

**CONSERVATION STORAGE REGULATION OF MACHHU-II RESERVOIR**



जलमे ही सब मजेपुके

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## PREFACE

Efficient utilisation of water resources requires that reservoirs must be operated in most judicious and scientific manner. Efficient regulation of the reservoirs can lead to increased benefits from the reservoir as well as significant reduction in damage due to floods. For this purpose, the Irrigation department, Govt. of Gujarat entered into an agreement with the National Institute of Hydrology, Roorkee for the preparation of Reservoir operation manual for the Machhu-II dam located in the Machhu river basin. The work has been taken up as a consultancy project.

The present report deals with the development of operation policies for conservation storage regulation of Machhu-II dam. Detailed basin description and data used in this study have been presented. Solution strategy adopted and the simulation results using recommended policy have been detailed in tabular form.

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## CHAPTER 1

### 1.0 INTRODUCTION

The Irrigation department, Govt. of Gujarat, Gujarat has requested the National Institute of Hydrology, Roorkee to prepare Reservoir operation manual for Machhu-II dam located in the Machhu basin. This work has been entrusted to NIH through an agreement signed between Irrigation department, Govt. of Gujarat and National Institute of Hydrology, Roorkee.

The scope of the project is preparation of reservoir operation manual and flood forecasting schemes for Machhu-II project with the following objectives:

- a) To develop reservoir operation manual for conservation as well as flood control (i.e. flood forecasting and flood warning).
- b) To develop spillway gate operation schedule for normal and emergency flood conditions including floods of different return periods 100, 200, 500, 1000 years as well as maximum observed flood SPF and PMF.
- c) To recommend establishment of comprehensive flood warning system, reservoir inflow/outflow monitoring.

This work has been subdivided into two parts, first dealing with development of operation policies for conservation purposes and second dealing with the development of policies for flood regulation.

The aim of this report is to develop operation policies for conservation purposes for Machhu-II reservoir. Detailed basin description and data used in this study have been presented along with the existing hydrometeorological network. Solution strategy adopted and the results obtained have been described. Simulation results have been detailed in tabular form. The recommended rule levels have been given both in tabular and pictorial forms

## CHAPTER 2

### BASIN DESCRIPTION AND DATA AVAILABILITY

#### 2.0 MACHHU RIVER BASIN

Machhu is one of the major rivers of Saurashtra region of Gujarat. It rises near Bhadla in the Rajkot district of Gujarat at an elevation of 275 m at North latitude 22°11' and East longitude 71°6' and flows in a generally northern, north-western course and disappears in the little Runn of Kutch downstream of Malia. On the way, a few rivers and tributaries join it. Important among them are Jumbud', Banaiya, Patalia Vonkala, Asoi, Maha and Matelio. The total length of the Machhu river is 161 km and its total catchment area is 2331 sq. km.

An index map of the Machhu basin up to the Morbi town showing the major hydraulic structures, rain and discharge gauging stations is given in Fig. 1. Two important hydraulic structures located in the Machhu basin are the Machhu-I dam and the Machhu-II dam. A brief description of these follows.

#### 2.1 MACHHU-I DAM

This dam is located on river Machhu near Jalsika village in Wankaner taluka of Rajkot district. The location of the dam is 57 km from the source of the river. The town of Wankaner, one of the seats of former princely states, lies 22 km downstream of Machhu-I dam. The dam was completed in 1958. The catchment area up to the dam site is 735 sq. km. The project has been designed for gross and live storage capacities of 72.70 Mcum and 70.8 Mcum respectively with FRL at 135.33 m.

The Machhu-I dam has been conceived as a reservoir impounding water for purposes of irrigation and municipal water supply. The spillway of this project was designed to pass a flood

of 2595 cumec with HFL at 137.46m. The command area of project lies on the left bank of river Machhu in Wankaner and Morbi talukas of Rajkot district. The gross command area is 18218 ha. and culturable command area is 10409 ha.

## 2.2 MACHHU-II DAM

This dam is located on river Machhu near village Jodhpur in Morbi taluka of Rajkot district. It is 103 km from the source of the river. This dam was breached in 1979 floods. The dam has been rebuilt now. The total catchment area up to the dam site is 1928 sq. km. The gross and live storage capacities of this dam are 1699 and 1010 million cubic meter respectively. The Machhu-II dam has been conceived as a reservoir impounding water for irrigation and municipal water supply and for flood control. The highest observed flood for this project is 13026 cumec (4.60 lakh cusec) while the peak of design flood hydrograph is 26420 cumec (9.32 lakh cusec).

The towns of Morbi and Malia, lie 9 km and 46 km downstream of Machhu-II dam respectively. The Morbi town is situated on the left banks of the river whereas the Malia town is situated about 1.5 km away from the left bank. The area under the command lies on left bank of river Machhu. Geographically, the command lies between north latitudes of 22°46' and 22°57' and east longitudes of 70°52' and 70°40'. The area has more or less flat topography which is characteristic of the coastal low-lands.

Most of the annual rainfall in the catchment area falls in the monsoon months of June to September. The average annual rainfall in the Machhu-II catchment is 602.1 mm. The maximum temperature reaches around 43°C in the hottest month of May whereas the lowest temperature falls to 6°C in the coldest month of January.



### 2.3 EXISTING HYDROMETEOROLOGICAL NETWORK

The existing network of hydrological & meteorological stations located in/around the Machhu basin is as follows:

(i) Rain gauge stations are located at Malia, Morbi, Machhu-II, Lunsar, Wankaner, Machhu-I, Beti, Kuvadva, Adiya, Anandpur, Rajkot, Chotila, Than, and Sardhar.

(ii) River gauging sites are located on river Machhu at Beti, Machhu-I dam, Wankaner, Machhu-II dam and Morbi. In addition, the gauges are also located at Matel (Matelio river) and Dhuva (Maha river).

(iii) Wireless stations (Police) are located at Malia, Morbi, Wankaner, Rajkot and Chotila. The proposed wireless stations are at Beti, Machhu-I, Machhu-II, Than and Maha. The existing police wireless stations are connected with Rajkot and Rajkot is connected with Ahmedabad wireless station.

### 2.4 DATA USED FOR CONSERVATION REGULATION

The monthly inflow series (in million cubic meter) for Machhu-II reservoir for the period 1958 to 1984 had been worked out by the Gujarat Irrigation Department and the same has been used in this study. This data is given in Table 1. The elevation-area-capacity table for the reservoir as given in Table 2 was also supplied. The Fig. 2 contains a plot of reservoir Elevation-Area and Fig. 3 a plot of Elevation-Capacity curve for this dam. The spillway rating curves for the Main and Additional spillways have been plotted in Fig. 4 and 5 respectively. The information about average monthly water supply demand and average monthly irrigation demand (supplied by the Gujarat Irrigation Department) is given in Table 3. The actual values of monthly evaporation, supplied by Gujarat Irrigation Department, for the Rajkot station covered only the period 1973 to 1989. Moreover, these values were found to be comparatively less than normal values in all the

years. Therefore, the normal values for monthly evaporation for the basin have been used in this study. These are presented in Table 4.

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## CONSERVATION REGULATION OF MACHHU-II RESERVOIR

## 3.0 THE SOLUTION STRATEGY ADOPTED

A number of rule curves for reservoir operation were developed using various scenarios of reservoir inflows and levels. An exhaustive reservoir operation simulation study was undertaken using these rule curves. The results of simulation were intercompared. The operation policy which best meets the objectives of the conservation storage regulation has been finally recommended for adoption.

## 3.1 MONTHLY DEPENDABLE YIELD

The monthly inflow series for 37 years (1958 to 1984) was analyzed using statistical approach. The power transformation approach was used for this purpose. This approach is a standard technique and has been extensively used in hydrological analysis. The inflow series for each month was transformed to a (nearly) normally distributed series using power transformation approach. The monthly yields were estimated for 50%, 60%, 70%, 75%, 80% and 90% probabilities for the transformed series. These were then transformed back to original domain. The results of this analysis for twelve months are given in Table 5.

## 3.2 SIMULATION OF MONTHLY OPERATION

A computer program has been developed to simulate the monthly operation of the reservoir. The monthly inflow data for the period 1958-59 to 1984-85, average monthly water supply and irrigation demands and normal values of monthly evaporation are input to the program. Following ratios/quantities are computed:

1. Release in cumec which includes irrigation and water supply release and spill,
2. Spill in cumec,

3. Release/Total demand for both irrigation and water supply (RTD),
4. Release/Water supply demand (RWSD),
5. Monsoon deficit - This is the sum of difference between release and total demand for the monsoon months (June to October) considering only those months when RTD is less than 1.0. This is expressed in volume units (cubic meters) and also as a percentage of total demand in the monsoon period.
6. Non-monsoon deficit - The sum of difference between release and total demand for the non-monsoon months (November to May) considering only those months when RTD is less than 1.0. This is expressed in volume units(cubic meters) and also as a percentage of total demand in the non-monsoon period.
7. Total deficit - The sum of monsoon and non-monsoon deficits. This is expressed as volume (cubic meters) and also as a percentage of total demand in the water year.
8. Spill - Total volume of water in cubic meters spilled during the water year.

### 3.3 RULE CURVE COMPUTATIONS

The computations for deriving rule curves have been made using monthly yield series for different probability levels along with average monthly irrigation and water supply demands. The evaporation loss has been considered at normal monthly rate over the surface area of reservoir corresponding to a particular elevation. Three scenarios were examined:

- a) Using monthly dependable yields at various probability levels,
- b) By taking the reservoir to Full Reservoir Level (FRL) at the end of monsoon season (end of September),
- c) By keeping the reservoir at FRL from end of May to end of

September.

### 3.3.1 Using Monthly Dependable Yield Series

In this approach, the water availability was assumed as corresponding to particular monthly yield series. Computations of end-of-month reservoir levels were made for 12 months after allowing for irrigation and water supply demands in full and the evaporation losses from the reservoir surface. The elevation-area-capacity table was used and the intermediate values were linearly interpolated whenever required. The computations were made on the basis of the water year. The reservoir was assumed to be at the dead storage level (47.25 m) at the end of the water year, i.e. at the end of May. The backward computations were made for the non-monsoon period. If the storage at the end of any month is known, then storage at the beginning of the month can be calculated as follows :

$$\text{Storage}_{\text{begin}} = \text{Storage}_{\text{end}} - \text{Inflow} + \text{Release} + \text{Evaporation}$$

The month-end reservoir levels, thus obtained, provide the upper rule curve for corresponding water availability to meet target irrigation and water supply demands. These rule levels are given in Table 6.

Monthly reservoir operation simulation runs were made using a computer program. Separate runs were taken using the rule levels corresponding to monthly yield series with probability levels of 50%, 60%, 70%, 75%, 80% and 90%. The carry-over of storage from one year to the next year was accounted for.

### 3.3.2 Using September End Level at FRL and 50% Monthly Yield Series

In the light of the simulation runs made using different rule levels corresponding to respective monthly yield series, it

was considered appropriate to examine the scenario when the reservoir is filled to FRL (57.32 m) at the end of September. The corresponding rule levels for August-end, July-end and June-end were worked out assuming the inflows corresponding to 50% yield series and fully meeting irrigation and water supply demands by making backward computations. Similarly, by forward computations, the month end rule levels for October to May were worked out. These represent desired upper levels for conservation regulation (termed as rule curve A). In addition to this, to consider critical periods from water supply and irrigation demand points of view, middle and lower curves of month-end rule levels were also computed using the following criterion:

- (a) Middle curve using 75% monthly yield series as expected inflow and to meet water supply and irrigation demands in full,
- (b) Lower curve using 90% monthly yield series as expected inflow and to meet water supply demand in full.

These rule levels (termed as rule curve B and rule curve C respectively) along with upper rule levels are also given in Table 7. The three curves A, B, and C are also plotted in Fig. 6.

This strategy has been used keeping in view the fact that the volume of the design flood hydrograph is 1785.6 million cubic meter which is much higher in comparison to reservoir capacity of 101 million cubic meter at FRL of 57.32 m. There is, as such, no likelihood of any additional advantage from the flood moderation point of view by keeping the reservoir level below FRL. This fact was also confirmed during the preliminary runs for reservoir operation for flood control.

### **3.3.3 Operation of Reservoir by Using FRL as Rule Curve**

The operation of the reservoir was also simulated by keeping the FRL as the upper rule curve level for the period May-end to

September-end instead of curve A in Fig. 6. From the examination of the results, it was noticed that there is no perceptible improvement in the performance of the reservoir by following this strategy except for some reduction in amount of water spilled during non-monsoon months. However, this strategy also leads to complete blockage of the river downstream of the reservoir. Therefore, this alternative may not be desirable from the environmental considerations.

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## CHAPTER 4

### RECOMMENDED OPERATION PROCEDURE

#### 4.0 RECOMMENDED PROCEDURE FOR CONSERVATION REGULATION

The recommended procedure for conservation operation of the Machhu-II reservoir using the three rule curves A, B, and C is as follows:

For a particular month:

1. Try to maintain the reservoir at rule level A while meeting full demands for water supply and irrigation.
2. If it is not possible maintain reservoir at level at A, meet all the demands for water supply and irrigation so long as reservoir level is at or above level B.
3. If it is likely that reservoir will go below level B while satisfying both demands in full, meet 75% of irrigation demands and full water supply demand, as long as reservoir level could be maintained above rule level C. In some cases it may become necessary to further reduce release for irrigation in order to maintain reservoir above rule level C.
4. If the reservoir level is at or below rule level C, make release to meet only water supply demand.
5. It is advisable to review the situation periodically within a month, at weekly or 10-daily intervals and modify the previous decision for the remaining duration of that month in view of the recent information (actual inflows, evaporation etc.) and follow steps (1) to (4) to operate the reservoir.

#### 4.1 MONTHLY OPERATION SIMULATION USING RECOMMENDED PROCEDURE

Monthly operation simulation runs were made using the rule levels corresponding to curves A, B and C and following the recommended procedure for the period 1958-59 to 1984-85 using actual monthly inflows, average water supply and irrigation



demands and normal values of monthly evaporation.

The results of these simulations are given in Table 8. The number of times when release\total demand (RTD) or release\ water supply demand (RWSD) were less than 1.0 during each of 12 months for these two alternatives are given in Table 9. It is seen that with the use of recommended operation procedure, in only some months RTD is less than 0.75 or RWSD is less than 1.0.

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CHAPTER 5  
CONCLUSIONS

5.0 CONCLUSIONS

A procedure has been developed for regulation of the Machhu-II reservoir to meet various conservation purposes. A number of scenarios in terms of reservoir inflows and levels were used and the trial operation procedure was developed. This procedure was refined by a detailed simulation analysis.

The performance of the recommended regulation policy was tested through simulation of reservoir operation on monthly basis. The results of the analysis show that through the recommended policy, it is possible to meet the various conservation purposes in a satisfactory manner.

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## FIGURES

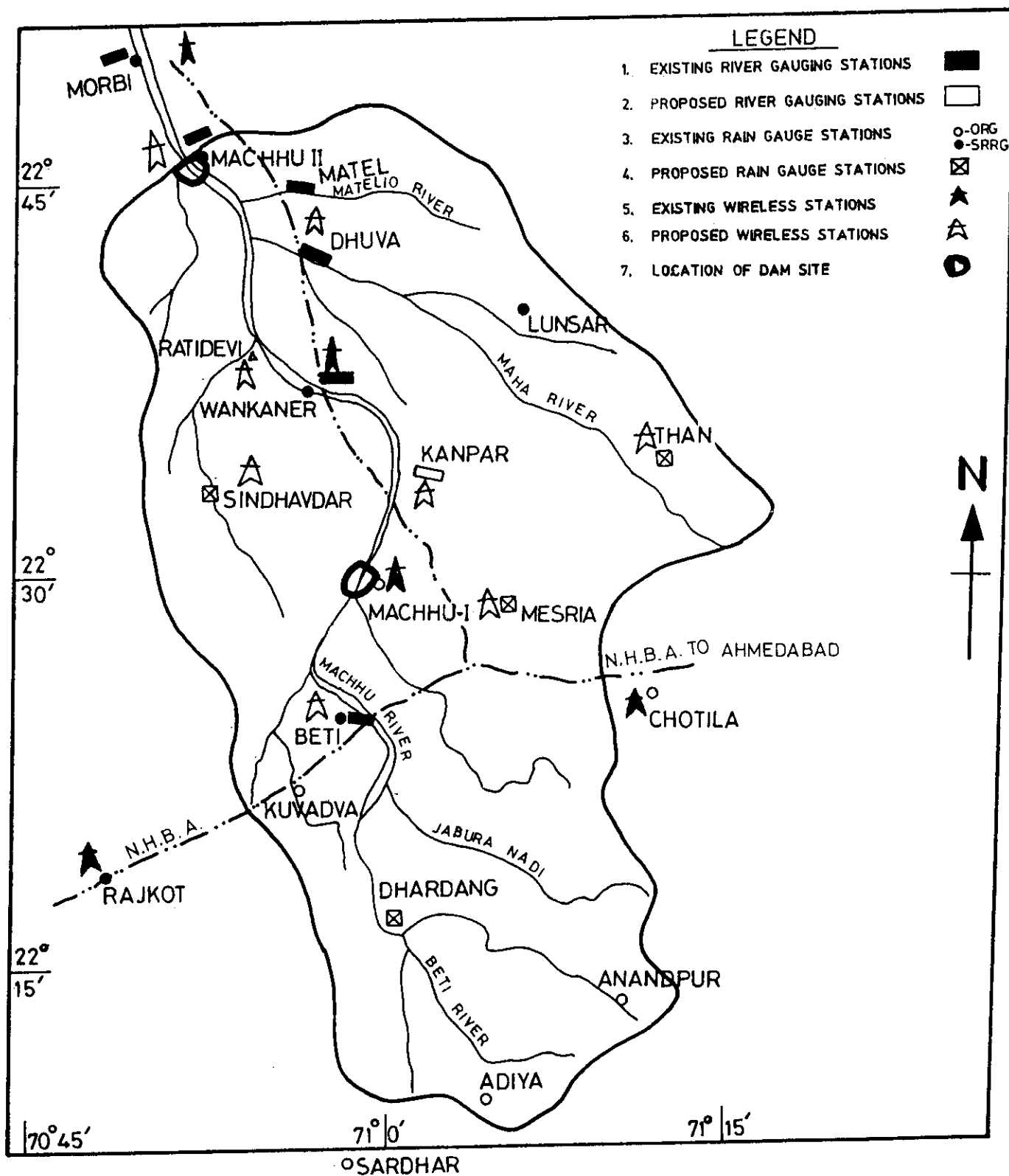
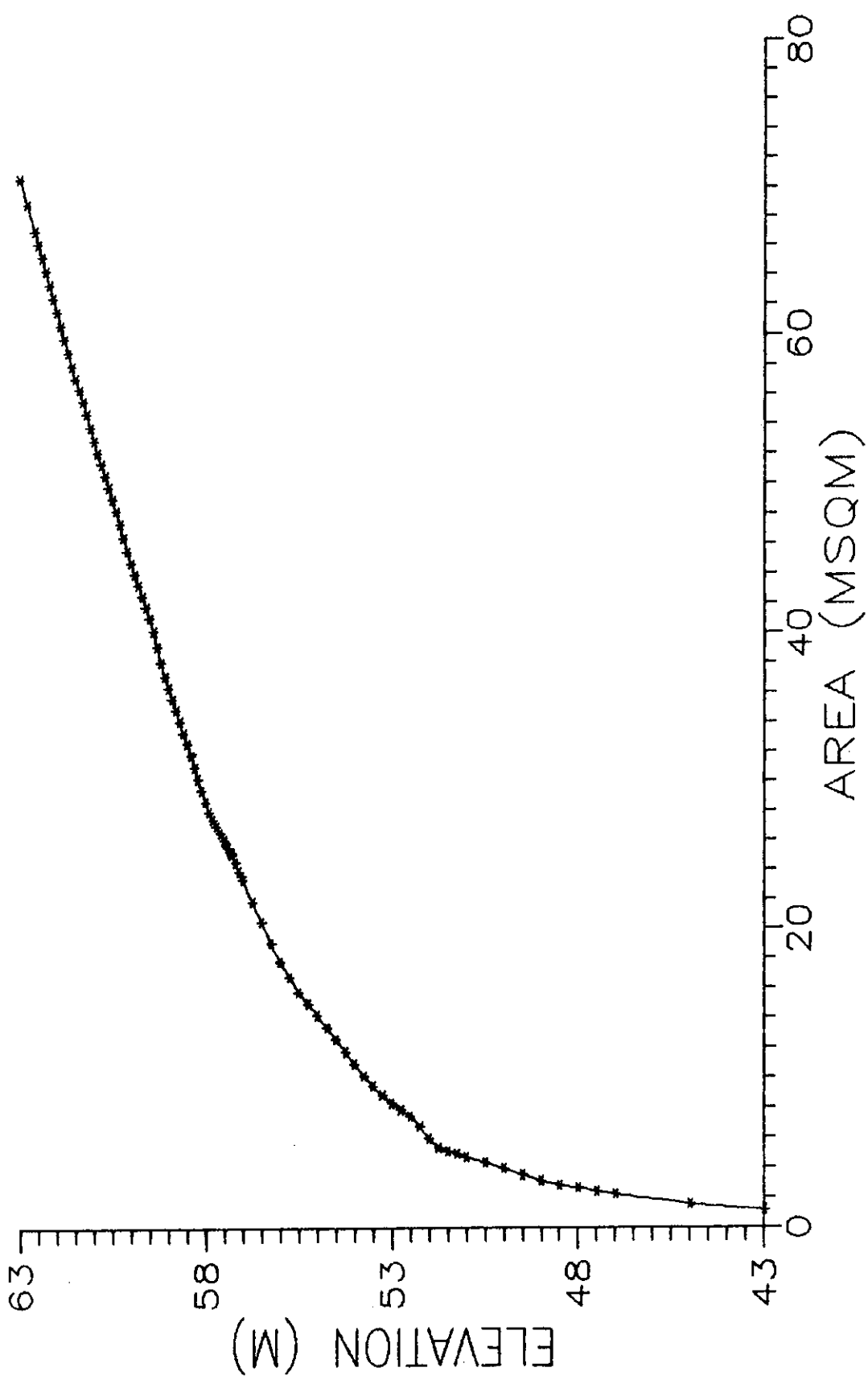
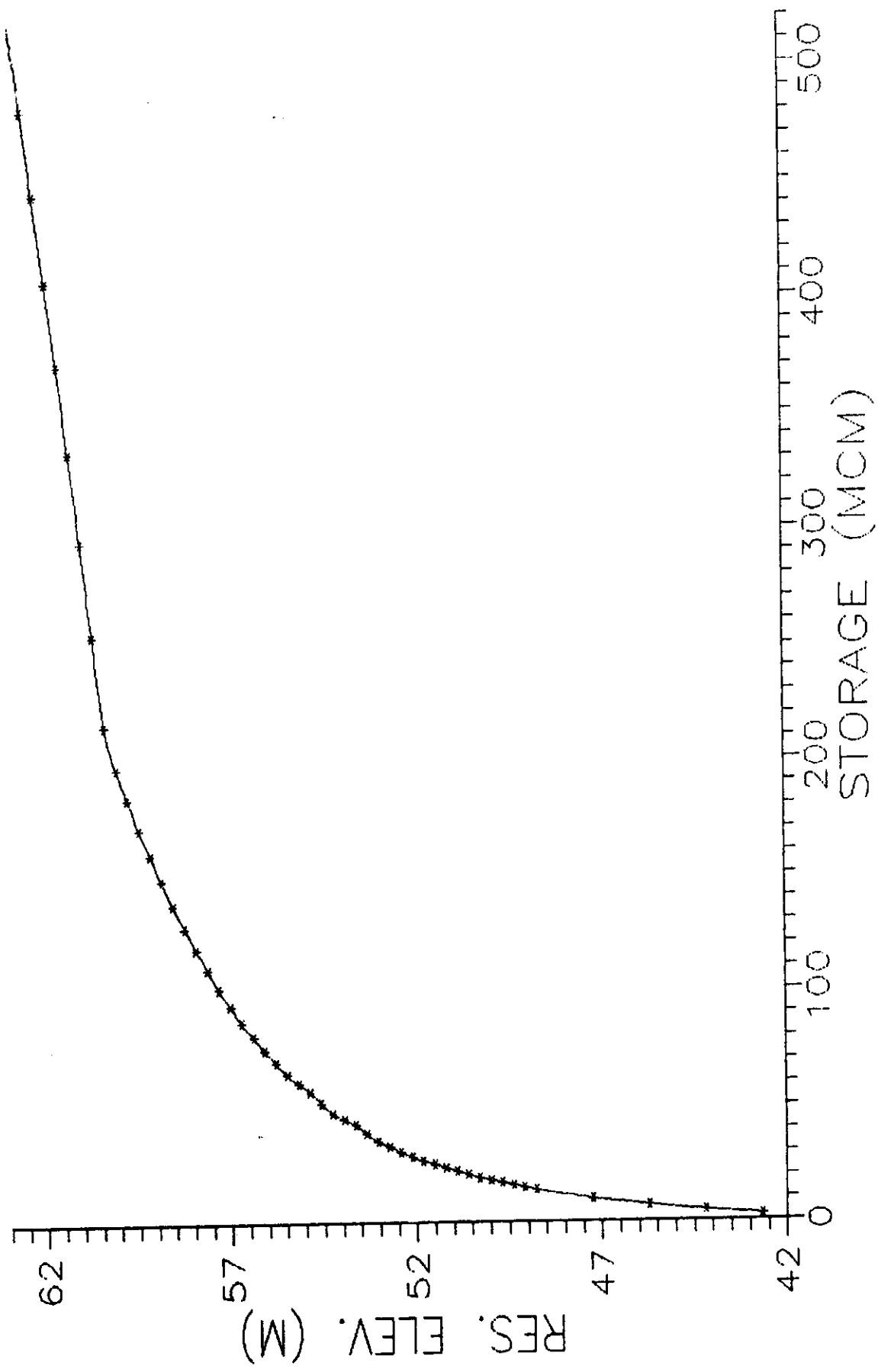


FIG. 1. INDEX MAP OF MACHHU BASIN UPTO MACHHU II DAM



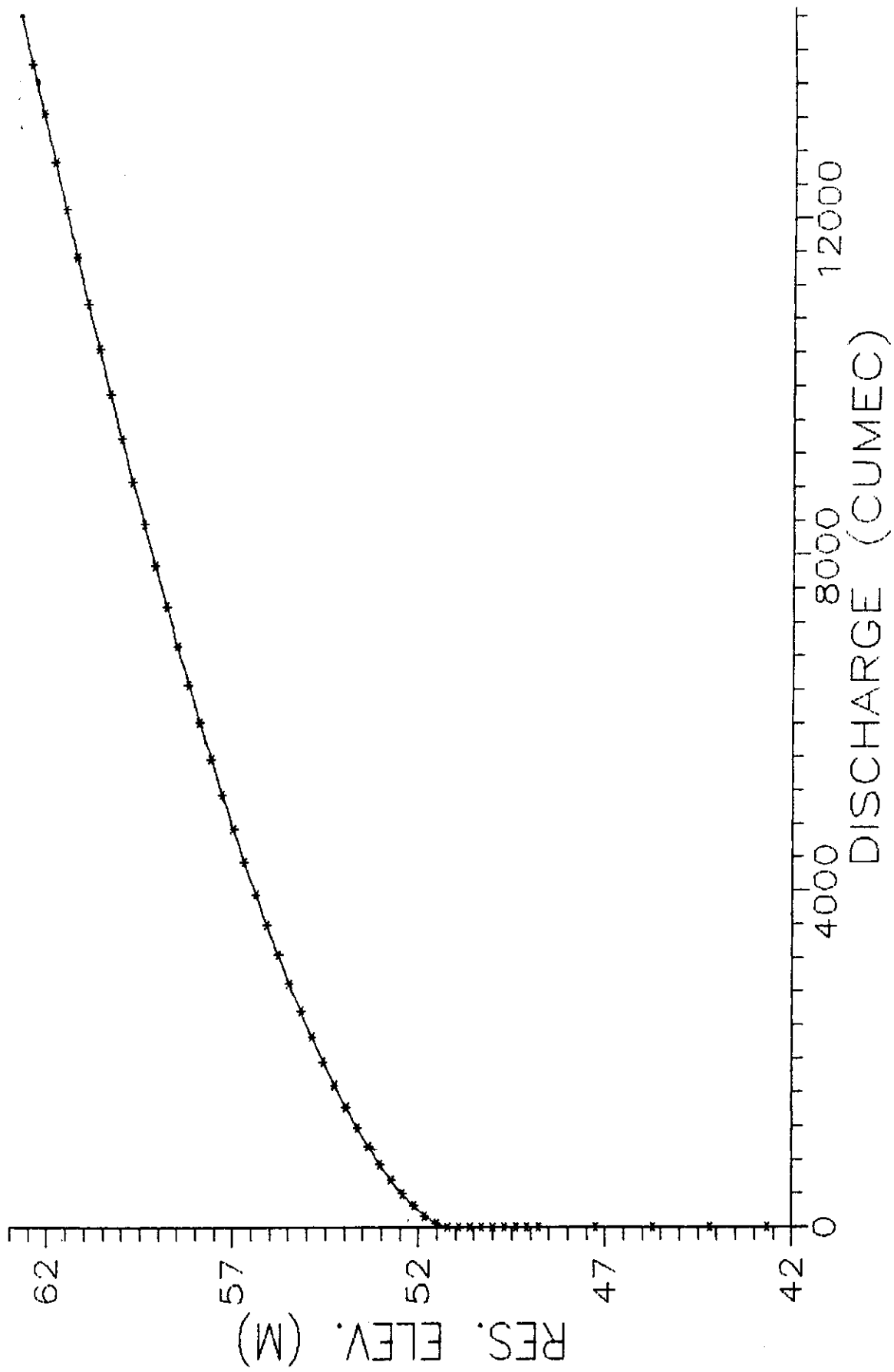
ELEVATION AREA CURVE

(FIG. 2. )



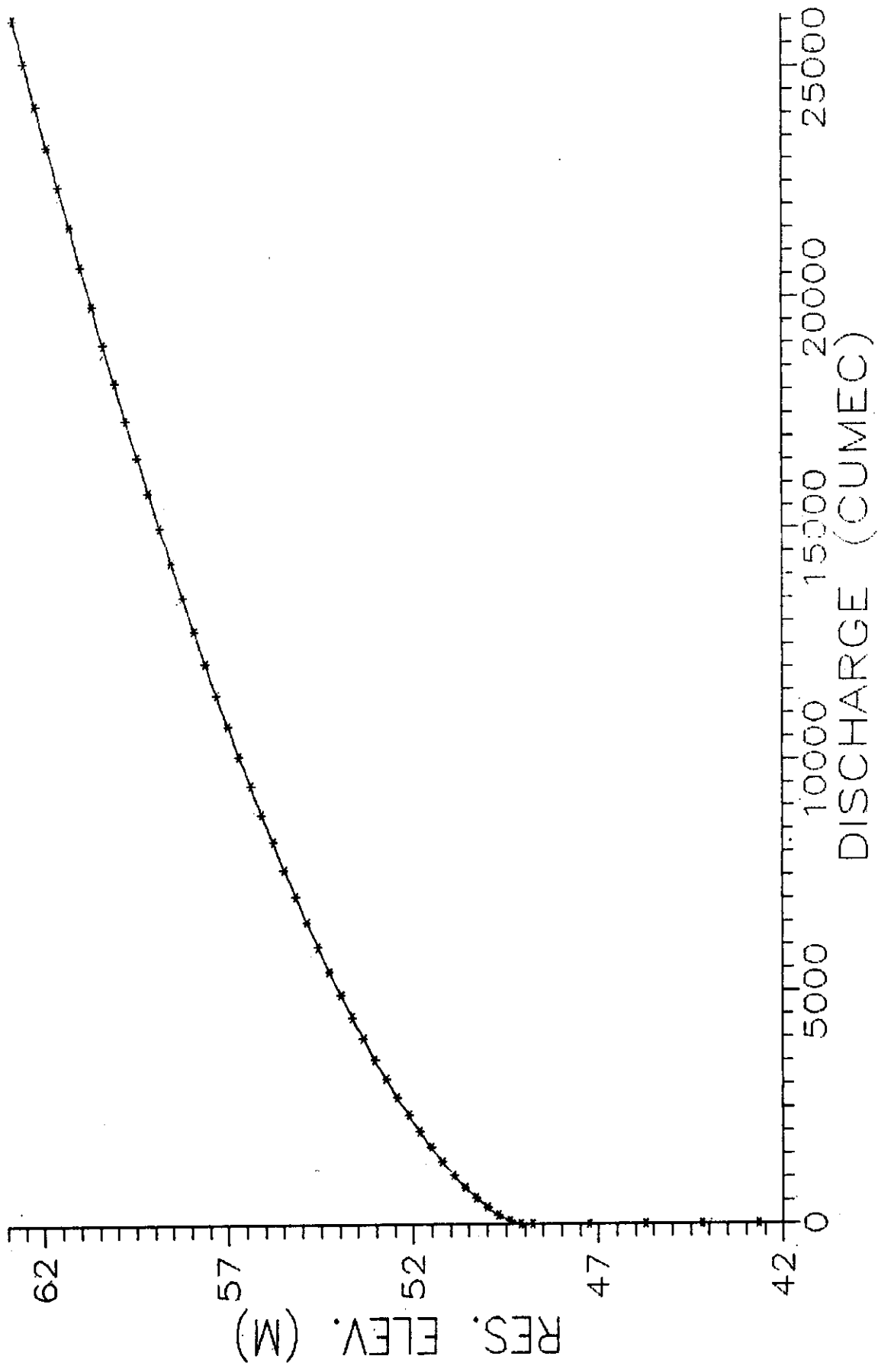
STORAGE ELEVATION CURVE

(FIG. 3.)



SPILLWAY RATING CURVE FOR MAIN SPILLWAY  
(FIG. 4. )





SPILLWAY RATING CURVE FOR ADDITIONAL SPILLWAY  
(FIG. 5.)

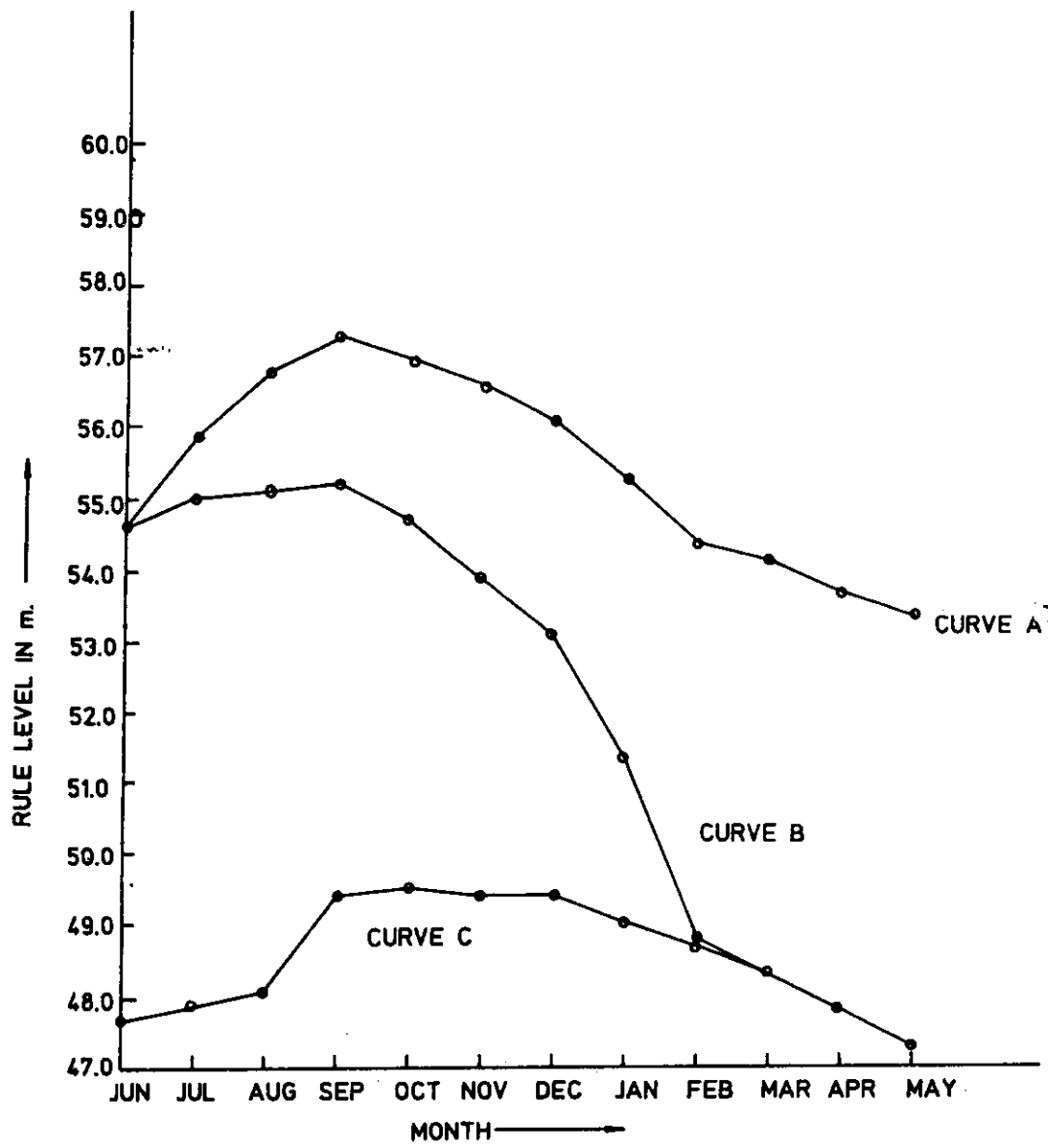


FIG.6 - RECOMMENDED RULE LEVELS

# TABLES

Table 1  
 Monthly Inflow Series for Machhu II Reservoir  
 in million cubic meter

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1958	0	0	0	0	0	2.519	20.608	40.405	73.203	6.922	9.561	3.258
1959	0	0	0	0	0	5.666	0.058	16.296	68.153	8.167	5.876	5.606
1960	0	0	0	0	0	35.628	20.656	0.000	21.599	2.803	2.017	1.865
1961	0	0	0	0	0	25.623	45.789	19.068	25.802	4.186	3.011	2.771
1962	0	0	0	0	0	7.160	6.925	3.975	73.203	6.922	9.561	3.258
1963	0	0	0	0	0	1.055	12.859	47.938	26.506	3.145	2.262	2.018
1964	0	0	0	0	0	6.361	49.789	39.353	22.635	6.190	2.016	2.776
1965	0	0	0	0	0	1.862	99.509	36.670	6.983	5.304	3.816	3.510
1966	0	0	0	0	0	24.440	48.655	0.000	65.275	4.981	3.586	3.297
1967	0	0	0	0	0	12.823	92.713	14.017	6.806	4.549	3.273	3.011
1968	0	0	0	0	0	0.000	99.335	60.662	17.169	8.186	5.888	5.617
1969	0	0	0	0	0	8.868	30.112	5.122	21.790	2.365	1.701	1.565
1970	0	0	0	0	0	15.903	32.526	99.116	61.109	9.311	6.699	6.613
1971	0	0	0	0	0	24.477	26.972	29.157	10.550	3.282	2.361	2.172
1972	0	0	0	0	0	10.221	3.498	2.017	6.018	0.783	0.563	0.518
1973	0	0	0	0	0	6.698	4.310	17.778	23.784	1.892	1.362	1.253
1974	0	0	0	0	0	0.477	0.000	0.000	32.960	1.204	0.866	0.797
1975	0	0	0	0	0	25.324	26.172	68.618	73.550	6.272	5.016	4.615
1976	0	0	0	0	0	21.516	86.946	62.744	46.195	7.926	5.631	5.180
1977	0	0	0	0	0	19.285	59.795	32.846	35.808	5.336	3.839	3.532
1978	0	0	0	0	0	12.155	16.739	64.332	6.352	3.585	2.579	2.375
1979	0	0	0	0	0	31.880	0.000	99.037	91.707	11.902	8.563	7.971
1980	0	0	0	0	0	12.673	14.011	11.000	21.372	3.907	2.090	2.500
1981	0	0	0	0	0	14.032	30.046	69.370	37.069	6.756	6.882	6.692
1982	0	0	0	0	0	5.709	6.045	12.629	0.000	0.962	0.479	0.425
1983	0	0	0	0	0	10.360	76.749	46.362	19.270	5.498	3.995	3.639
1984	0	0	0	0	0	11.223	39.134	54.278	61.562	4.903	3.528	3.245

Table 2

## Elevation-Area-Capacity-Discharge Table for Machhu II

Elevation (m)	Area (Million m <sup>2</sup> )	Capacity (Million m <sup>3</sup> )	Rel-Add (cumec)	Rel-Main (cumec)	Rel-Tot (cumec)
43.000	1.175	2.934	0.00	0.00	0.00
45.000	1.536	5.651	0.00	0.00	0.00
47.000	2.212	9.295	0.00	0.00	0.00
47.500	2.418	10.45	0.00	0.00	0.00
48.000	2.620	11.75	0.00	0.00	0.00
48.500	2.823	13.06	0.00	0.00	0.00
49.000	3.119	14.58	0.00	0.00	0.00
49.500	3.524	16.35	114.17	0.00	114.17
50.000	3.931	18.11	354.81	0.00	354.81
50.500	4.325	20.12	716.60	0.00	716.60
51.000	4.703	22.49	1142.46	0.00	1142.46
51.250	4.893	23.67	1376.63	4.79	1381.42
51.500	5.082	24.86	1634.94	44.70	1679.64
51.750	5.297	26.05	1903.20	114.45	2017.65
52.000	5.918	27.50	2191.44	204.90	2396.34
52.250	6.722	29.08	2492.40	312.02	2804.42
52.500	7.427	30.76	2804.16	433.27	3237.43
52.750	7.847	32.71	3137.61	571.81	3709.42
53.000	8.275	34.71	3477.20	722.02	4199.22
53.250	8.830	37.48	3839.16	889.20	4728.36
53.500	9.422	40.40	4209.28	1066.40	5275.68
53.750	10.10	42.98	4591.53	1254.99	5846.57
54.000	10.91	44.98	4992.99	1458.21	6451.20
54.250	11.72	47.05	5396.95	1667.77	7064.73
54.500	12.55	50.74	5828.37	1897.10	7725.47
54.750	13.37	54.53	6263.42	2132.71	8396.13
55.000	14.18	57.96	6713.53	2380.26	9093.78
55.250	14.96	61.02	7178.53	2639.79	9818.32
55.500	15.75	64.18	7642.39	2902.74	10545.14
55.750	16.77	68.40	8135.79	3186.13	11321.91
56.000	17.80	72.66	8628.22	3470.75	12098.97
56.250	19.05	77.34	9137.16	3768.84	12906.00
56.500	20.45	82.31	9655.66	4076.62	13732.28
56.750	21.86	87.47	10176.84	4389.30	14566.14
57.000	23.33	93.39	10724.47	4720.89	15445.36
57.050	23.62	94.58	10833.39	4787.11	15620.50
57.100	23.91	95.77	10942.17	4853.31	15795.47
57.200	24.49	98.15	11159.70	4985.70	16145.40
57.300	25.06	100.5	11377.24	5118.09	16495.33
57.320	25.18	101.0	11420.75	5144.57	16565.32
57.400	25.55	103.2	11605.13	5257.84	16862.97
57.500	26.01	106.0	11835.60	5399.43	17235.03
57.600	26.48	108.8	12066.07	5541.02	17607.09
57.700	26.95	111.6	12294.95	5681.16	17976.12
57.800	27.44	114.5	12523.44	5820.95	18344.38
57.900	27.92	117.3	12751.93	5960.74	18712.66
58.000	28.61	120.3	12989.61	6106.92	19096.53

... Contd.

Elevation (m)	Area (Million m <sup>2</sup> )	Capacity (Million m <sup>3</sup> )	Rel-Add (cumec)	Rel-Main (cumec)	Rel-Tot (cumec)
58.100	29.40	123.4	13231.24	6255.86	19487.10
58.200	30.19	126.6	13472.86	6404.79	19877.65
58.300	30.98	129.7	13711.92	6553.36	20265.28
58.400	31.77	132.9	13949.91	6701.77	20651.68
58.500	32.56	136.1	14187.89	6850.18	21038.07
58.600	33.32	139.5	14433.90	7004.24	21438.13
58.700	34.07	143.1	14685.25	7162.04	21847.29
58.800	34.82	146.6	14936.60	7319.85	22256.44
58.900	35.58	150.1	15186.25	7476.02	22662.27
59.000	36.35	153.7	15434.76	7631.09	23065.85
59.100	37.12	157.2	15683.28	7786.17	23469.45
59.200	38.03	160.8	15937.35	7945.67	23883.02
59.300	39.10	164.4	16197.00	8109.59	24306.58
59.400	40.17	168.1	16456.65	8273.51	24730.16
59.500	41.07	172.0	16714.22	8436.76	25150.98
59.600	41.80	176.3	16969.74	8599.34	25569.09
59.700	42.53	180.6	17225.25	8761.92	25987.17
59.800	43.27	184.9	17486.21	8928.29	26414.50
59.900	44.01	189.3	17755.36	9100.33	26855.69
60.000	44.75	193.6	18024.49	9272.37	27296.87
60.100	45.55	198.6	18292.12	9443.42	27735.54
60.200	46.45	204.6	18557.46	9612.97	28170.43
60.300	47.36	210.7	18822.80	9782.52	28605.32
60.400	48.22	218.8	19092.31	9954.77	29047.08
60.500	48.98	231.8	19371.52	10133.28	29504.80
60.600	49.75	244.8	19650.74	10311.79	29962.53
60.700	50.51	257.8	19928.70	10489.45	30418.15
60.800	51.28	270.8	20203.75	10665.12	30868.87
60.900	52.05	283.9	20478.80	10840.80	31319.61
61.000	52.85	296.9	20756.58	11018.23	31774.81
61.100	53.76	309.8	21045.30	11202.67	32247.98
61.200	54.66	322.8	21334.02	11387.11	32721.13
61.300	55.54	335.5	21621.08	11570.93	33192.01
61.400	56.32	347.6	21901.61	11752.26	33653.87
61.500	57.09	359.7	22182.12	11933.59	34115.71
61.600	57.88	371.8	22464.04	12115.78	34579.82
61.700	58.79	383.9	22758.58	12305.62	35064.20
61.800	59.71	395.9	23053.11	12495.45	35548.57
61.900	60.62	408.0	23347.15	12685.02	36032.18
62.000	61.53	420.1	23636.60	12872.11	36508.71
62.100	62.45	432.2	23926.05	13059.20	36985.26
62.200	63.36	444.3	24215.50	13246.29	37461.79
62.300	64.28	456.4	24519.30	13443.04	37962.34
62.400	65.19	468.4	24823.12	13639.80	38462.91
62.500	66.11	480.5	25126.92	13836.55	38963.47
62.600	67.02	492.6	25435.31	14036.72	39472.03
62.800	68.85	516.7	26052.07	14437.05	40489.12
63.000	70.59	539.6	26657.88	14831.04	41488.91

Note : Rel-Add -- Release capacity of additional spillway,  
 Rel-Main -- Release capacity of main spillway,  
 Rel-Tot -- Release capacity of both spillways.

Table 3

AVERAGE MONTHLY IRRIGATION & WATER SUPPLY DEMANDS  
FOR MACHHU II IN MCM

Month	Water Supply Demand	Irrigation Demand	Total Demand
Jan	0.733	10.560	11.293
Feb	0.664	9.022	9.686
Mar	0.733	0.166	0.899
Apr	0.709	0.000	0.709
May	0.733	0.000	0.733
Jun	0.709	0.000	0.709
Jul	0.728	0.120	0.848
Aug	0.733	7.260	7.993
Sep	0.709	8.960	9.669
Oct	0.733	7.050	7.783
Nov	0.709	8.660	9.369
Dec	0.733	8.330	9.063

Table 4

Normal Monthly Evaporation Depths for Machhu II  
in meter/month

Month	Evap_Depth(m)	Month	Evap_Depth(m)
Jan	0.127	Jul	0.229
Feb	0.127	Aug	0.203
Mar	0.203	Sep	0.203
Apr	0.229	Oct	0.178
May	0.254	Nov	0.152
Jun	0.229	Dec	0.127



Table 5  
Monthly Yield Estimation

Month	Monthly Yield (million cubic meter)					
	Probability Level for Value to be Equalled or Exceeded					
	50%	60%	70%	75%	80%	90%
Jan	0	0	0	0	0	0
Feb	0	0	0	0	0	0
Mar	0	0	0	0	0	0
Apr	0	0	0	0	0	0
May	0	0	0	0	0	0
Jun	11.1	8.7	6.4	5.2	4.1	1.6
Jul	27.0	19.7	13.2	10.1	7.1	1.7
Aug	29.5	22.3	15.4	12.0	8.6	1.9
Sep	28.4	22.6	17.0	14.2	11.4	5.4
Oct	4.6	3.9	3.2	2.8	2.5	1.6
Nov	3.2	2.6	2.1	1.8	1.6	1.0
Dec	2.9	2.5	2.0	1.8	1.5	1.0

Table 6

Rule Levels Using Monthly Inflows of Various Probability

Exceedance probability	Rule Level for Different Months (in meter)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
50x	53.556	52.393	51.987	51.555	51.013	50.340	53.933	55.444	56.329	55.930	55.362	54.721
60x	50.813	47.809	47.250	46.934	46.541	49.677	53.021	54.271	54.978	54.500	53.629	52.907
70x	47.250	47.082	46.819	46.528	46.165	49.025	51.784	52.706	53.300	52.800	51.112	49.197
75x	47.096	46.933	46.677	46.394	46.042	48.655	50.893	51.509	52.137	50.896	48.729	47.250
80x	47.096	46.933	46.677	46.394	46.042	48.235	49.947	49.860	50.123	48.241	47.250	47.250
90x	47.096	46.933	46.677	46.394	46.042	47.280	47.376	47.250	47.250	47.250	47.250	47.250

Table 7  
RECOMMENDED RULE LEVELS

Month	Rule Level in meter		
	Sep end FRL With 50% Flow	Irr, Water Supply With 75% Flow	Water Supply only With 90% Flow
Jan	55.26	51.30	49.04
Feb	54.42	48.79	48.73
Mar	54.15	48.25	48.25
Apr	53.74	47.75	47.75
May	53.43	47.25	47.25
Jun	54.59	54.59	47.71
Jul	55.86	55.01	47.86
Aug	56.75	55.10	48.12
Sep	57.32	55.22	49.40
Oct	57.00	54.67	49.47
Nov	56.57	53.90	49.40
Dec	56.12	53.11	49.36

Table - 8

Monthly Operation Simulation of Machhu-II  
Using Recommended Policy

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1958-06	9.792	47.250	2.519	2.519	0.553	0.274	0.709	0.709	0.000	0.000	11.049	47.730	54.590
1958-07	11.049	47.730	20.608	23.127	1.095	0.272	0.848	0.818	0.030	0.000	29.744	52.354	55.860
1958-08	29.744	52.354	40.405	63.532	2.207	0.274	7.993	7.993	0.000	0.000	59.949	55.164	56.750
1958-09	59.949	55.164	73.203	136.735	4.047	0.274	9.669	9.669	0.000	18.437	101.000	57.320	57.320
1958-10	101.000	57.320	6.922	143.657	4.318	0.274	7.783	7.783	0.000	2.428	93.393	57.000	57.000
1958-11	93.393	57.000	9.561	153.218	3.357	0.274	9.369	9.369	0.000	6.512	83.715	56.570	56.570
1958-12	83.715	56.570	3.258	156.476	2.487	0.274	9.063	9.063	0.000	0.657	74.766	56.120	56.120
1959-01	74.766	56.120	0.000	156.476	2.115	0.274	11.293	11.293	0.000	0.212	61.146	55.260	55.260
1959-02	61.146	55.260	0.000	156.476	1.732	0.274	9.686	9.686	0.000	0.213	49.515	54.420	54.420
1959-03	49.515	54.420	0.000	156.476	2.403	0.274	0.899	0.899	0.000	0.000	46.213	54.148	54.150
1959-04	46.213	54.148	0.000	156.476	2.457	0.274	0.709	0.709	0.000	0.149	42.897	53.740	53.740
1959-05	42.897	53.740	0.000	156.476	2.454	0.274	0.733	0.733	0.000	0.122	39.589	53.430	53.430
Monsoon deficit =			0.030 m m3,	Non-monsoon deficit =			0.000 m m3,	Total deficit =			0.030 m m3,	Spill = 28.730 m m3	
% Monsoon deficit =			0.11,	% Non-monsoon deficit =			0.00,	% Total deficit =			0.04		

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1959-06	39.589	53.430	5.666	5.666	2.187	0.274	0.709	0.709	0.000	0.000	42.359	53.672	54.590
1959-07	42.359	53.672	0.058	5.724	2.193	0.272	0.848	0.818	0.030	0.000	39.416	53.415	55.860
1959-08	39.416	53.415	16.296	22.020	2.136	0.274	7.993	6.178	1.815	0.000	47.398	54.282	56.750
1959-09	47.398	54.282	68.153	90.173	3.756	0.274	9.669	9.669	0.000	1.126	101.000	57.320	57.320
1959-10	101.000	57.320	8.167	98.340	4.318	0.274	7.783	7.783	0.000	3.673	93.393	57.000	57.000
1959-11	93.393	57.000	5.876	104.216	3.357	0.274	9.369	9.369	0.000	2.827	83.715	56.570	56.570
1959-12	83.715	56.570	5.606	109.822	2.487	0.274	9.063	9.063	0.000	3.005	74.766	56.120	56.120
1960-01	74.766	56.120	0.000	109.822	2.115	0.274	11.293	11.293	0.000	0.212	61.146	55.260	55.260
1960-02	61.146	55.260	0.000	109.822	1.732	0.274	9.686	9.686	0.000	0.213	49.515	54.420	54.420
1960-03	49.515	54.420	0.000	109.822	2.403	0.274	0.899	0.899	0.000	0.000	46.213	54.148	54.150
1960-04	46.213	54.148	0.000	109.822	2.457	0.274	0.709	0.709	0.000	0.149	42.897	53.740	53.740
1960-05	42.897	53.740	0.000	109.822	2.454	0.274	0.733	0.733	0.000	0.122	39.589	53.430	53.430
Monsoon deficit =			1.845 m m3,	Non-monsoon deficit =			0.000 m m3,	Total deficit =			1.845 m m3,	Spill = 11.327 m m3	
% Monsoon deficit =			2.68,	% Non-monsoon deficit =			0.00,	% Total deficit =			1.67		

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1960-06	39.589	53.430	35.628	35.628	2.531	0.274	0.709	0.709	0.000	19.865	52.113	54.590	54.590
1960-07	52.113	54.590	20.656	56.284	3.394	0.272	0.848	0.848	0.000	0.000	68.527	55.757	55.860
1960-08	68.527	55.757	0.000	56.284	3.175	0.274	7.993	6.178	1.815	0.000	59.173	55.100	56.750
1960-09	59.173	55.100	21.599	77.883	3.161	0.274	9.669	9.669	0.000	0.000	67.942	55.723	57.320
1960-10	67.942	55.723	2.803	80.686	2.795	0.274	7.783	7.783	0.000	0.000	60.167	55.181	57.000
1960-11	60.167	55.181	2.017	82.703	2.074	0.274	9.369	9.369	0.000	0.000	50.741	54.500	56.570
1960-12	50.741	54.500	1.865	84.568	1.418	0.274	9.063	9.063	0.000	0.000	42.125	53.648	56.120
1961-01	42.125	53.648	0.000	84.568	1.069	0.274	11.293	11.293	0.000	0.000	29.763	52.357	55.260
1961-02	29.763	52.357	0.000	84.568	0.715	0.274	9.686	9.686	0.000	0.000	19.362	50.339	54.420
1961-03	19.362	50.339	0.000	84.568	0.815	0.274	0.899	0.899	0.000	0.000	17.648	49.869	54.150
1961-04	17.648	49.869	0.000	84.568	0.835	0.274	0.709	0.709	0.000	0.000	16.104	49.431	53.740
1961-05	16.104	49.431	0.000	84.568	0.835	0.274	0.733	0.733	0.000	0.000	14.536	48.987	53.430
Monsoon deficit =			1.815 m m3,	Non-monsoon deficit =			0.000 m m3,	Total deficit =			1.815 m m3,	Spill = 19.865 m m3	
% Monsoon deficit =			2.64,	% Non-monsoon deficit =			0.00,	% Total deficit =			1.64		

... Contd.

Year-Mn	Init-Stor	Init_lev	Inflow	Cum_inf	Evapr	WS_dem	Tot_demd	Release	Deficit	Spill	End stor	End_lev	Rule
	(m m3)	(m)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m)	(m)
1961-06	14.536	48.987	25.623	25.623	1.380	0.274	0.709	0.709	0.000	0.000	38.069	53.300	54.590
1961-07	38.069	53.300	45.789	71.412	2.996	0.272	0.848	0.848	0.000	9.740	70.275	55.860	55.860
1961-08	70.275	55.860	19.068	90.480	3.690	0.274	7.993	7.993	0.000	0.000	77.659	56.266	56.750
1961-09	77.659	56.266	25.802	116.282	4.215	0.274	9.669	9.669	0.000	0.000	89.577	56.830	57.320
1961-10	89.577	56.839	4.186	120.468	3.809	0.274	7.783	7.783	0.000	0.000	82.171	56.493	57.000
1961-11	82.171	56.493	3.011	123.479	2.908	0.274	9.369	9.369	0.000	0.000	72.905	56.014	56.570
1961-12	72.905	56.014	2.771	126.250	2.139	0.274	9.063	9.063	0.000	0.000	64.474	55.517	56.120
1962-01	64.474	55.517	0.000	126.250	1.810	0.274	11.293	11.293	0.000	0.000	51.371	54.541	55.260
1962-02	51.371	54.541	0.000	126.250	1.402	0.274	9.686	9.686	0.000	0.000	40.283	53.490	54.420
1962-03	40.283	53.490	0.000	126.250	1.851	0.274	0.899	0.899	0.000	0.000	37.533	53.255	54.150
1962-04	37.533	53.255	0.000	126.250	1.963	0.274	0.709	0.709	0.000	0.000	34.860	53.019	53.740
1962-05	34.860	53.019	0.000	126.250	2.035	0.274	0.733	0.733	0.000	0.000	32.092	52.671	53.430
Monsoon deficit = 0.000 m m3, Non-monsoon deficit = 0.000 m m3, Total deficit = 0.000 m m3, Spill = 9.740 m m3													
% Monsoon deficit = 0.00, % Non-monsoon deficit = 0.00, % Total deficit = 0.00													

Year-Mn	Init-Stor	Init_lev	Inflow	Cum_inf	Evapr	WS_dem	Tot_demd	Release	Deficit	Spill	End stor	End_lev	Rule
	(m m3)	(m)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m)	(m)
1962-06	32.092	52.671	7.160	7.160	1.876	0.274	0.709	0.709	0.000	0.000	36.667	53.182	54.590
1962-07	36.667	53.182	6.925	14.085	2.078	0.272	0.848	0.818	0.030	0.000	40.696	53.525	55.860
1962-08	40.696	53.525	3.975	18.060	1.842	0.274	7.993	6.178	1.815	0.000	36.651	53.180	56.750
1962-09	36.651	53.180	18.196	36.256	2.004	0.274	9.669	7.429	2.240	0.000	45.414	54.052	57.320
1962-10	45.414	54.052	1.306	37.562	1.797	0.274	7.783	6.021	1.762	0.000	38.902	53.371	57.000
1962-11	38.902	53.371	0.960	38.522	1.267	0.274	9.369	7.204	2.165	0.000	31.391	52.581	56.570
1962-12	31.391	52.581	0.865	39.387	0.799	0.274	9.063	6.981	2.082	0.000	24.476	51.420	56.120
1963-01	24.476	51.420	0.000	39.387	0.519	0.274	11.293	9.234	2.059	0.000	14.723	49.040	55.260
1963-02	14.723	49.040	0.000	39.387	0.385	0.274	9.686	0.673	9.013	0.000	13.665	48.730	54.420
1963-03	13.665	48.730	0.000	39.387	0.571	0.274	0.899	0.733	0.166	0.000	12.361	48.232	54.150
1963-04	12.361	48.232	0.000	39.387	0.598	0.274	0.709	0.709	0.000	0.000	11.053	47.732	53.740
1963-05	11.053	47.732	0.000	39.387	0.613	0.274	0.733	0.648	0.085	0.000	9.792	47.250	53.430
Monsoon deficit = 5.847 m m3, Non-monsoon deficit = 15.571 m m3, Total deficit = 21.418 m m3, Spill = 0.000 m m3													
% Monsoon deficit = 8.50, % Non-monsoon deficit = 37.29, % Total deficit = 19.38													

Year-Mn	Init-Stor	Init_lev	Inflow	Cum_inf	Evapr	WS_dem	Tot_demd	Release	Deficit	Spill	End stor	End_lev	Rule
	(m m3)	(m)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m m3)	(m)	(m)
1963-06	9.792	47.250	1.055	1.055	0.531	0.274	0.709	0.524	0.185	0.000	9.792	47.250	54.590
1963-07	9.792	47.250	12.859	13.914	0.778	0.272	0.848	0.818	0.030	0.000	21.055	50.698	55.860
1963-08	21.055	50.698	47.938	61.852	1.925	0.274	7.993	7.892	0.101	0.000	59.177	55.100	56.750
1963-09	59.177	55.100	26.506	88.358	3.279	0.274	9.669	9.669	0.000	0.000	72.735	56.004	57.320
1963-10	72.735	56.004	3.145	91.503	3.007	0.274	7.783	7.783	0.000	0.000	65.090	55.554	57.000
1963-11	65.090	55.554	2.262	93.765	2.250	0.274	9.369	9.369	0.000	0.000	55.733	54.829	56.570
1963-12	55.733	54.829	2.018	95.783	1.611	0.274	9.063	9.063	0.000	0.000	47.077	54.253	56.120
1964-01	47.077	54.253	0.000	95.783	1.268	0.274	11.293	11.293	0.000	0.000	34.516	52.976	55.260
1964-02	34.516	52.976	0.000	95.783	0.837	0.274	9.686	9.686	0.000	0.000	23.994	51.318	54.420
1964-03	23.994	51.318	0.000	95.783	0.973	0.274	0.899	0.899	0.000	0.000	22.121	50.923	54.150
1964-04	22.121	50.923	0.000	95.783	1.032	0.274	0.709	0.709	0.000	0.000	20.381	50.555	53.740
1964-05	20.381	50.555	0.000	95.783	1.067	0.274	0.733	0.733	0.000	0.000	18.580	50.132	53.430
Monsoon deficit = 0.316 m m3, Non-monsoon deficit = 0.000 m m3, Total deficit = 0.316 m m3, Spill = 0.000 m m3													
% Monsoon deficit = 0.46, % Non-monsoon deficit = 0.00, % Total deficit = 0.29													

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Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1964-06	18.580	50.132	6.361	6.361	1.014	0.274	0.709	0.709	0.000	0.000	23.218	51.154	54.590
1964-07	23.218	51.154	49.789	56.150	2.506	0.272	0.848	0.848	0.000	0.000	69.653	55.824	55.860
1964-08	69.653	55.824	39.353	95.503	3.952	0.274	7.993	7.993	0.000	9.593	87.468	56.750	56.750
1964-09	87.468	56.750	22.635	118.138	4.647	0.274	9.669	9.669	0.000	0.000	95.787	57.101	57.320
1964-10	95.787	57.101	6.190	124.328	4.131	0.274	7.783	7.783	0.000	0.000	90.663	56.859	57.000
1964-11	90.663	56.859	2.016	126.344	3.205	0.274	9.369	9.369	0.000	0.000	79.505	56.359	56.570
1964-12	79.505	56.359	2.776	129.120	2.351	0.274	9.063	9.063	0.000	0.000	70.867	55.895	56.120
1965-01	70.867	55.895	0.000	129.120	1.996	0.274	11.293	11.293	0.000	0.000	57.578	54.969	55.260
1965-02	57.578	54.969	0.000	129.120	1.619	0.274	9.686	9.686	0.000	0.000	46.273	54.156	54.420
1965-03	46.273	54.156	0.000	129.120	2.192	0.274	0.899	0.899	0.000	0.000	43.181	53.776	54.150
1965-04	43.181	53.776	0.000	129.120	2.240	0.274	0.709	0.709	0.000	0.000	40.232	53.485	53.740
1965-05	40.232	53.485	0.000	129.120	2.306	0.274	0.733	0.733	0.000	0.000	37.193	53.226	53.430
Monsoon deficit =		0.000 m m3,		Non-monsoon deficit =		0.000 m m3,		Total deficit =		0.000 m m3,		Spill = 9.593 m m3	
% Monsoon deficit =		0.00,		% Non-monsoon deficit =		0.00,		% Total deficit =		0.00			

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1965-06	37.193	53.226	1.862	1.862	1.990	0.274	0.709	0.709	0.000	0.000	36.355	53.155	54.590
1965-07	36.355	53.155	99.509	101.371	2.957	0.272	0.848	0.848	0.000	61.785	70.275	55.860	55.860
1965-08	70.275	55.860	36.670	138.041	3.967	0.274	7.993	7.993	0.000	7.516	87.468	56.750	56.750
1965-09	87.468	56.750	6.983	145.024	4.245	0.274	9.669	9.669	0.000	0.000	80.537	56.411	57.320
1965-10	80.537	56.411	5.304	150.328	3.404	0.274	7.783	7.783	0.000	0.000	74.655	56.114	57.000
1965-11	74.655	56.114	3.816	154.144	2.629	0.274	9.369	9.369	0.000	0.000	66.473	55.636	56.570
1965-12	66.473	55.636	3.510	157.654	1.952	0.274	9.063	9.063	0.000	0.000	58.968	55.083	56.120
1966-01	58.968	55.083	0.000	157.654	1.636	0.274	11.293	11.293	0.000	0.000	46.039	54.128	55.260
1966-02	46.039	54.128	0.000	157.654	1.250	0.274	9.686	9.686	0.000	0.000	35.103	53.049	54.420
1966-03	35.103	53.049	0.000	157.654	1.642	0.274	0.899	0.899	0.000	0.000	32.562	52.731	54.150
1966-04	32.562	52.731	0.000	157.654	1.724	0.274	0.709	0.709	0.000	0.000	30.129	52.415	53.740
1966-05	30.129	52.415	0.000	157.654	1.686	0.274	0.733	0.733	0.000	0.000	27.710	52.053	53.430
Monsoon deficit =		0.000 m m3,		Non-monsoon deficit =		0.000 m m3,		Total deficit =		0.000 m m3,		Spill = 69.301 m m3	
% Monsoon deficit =		0.00,		% Non-monsoon deficit =		0.00,		% Total deficit =		0.00			

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1966-06	27.710	52.033	24.440	24.440	2.093	0.274	0.709	0.709	0.000	0.000	49.349	54.409	54.590
1966-07	49.349	54.409	48.655	73.095	3.374	0.272	0.848	0.848	0.000	23.507	70.275	55.860	55.860
1966-08	70.275	55.860	0.000	73.095	3.218	0.274	7.993	7.879	0.114	0.000	59.177	55.100	56.750
1966-09	59.177	55.100	65.275	138.370	4.026	0.274	9.669	9.669	0.000	9.756	101.000	57.320	57.320
1966-10	101.000	57.320	4.981	143.351	4.318	0.274	7.783	7.783	0.000	0.487	93.393	57.000	57.000
1966-11	93.393	57.000	3.586	146.937	3.357	0.274	9.369	9.369	0.000	0.537	83.715	56.570	56.570
1966-12	83.715	56.570	3.297	150.234	2.487	0.274	9.063	9.063	0.000	0.696	74.766	56.120	56.120
1967-01	74.766	56.120	0.000	150.234	2.115	0.274	11.293	11.293	0.000	0.212	61.146	55.260	55.260
1967-02	61.146	55.260	0.000	150.234	1.732	0.274	9.686	9.686	0.000	0.213	49.515	54.420	54.420
1967-03	49.515	54.420	0.000	150.234	2.403	0.274	0.899	0.899	0.000	0.000	46.213	54.148	54.150
1967-04	46.213	54.148	0.000	150.234	2.457	0.274	0.709	0.709	0.000	0.149	42.897	53.740	53.740
1967-05	42.897	53.740	0.000	150.234	2.454	0.274	0.733	0.733	0.000	0.122	39.589	53.430	53.430
Monsoon deficit =		0.114 m m3,		Non-monsoon deficit =		0.000 m m3,		Total deficit =		0.114 m m3,		Spill = 35.680 m m3	
% Monsoon deficit =		0.17,		% Non-monsoon deficit =		0.00,		% Total deficit =		0.10			

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Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1967-06	39.589	53.430	12.823	12.823	2.460	0.274	0.709	0.709	0.000	0.000	49.243	54.402	54.590
1967-07	49.243	54.402	92.713	105.556	3.372	0.272	0.848	0.848	0.000	67.462	70.275	55.860	55.860
1967-08	70.275	55.860	14.017	119.553	3.556	0.274	7.993	7.993	0.000	0.000	72.742	56.005	56.750
1967-09	72.742	56.005	6.806	126.359	3.462	0.274	9.669	9.669	0.000	0.000	66.418	55.632	57.320
1967-10	66.418	55.632	4.549	130.908	2.768	0.274	7.783	7.783	0.000	0.000	60.416	55.201	57.000
1967-11	60.416	55.201	3.273	134.181	2.103	0.274	9.369	9.369	0.000	0.000	52.217	54.597	56.570
1967-12	52.217	54.597	3.011	137.192	1.502	0.274	9.063	9.063	0.000	0.000	44.663	53.962	56.120
1968-01	44.663	53.962	0.000	137.192	1.176	0.274	11.293	11.293	0.000	0.000	32.194	52.684	55.260
1968-02	32.194	52.684	0.000	137.192	0.782	0.274	9.686	9.686	0.000	0.000	21.726	50.839	54.420
1968-03	21.726	50.839	0.000	137.192	0.901	0.274	0.899	0.899	0.000	0.000	19.926	50.458	54.150
1968-04	19.926	50.458	0.000	137.192	0.946	0.274	0.709	0.709	0.000	0.000	18.271	50.045	53.740
1968-05	18.271	50.045	0.000	137.192	0.958	0.274	0.733	0.733	0.000	0.000	16.580	49.566	53.430
Monsoon deficit = 0.000 m m3, Non-monsoon deficit = 0.000 m m3, Total deficit = 0.000 m m3, Spill = 67.462 m m3													
% Monsoon deficit = 0.00, % Non-monsoon deficit = 0.00, % Total deficit = 0.00													

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1968-06	16.580	49.566	0.000	0.000	0.780	0.274	0.709	0.709	0.000	0.000	15.090	49.144	54.590
1968-07	15.090	49.144	99.335	99.335	2.342	0.272	0.848	0.848	0.000	40.961	70.275	55.860	55.860
1968-08	70.275	55.860	60.662	159.997	3.967	0.274	7.993	7.993	0.000	31.508	87.468	56.750	56.750
1968-09	87.468	56.750	17.169	177.166	4.514	0.274	9.669	9.669	0.000	0.000	90.454	56.876	57.320
1968-10	90.454	56.876	8.186	185.352	3.945	0.274	7.783	7.783	0.000	0.000	86.912	56.727	57.000
1968-11	86.912	56.727	5.888	191.240	3.162	0.274	9.369	9.369	0.000	0.000	80.269	56.398	56.570
1968-12	80.269	56.398	5.617	196.857	2.419	0.274	9.063	9.063	0.000	0.000	74.404	56.102	56.120
1969-01	74.404	56.102	0.000	196.857	2.107	0.274	11.293	11.293	0.000	0.000	61.004	55.249	55.260
1969-02	61.004	55.249	0.000	196.857	1.730	0.274	9.686	9.686	0.000	0.074	49.515	54.420	54.420
1969-03	49.515	54.420	0.000	196.857	2.403	0.274	0.899	0.899	0.000	0.000	46.213	54.148	54.150
1969-04	46.213	54.148	0.000	196.857	2.457	0.274	0.709	0.709	0.000	0.149	42.897	53.740	53.740
1969-05	42.897	53.740	0.000	196.857	2.454	0.274	0.733	0.733	0.000	0.122	39.589	53.430	53.430
Monsoon deficit = 0.000 m m3, Non-monsoon deficit = 0.000 m m3, Total deficit = 0.000 m m3, Spill = 72.814 m m3													
% Monsoon deficit = 0.00, % Non-monsoon deficit = 0.00, % Total deficit = 0.00													

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1969-06	39.589	53.430	8.868	8.868	2.329	0.274	0.709	0.709	0.000	0.000	45.419	54.053	54.590
1969-07	45.419	54.053	30.112	38.980	3.241	0.272	0.848	0.848	0.000	1.168	70.275	55.860	55.860
1969-08	70.275	55.860	5.122	44.102	3.344	0.274	7.993	7.993	0.000	0.000	64.060	55.493	56.750
1969-09	64.060	55.493	21.790	65.892	3.405	0.274	9.669	9.669	0.000	0.000	72.776	56.007	57.320
1969-10	72.776	56.007	2.365	68.257	2.992	0.274	7.783	7.783	0.000	0.000	64.366	55.511	57.000
1969-11	64.366	55.511	1.701	69.958	2.216	0.274	9.369	9.369	0.000	0.000	54.482	54.747	56.570
1969-12	54.482	54.747	1.565	71.523	1.552	0.274	9.063	9.063	0.000	0.000	45.431	54.054	56.120
1970-01	45.431	54.054	0.000	71.523	1.205	0.274	11.293	11.293	0.000	0.000	32.933	52.778	55.260
1970-02	32.933	52.778	0.000	71.523	0.800	0.274	9.686	9.686	0.000	0.000	22.448	50.992	54.420
1970-03	22.448	50.992	0.000	71.523	0.924	0.274	0.899	0.899	0.000	0.000	20.625	50.607	54.150
1970-04	20.625	50.607	0.000	71.523	0.976	0.274	0.709	0.709	0.000	0.000	18.940	50.233	53.740
1970-05	18.940	50.233	0.000	71.523	0.996	0.274	0.733	0.733	0.000	0.000	17.210	49.745	53.430
Monsoon deficit = 0.000 m m3, Non-monsoon deficit = 0.000 m m3, Total deficit = 0.000 m m3, Spill = 1.168 m m3													
% Monsoon deficit = 0.00, % Non-monsoon deficit = 0.00, % Total deficit = 0.00													

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Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1970-06	17.210	49.745	15.903	15.903	1.286	0.274	0.709	0.709	0.000	0.000	11.119	52.546	54.590
1970-07	31.119	52.546	32.526	48.429	2.550	0.272	0.848	0.848	0.000	0.000	40.247	55.138	55.860
1970-08	60.247	55.188	99.116	147.545	3.718	0.274	7.993	7.993	0.000	60.134	87.468	56.750	56.750
1970-09	87.468	56.750	61.109	208.654	4.775	0.274	9.669	9.669	0.000	33.133	101.000	57.320	57.320
1970-10	101.000	57.320	9.311	217.965	4.318	0.274	7.783	7.783	0.000	4.817	93.393	57.000	57.000
1970-11	93.393	57.000	6.699	224.664	3.357	0.274	9.569	9.569	0.000	5.650	83.715	56.570	56.570
1970-12	83.715	56.570	6.613	231.277	2.487	0.274	9.063	9.063	0.000	4.012	74.766	56.120	56.120
1971-01	74.766	56.120	0.000	231.277	2.115	0.274	11.293	11.293	0.000	1.112	63.146	55.260	55.260
1971-02	61.146	55.260	0.000	231.277	1.732	0.274	9.686	9.686	0.000	0.213	49.515	54.420	54.420
1971-03	49.515	54.420	0.000	231.277	2.463	0.274	0.899	0.899	0.000	0.000	46.213	54.148	54.150
1971-04	46.213	54.148	0.000	231.277	2.457	0.274	0.709	0.709	0.000	0.149	42.897	53.740	53.740
1971-05	42.897	53.740	0.000	231.277	2.454	0.274	0.733	0.733	0.000	0.122	39.589	53.430	53.430
Monsoon deficit =	0.000 m m3,	Non-monsoon deficit =	0.000 m m3,	Total deficit =	0.000 m m3,	Spill =	106.493 m m3						
% Monsoon deficit =	0.00,	% Non-monsoon deficit =	0.00,	% Total deficit =	0.00								

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1971-06	39.589	53.430	24.477	24.477	2.531	0.274	0.709	0.709	0.000	8.714	52.113	54.590	54.590
1971-07	52.113	54.590	26.972	51.449	3.442	0.272	0.848	0.848	0.000	4.520	70.275	55.860	55.860
1971-08	70.275	55.860	29.157	80.606	3.967	0.274	7.993	7.993	0.000	0.003	87.468	56.750	56.750
1971-09	87.468	56.750	10.550	91.156	4.343	0.274	9.669	9.669	0.000	0.000	84.006	56.584	57.320
1971-10	84.006	56.584	3.282	94.438	3.524	0.274	7.783	7.783	0.000	0.000	75.981	56.181	57.000
1971-11	75.981	56.181	2.361	96.799	2.655	0.274	9.369	9.369	0.000	0.000	66.318	55.627	56.570
1971-12	66.318	55.627	2.172	98.971	1.926	0.274	9.063	9.063	0.000	0.000	57.502	54.962	56.120
1972-01	57.502	54.962	0.000	98.971	1.577	0.274	11.293	11.293	0.000	0.000	44.632	53.958	55.260
1972-02	44.632	53.958	0.000	98.971	1.196	0.274	9.686	9.686	0.000	0.000	33.750	52.880	54.420
1972-03	33.750	52.880	0.000	98.971	1.584	0.274	0.899	0.899	0.000	0.000	31.267	52.565	54.150
1972-04	31.267	52.565	0.000	98.971	1.624	0.274	0.709	0.709	0.000	0.000	28.934	52.227	53.740
1972-05	28.934	52.227	0.000	98.971	1.541	0.274	0.733	0.733	0.000	0.000	26.660	51.866	53.430
Monsoon deficit =	0.000 m m3,	Non-monsoon deficit =	0.000 m m3,	Total deficit =	0.000 m m3,	Spill =	13.227 m m3						
% Monsoon deficit =	0.00,	% Non-monsoon deficit =	0.00,	% Total deficit =	0.00								

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1972-06	26.660	51.866	10.221	10.221	1.573	0.274	0.709	0.709	0.000	0.000	34.999	52.986	54.590
1972-07	34.999	52.986	3.498	13.719	1.908	0.272	0.848	0.813	0.030	0.000	38.371	53.072	55.860
1972-08	35.371	53.072	2.017	15.736	1.565	0.274	7.993	6.178	1.815	0.000	29.645	52.339	56.750
1972-09	29.645	52.339	6.018	21.754	1.283	0.274	9.669	7.429	2.240	0.000	26.951	51.913	57.320
1972-10	26.951	51.913	0.783	22.537	0.896	0.274	7.783	6.021	1.762	0.000	20.817	50.647	57.000
1972-11	20.817	50.647	0.563	23.100	0.599	0.274	9.369	4.786	4.583	0.000	15.995	49.400	56.570
1972-12	15.995	49.400	0.518	23.618	0.428	0.274	9.063	0.733	8.330	0.000	15.352	49.218	56.120
1973-01	15.352	49.218	0.000	23.618	0.402	0.274	11.293	0.733	10.560	0.000	14.217	48.897	55.260
1973-02	14.217	48.897	0.000	23.618	0.373	0.274	9.686	0.664	9.022	0.000	13.180	48.545	54.420
1973-03	13.180	48.545	0.000	23.618	0.556	0.274	0.899	0.733	0.166	0.000	11.891	48.052	54.150
1973-04	11.891	48.052	0.000	23.618	0.582	0.274	0.709	0.709	0.000	0.000	10.600	47.559	53.740
1973-05	10.600	47.559	0.000	23.618	0.604	0.274	0.733	0.203	0.530	0.000	9.792	47.250	53.430
Monsoon deficit =	5.847 m m3,	Non-monsoon deficit =	33.190 m m3,	Total deficit =	39.038 m m3,	Spill =	0.000 m m3						
% Monsoon deficit =	8.50,	% Non-monsoon deficit =	79.49,	% Total deficit =	35.33								

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Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1973-06	9.792	47.250	6.698	6.698	0.637	0.274	0.709	0.709	0.000	0.000	15.144	49.159	54.590
1973-07	15.144	49.159	4.310	11.008	0.814	0.272	0.848	0.818	0.030	0.000	17.821	49.918	55.860
1973-08	17.821	49.918	17.778	28.786	1.039	0.274	7.993	6.178	1.815	0.000	28.382	52.140	56.750
1973-09	28.382	52.140	23.784	52.570	1.675	0.274	9.669	7.429	2.240	0.000	43.062	53.761	57.320
1973-10	43.062	53.761	1.892	54.462	1.684	0.274	7.783	6.021	1.762	0.000	37.250	53.231	57.000
1973-11	37.250	53.231	1.362	55.824	1.221	0.274	9.369	7.204	2.165	0.000	30.188	52.424	56.570
1973-12	30.188	52.424	1.253	57.077	0.773	0.274	9.063	6.981	2.082	0.000	23.687	51.253	56.120
1974-01	23.687	51.253	0.000	57.077	0.511	0.274	11.293	8.453	2.840	0.000	14.723	49.040	55.260
1974-02	14.723	49.040	0.000	57.077	0.385	0.274	9.686	0.673	9.013	0.000	13.665	48.730	54.420
1974-03	13.665	48.730	0.000	57.077	0.571	0.274	0.899	0.733	0.166	0.000	12.361	48.232	54.150
1974-04	12.361	48.232	0.000	57.077	0.598	0.274	0.709	0.709	0.000	0.000	11.053	47.732	53.740
1974-05	11.053	47.732	0.000	57.077	0.613	0.274	0.733	0.648	0.085	0.000	9.792	47.250	53.430
Monsoon deficit : 5.847 m m3, Non-monsoon deficit : 16.351 m m3, Total deficit : 22.199 m m3, Spill : 0.000 m m3													
% Monsoon deficit = 8.50, % Non-monsoon deficit = 39.16, % Total deficit = 20.09													

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1974-06	9.792	47.250	0.477	0.477	0.529	0.274	0.709	0.000	0.709	0.000	9.740	47.224	54.590
1974-07	9.740	47.224	0.000	0.477	0.516	0.272	0.848	0.000	0.848	0.000	9.224	46.964	55.860
1974-08	9.224	46.964	0.000	0.477	0.437	0.274	7.993	0.000	7.993	0.000	8.787	46.745	56.750
1974-09	8.787	46.745	32.960	33.437	1.023	0.274	9.669	7.429	2.240	0.000	33.296	52.823	57.320
1974-10	33.296	52.823	1.204	34.641	1.225	0.274	7.783	6.021	1.762	0.000	27.254	51.961	57.000
1974-11	27.254	51.961	0.866	35.507	0.769	0.274	9.369	7.204	2.165	0.000	20.147	50.505	56.570
1974-12	20.147	50.505	0.797	36.304	0.491	0.274	9.063	4.598	4.465	0.000	15.854	49.360	56.120
1975-01	15.854	49.360	0.000	36.304	0.416	0.274	11.293	0.733	10.560	0.000	14.705	49.035	55.260
1975-02	14.705	49.035	0.000	36.304	0.385	0.274	9.686	0.664	9.022	0.000	13.656	48.726	54.420
1975-03	13.656	48.726	0.000	36.304	0.571	0.274	0.899	0.733	0.166	0.000	12.352	48.228	54.150
1975-04	12.352	48.228	0.000	36.304	0.598	0.274	0.709	0.709	0.000	0.000	11.044	47.729	53.740
1975-05	11.044	47.729	0.000	36.304	0.613	0.274	0.733	0.639	0.094	0.000	9.792	47.250	53.430
Monsoon deficit : 13.552 m m3, Non-monsoon deficit : 26.471 m m3, Total deficit : 40.024 m m3, Spill : 0.000 m m3													
% Monsoon deficit = 19.71, % Non-monsoon deficit = 63.40, % Total deficit = 36.22													

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1975-06	9.792	47.250	25.324	25.324	1.177	0.274	0.709	0.709	0.000	0.000	33.230	52.815	54.590
1975-07	33.230	52.815	26.172	51.496	2.481	0.272	0.848	0.818	0.030	0.000	56.103	54.854	55.860
1975-08	56.103	54.854	68.618	120.114	3.611	0.274	7.993	7.993	0.000	25.649	87.468	56.750	56.750
1975-09	87.468	56.750	73.550	193.664	4.775	0.274	9.669	9.669	0.000	45.574	101.000	57.320	57.320
1975-10	101.000	57.320	6.272	199.936	4.318	0.274	7.783	7.783	0.000	1.778	93.393	57.000	57.000
1975-11	93.393	57.000	5.016	204.952	3.357	0.274	9.369	9.369	0.000	1.967	83.715	56.570	56.570
1975-12	83.715	56.570	4.615	209.567	2.487	0.274	9.063	9.063	0.000	2.014	74.766	56.120	56.120
1976-01	74.766	56.120	0.000	209.567	2.115	0.274	11.293	11.293	0.000	0.212	61.146	55.260	55.260
1976-02	61.146	55.260	0.000	209.567	1.732	0.274	9.686	9.686	0.000	0.213	49.515	54.420	54.420
1976-03	49.515	54.420	0.000	209.567	2.403	0.274	0.899	0.899	0.000	0.000	46.213	54.148	54.150
1976-04	46.213	54.148	0.000	209.567	2.457	0.274	0.709	0.709	0.000	0.149	42.897	53.740	53.740
1976-05	42.897	53.740	0.000	209.567	2.454	0.274	0.733	0.733	0.000	0.122	39.589	53.430	53.430
Monsoon deficit : 0.030 m m3, Non-monsoon deficit : 0.000 m m3, Total deficit : 0.030 m m3, Spill : 77.679 m m3													
% Monsoon deficit = 0.04, % Non-monsoon deficit = 0.00, % Total deficit = 0.03													

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Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1976-06	39.589	53.430	21.516	21.516	2.531	0.274	0.709	0.709	0.000	5.753	52.113	54.590	54.590
1976-07	52.113	54.590	86.946	108.462	3.442	0.272	0.848	0.848	0.000	64.494	70.275	55.860	55.860
1976-08	70.275	55.860	62.744	171.206	3.967	0.274	7.993	7.993	0.000	33.590	87.468	56.750	56.750
1976-09	87.468	56.750	46.195	217.401	4.775	0.274	9.669	9.669	0.000	18.219	101.000	57.320	57.320
1976-10	101.000	57.320	7.926	225.327	4.318	0.274	7.783	7.783	0.000	3.432	93.393	57.000	57.000
1976-11	93.393	57.000	5.631	230.958	3.357	0.274	9.369	9.369	0.000	2.582	83.715	56.570	56.570
1976-12	83.715	56.570	5.180	236.138	2.487	0.274	9.063	9.063	0.000	2.579	74.766	56.120	56.120
1977-01	74.766	56.120	0.000	236.138	2.115	0.274	11.293	11.293	0.000	0.212	61.146	55.260	55.260
1977-02	61.146	55.260	0.000	236.138	1.732	0.274	9.686	9.686	0.000	0.213	49.515	54.420	54.420
1977-03	49.515	54.420	0.000	236.138	2.403	0.274	0.899	0.899	0.000	0.000	46.213	54.148	54.150
1977-04	46.213	54.148	0.000	236.138	2.457	0.274	0.709	0.709	0.000	0.149	42.897	53.740	53.740
1977-05	42.897	53.740	0.000	236.138	2.454	0.274	0.733	0.733	0.000	0.122	39.589	53.430	53.430
Monsoon deficit = 0.000 m m3, Non-monsoon deficit = 0.000 m m3, Total deficit = 0.000 m m3, Spill = 131.346 m m3													
% Monsoon deficit = 0.00, % Non-monsoon deficit = 0.00, % Total deficit = 0.00													

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1977-06	39.589	53.430	19.285	19.285	2.531	0.274	0.709	0.709	0.000	3.522	52.113	54.590	54.590
1977-07	52.113	54.590	59.795	79.080	3.442	0.272	0.848	0.848	0.000	37.343	70.275	55.860	55.860
1977-08	70.275	55.860	32.846	111.926	3.967	0.274	7.993	7.993	0.000	3.692	87.468	56.750	56.750
1977-09	87.468	56.750	35.808	147.734	4.775	0.274	9.669	9.669	0.000	7.832	101.000	57.320	57.320
1977-10	101.000	57.320	5.336	153.070	4.318	0.274	7.783	7.783	0.000	0.842	93.393	57.000	57.000
1977-11	93.393	57.000	3.839	156.909	3.357	0.274	9.369	9.369	0.000	0.790	83.715	56.570	56.570
1977-12	83.715	56.570	3.532	160.441	2.487	0.274	9.063	9.063	0.000	0.931	74.766	56.120	56.120
1978-01	74.766	56.120	0.000	160.441	2.115	0.274	11.293	11.293	0.000	0.212	61.146	55.260	55.260
1978-02	61.146	55.260	0.000	160.441	1.732	0.274	9.686	9.686	0.000	0.213	49.515	54.420	54.420
1978-03	49.515	54.420	0.000	160.441	2.403	0.274	0.899	0.899	0.000	0.000	46.213	54.148	54.150
1978-04	46.213	54.148	0.000	160.441	2.457	0.274	0.709	0.709	0.000	0.149	42.897	53.740	53.740
1978-05	42.897	53.740	0.000	160.441	2.454	0.274	0.733	0.733	0.000	0.122	39.589	53.430	53.430
Monsoon deficit = 0.000 m m3, Non-monsoon deficit = 0.000 m m3, Total deficit = 0.000 m m3, Spill = 55.649 m m3													
% Monsoon deficit = 0.00, % Non-monsoon deficit = 0.00, % Total deficit = 0.00													

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1978-06	39.589	53.430	12.155	12.155	2.444	0.274	0.709	0.709	0.000	0.000	48.592	54.360	54.590
1978-07	48.592	54.360	16.739	28.894	3.107	0.272	0.848	0.848	0.000	0.000	61.376	55.278	55.860
1978-08	61.376	55.278	64.332	93.226	3.747	0.274	7.993	7.993	0.000	26.500	87.468	56.750	56.750
1978-09	87.468	56.750	6.352	99.578	4.227	0.274	9.669	9.669	0.000	0.000	79.924	56.381	57.320
1978-10	79.924	56.381	3.585	103.163	3.338	0.274	7.783	7.783	0.000	0.000	72.388	55.984	57.000
1978-11	72.388	55.984	2.579	105.742	2.524	0.274	9.369	9.369	0.000	0.000	63.074	55.415	56.570
1978-12	63.074	55.415	2.375	108.117	1.832	0.274	9.063	9.063	0.000	0.000	54.554	54.751	56.120
1979-01	54.554	54.751	0.000	108.117	1.466	0.274	11.293	11.293	0.000	0.000	41.795	53.620	55.260
1979-02	41.795	53.620	0.000	108.117	1.092	0.274	9.686	9.686	0.000	0.000	31.017	52.533	54.420
1979-03	31.017	52.533	0.000	108.117	1.422	0.274	0.899	0.899	0.000	0.000	28.696	52.189	54.150
1979-04	28.696	52.189	0.000	108.117	1.373	0.274	0.709	0.709	0.000	0.000	26.614	51.859	53.740
1979-05	26.614	51.859	0.000	108.117	1.333	0.274	0.733	0.733	0.000	0.000	24.549	51.435	53.430
Monsoon deficit = 0.000 m m3, Non-monsoon deficit = 0.000 m m3, Total deficit = 0.000 m m3, Spill = 26.500 m m3													
% Monsoon deficit = 0.00, % Non-monsoon deficit = 0.00, % Total deficit = 0.00													

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Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1979-06	24.549	51.435	31.880	31.880	2.047	0.274	0.709	0.709	0.000	1.560	52.113	54.590	54.590
1979-07	52.113	54.590	0.000	31.880	2.851	0.272	0.848	0.818	0.030	0.000	48.444	54.350	55.860
1979-08	48.444	54.350	99.037	130.917	3.443	0.274	7.993	7.993	0.000	48.577	87.468	56.750	56.750
1979-09	87.468	56.750	91.707	222.624	4.775	0.274	9.669	9.669	0.000	63.731	101.000	57.320	57.320
1979-10	101.000	57.320	11.902	234.526	4.318	0.274	7.783	7.783	0.000	7.408	93.393	57.000	57.000
1979-11	93.393	57.000	8.563	243.089	3.357	0.274	9.369	9.369	0.000	5.514	83.715	56.570	56.570
1979-12	83.715	56.570	7.971	251.060	2.487	0.274	9.063	9.063	0.000	5.370	74.766	56.120	56.120
1980-01	74.766	56.120	0.000	251.060	2.115	0.274	11.293	11.293	0.000	0.212	61.146	55.260	55.260
1980-02	61.146	55.260	0.000	251.060	1.732	0.274	9.686	9.686	0.000	0.213	49.515	54.420	54.420
1980-03	49.515	54.420	0.000	251.060	2.403	0.274	0.899	0.899	0.000	0.000	46.213	54.148	54.150
1980-04	46.213	54.148	0.000	251.060	2.457	0.274	0.709	0.709	0.000	0.149	42.897	53.740	53.740
1980-05	42.897	53.740	0.000	251.060	2.454	0.274	0.733	0.733	0.000	0.122	39.589	53.430	53.430
Monsoon deficit =	0.030 m m3, Non-monsoon deficit =		0.000 m m3, Total deficit =		0.030 m m3, Spill =		132.856 m m3						
% Monsoon deficit =	0.04, % Non-monsoon deficit =		0.00, % Total deficit =		0.03								

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1980-06	39.589	53.430	12.673	12.673	2.456	0.274	0.709	0.709	0.000	0.000	49.097	54.393	54.590
1980-07	49.097	54.393	14.011	26.684	3.056	0.272	0.848	0.848	0.000	0.000	59.204	55.102	55.860
1980-08	59.204	55.102	11.000	37.684	2.944	0.274	7.993	7.993	0.000	0.000	59.267	55.107	56.750
1980-09	59.267	55.107	21.372	59.056	3.160	0.274	9.669	9.669	0.000	0.000	67.809	55.715	57.320
1980-10	67.809	55.715	3.907	62.963	2.813	0.274	7.783	7.783	0.000	0.000	61.120	55.258	57.000
1980-11	61.120	55.258	2.090	65.053	2.109	0.274	9.369	9.369	0.000	0.000	51.732	54.565	56.570
1980-12	51.732	54.565	2.500	67.553	1.470	0.274	9.063	9.063	0.000	0.000	43.699	53.841	56.120
1981-01	43.699	53.841	0.000	67.553	1.138	0.274	11.293	11.293	0.000	0.000	31.267	52.565	55.260
1981-02	31.267	52.565	0.000	67.553	0.760	0.274	9.686	9.686	0.000	0.000	20.821	50.648	54.420
1981-03	20.821	50.648	0.000	67.553	0.871	0.274	0.899	0.899	0.000	0.000	19.051	50.264	54.150
1981-04	19.051	50.264	0.000	67.553	0.907	0.274	0.709	0.709	0.000	0.000	17.435	49.809	53.740
1981-05	17.435	49.809	0.000	67.553	0.911	0.274	0.733	0.733	0.000	0.000	15.791	49.342	53.430
Monsoon deficit =	0.000 m m3, Non-monsoon deficit =		0.000 m m3, Total deficit =		0.000 m m3, Spill =		0.000 m m3						
% Monsoon deficit =	0.00, % Non-monsoon deficit =		0.00, % Total deficit =		0.00								

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1981-06	15.791	49.342	14.032	14.032	1.097	0.274	0.709	0.709	0.000	0.000	28.017	52.082	54.590
1981-07	28.017	52.082	30.046	44.078	2.251	0.272	0.848	0.818	0.030	0.000	54.995	54.780	55.860
1981-08	54.995	54.780	69.370	113.448	3.587	0.274	7.993	7.993	0.000	25.317	87.468	56.750	56.750
1981-09	87.468	56.750	37.069	150.517	4.775	0.274	9.669	9.669	0.000	9.093	101.000	57.320	57.320
1981-10	101.000	57.320	6.756	157.273	4.318	0.274	7.783	7.783	0.000	2.262	93.393	57.000	57.000
1981-11	93.393	57.000	6.882	164.155	3.357	0.274	9.369	9.369	0.000	3.833	83.715	56.570	56.570
1981-12	83.715	56.570	6.692	170.847	2.487	0.274	9.063	9.063	0.000	4.091	74.766	56.120	56.120
1982-01	74.766	56.120	0.000	170.847	2.115	0.274	11.293	11.293	0.000	0.212	61.146	55.260	55.260
1982-02	61.146	55.260	0.000	170.847	1.732	0.274	9.686	9.686	0.000	0.213	49.515	54.420	54.420
1982-03	49.515	54.420	0.000	170.847	2.403	0.274	0.899	0.899	0.000	0.000	46.213	54.148	54.150
1982-04	46.213	54.148	0.000	170.847	2.457	0.274	0.709	0.709	0.000	0.149	42.897	53.740	53.740
1982-05	42.897	53.740	0.000	170.847	2.454	0.274	0.733	0.733	0.000	0.122	39.589	53.430	53.430
Monsoon deficit =	0.030 m m3, Non-monsoon deficit =		0.000 m m3, Total deficit =		0.030 m m3, Spill =		45.293 m m3						
% Monsoon deficit =	0.04, % Non-monsoon deficit =		0.00, % Total deficit =		0.03								

... Contd.

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1982-06	39.589	53.430	5.709	5.709	2.189	0.274	0.709	0.709	0.000	0.000	42.400	53.678	54.590
1982-07	42.400	53.678	6.045	11.754	2.390	0.272	0.848	0.818	0.030	0.000	45.237	54.031	55.860
1982-08	45.237	54.031	12.629	24.383	2.360	0.274	7.993	6.178	1.815	0.000	49.328	54.408	56.750
1982-09	49.328	54.408	0.000	24.383	2.185	0.274	9.669	7.429	2.240	0.000	39.714	53.441	57.320
1982-10	39.714	53.441	0.962	25.345	1.532	0.274	7.783	6.021	1.762	0.000	33.123	52.802	57.000
1982-11	33.123	52.802	0.479	25.824	0.997	0.274	9.369	7.204	2.165	0.000	25.402	51.615	56.570
1982-12	25.402	51.615	0.425	26.249	0.581	0.274	9.063	6.981	2.082	0.000	18.265	50.044	56.120
1983-01	18.265	50.044	0.000	26.249	0.452	0.274	11.293	3.090	8.203	0.000	14.723	49.040	55.260
1983-02	14.723	49.040	0.000	26.249	0.385	0.274	9.686	0.673	9.013	0.000	13.665	48.730	54.420
1983-03	13.665	48.730	0.000	26.249	0.571	0.274	0.899	0.733	0.166	0.000	12.361	48.232	54.150
1983-04	12.361	48.232	0.000	26.249	0.598	0.274	0.709	0.709	0.000	0.000	11.053	47.732	53.740
1983-05	11.053	47.732	0.000	26.249	0.613	0.274	0.733	0.648	0.085	0.000	9.792	47.250	53.430
Monsoon deficit :	5.847 m m3,	Non-monsoon deficit :	21.714 m m3,	Total deficit :	27.562 m m3,	Spill :	0.000 m m3						
% Monsoon deficit :	8.50,	% Non-monsoon deficit :	52.01,	% Total deficit :	24.94								

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1983-06	9.792	47.250	10.360	10.360	0.731	0.274	0.709	0.709	0.000	0.000	18.712	50.169	54.590
1983-07	18.712	50.169	76.749	87.109	2.437	0.272	0.848	0.848	0.000	21.901	70.275	55.860	55.860
1983-08	70.275	55.860	46.362	133.471	3.967	0.274	7.993	7.993	0.000	17.208	87.468	56.750	56.750
1983-09	87.468	56.750	19.270	152.741	4.565	0.274	9.669	9.669	0.000	0.000	92.504	56.962	57.320
1983-10	92.504	56.962	5.498	158.239	3.975	0.274	7.783	7.783	0.000	0.000	86.244	56.696	57.000
1983-11	86.244	56.696	3.995	162.234	3.095	0.274	9.369	9.369	0.000	0.000	77.775	56.272	56.570
1983-12	77.775	56.272	3.639	165.873	2.307	0.274	9.063	9.063	0.000	0.000	70.043	55.846	56.120
1984-01	70.043	55.846	0.000	165.873	1.971	0.274	11.293	11.293	0.000	0.000	56.780	54.903	55.260
1984-02	56.780	54.903	0.000	165.873	1.587	0.274	9.686	9.686	0.000	0.000	45.507	54.063	54.420
1984-03	45.507	54.063	0.000	165.873	2.132	0.274	0.899	0.899	0.000	0.000	42.475	53.687	54.150
1984-04	42.475	53.687	0.000	165.873	2.192	0.274	0.709	0.709	0.000	0.000	39.575	53.429	53.740
1984-05	39.575	53.429	0.000	165.873	2.274	0.274	0.733	0.733	0.000	0.000	36.568	53.173	53.430
Monsoon deficit :	0.000 m m3,	Non-monsoon deficit :	0.000 m m3,	Total deficit :	0.000 m m3,	Spill :	39.110 m m3						
% Monsoon deficit :	0.00,	% Non-monsoon deficit :	0.00,	% Total deficit :	0.00								

Year-Mn	Init-Stor (m m3)	Init_lev (m)	Inflow (m m3)	Cum_inf (m m3)	Evapr (m m3)	WS_dem (m m3)	Tot_demd (m m3)	Release (m m3)	Deficit (m m3)	Spill (m m3)	End stor (m m3)	End_lev (m)	Rule (m)
1984-06	36.568	53.173	11.223	11.223	2.234	0.274	0.709	0.709	0.000	0.000	44.848	53.984	54.590
1984-07	44.848	53.984	39.134	50.357	3.215	0.272	0.848	0.848	0.000	9.645	70.275	55.860	55.860
1984-08	70.275	55.860	54.278	104.635	3.967	0.274	7.993	7.993	0.000	25.124	87.468	56.750	56.750
1984-09	87.468	56.750	61.562	166.197	4.775	0.274	9.669	9.669	0.000	33.586	101.000	57.320	57.320
1984-10	101.000	57.320	4.903	171.100	4.318	0.274	7.783	7.783	0.000	0.409	93.393	57.000	57.000
1984-11	93.393	57.000	3.528	174.628	3.357	0.274	9.369	9.369	0.000	0.479	83.715	56.570	56.570
1984-12	83.715	56.570	3.245	177.873	2.487	0.274	9.063	9.063	0.000	0.644	74.766	56.120	56.120
1985-01	74.766	56.120	0.000	177.873	2.115	0.274	11.293	11.293	0.000	0.212	61.146	55.260	55.260
1985-02	61.146	55.260	0.000	177.873	1.732	0.274	9.686	9.686	0.000	0.213	49.515	54.420	54.420
1985-03	49.515	54.420	0.000	177.873	2.403	0.274	0.899	0.899	0.000	0.000	46.213	54.148	54.150
1985-04	46.213	54.148	0.000	177.873	2.457	0.274	0.709	0.709	0.000	0.149	42.897	53.740	53.740
1985-05	42.897	53.740	0.000	177.873	2.454	0.274	0.733	0.733	0.000	0.122	39.589	53.430	53.430
Monsoon deficit :	0.000 m m3,	Non-monsoon deficit :	0.000 m m3,	Total deficit :	0.000 m m3,	Spill :	70.584 m m3						
% Monsoon deficit :	0.00,	% Non-monsoon deficit :	0.00,	% Total deficit :	0.00								

Table 9

Monthly Operation Simulation - Number of Failures  
for 1958-59 to 1984-85

Month	Number of times Release/Total Demand (RTD) less than 1.0 or 0.75 or release/W.S. demand (RWS) less than 1.0 in concerned month					
	With Carry over			Without Carry over		
	RTD<1.0	RTD<0.75	RWS<1.0	RTD<1.0	RTD<0.75	RWS<1.0
January	5	4	0	5	5	0
February	5	5	0	8	5	1
March	5	0	0	8	1	1
April	0	0	0	2	2	2
May	5	1	5	8	3	8
June	2	2	2	3	3	3
July	11	1	1	17	1	1
August	9	1	1	11	1	1
September	5	0	0	8	1	0
October	5	0	0	8	2	0
November	5	1	0	7	3	0
December	5	2	0	4	4	0