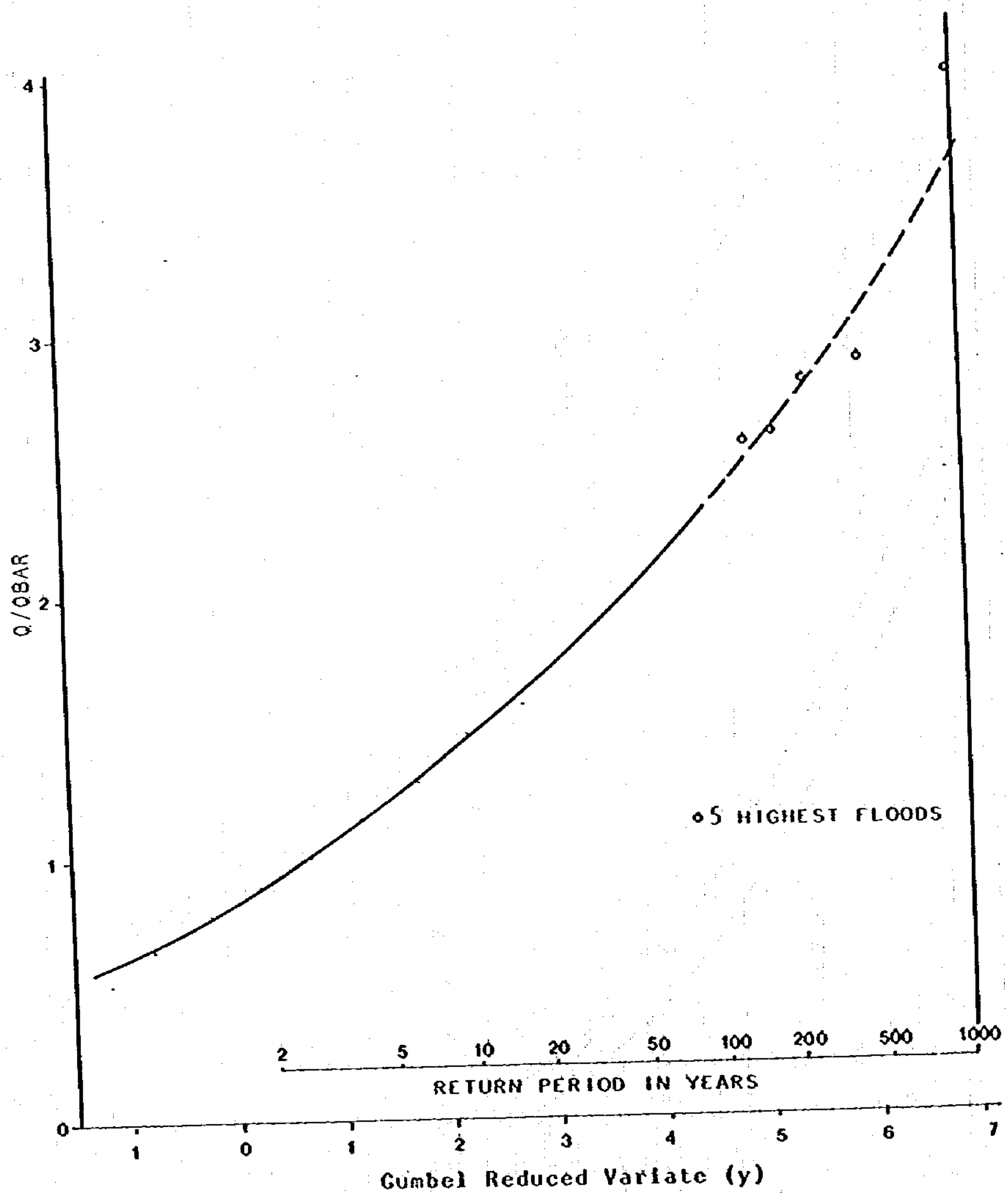


Fig I-6 Rating Curve at Kopomaja



Source:DPHA(1981) FLOOD DESIGN MANUAL FOR JAVA

Fig.I-7 Average Flood Frequency Growth Curve

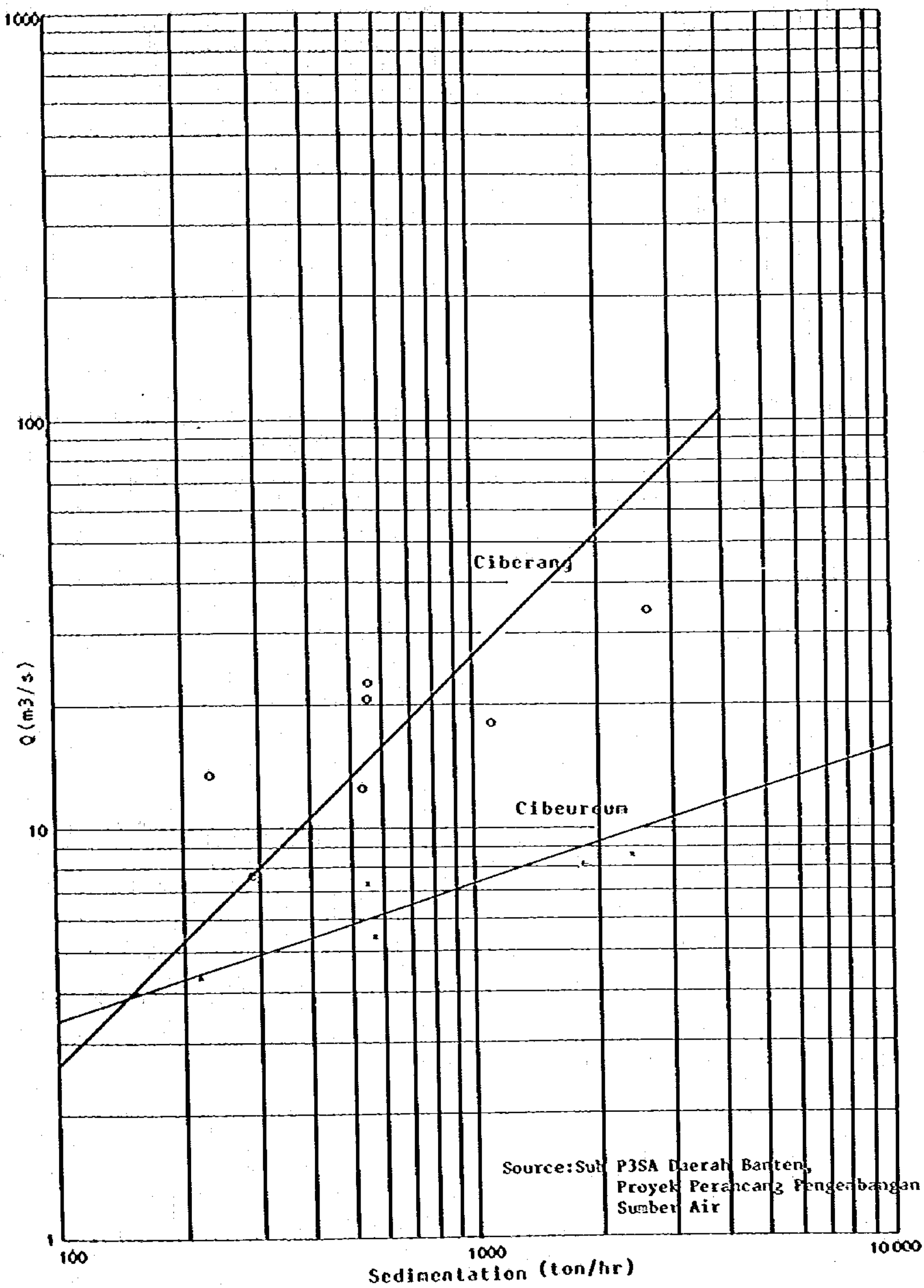


Fig.I-8 Sedimentation Rating Curve

ANNEX - II

SOILS AND LAND CAPABILITY

ANNEX - II SOILS AND LAND CAPABILITY

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ANNEX - II

SOILS AND LAND CAPABILITY

1. SOILS

1.1 General

The findings of the reconnaissance land resources survey of the K-C-C Irrigation Development Project area are presented in two preceding study reports;

(1) Preliminary soil map in the Banten area (scale: 1/250,000), 1966, Soil Research Institute, Bogor.

(2) Report of Land capability survey in the Ciujung watershed and soil map (scale: 1/25,000), 1979, Directorate of Land Use, Jakarta.

The present soil study aims at identifying major soil groups and their distribution and examining the suitability of each soil group for irrigation farming on the basis of field investigation and the findings of past studies mentioned above.

The present report deals with the procedure of the field investigation, major characteristics and land capability of the soil units and soil phases identified in the survey area. The result of the present soil studies is summarized in the SOIL MAP (see Fig.II-1).

1.2 Procedure of Soil Survey

The soil survey is carried out over the area of about 11,300ha by using the topographic map (scale: 1/5,000) and the aerial photos (scale: 1/20,000) taken in March, 1981. The identification and delineation of land units are primarily made on the basis of the aerial photo interpretation for land forms. The preliminary land unit map thus made through photo interpretation is checked and adjusted in the field reconnaissance.

The soil profile survey is then made on the basis of the preliminary land unit map and 32 soil pits are dug to a depth of about one meter. Each soil pit is observed in accordance with the "Guideline for Soil Profile Description" of FAO in 1977. In addition, 46 test boring exploration with one meter hand auger or stick are done to ascertain soil group boundary.

For physico-chemical analyses in labortory, 20 soil samples are collected at the representative horizons of seven (7) profiles. Besides, 20 core samples are taken from typical four (4) soil pits. These core samples are tested for their moisture retention curves (pF). The soil analyses are taken by the Soil Research Institute in Bogor. The items of physico-chemical analysis are (a) pH (H_2O, KCl), (b) total carbon, (c) total nitrogen, (d) available phosphate, (e) phosphate absorption coefficient, (f) cation exchange capacity (CEC), (g) exchangeable cation (Ca, Mg, Na, K), (h) particle size distribution and (i) pF-moisture curves. The results of soil analysis are shown in Table II-1.

1.3 Soil Classification

The soils in the survey area are classified into four (4) soil units, i.e. Eutric Fluvisols, Eutric Gleysols, Orthic Acrisols and Dystric Nitosols according to the FAO/UNESCO soil classification system. These soil units are, furthermore, sub-classified into 12 soil phases which are the special category of soil grouping to separate the soil according to the physiography significant to its practical use and management such as the difference in slope and effective soil depth as shown in Table II-2. The principal properties of each soil units and soil phases are outlined as follows:

(1) Eutric Fluvisols (Grayish Brown Alluvial Soils in Indonesian System)

The soils of this soil unit extend on the natural levee along the Cibeureum river to limited extent. The soils are derived from alluvial deposits and generally immature with no predominant morphological characteristics. In general, the soils having a weak profile development of A-(B)-C horizon. The topsoils are dark brown in color, fine in texture, weak subangular blocky in structure, slightly sticky and plastic in consistence. The subsoils are brownish gray in color, fine in texture, sructureless massive in structure, sticky and plastic in consistence. As for chemical properties, pH value of the soils show less than 5.6 throughout the profile. The cation exchange capacity (CEC) ranges from 35 to 43 meq/100g with more than 80% of the base saturation degree. The soils of this soil unit consist of one (1) Phase as shown in followings:

Phase 1: Flat, Deep, Eutric Fluvisols

The relief of the soils of this Phase is nearly level with slope less than 2%. The effective soil depth is deep. The soils are presently put under cultivation of upland crops. The soils have generally good agricultural potential. The soils are suitable not only for rice but also for a wide range crops. These soils occupy about 110ha or 1.0% of the survey area.

(2) Eutric Gleysols (Gray Hydromorphic Soils in Indonesian System)

The soils of this soil unit, typical wet soils are developed on the valley bottom which densely dissects the hilly land. The soils are derived from run-off deposits from adjacent elevated areas. The soils have horizon sequence of A-Bg-Cg showing hydromorphic properties within 50cm of the surface. Their topsoils and subsoils are predominantly gray in color, fine in texture, structureless massive in structure, very sticky and very plastic in consistence. In general, the soils are characterized by low chroma less than 2 in soil color which indicates that the soils are under reductive conditons. The pH value ranges from 5.1 to 6.2. The cation exchange capacity is over 20 meq/100g. The base saturation degree averages more than 75%. The soils are classified into three (3) Phases as shown below:

Phase 2: Flat, Deep, Eutric Gleysols

The land covered with the soils of this Phase is topographically flat or almost flat. The effective soil depth is deep. At present, the soils are mainly used for the cultivation of rainfed rice in the wet season. Their agricultural potential depends on the degree of water control feasible. The soils of this Phase are extend over about 3,280ha or 29.0% of the survey area.

Phase 3: Gently sloping, Deep, Eutric Gleysols

The soils of this Phase developed on the narrow gently sloping valley bottom among the hilly land. The condition of the soil properties, present land use and agricultural potential are almost similar to those of Phase 2 explained hereinabove. The areas of this Phase are estimated at around 370ha or 3.3% of the total survey area.

Phase 4: Depressed, Deep, Eutric Gleysols

The soils of this Phase are poorly drained soils in the lowlying area and/or in depressions. At present, the areas of this Phase are mostly covered with brush and aquatic plants. This Phase represents 60ha or 0.5% of the survey area.

(3) Orthic Acrisols (Yellowish Brown Podzolic Soils in Indonesian System)

The soils of this soil unit, extending on the hilly land, have a distinct argillic B horizon. The relief is gently undulating with steep slope at its edge. The soils are derived from tuff. Generally, the soils have A-Bt-C in horizon sequence. The topsoils are grayish brown in color, medium in texture, weak subangular blocky in structure, slightly sticky and slightly plastic in consistence. The subsoils are brownish gray in color, medium to fine in texture, moderate subangular blocky in structue, sticky and plastic in consistence. According to the chemical analysis, pH value ranges from 4.8 to 5.6. The cation exchange capacity is generally low, showing less than 34.2 meq/100g. The base saturation degree averages about 50%. The soils of this soil unit are, furthermore, classified into five (5) Phases as follows:

Phase 5: Flat, Deep, Orthic Acrisols

The soils of this Phase cover the flat or almost flat land on the upper hill. The effective soil depth is generally deep. The soils are presently used for the cultivation of rainfed rice and upland crops in the wet season. During the dry season, however, the soils are left fallow due to lack of water. The soils are chemically poor, being acid, and lacking in natural fertility. The soils of this Phase are estimated at 920ha or 8.1% of the survey area.

Phase 6: Gently Sloping, Deep, Orthic Acrisols

The soils of this Phase extend the undulating land on the hill slopes. The condition of soil properties and present land use are generally same as Phase 5. These soils occupy 620ha in total or 5.5% of the survey area.

Phase 7: Sloping, Deep, Orthic Acrisols

The relief of this Phase is steeply dissected to hilly land. The effective soil depth is generally deep. At present, the land of this Phase is mainly covered by shrub. The soils represent about 110ha or 1.0% of the survey area.

Phase 8: Gently sloping, Shallow, Orthic Acrisols

The soils of this Phase are developed on the gently sloping land on the hill slopes. The effective soil depth is generally shallow. The soils of this Phase include Dystric Regosols. The soils are mainly used for cultivation of rainfed rice in the wet season. The agricultural potential of the soils is generally low. The extents are estimated at about 100ha or 0.9% of the survey area.

Phase 9: Sloping, Shallow, Orthic Acrisols

The relief of this Phase is steeply dissected to hilly land. The erosion hazard of this Phase is great. The soils have shallow effective soil depth and are presently left. The agricultural potential is generally low. The area of this Phase occupy about 20ha or 0.2% of the survey area.

(4) Dystric Nitosols (Reddish Latosols in Indonesian System)

The soils of this soil unit are mainly developed on the sloping or undulating hilly land. The soils are derived from tuff and have shinny ped surfaces to a great depth. The soils generally have A-Bt-C horizons. The topsoils are dark reddish brown to brown in color, medium to fine in texture, weak subangular blocky in structure, sticky and slightly plastic in consistence. The subsoils are dark reddish brown to brownish gray in color, fine in texture, medium subangular blocky in structure, sticky and plastic in consistence. The pH value averages 5.3. The cation exchange capacity ranges from 20.9 to 29.0 meq/100g. The base saturation degree is generally low, showing about 50%. The soils of this soil unit are classified into three (3) Phases as shown in below:

Phase 10: Flat, Deep, Dystric Nitosols

The soils of this Phase develop on the almost flat land of the upper hilly land. The effective soil depth is generally deep. The area of this Phase is mostly used for cultivation of upland crops. The soils have generally high agricultural potential. The soils represent 830ha or 7.3% of the survey area.

Phase 11: Gently Sloping, Deep, Dystric Nitosols

The land covered with the soils of this Phase is topographically undulating hilly land. The characteristics of these soils are almost same as the Phase 10. The land is mainly covered by upland field and/or shrub occupying about 2,620ha or 23.2% of the survey area.

Phase 12: Sloping, Deep, Dystric Nitosols

In general, the relief of this Phase is steeply dissected. The conditions of the soil properties are almost similar to those of Phase 10 and 11. The area of this soils is presently put under shrub. The soils are estimated at about 2,260ha or 20.0% of the survey area.

The typical soil profile of these soil units is shown in Table II-3.

2. LAND CAPABILITY

2.1 General

Three (3) major land classification systems have been applied for water resources development projects in Indonesia as follows:

(1) USDA land capability classification system /1

(2) USBR land classification system /2

(3) FAO land suitability classification system /3

(4) Japanese land classification standard /4

The USDA system is most widely used, but it does not meet the particular requirement for irrigation project. It is mainly used for rainfed agriculture in general. In the USDA system, lands are classified into eight (8) classes and lower four (4) classes from V to VIII are ranked as "not suitable for agricultural production".

The USBR system was devised originally for irrigated land use. However, the basic concept of the USBR system is generally to assess the lands under arid climate and/or assess land productivity for dryland field crops such as wheat, barley, cotton, etc. Some modification of this system is required under Indonesian condition due to the different requirements for irrigated rice cultivation under humid climate. Although several approaches to the modification have been made by various study groups, none of them has been fully authorized at present. The USBR system has six (6) classes, I to III being arable, IV being suitable only for special uses and VI nonarable. Class V is reserved for undecided suitability, but in practice this class is often omitted.

The FAO system is more flexible than US systems and can be applied to the full range of environments. It is the system that the Soil Research Institute in Bogor recommends for use in Indonesia. However, this system does not serve the detailed criteria for suitability assessment on the irrigated rice cultivation. The FAO system for land suitability classification is used for assessment of lands in terms of

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/1: Land Capability Classification, Agricultual Handbook No. 210, 1961, Soil Conservation Services, USDA

/2: Bureau of Reclamation Manual Vol. 5 Irrigated Land Use, Part 2: Land Classification, 1953, USBR

/3: A Framework for Land Evaluation, 1976, FAO

/4: Outline of Land Classification based on Soil Survey in Japan, 1977, National Institute of Agricultural Science, Tokyo their relative suitability for a specific type of use. In the FAO system, the land suitability classes for each specific utilization type reflect degrees of suitability or of limitation, i.e., S_1 (highly suitable), S_2 (moderately suitable), S_3 (marginally suitable), N_1 (currently not suitable) and N_2 (permanently not suitable).

Considering all these, it is conceived that the Japanese land classification standard for rice can be applied to the feasibility study on the K-C-C Irrigation Development Project. The Japanese system is devised originally for rice cultivation and its classification criteria are detailed enough for land capability assessment on a feasibility study level. In the Japanese system, lands are classified into four (4) capability classes, i.e., I, II, III and IV. Each class is defined as follows:

Class I — Land has almost no limitation for crop production and/or no risk of soil damage. It is naturally fertile and has a great potential for crop production without any improvement practices of soils.

Class II — Land has some limitations for crop production and/or some risks of soil damage, and riquires some soil improvement practices for normal crop production.

Class III — Land has many limitations for crop production and/or is likely subject to risks of soil damage, and fairly intensive improvement practices are required.

Class IV — Land has great natural limitations than these in Class III, but can be utilized for cultivation of some specific crops under very careful management.

The Japanese system, four (4) class classification of arable land, is, therefore, correlative with US systems. And it is considered that the FAO system of suitability classes from S_1 to N_1 nearly correspond to four (4) classes described in the Japanese system.

In view of above consideration, the Japanese system seems to be most suitable for land capability classification for rice fields due to its detailed correlative with other systems.

2.2 Specification of Land Capability Classification

In the Japanese system, there are 13 factors for assessment of land capability as shown below:

(1) thinckness of top soil
(2) effective soil depth
(3) gravel content in top soil
(4) easiness of plowing
(5) permeability under submerged condition /1
(6) state of redox potential
(7) wetness of land /2
(8) inherent fertility
(9) content of available nutrient
(10) degree of hazard
(11) frequency of hazard
(12) slope /2
(13) erosion /2

The specification of land capability class are explained as follows:

(1) Thickness of top soil (code: t)

The top soil is the first horizon where plant roots can easily penetrate, and generally corresponds to the plowed layer. The classes are grouped according to the thickness of top soil as follows:

Thickness of top soil (cm)	Class		
	Rice	Upland crops	Orchard
more than 25	I	I	I
25 ~ 15	I	II	I
less than 15	II	III - IV*	III - IV*

Remark: *: When effective soil depth is placed to class IV, this factor also is placed to class IV.

/1: Factors for rice only
/2: Factors for upland crops only

(2) Effective soil depth (code: d)

Effective soil depth is the depth up to bedrock, hard pan and gravel layer which plant roots can not penetrate. The classes are grouped, according to thickness of the effective soil depth, as follows:

Effective soil depth (cm)	Class		
	Rice	Upland crops	Orchard
more than 100	I	I	I
100 - 50	I	II	II
50 - 25	II	III	III
15 - 25	III	III	IV
less than 15	IV	IV	IV

(3) Gravel content in top soil (code: g)

Gravel contents in top soil are expressed by the percentage of the exposed surface area of gravel on the soil profile, and are graded into the following classes:

Gravel content (%)	Class		
	Rice	Upland crops	Orchard
less than 5	I	I	I
5 - 10	I	II	I
10 - 20	I - II	II - III	I - II
20 - 50	II - III	III - IV	II - III
more than 50	IV	IV	IV

(4) Easiness of plowing (code: p)

Easiness of plowing largely depends upon the quantity and quality of clay and organic matter and moisture condition. In order to estimate the class of this factor, the following four (4) sub-factors are used.

(a) Soil texture of top soil (evaluated by clay content); (%)

		content of clay
1. coarse to medium	:	less than 15
2. fine	:	15 - 25
3. very fine	:	more than 25

(b) Stickness of top soil;

1. none and/or slightly sticky
2. sticky
3. very sticky

(c) Consistence when dry;

1. loose
2. hard
3. very hard

These sub-factors are combined altogether to determine capability classes as follows:

Sub-factors a	b	c	Class	Criteria
1	1	(2)	I	Easy to slightly difficult
2	1	1	I	
2	2	1	I	
2	2	2	I - II	Moderately difficult
3	3	2	II - III	
3	3	3	III	Very difficult

(5) Permeability under submerged condition (code: 1)

This factor affects irrigation water requirement, soil temperature, and leaching of the nutrients or development of reduced condition of the soil. This standard factor is evaluated mainly by the combination of soil texture and the presence of compact layer within 50cm from the surface, as sub-factors:

(a) Soil texture (evaluated by clay content); (%)

		content of clay
1. very fine	:	more than 25
2. fine	:	25 - 15
3. medium to coarse	:	less than 15

(b) Compactness (evaluated by hardness meter); (kg/cm^2)

1. compact	:	more than 14.0
2. medium	:	14.0 - 1.4
3. loose	:	less than 1.4

Sub-factors a	b	Class Rice	Criteria
1	1	I	Poorly to imperfectly permeable
1	2	I	
2	2	I - II	Moderately to well permeable
3	2	II	
3	3	III	Permeable

(6) State of redox potential (code: r)

This factor indicates the risk of root damage owing to the strong reduction of soil, resulting in low rice production. The following sub-factors are used for the evaluation of this factor.

(a) Content of easily decomposable organic matter in top soil; (NH_4-Nmg/100g)

1. low : less than 10
2. medium : 10 - 20
3. high : more than 20

(b) Content of free iron oxides in top soil; (%)

1. high : more than 1.5 for dry soil
2. medium : 1.5 - 0.8
3. low : less than 0.8

(c) Degree of gleyzation;

1. weak : no gley horizon within 50cm from the surface
2. medium : gley horizon exist within 50cm from the surface
3. strong : gley horizon exist throughout profile or exist below plowing layer

Sub-factors				Criteria
a	b	c	Class	(risk of root damage)
1	1	2	I	None to weak
1	3	2	I	
2	1	2	I	
1	1-2	3	II	Moderate to strong
1	3	3	II	
2	1-2	3	II	
3	1	2	II	
2	3	3	III	Very stong
3	2	2	III	
3	1	3	III	
3	3	2	III	

(7) Wetness of land (code: w; wet condition, (w); dry condition)

This factor is only applied to upland crops and orchard. This factor is used for the estimation of wet or drought injury of upland crops and trees, and is evaluated by the combination of the following three (3) sub-factors:

(a) Permeability;

1. high
2. medium
3. low

(b) Water holding capacity (evaluated by AMC*);

1. high	:	more than 20
2. medium	:	20 - 10
3. low	:	less than 10

Remark: * ; AMC = Field Capacity (pF1.5) - Wilting Point (pF4.2)

(c) Moisture condition;

(2). dry
1. slightly moist
2. moist
3. wet

Sub-factors a	b	c	Class	Criteria (risk of drought or wetness)
1	3	(2)	(IV)	High possibility of drought
1	3	1	(III)	Possibility of drought
1	2	1	(II)	Low possibility of drought
1	1	1	I	None
2	2	2	II	Low possibility of overwetness
1-3	1	3	III	Possibility of overwetness
3	2	3	IV	High possibility of overselness

(8) Inherent fertility (code: f)

Inherent fertility is evaluated by the combination of the following three (3) sub-factors:

(a) Nutrient holding capacity (evaluated by CEC); (meq/100g)

1. high : more than 20
2. medium : 20 - 6
3. low : less than 6

(b) Nutrient fixation power (evaluated by phosphate absorption coefficient); (P_2O_5 mg/100g)

1. very low : less than 700
2. low : 700 - 1,500
3. medium : 1,500 - 2,000
4. high : more than 2,000

(c) Base status in soil (evaluated by base saturation degree); (%)

1. good : more than 50
2. medium : 50 - 30
3. poor : less than 30

For rice

Sub-factors a	b	c	Class	Criteria
1	1-2	2	I	Fertile
2	1-2	1	I	
1	1-2	3	II	Medium
1	3-4	2	II	
2	1-2	2	II	
3	1	2	II	
2	3-4	3	III	Infertile
3	2	2	III	
3	3-4	3	III	

For upland crops and orchard

Sub-factors a	b	c	Class	Criteria
1	2	1	I	Fertile
2	1	2	I	
1	2	3	II	Medium
1	3	1	II	
1	3	2	II	
2	1	3	II	
2	4	1	II	
1	3	3	III	Infertile
2	4	2	III	
3	1	1	III	

(9) Content of available nutrients; (code: n)

Content of available nutrients in soil is closely related to the inherent soil fertility, and are evidently influenced to cultivation practices. The capability class is evaluated by the combination of the following sub-factors:

(a) Content of exchangeable calcium; (meq/100g)

1. high : more than 7.2
2. medium : 7.2 - 3.4
3. low : less than 3.4

(b) Content of exchangeable magnesium; (meq/100g)

1. high : more than 1.2
2. medium : 1.2 - 0.5
3. low : less than 0.5

(c) Content of available potassium; (meq/100g)

1. high	:	more than 0.3
2. medium	:	0.3 - 0.1
3. low	:	less than 0.1

(d) Content of available phosphate; (P_2O_5 mg/100g)

1. high	:	more than 10
2. medium	:	10 - 2
3. low	:	less than 2

(e) Content of available nitrogen; (NH_4-Nmg/100g)

1. high	:	more than 20
2. medium	:	20 - 10
3. low	:	less than 10

(f) Content of available silica; (SiO_2mg/100g)

1. high	:	more than 15
2. medium	:	15 - 5
3. low	:	less than 5

(g) Content of micro elements (evaluated by the risk of deficiency);

1. none and/or weak
2. medium
3. serious

(h) Acidity (evaluated by pH);

Paddy	Upland & Orchard			
1	1	weak	:	more than 6.0
1	2	medium	:	6.0 - 5.0
2	3	strong	:	5.0 - 4.5
3	4	very strong	:	less than 4.5

Class	Criteria
I	High
II	Medium
III	Low

(10) Degree of hazard; (code: i)

This factor means limitation caused by the presence in excess of substances such as sulphur compounds, soluble salts, heavy metals, etc. Dependent sub-factors for this factor are as follows:

(a) Presence of harmful substances;

(i) Harmful sulfphur compounds:

1. none
2. slightly
3. moderately
4. seriously

(ii) Salts content (evaluated by chlorine content as an indicator); (%)

1. low	:	less than 0.1
2. medium	:	0.1 - 0.3
3. high	:	more than 0.3

(iii) Heavy metals;

1. none
2. slightly
3. moderately
4. seriously

(iv) Irrigation water quality;

		Temp. (⁰C)	pH	Total nitrogen (ppm)	Salts content (ppm)
1.	good	> 20	6.0-7.5	< 1.0	< 500
2.	medium	20-15	4.0-6.0/ 7.5-8.5	1.0-5.0	500-2,000
3-4.	polluted	< 15	< 4.0>8.5	> 5.0	> 2,000

(b) Physical hazard

Presence of bedrock, pan, compact layer or gravel layer that disturb root development within 50cm of the surfacem and difficult of their removal:

1. none
2. slightly difficult
3. very difficult

The class of this factor is decided by the lowest grade among the dependent sub-factors.

Class	Criteria
I	None
II	Slightly
III	Moderately
IV	Seriously

(11) Frequency of hazard; (code: a)

This factor is mainly influenced by natural environmental condition. The class of this factor is determined by the combination of the following two (2) dependent sub-factors:

(a) Risk of overhead flooding inundation;

1. none and/or rarely : no risk if rainfall with high intensity occurs
2. moderately : even if inundation occurs due to high rainfall intensity, excess water is drained out in a short period
3. frequently : inundation continuous for a long period if rainfall with high intensity occurs

(b) Risk of land creep;

1. none and/or rarely
2. moderately
3. frequently

The class of this factor is determined by the lowest grade of two (2) dependent sub-factors.

Class	Criteria
I	None to rarely
II	Moderately
III	Frequently

(12) Slope; (code: s)

This factor is applied to upland and orchard only. The class of this factor is decided by the combination of the following sub-factors:

(a) Natural slope as a main dependent sub-factors: five (5) grades as shown in the following table
(b) Direction of slope
(c) Artificial slope

Steepness of slope (%)	Class	
	Upland crops	Orchard
less than 6	I	I
6 - 14	II	I - II
14 - 28	III	I - III
28 - 47	IV	II - III
more than 47	IV	IV

(13) Erosion; (code: e)

The class of this factor is determined by the combination of the following sub-factors:

(a) Occurrence of rill or gully;

			Occurrence of rill	Occurrence of gully
1.	none	:	none	none
2.	rarely	:	rarely	none
3.	moderately	:	sometimes	none
4.	frequently	:	frequently	exist

(b) Resisting power to water erosion;

1. strong
2. medium
3. weak

(c) Resisting power to wind erosion;

1. strong
2. medium
3. weak

Class	Criteria
I	None or very slightly
II	Slightly
III	Seriously
IV	Very seriously

The specification of Japanese land capability class is summarized in Table II-4.

2.3 Land Capability

The land is evaluated by using the assessment factors mentioned above. The land capability class is determined at the lowest class of the factors. Limitation on suitability of land due to 13 factors are indicated by use of codes like "t", "g", "d" either individually and collectively, as shown in the following example.

	Factor	Code	Paddy	Upland
1.	thickness of top soil	t	I	III
2.	effective soil depth	d	I	I
3.	gravel content in top soil	g	I	I
4.	easiness of plowing	p	II (3,3,2)	II (2,2,2)
5.	permeability under submarged condition	l	II (1,3)	-
6.	state of redox potential	r	II (2,1,3)	-
7.	wetness of land	w	-	IV (3,1,3)
8.	inherent fertility	f	I (1,2,2)	III (1,2,3)
9.	content of available nutrient	n	II (2,1,1,1, 2,2,2,2)	III (3,3,3, 3,3,3)
10.	degree of hazard	i	I (1,1)	I (1,1)
11.	frequency of hazard	a	I (1,1)	I (1,1)
12.	slope	s	-	I (1,1,1)
13.	erosion	e	-	I (1,1,1)

Land capability class : Paddy; IIplrn
Upland; IVw

On the basis of land classification specifications defined in Section 2.2, the land in the survey area is graded into four (4) classes, i.e. Class I to Class IV. The limitations for the cultivation of rice and upland crops in each class are outlined as follows:

(1) Class I: Arable

The land of Class I having almost no significant limitation is highly suitable for irrigation farming, being capable of producing sustained and high yields of crops at reasonable cost.

As for the rice cultivation, the land of Class I is estimated at around 3,650ha. It is 32.3% of the total survey area of 11,300ha.

In the survey area, there is no land of Class I for the cultivation of upland crops.

(2) Class II: Arable

The land of Class II is moderately suitable for the crop cultivation, and relatively high productivity can be expected. However, the land of Class II has some limitations for crop production and more costly to farm.

As to the rice cultivation, the land of Class II has such limitations as medium nutrient fixation power (code: f) and medium contents of available phosphate (n). The land extends over 7,470ha or 66.1% of the survey area.

Concerning with the cultivation of upland crops, the land of Class II has some limitations caused by moderately difficulty in plowing because of heavy texture (p), medium degree of gleyzation (r), medium permeability and medium water holding capacity (w), medium nutrient fixation power (f) and medium contents of available phosphate and medium acidity (n). The land has the acreage of 3,760ha or 33.3% of the survey area.

(3) Class III: Arable

The Class III is of marginally suitable land where the cultivation of rice and upland crops is fairly productive. But, there are many limitations for crop production. These constraints will increase in cost for improvement.

As for the rice cultivation, the land of Class III has shallow effective soil depth (d), strong degree of gleyzation (r) and susceptibility to an inundation (a) as a limitation. The land is estimated at 160ha or 1.4% of the survey area.

In regard to the cultivation of upland crops, the land of Class II has many limiting factors as shallow effective soil depth (d), low contents of available phosphate (n), rolling topography (s) and serious susceptibility to the soil erosion (e). The land is about 7,460ha, corresponding to about 66.0% of the survey area.

(4) Class IV: Limited arable

The land of Class IV is distinctly restricted suitable for the cultivation of rice and upland crops. The land has less productivity than that in Class III because of unfavorable physical conditions. These limitations are difficult to surmount economically.

With respect to the rice cultivation, the land of Class IV has specific constraint of very shallow effective soil depth (d). The land extends over about 20ha or 0.2% of the survey area.

As to the cultivation of upland crops, the land of Class IV has excessive dificiencies of significantly thin top soil (t), very shallow effective soil depth (d), wet condition (w) and very serious susceptibility to the soil erosion (e). The land is estimated at 80ha or 0.7% of the survey area.

The correlation between soil units and land capability class is shown in Table II-5 and summarized as follows:

	Soil Unit	Capability Class (Paddy/Upland)	Survey Area (ha)	Proportional Extent (%)
I.	Eutric Fluvisols		110	1.0
	Phase 1. Flat, Deep	IIn/IIwfn	110	1.0
II.	Eutric Gleysols		3,710	32.8
	Phase 2. Flat, Deep	I/IIprw	3,280	29.0
	Phase 3. Gently sloping, Deep	I/IIprw	370	3.3
	Phase 4. Depressed, Deep	IIIra/IVw	60	0.5

Soil Unit	Capability Class (Paddy/Upland)	Survey Area (ha)	Proportional Extent (%)
III. Orthic Acrisols		1,770	15.7
Phase 5. Flat, Decpt	IIfn/IIIn	920	8.1
Phase 6. Gently sloping, Deep	IIfn/IIIn	620	5.5
Phase 7. Sloping, Deep	IIfn/IIIne	110	1.0
Phase 8. Gently sloping, Shallow	IIId/IIIdne	100	0.9
Phase 9. Sloping, Shallow	IVd/IVtde	20	0.2
IV. Dystric Nitosols		5,710	50.5
Phase 10. Flat, Deep	IIfn/IIIn	830	7.3
Phase 11. Gently sloping, Deep	IIfn/IIIn	2,620	23.2
Phase 12. Sloping, Deep	IIfn/IIInse	2,260	20.0
Total		11,300	100.0

The LAND CAPABILITY MAP is shown in Fig. II-2. The acreage of each class in the survey area is summarized as follows:

Capability Class (Paddy/Upland)	Survey Area (ha)	Proportional Extent (%)
1. I/II	3,650	32.3
I/IIprw	3,650	32.3
2. II/II	110	1.0
IIn/IIwfn	110	1.0
3. II/III	7,360	65.1
IIfn/IIIn	4,990	44.1
IIfn/IIIne	110	1.0
IIfn/IIInse	2,260	20.0

Capability Class (Paddy/Upland)	Survey Area (ha)	Proportional Extent (%)
4. III/III	100	0.9
IIId/IIIdne	100	0.9
5. III/IV	60	0.5
IIIra/IVw	60	0.5
6. IV/IV	20	0.2
IVd/IVtde	20	0.2
Total	11,300	100.0

As described hereinbefore, it is considered that most of the soils in the survey area are suitable for the cultivation of rice and upland crops. The arable lands, preferably composed of Class I, II and III, acceptable for the development plan, are estimated at around 11,200ha in gross and equivalent to about 99.3% of the survey area.

In the future when the irrigation systems with drainage improvement will be developed, the arable lands demarcated above can be used intensively for year-round crop cultivation. However, the rice cultivation is quite suitable in the wet season, because of the ground water table comes into the root zone of plants. On the other hand, in the case that the ground water table falls in the dry season, the cultivation of upland crops such as groundnuts and soybeans is more profitable for the saving of irrigation water.

Table II-1 Results of Soil Analysis (1/2)

(Physio-chemical)

Sample No.	Gravel Content (%)	Texture Sand (%)	Texture Silt (%)	Texture Clay (%)	pH H_2O	pH KCl	1N NH_4OAc pH 7.0 Exchangeable Cations Ca (m.eq.per 100 gram soils)	Mg	K	Na	CEC	Base Saturation (%)	Organic Matter C (%)	Organic Matter N (%)	C/N	25% HCl P_2O_5 (mg/100 gram soils)	25% HCl K_2O (mg/100 gram soils)	Available P_2O_5 (ppm)	Absorption Coefficient P_2O_5 (mg/100 gram soils)
Fluvisols																			
3-1	9.2	4	45	51	5.5	4.3	20.1	8.3	0.4	0.5	35.2	83	1.92	0.23	8	21	21	4	1622
3-2	6.7	3	40	57	5.6	4.0	25.2	9.2	0.3	0.3	41.9	84	0.99	0.12	8	21	19	1	1625
3-3	35.6	1	22	77	5.5	4.1	26.9	9.9	0.2	0.4	43.3	86	0.67	0.10	7	8	16	1	2491
Nitosols																			
5-1	10.1	58	33	9	5.1	4.0	2.4	1.4	0.3	0.2	5.7	75	0.83	0.09	9	6	13	2	345
5-2	4.1	44	32	24	5.3	3.9	4.0	2.5	0.2	0.1	10.4	65	0.63	0.08	8	5	13	2	576
5-3	2.9	37	35	28	5.3	3.8	2.8	2.1	0.4	0.1	11.5	47	0.50	0.07	9	4	17	1	597
5-4	2.4	28	27	45	5.0	3.7	4.0	3.1	0.5	0.2	16.6	47	0.43	0.06	7	3	22	1	921
Gleysols																			
7-1	16.6	4	42	54	5.1	3.8	16.6	7.6	0.1	0.4	33.1	75	1.51	0.16	9	12	14	8	1815
7-2	10.7	6	46	48	5.8	4.3	24.0	10.9	0.1	0.7	43.0	83	0.64	0.09	7	13	12	3	1573
7-3	7.2	10	46	44	6.2	4.5	23.6	10.7	0.4	0.9	36.6	97	0.45	0.07	6	26	20	12	1459
Nitosols																			
11-1	3.2	40	25	35	5.3	4.3	8.4	6.7	0.3	0.1	23.5	66	1.79	0.20	9	25	23	7	1192
11-2	3.6	22	17	61	5.2	3.9	8.8	5.7	0.1	0.1	26.1	56	0.75	0.10	8	16	12	1	1255
Acrisols																			
14-1	1.1	51	24	25	4.8	3.6	4.1	2.0	0.3	0.2	12.7	52	0.87	0.10	9	11	10	3	786
14-2	2.2	60	19	21	5.6	4.0	4.6	2.0	0.1	0.1	9.7	70	0.35	0.06	6	10	4	2	642
14-3	4.2	25	17	58	5.5	3.8	13.9	6.3	0.1	0.5	34.2	61	0.37	0.05	7	3	9	1	1356
Gleysols																			
15-1	1.3	41	34	25	5.3	4.1	11.8	4.3	0.1	0.3	20.9	79	0.95	0.10	10	24	9	14	964
15-2	0.2	27	42	31	6.2	4.6	15.2	5.4	0.1	0.7	25.9	83	0.52	0.06	9	10	7	2	1165
15-3	0.6	9	48	43	5.9	4.0	12.5	5.8	0.1	0.9	25.5	76	0.45	0.08	6	16	8	6	1043
Nitosols																			
16-1	0.6	27	33	40	5.0	3.7	4.0	4.4	0.1	0.5	20.9	43	1.36	0.16	9	13	12	4	944
16-2	0.7	16	31	53	5.5	3.7	8.3	8.1	0.3	0.6	29.0	60	0.52	0.07	7	5	16	1	1397

Table II-1 Results of Soil Analysis (2/2)

(pF-moisture content relationships)

Sample No.	Bulk Density (g/cc)	Tatal Porosity (Vol. %)	Water Capacity (Vol. %) 10 cm (pF 1)	31 cm/1 (pF1.5)	100 cm (pF 2)	1/3 atm (pF 2.54)	15 atm (pF 4.2)	Drainage Pores (Vol. %) Fast	Slow	Available/2 Moisture content (Vol. %)
Nitosols										
11-1	1.06	60.0	46.6	44.0	41.2	36.3	25.1	18.8	4.9	18.9
11-2	1.03	61.1	52.1	49.5	46.3	42.1	31.3	14.8	4.2	18.2
Nitosols										
12-1	1.28	51.7	38.6	36.5	32.9	28.2	17.7	18.8	4.7	18.8
12-2	1.27	52.1	51.1	49.5	45.9	41.6	30.9	6.2	4.3	18.6
Acrisols										
14-1	1.52	42.6	42.2	40.0	36.7	31.0	19.5	5.9	5.7	20.5
14-2	1.55	41.5	40.2	37.5	33.9	29.4	19.3	7.6	4.5	18.2
14-3	1.46	44.9	43.8	41.0	38.2	34.7	23.3	6.7	3.5	17.7
Nitosols										
20-1	1.37	48.3	36.8	35.0	31.7	26.4	16.7	16.6	5.3	18.3
20-2	1.15	56.6	55.7	53.5	50.5	45.6	34.1	6.1	4.9	19.4
20-3	1.16	56.2	54.6	52.5	49.3	44.9	34.9	6.9	4.4	17.6

Remarks: /1 : The value is estimated graphically
/2 : AMC = (pF1.5) - (pF4.2)

Table II-2 Soil Classification

Soil Units	Soil Phase
I. Eutric Fluvisols	1. Flat, Deep
II. Eutric Gleysols	2. Flat, Deep
	3. Gently sloping, Deep
	4. Depressed, Deep
III. Orthic Acrisols	5. Flat, Deep
	6. Gently Sloping, Deep
	7. Sloping, Deep
	8. Gently sloping, Shallow
	9. Sloping, Shallow
IV. Dystric Nitosols	10. Flat, Deep
	11. Gently sloping, Deep
	12. Sloping, Deep

Remarks:

	Slope (%)
Flat	less than 2
Gently sloping	2 - 6
Sloping	more than 6
Depressed	Swampy Land (including artificially swamp)

	Effective soil depth (cm)
Deep	more than 50
Moderately deep	50 - 25
Shallow	less than 25

Tabel II-3 Soil Profile Description (1/4)

1. Profile Number	No.3
2. Date of Examination	11 November, 1982
3. Soil Classification	
1) FAO/UNESCO System	Eutric Fluvisols
2) Indonesian System	Grayish Brown alluvial Soils
4. Location	Parakan, Ds. Parakan, Kec. Kopo
5. Physiograghy	Flat natural levee
6. Drainage	Moderately well
7. Parent Material	Alluvial deposits
8. Vegetation or Land Use	Dryland field

Horizon	Depth (cm)	Discription
Ap	0-15	Brownish black (5YR 3/1), silty clay, weak subangular blocky, slightly sticky and slightly plastic, fine roots, clear smooth boundary, pH 5.5
B_2	15-55	Grayish brown (5YR 4/2), clay, structureless massive, sticky and plastic, fine roots, clear smooth boundary, pH 5.6
C	55-100(+)	Brownish gray (7.5YR 5/1), clay, few fine distinct orange (5YR 6/8) mottles, structureless massive, stickyand plastic, pH 5.5

Tabel II-3 Soil Profile Description (2/4)

1. Profile Number	No. 15
2. Date of Examination	18 November, 1982
3. Soil Classification	
1) FAO/UNESCO System	Eutric Gleysols
2) Indonesian System	Grayish Hydromorphic Soils
4. Location	Junti, Ds. Junti, Kec. Kopo
5. Physiograghy	Flat valley bottom
6. Drainage	Poor
7. Parent Material	Run-off deposits
8. Vegetation or Land Use	Roce field

Horizon	Depth (cm)	Discription
Ap	0-15	Grayish brown (5YR 5/2), loam, fine medium distinct red (10R 4/6) mottles, structureless massive, sticky and plastic, fine roots, clear smooth boundary, pH 5.3
Bg_2	12-40	Brownish gray (5YR 5/1), clay, common medium distinct reddish black (7.5R 1.7/1) mottles, structureless massive, very sticky and vely plastic, fine roots, gradual smooth boundary, pH 6.2
Cg	40-100(+)	Grayish brown (7.5YR 6/2), silty clay, common medium distinct reddish black (7.5R 1.7/1) mottles, structureless massive, very sticky and very plastic, pH 5.9

Tabel II-3 Soil Profile Description (3/4)

1. Profile Number	No.14
2. Date of Examination	12 November, 1982
3. Soil Classification	
1) FAO/UNESCO System	Orthic Acrisols
2) Indonesian System	Yellowish Brown Podzoric Soils
4. Location	Wanasari, Ds. Junti, Kec. Kopo
5. Physiograghy	Flat hilly land
6. Drainage	Moderately well
7. Parent Material	Tuff
8. Vegetation or Land Use	Rice field

Horizon	Depth (cm)	Discription
Ap	0-20	Grayish brown (7.5Y 6/2), snady clay, few medium distinct bright brown (2.5YR 5/8) mottles, weak subangular blocky, slightly sticky and slightly plastic, fine roots, clear smooth boundary, pH 4.8
B_1	20-40	Brownish gray (7.5YR 6/1), snady clay, few fine distinct black (7.5YR 1.7/1) mottles, moderate subangular blocky, slightly sticky and slightly plastic, gradual smooth boundary, pH 5.6
Bt_2	40-100(+)	Brownish gray (5YR 6/1), clay, common few prominent red (10R 5/8) mottles, structureless massive, sticky and plastic, pH 5.5

Tabel II-3 Soil Profile Description (4/4)

1. Profile Number	No.16
2. Date of Examination	23 November, 1982
3. Soil Classification	
1) FAO/UNESCO System	Dystric Nitosols
2) Indonesian System	Reddish Latosols
4. Location	Pasir Limus, Ds. Pasir Limus, Kec Pamarayan
5. Physiograghy	Undulating hilly land
6. Drainage	well
7. Parent Material	Tuff
8. Vegetation or Land Use	Shrub

Horizon	Depth (cm)	Discription
Ap	0-45	Dark reddish brown (5YR 3/4), clay loam, weak subangular blocky, sticky and slightly plastic, medium roots, gradual smooth boundary, pH 5.0
Bt_2	45-100(+)	Brownish gray (7.5YR 6/1), clay, common medium distinct dark rddish brown (2.5YR 3/6) mottles, medium subangular blocky, sticky and plastic, medium roots, ph 5.5

Table II-4 Summary of Land Classification

Item	Code	Class I Paddy	Class I Upland	Class I Orchard	Class II Paddy	Class II Upland	Class II Orchard	Class III Paddy	Class III Upland	Class III Orchard	Class IV Paddy	Class IV Upland	Class IV Orchard
1. Thickness of top soil	t	> 15cm	> 25cm	> 15cm	< 15cm	25-15cm	—	—	< 15cm	—	—	—	
2. Effective depth soil	d	> 50cm		> 100cm	50-25cm		100-50cm	25-15cm	50-15cm	50-25cm	< 15cm		< 25cm
3. Gravel content in top soil	g	< 20%	< 5%	< 10%	20-50%	5-20%	10-50%	—	10-50%	20-50%	> 50%	> 20%	> 50%
4. Easiness of plowing	p	Easy to slightly diffecult			Moderately difficult				Very difficult		—	—	—
5. Permeability under submerged condition	l	Poorly to imperfectly permeable	—	—	Moderately to well permeable	—	—	Well to excessively permeable	—	—	—	—	—
6. State of redox potentiality (Risk of root damage)	r	None to weak	—	—	Moderate to strong	—	—	Very strong	—	—	—	—	—
7. Wetness of land (Risk of drought or wetness)	Wet: W	—		None	—	Low possibility of over wetness		—	Possibility of over wetness		—	High possibility of over wetness	
	Dry: (W)	—		None	—	Low Possibility of drought		—	Possibility of drought		—	High possibility of drought	
8. Inherent fertility	f		Fertile			Medium			Infertile		—	—	—
9. Content of available nutrients	n		High			Medium			Low		—	—	—
10. Degree of hazard	i		None			Slightly			Moderately			Seriously	
11. Frequency of hazard	a		None to rarely			Moderately			Frequently		—	—	—
12. Slope	s	—	< 6%	< 28%	—	6-14%	14-47%	—	14-28%	28-47%	—	> 28%	> 47%
13. Erosion	e	None or very slightly				Slightly			Seriously			Very seriously	

Table II-5 Soil Phase and Land Classification Class

Item	Code	Eutric Fluvisols		Eutric Gleysols						Orthic Acrisols										Dystric Nitosols					
		F/R	D/U	F/R	D/U	G/R	D/U	De/R	D/U	F/R	D/U	G/R	D/U	S/R	D/U	G/R	S/U	S/R	S/U	F/R	D/U	G/R	D/U	S/R	D/U
1. Thickness of top soil	t	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	II	II	IV	I	I	I	I	I	I
2. Effective soil depth	d	I	I	I	I	I	I	I	I	I	I	I	I	I	I	III	III	IV	IV	I	I	I	I	I	I
3. Gravel content in top soil	g	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
4. Easiness of plowing	p	I	I	I	II	I	II	I	II	I	I	I	I	I	I	II	II	II	II	I	I	I	I	I	I
5. Permeability under submerged condition	f	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-
6. State of redox potential	r	I	I	I	II	I	II	III	III	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
7. Wetness of land	w	-	II	-	II	-	II	-	IV	-	I	-	I	-	I	-	I	-	I	-	I	-	I	-	I
8. Inherent fertility	f	I	II	I	I	I	I	I	I	II	II	II	II	II	II	II	II	II	II	II	II	II	II	II	II
9. Content of available nutrient /1	n	II	II	I	I	I	I	I	I	II	III	II	III	II	III	II	III	II	III	II	III	II	III	II	III
10. Degree of hazard	l	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
11. Frequency of harzard	a	I	I	I	I	I	I	III	III	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I
12. Slope	s	-	I	-	I	-	I	-	I	-	I	-	I	-	II	-	II	-	II	-	I	-	I	-	III
13. Ersion	e	-	I	-	I	-	I	-	I	-	I	-	II	-	III	-	III	-	IV	-	I	-	II	-	III
Land classification class		IIn/	IIwfn	I/	IIprw	I/	IIprw	IIIrn/	IVw	IIfn/	IIIn	IIfn/	IIIn	IIfn/	IIIne	IIId/	IIIdne	IVd/	IVtde	IIfn/	IIIn	IIfn/	IIIn	IIfn/	IIIn

Remarks: F = Flat, D = Deep, G = Gently sloping, S = Shallow, S = Sloping, De = Depressed
R = Rice, U = Upland crops
/1: This factor is evaluated by sub-factors except for (e), (f) and (g)

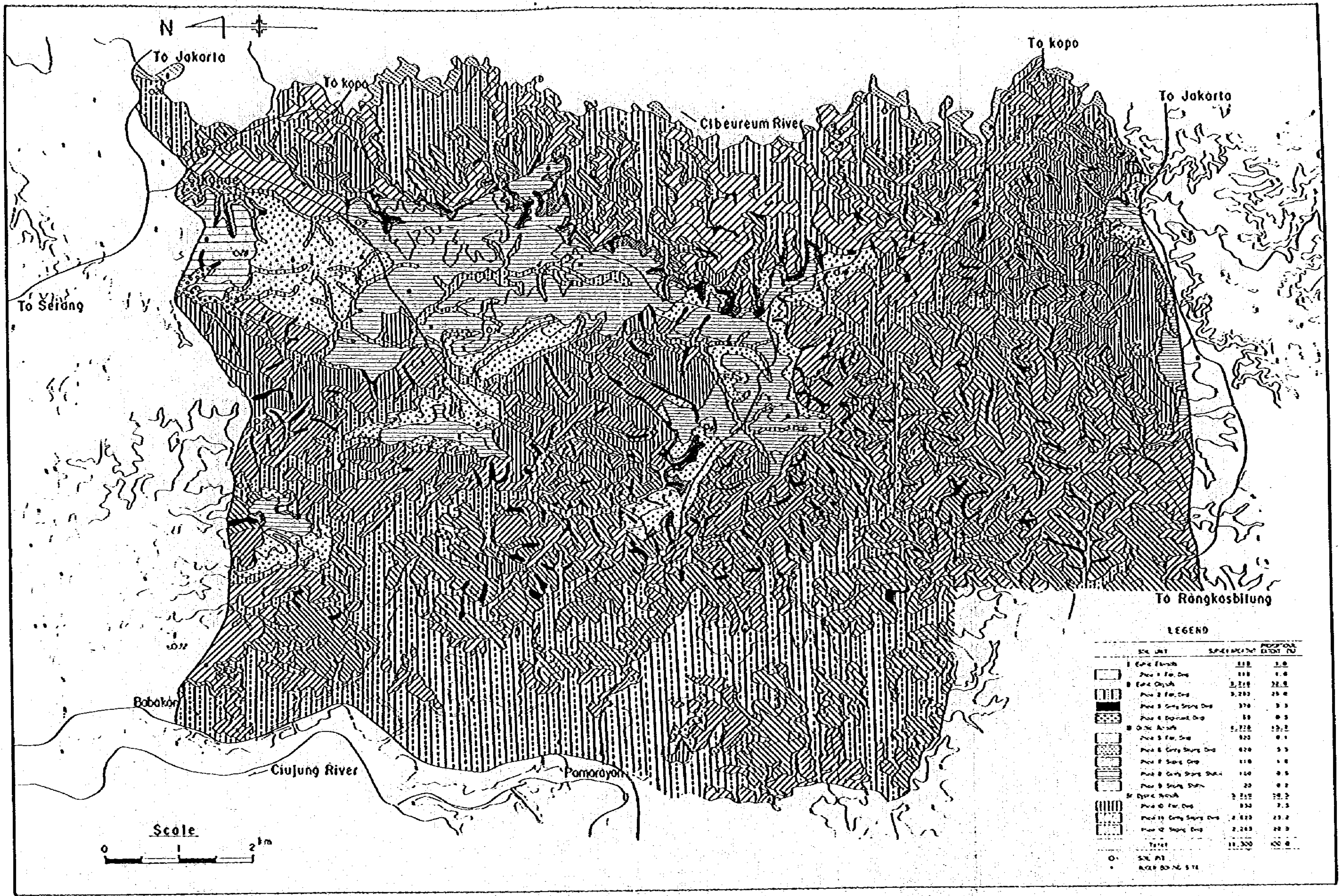

Fig.II-1 SOIL MAP

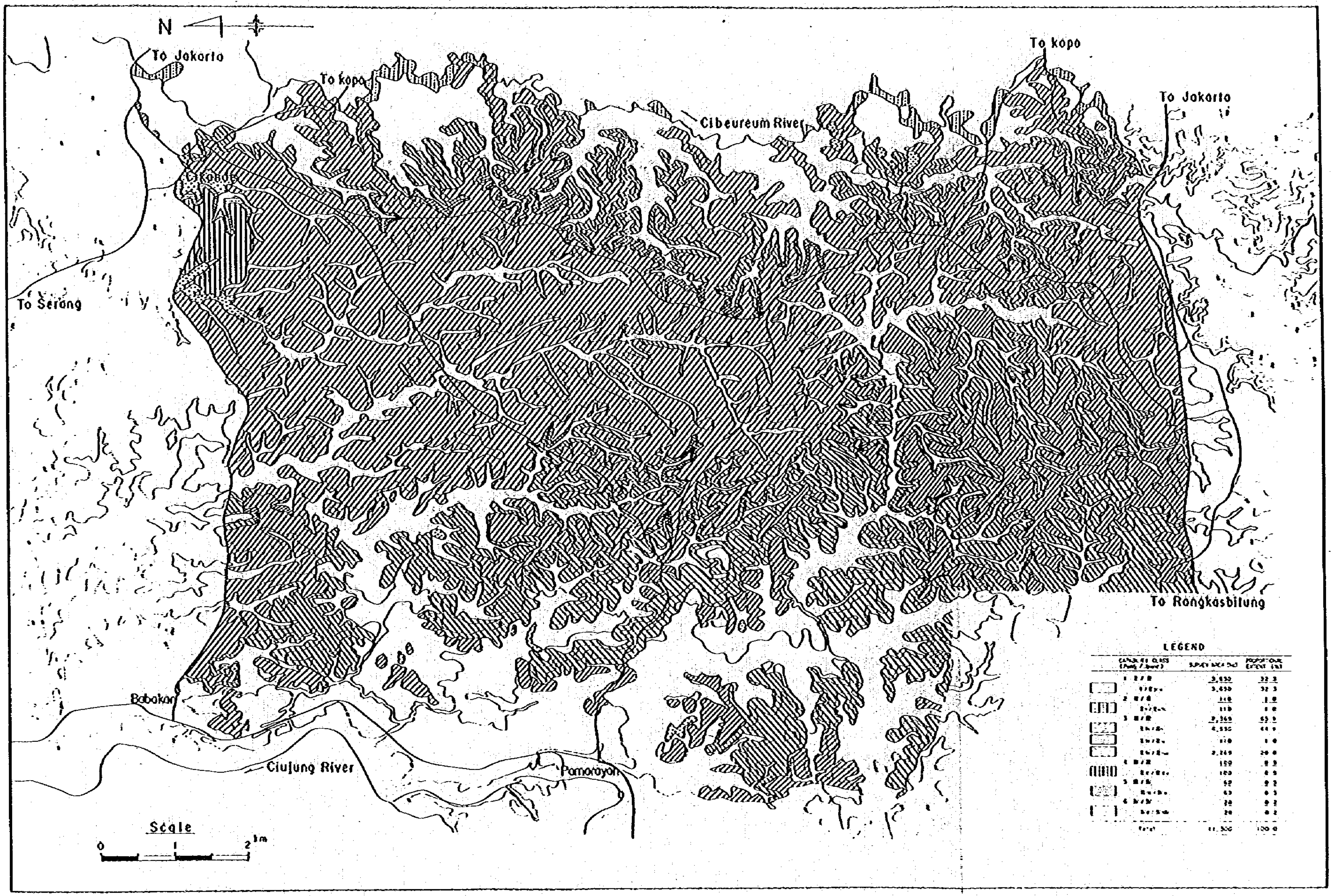

Fig. II-2 LAND CAPABILITY MAP

ANNEX - III

GEOLOGY

ANNEX - III GEOLOGY

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ANNEX - III

GEOLOGY

1. GENERAL

Until sometime during the Tertiary period, Java island along with other Indonesian islands was directly connected to the Asian mainland. Shifting of the earth's crust and volcanic activity during the Miocene and Pliocene epochs (corresponding to the close of the Cenozoic era) raised the present Indonesian islands further from the sea floor, and subsequent collision between the Asian and Australian continental plates created the present topography of the region. In terms of geological structure, strata of the Cenozoic era are widely present.

Java island lies along an extension of the Mediterranean - Himalaya volcanic belt, and as a result features numerous volcanoes. This volcanic activity has created complex geological and topographical conditions. Historic changes in these conditions are outlined in Fig.III-1.

According to the data collected during the field study, Java was connected to the Asian mainland a number of times during the Pleistocene epoch (Diluvial age). This condition was brought about by ice age drops in ocean levels and permitted the migration onto Java of numerous species of plant and animal life fleeing the cold and dryness of glacial regions for the tropical rainforest of the area. Java attained its present day topographical profile with the close of the last ice age, and subsequent rise in ocean levels which again cut Java (as well as other islands in the region) off from the mainland.

As implied by the above discussion, Java's geologic composition contains no Paleozoic strata. The oldest formations are scattered instances of Jurassic strata of the Mesozoic era present in mountainous areas. Cretaceous formations are also evident at some locations.

Stratification of Java's geologic structure can be summarized on a historic basis as shown in Table III-1.

The K-C-C area is part of the coastal plain, and ranges in elevation from 5m to 50m. The oldest geologic formation in the area is Miocene sedimentary rock. Sedimentary rock of the Pliocene and Pleistocene epochs is predominant throughout the area.

Geologic structure in the North Banten area is summarized in TableIII-2.

Table III-1 GEOLOGIC STRUCTURE OF JAVA ISLAND

Paleogenic:	Eocenic: (limited distribution)	conglomerate, sandstone, shale, limestone, coal shale, igneous rock, granite, gabbro, peridotite
	Oligocenic:	dark green breccia, sandstone, shale limestone, maar
Neocenic (fossilized remains of freshwater and brackish shellfish and plants)	Miocenic Pliocenic	sandstone containing limestone, shale, pyroclastic material, volcanic rock, tuff, pyroxene andesite, basalt
Quaternary	Pleistocene	large amounts of elevated coral reef
		Recent

TableIII-2 GEOLOGIC STRUCTURE OF THE NORTH BANTEN AREA

Geologic epoch	Type of Stratum	Characteristics	Symbol
Recent (Alluvium)	sedimentary facie	fluvial deposits (clay, silt, sand, gravel)	A
	volcanic	basalt, andesite	
Pleistocene (Diluvium)	volcanic	breccia, tuff, lapilli, lava flow, mud flow	Kw
	sedimentary facie	marine clay, sand, river terrace	D
Pliocene	upper facie	grey tuffaceous sand (marine) containing tuffaceous clay, tuff, coral reef, coarse sand	P
	lower facie	pumice-tuff, volcanic breccia	
Miocene	upper facie	lignitic maar containing pumice-tuff, sandstone	M
	middle facie	sandstone containing maar, limestone, reef limestone, agglomerate, andesite	
	lower facie	carbonic agglomerate, sandstone, maar, limestone, andesite	

2 DAM SITE GEOLOGY (GADEG SITE)

The Gadeg dam site is located in the catchment area of the Cibeureum River. Fig.III-2 indicates topographic and geologic conditions prevailing at the site. Riverbed elevation is about 25m and river width is about 20m.

River terrace deposits are distributed along both banks downstream from the site. In particular, a wide, flat area is present on the left bank at the site. Ridges on both banks range in elevation from 40m - 50m, with the left bank ridge more developed.

The river course both above and below the dam site is extremely meandering. This phenomenon appears to be due to the formation after sedimentation of faults, joints and other weak lines resulting from volcanic activity and the effects of Danau Caldera.

On the basis of available data and field survey, a cross-section of the geologic structure at the site was formulated as indicated in Fig. III-3. According to this cross-section, the geology of the site consists primarily of Pliocene marine sediment. Rock consists of fine to coarse grained, gray tuff, lapilli, and pumice-tuff containing tuffaceous shale. A portion of agglomerate is also evident wherein fine grained material is packed tightly between pebbles of 10 - 50 mm diameter.

Strata incline gently in the direction of NS10 - 20°W and generally exhibit extremely mild folding. Judging from the condition of outcroppings, serious faulting, cracks, and/or joints do not appear to be present. However, examination of aerial photographs as well as conditions prevailing upstream from the site suggest possible small scale faulting at the site.

Surface strata at and around the site riverbed consists of a 1m thick top layer of sandy gravel underlaid by deposits of tuff. Slopes are covered by 6 - 10m thick weathered strata. Since outcroppings of tuff are evident on hill ridges, it can be assumed that fresh rock is generally distributed at lower levels along these locations.

Weathered strata exhibits medium compaction of N=15 - 20. If grouting is executed to reduce permeability, this layer should exhibit adequate bearing capacity for the foundation of a fill type dam. However, as the weathered strata displays a marked drop in strength under wet conditions, a more detailed study of the shear strength, deformation and permeability properties of the layer is recommended.

Judging from the nature of outcroppings, river terrace strata consist primarily of interbedded sand, silt and clay. Sand is blue-gray in color, while clay is light-brown. A thin gravelly layer is evident at the underface of the river terrace strata. The precise physical properties of this formation should be delineated through future detailed investigation.

The surface of weathered strata and river terrace formation shows evidence of collapse at scattered points. This is the result of erosion occuring during periods of flood, as well as erosion caused by surface runoff.

Base rock at the dam site displays adequate bearing capacity. Consequently, topography and particularly ridge conditions will be the major factors in determining dam design. The area immediately upstream from the proposed site features high, thick ridges where weathered stratum is thin and rock formation is generally stable.

Finally, the proposed dam site should be subjected to further detailed study in terms of hydraulic conditions, and ease and economy of construction.

The physical properties of the weathered strata at the site are as follows:

Soil:	sandy clay:	fine grained, includes angular quartz
	clayey sand:	red brown to grayish brown in color
	specific gravity:	G = 2.39 - 2.59
	moisture content:	Wn = 62 - 78
	liquid limit:	W_L = 110 - 161
	plastic limit:	Wp = 40 - 73
	plasticity index:	Ip = 70 - 100
	granularity:	sand: 1 - 12
		silt: 41
		clay: 16 - 58
	classification:	CH - MH
	maximum dry density:	d max. = 1.0 - 1.2
	optimum moisture content:	OMC = 35 - 54%

3. GEOLOGICAL STRUCTURE OF THE K-C-C AREA

Geological structure of K-C-C area consists of sedimentation from the Pliocene and Pleistocene epochs. According to surveys of C-J-C projects, the above sedimentary level is estimated at over 400m thick. Existing data on the geology of this area is indicated in Fig.III-4, and the geologic column is given in Fig.3-5. A further classification according to geologic epoch (Miocene, Pliocene, or Pleisticene) is necessary, although this is difficult with only the data at hand. Available data indicates that sedimentary stratum becomes thinner from east to west.

Proposed irrigable area will cover an area extending 20 - 30 km from north to south. Elevation gradually decreases northward from the hilly area to the direction of the Java Sea. Topography of the area is classified as shown in Table III-3 below.

Table III-3 ELEVATION AND GEOLOGIC STRUCTURE OF THE K-C-C AREA

Sector	Elevation	Geologic structure
Railroad (Jakarta-Serang)	40 - 50 m	Hilly area; composed of Pliocene sedimentary strata; gray tuff containing sand and clay (sand predominant), upper surface weathered
	20 - 40 m	Plateau; composed of Pliocene and Pleistocene sedimentary deposits, upper surface weathered, pronounced erosion of valleys in branching configuration
National road (Jakarta-Serang)	20 m	same as above
Coastal plain	5 - 10 m	Lowland; airfield), alluvial river deposits (sand, silt, clay) cover surface stratum.

The Project area is bounded on either side by the Ciujung and Cibeureum rivers, both of which flow south to north. The Pamarayan canal branches from the Ciujung river, transects the national road, and runs northward. Both of the above rivers pass over areas carved deeper than the level at which base rock is present, and consequently at certain points outcroppings of fresh rock are evident on the riverbed.

The surface of hill and plateau areas is covered by a 3 - 5m layer of weathered soil. Granulation of this weathered stratum is such that it falls primarily within the clayey soil classification. The layer features vertical cracks which results in a high degree of vertical permeability. Consequently, rainwater passes quickly through the weathered zone until reaching the underlying stratum of fine-grained tuffaceous soil which is impervious. Upon reaching the tuffaceous layer, rainwater subsequently flows laterally in the direction of decreasing elevation, occasionally coming to the surface at points where it serves as an irrigation source for low-lying areas. Where the amount of such water exiting the ground is substantial, slope erosion is evident, constituting a factor in the creation of the branching configuration of the area's topography.

Although the plateau area appears to feauture a fairly uniform geologic structure, the presence of a relatively thick sedimentary layer from the Pleistocene epoch on the eastern side of the C-J-C Project area indicates that a detailed investigation of the geology of the above area would be appropriate.

Ground bearing capacity and permeability within the Project area is as follows:

Groundbearing capacity

Pliocene - Pleistocene sedimentary strata: (heavily compacted)	over 15 t/m^2
Pliocene - Pleistocene weathered strata:	10 t/m^2
Alluvial strata: (low-lying coastal areas)	5 - 10 t/m^2

Permeability

Weathered strata (Plateau)

vertical permeability coefficient:	$k > 10^{-4}$ cm/s
horizontal permeability coefficient:	$k = 10^{-6} - 10^{-4}$ cm/s

Pliocene - Pleistocene sedimentary strata (including both permeable layers and aquiclude)

permeability coefficient:	$k = 10^{-6} - 10^{-3}$ cm/s

4. BORROW AREAS

A general survey in and around the K-C-C area was conducted in order to locate suitable borrow areas for aggregate materials. As adequate topographical maps were not available, promising potential sites were first determined from aerial photographs.

4.1 Hill Areas

The greater portion of rock within the Project area is tuffaceous sedimentary formation of the Cenozoic era and as such is not subject to consideration as aggregate material. The hardest rock in the area is Miocene formation found at Bedenganljol (EL 50 - 60 m) located between the road and railroad connecting Rangkasbitung and Bogor. However, a detailed investigation into the precise hardness and bearing capacity of this material is necessary. In addition, thick Miocene formation is present upstream from both the Gadeg and Karian sites.

Andesite and other igneous rock which exhibits good hardness and bearing capacity is present in the mountainous areas on the south, east and west of the Project area. In this case, however, hauling distance becomes greater.

4.2 Riverbed (refer to Fig.III-2)

Distribution of sand and gravel along the Cibeureum river is minimal. This appears to be due to the fact that the river flows largely through hilly area of Miocene and Pliocene formation. An estimated 50 - 200m^3 of sand and gravel is present in the heavily meandering river portions both upstream and downstream from the Gadeg site. In addition, river terrace is in evidence down stream from Gadeg, where inspection of outcroppings suggests large deposits of fine-grained sand. However, more detailed investigation is necessary to confirm precise amounts present.

Extensive deposits of gravel are present on the upper reaches of the Ciberang River. This material exhibits good hardness, although crushing would be necessary due to the large size of fragments. In particular, river terrace with substantial gravel content is located upstream from Nahggela. Determination of the precise nature of these deposits would again require further investigation. If found appropriate for use on the Project, said materials could be hauled along existing road to site areas.

Sand which would serve as appropriate fine aggregate is distributed along the heavily meandering portion of the Ciberang River downstream from Rangkasbitung. Although the fine grained content of this material is somewhat large, it represents the closest deposits to site areas. In addition, sand is relatively present in sandbars running north-south in river portions close to the Java Sea coast.

If dam design at the Gadeg site is to be of the fill-type, weathered rock and river terrace strata would serve as appropriate construction materials. Although further detailed survey is required to determine the optimum location for borrow areas, it is reasonable to assume that suitable material is available in proximity to the site.

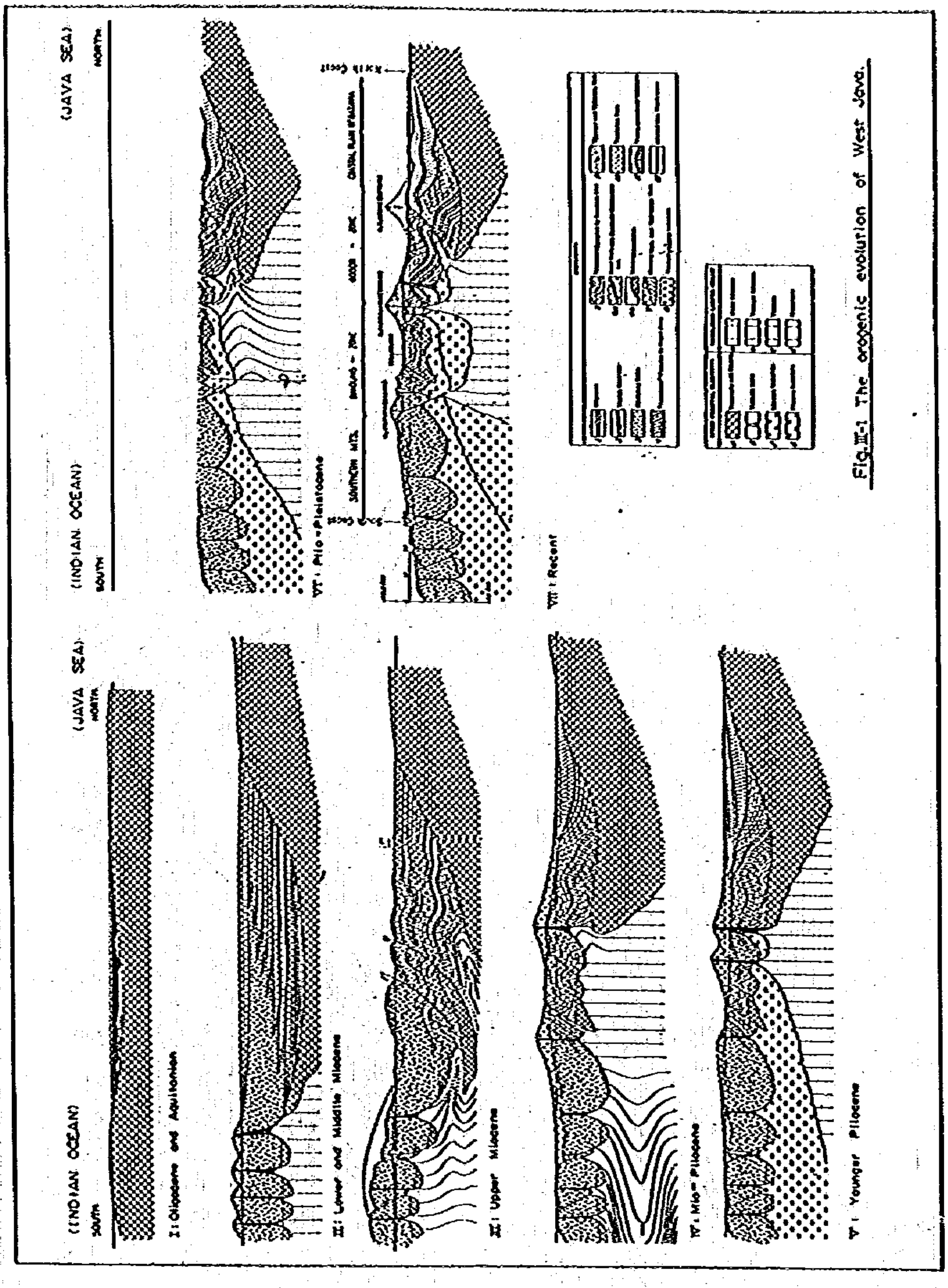

Fig.III-1 The orogenic evolution of West Java.

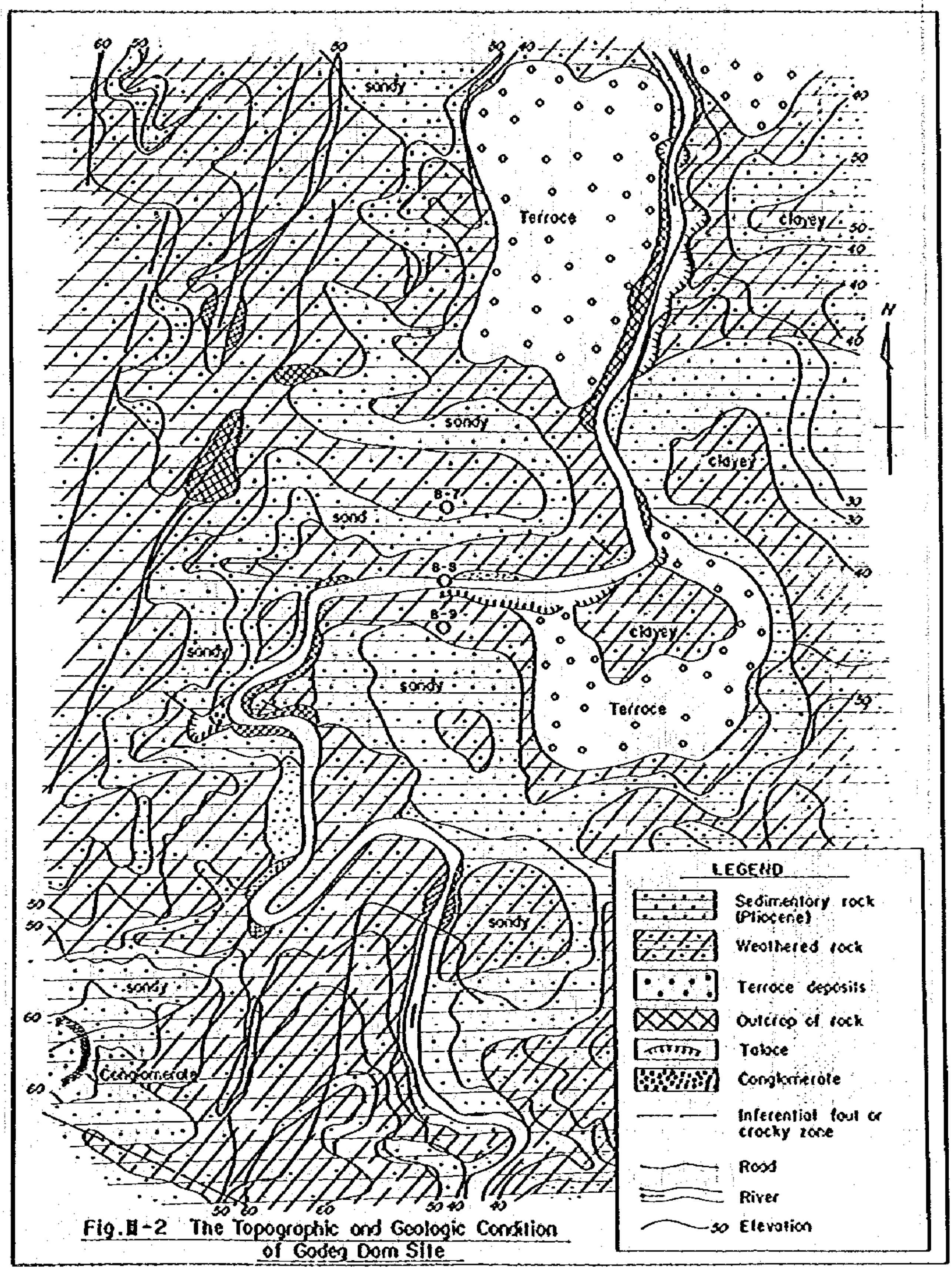

Fig.Ⅲ-2 The Topographic and Geologic Condition of Godeg Dam Site

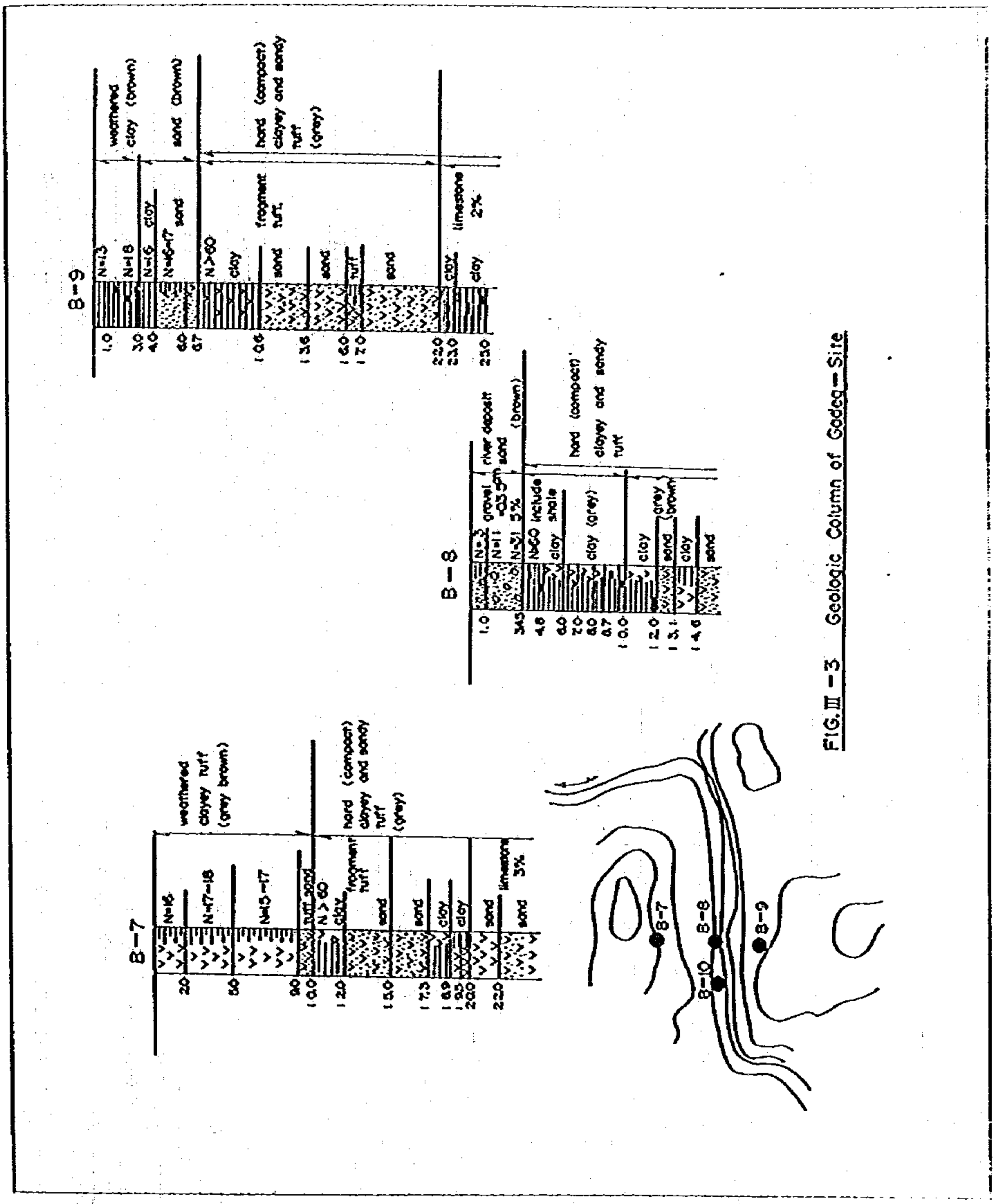

FIG. III -3 Geologic Column of Gadeg-Site

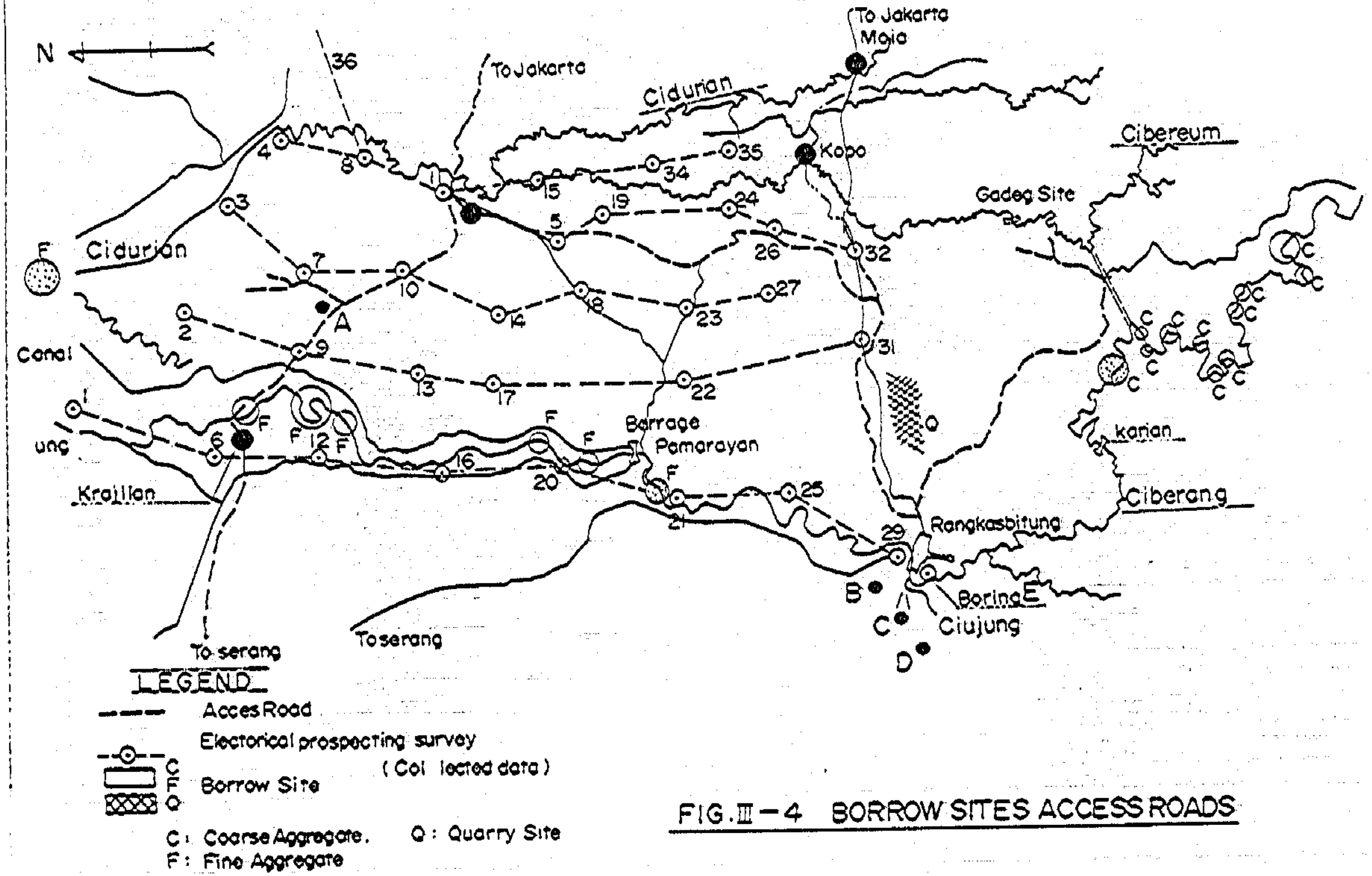

FIG. III − 4 BORROW SITES ACCESS ROADS

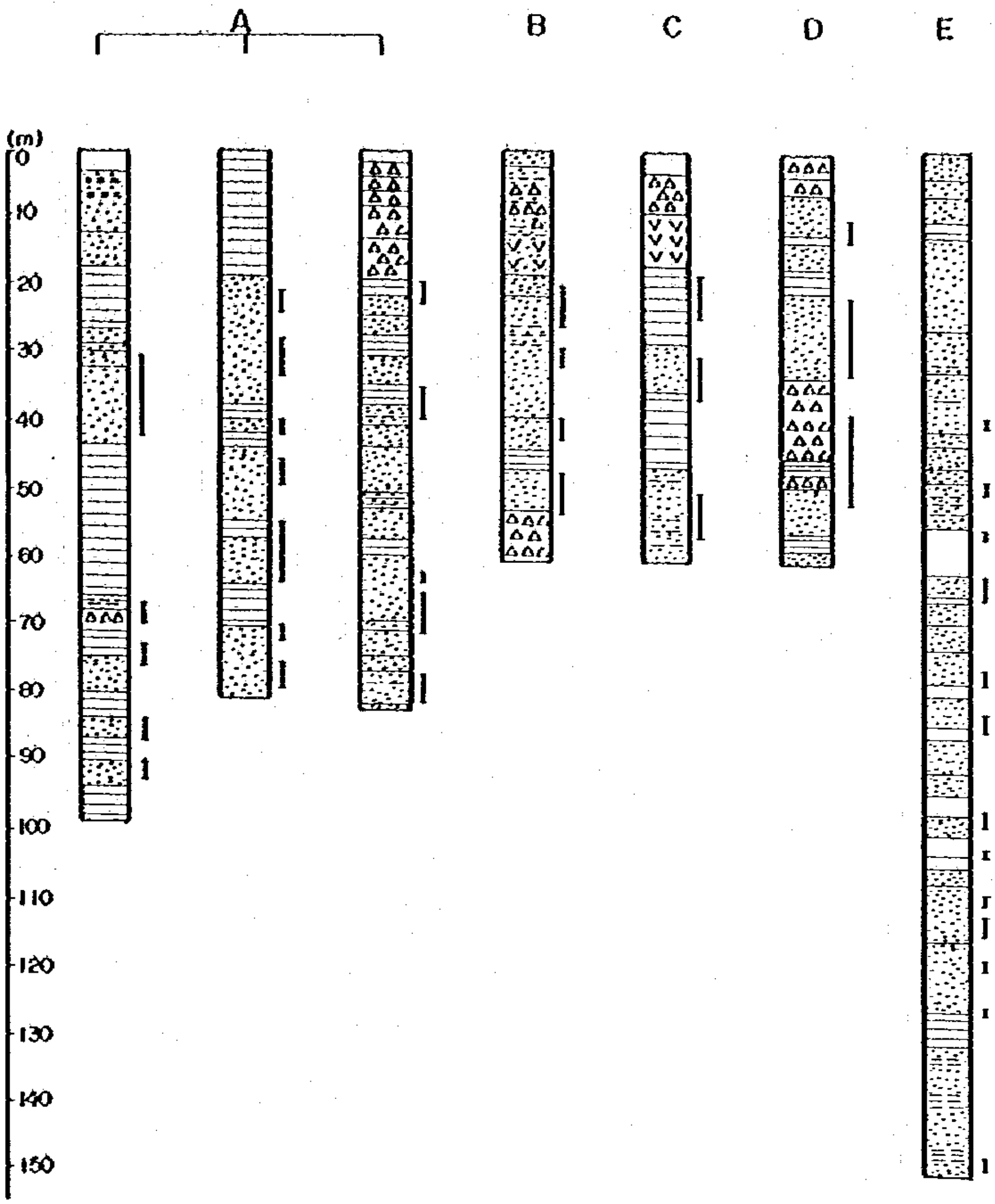

Fig.III-5 Geologic Column of Rangkasbitung Area and C-J-C Project Site