CHAPTER 6

DEVELOPMENT OF RESERVOIR SIMULATION MODEL AND FLOOD RISK ASSESSMENT MODEL USING GIS

6 DEVELOPMENT OF RESERVOIR SIMULATION MODEL AND FLOOD RISK ASSESSMENT MODEL USING GIS

In this chapter methodology adopted for development for Ukai Dam reservoir operation simulation model, real time Ukai reservoir operation and flood risk map for Surat City is described.

Methodology adopted according to following parts of research study is as below.

1 Development of simulation model to simulate reservoir operation using monthly available historical inflow. Month end storage and canal releases obtained from simulation. Month end storage overlaid over a simulation period. Ultimately, calculation of rule level for revised Ukai reservoir operation.

2 Preparation of excel program for flood forecasting based on real time reservoir operation.

3 Preparation of flood risk and flood hazard map for whole Surat city by using Cartosat data image and software (MicroDEM for Image Processing and DEM processing/Eshayal Smart for GIS Map Window 4.5 for Stereo Data Processing and Watershed Delineation).

6.1 Development of Simulation Model

In this research study, a water balance equation was derived and the performance of a project was analyzed. The water balance components were modeled without calibration, and compared with measured data, whenever possible. A reservoir simulation model was developed and the model storage capacities were compared with the observed storage capacities satisfactory. An optimization model was developed to solve the water resources of a large project in a computationally satisfactory manner. The optimal reservoir storage, optimal irrigation demand, and optimal reservoir release were computed. The optimal mean model total water requirements for the dry and wet seasons were also computed and the optimal contribution by rainfall, reservoir, uncontrolled river flow, and recycled water were determined. The optimal mean model total water requirements were compared with other computed values for the same and a significant water savings were achieved.

6.1.1 Methodology for Simulation Model

Methodology adopted in this study is as follow: (i) Estimation of the water balance components; (ii) Estimation of the overall project efficiency: (iii) Calculation of the total water requirements;

(iv) Simulation of the storage of reservoir systems, and (v) Optimization of the water withdrawals from the reservoir systems. (vi) Determination of month wise rule level for revise reservoir operation.

Reservoir simulation model is developed to simulate reservoir operation for 34 years (1973-2008) using monthly available historical inflows and monthly generated inflows. Monthly reservoir storage and canal releases are obtained from the simulation. Simulation model is developed to simulate reservoir operation using monthly available historical inflow. Month end storage and canal releases obtained from simulation. Month end storage overlaid over a simulation period. Ultimately, calculation of rule level for revised Ukai reservoir operation.

The planning and management of such a system often involves the establishment of optimal operating policies and the study of trade-off between objectives. Optimization model is developed in terms of determining values for a set of decision variables that will maximize or minimize an objective function subject to constraints. Constraints typically include storage capacities and other physical characteristics of the reservoir stream system, diversion or stream flow requirements for various purposes, and mass balance.

6.1.2 Constraints for Simulation

The reservoir operation program is simulated based on the following constraints

- **Storage Constraint:**

The reservoir storage in any month should not be more than the capacity of the reservoir and should not be less than the dead storage. The constraint is given as:

$$S_{min} \leq S_t \leq S_{max} \qquad t = 1, 2, 3 \ldots 12$$

Where,

S_t = Initial storage during the month 't'

S_{min} = Minimum storage capacity of the reservoir in MCM

S_{max} = Maximum capacity of the reservoir in MCM

- **Overflow Constraint:**

When the final storage exceeds the maximum capacity of the reservoir, the constraint is given by:

$$O_t = S_{t+1} - S_{max} \quad \text{and } O_t \geq 0 \qquad t = 1, 2, 3 \ldots 12$$

Where,

O_t = Surplus from the reservoir during time period t

S_{t+1} = Final storage in the month t in MCM

• **Releases Constraint:**

The irrigation release during any month should not exceed the irrigation demand and the constraint is given by:

$$R_t \leq D_t \qquad t = 1, 2, 3 \ldots 12$$

Where,

R_t = Releases for irrigation during time period t

D_t = Irrigation demand for the month t in MCM

• **Mass balance constraint:**

The relationship between the month to month storage is given by the continuity equation:

The continuity equation is stated by:

$$S_{t+1} = S_t + I_t - D_t - R_t - E_t - O_t \qquad t = 1,2,3,\ldots\ldots 12$$

Where,

I_t = Monthly inflow during time period t in MCM

E_t = Evaporation loss in the reservoir during time period t in MCM

R_t = Releases for the riparian rights in the river downstream during time period t in MCM

O_t = Surplus from the reservoir if any during time period t in MCM

S_{t+1} = Final storage in the month t in MCM

S_t = Storage in the reservoir at the beginning of time period t.

D_t = Demand of water to be satisfied during time period t.

6.1.3 Specimen Calculation

Specimen basic calculation for June – 1975 shown in Table.6.1 listed below.

Initial Storage in starting of month = 1142 Mm^3 + Inflow 406.8 Mm^3

= 1548.80 Mm^3 total storage.

Demand deduction = ULBC Requirement 59.21 Mm^3 + D/S Irrigation requirement 255.33 Mm^3

+ Hydro power 353.53 Mm^3

= 668.07 Mm^3

Final storage at month end = Total storage – Demand

= 1548.80 Mm^3 – 668.07 Mm^3

= 880.73 Mm^3

Specimen calculation for mean monthly inflow shown in Table. No 6.2.

Here, the time period for simulation is considered as month. Month as a unit of time is most appropriate because level to be maintained at the end will be determined and the data regarding inflows, evaporation and water demand to be satisfied by project is given per month. The reservoir simulation is carried out for 34 years. Revised rule levels calculated from 34 years historical flood data used for Ukai dam reservoir operation. Existing data available for 34 years as Ukai dam II^{nd} valley project implemented on Tapi River in the year 1973 i.e. 1974 to 2008. Hydrological cycle occur after every 100 years so, perfect prediction is not possible.

Table.6.1 Basic Calculation

Month	Initial Storage in starting of month	Inflow	ULBC Require-ment	D/S Irri. Require-ment	Through Hydro	Final Storage at month end	Spill	Final Storage after spill at month end	Average Storage	R.L. with respect to average storage	Surface area with respect to R.L. Of average storage	Monthly Evaporat ion Rate	Evapora-tion losses	Demand Deficit	Final Storage after Evaporation losses at month end	Storage	RL Low	Storage Low Row No	Storage High Row No	Storage High	RL High	RL Low	RL Low Row No	Area Low	RL HI Row No	RL High	Area High
	Mm^3	Mm^3	Mm^3	Mm^3	Mm^3	Mm^3	Mm^3	Mm^3	Mm^3	m	Mm^2	m	Mm^3	Mm^3	Mm^3												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Jun-75	1142	406.8	59.21	255.33	353.53	880.73	0	1142	1142	86.15	491.48	0.2	99.87	-40.66	1042.13	1140.42	86.14	476	477	1144.57	86.17	86.14	476	491.48	477	491.65	491.65
Jul-75	1042.13	1380.03	19.74	103.61	357.17	1941.64	0	1941.64	1491.89	88.54	505.04	0.1	51.31	0	1890.33	1488.21	88.51	554	555	1493.39	88.54	88.51	554	505.04	555	505.22	505.22
Aug-75	2438.41	4184.3	74.01	398.41	412.5	5737.78	0	5737.78	4088.1	98.5	561.91	0.1	57.09	0	5680.69	4080.37	98.48	880	881	4092.51	98.51	98.48	880	561.91	881	562.08	562.08
Sep-75	5680.69	4093.8	61.67	310.83	1813.67	7588.32	0	7588.32	6634.5	103.82	592.35	0.15	90.27	0	7498.04	6630.85	103.82	1055	1056	6648.66	103.85	103.82	1055	592.35	1056	592.52	592.52
Oct-75	7498.04	406.51	40.7	219.56	342.46	7301.84	0	7301.84	7399.94	105.13	599.83	0.2	121.89	0	7179.95	7396.48	105.13	1098	1099	7414.29	105.16	105.13	1098	599.83	1099	600	600
Nov-75	7179.95	106.96	74.01	252.86	292.55	6667.49	0	6667.49	6923.72	104.32	595.13	0.15	90.7	0	6576.8	6915.74	104.3	1071	1072	6933.54	104.33	104.3	1071	595.13	1072	595.3	595.3
Dec-75	6576.8	182.06	55.51	293.57	528.99	5880.78	0	5880.78	6228.79	103.08	588	0.13	74.68	0	5806.11	6216.54	103.05	1030	1031	6232.72	103.08	103.05	1030	588	1031	588.17	588.17
Jan-76	5806.11	30.26	86.34	318.24	722.21	4709.58	0	4709.58	5257.84	101.16	577.05	0.13	73.28	0	4636.29	5244.16	101.13	967	968	5258.87	101.16	101.13	967	577.05	968	577.22	577.22
Feb-76	4636.29	0	85.11	358.94	623.89	3568.35	0	3568.35	4102.32	98.54	562.08	0.13	71.38	0	3496.96	4092.51	98.51	881	882	4104.65	98.54	98.51	881	562.08	882	562.26	562.26
Mar-76	3496.96	0	90.04	323.17	713.11	2370.64	0	2370.64	2933.8	95.38	544.17	0.2	110.58	0	2260.06	2931.63	95.37	778	779	2942.02	95.4	95.37	778	544.17	779	544.35	544.35
Apr-76	2260.06	0	88.81	347.84	720.36	1103.06	0	1142	1701.03	89.77	512.18	0.23	117.08	-28.27	1024.92	1700.66	89.76	594	595	1705.84	89.79	89.76	594	512.18	595	512.35	512.35
May-76	1024.92	0	90.04	379.91	779.86	-224.9	0	1142	1083.46	85.72	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-76	1017.78	2013	59.21	255.33	829.9	1886.34	0	1886.34	1452.06	88.29	503.65	0.2	102.34	0	1784	1449.28	88.27	546	547	1453.83	88.3	88.27	546	503.65	547	503.83	503.83
Jul-76	1784	3849.27	19.74	103.61	947.21	4562.7	0	4562.7	3173.35	96.08	548.17	0.1	55.69	0	4507.01	3172.06	96.07	801	802	3183.15	96.1	96.07	801	548.17	802	548.35	548.35
Aug-76	4507.01	5321.86	74.01	398.41	801.58	8554.87	43.87	8511	6509.01	103.6	591.13	0.1	60.06	0	8450.94	6507.84	103.6	1048	1049	6524.02	103.63	103.6	1048	591.13	1049	591.3	591.3
Sep-76	8450.94	5002.7	61.67	310.83	865.03	12216.11	3705.1	8511	8480.97	106.99	610.44	0.15	93.03	0	8417.97	8480.18	106.99	1159	1160	8498.73	107.02	106.99	1159	610.44	1160	610.52	610.52
Oct-76	8417.97	194.89	40.7	219.56	817.43	7535.17	0	7535.17	7976.57	106.29	606.44	0.2	123.23	0	7411.95	7974.19	106.28	1136	1137	7991.19	106.31	106.28	1136	606.44	1137	606.61	606.61
Nov-76	7411.95	510.56	74.01	252.86	566.41	7029.22	0	7029.22	7220.58	104.82	598.09	0.15	91.15	0	6938.07	7218.43	104.82	1088	1089	7236.24	104.85	104.82	1088	598.09	1089	598.26	598.26
Dec-76	6938.07	33.37	55.51	293.57	645.3	5977.07	0	5977.07	6457.57	103.51	590.44	0.13	74.99	0	5902.08	6443.1	103.48	1044	1045	6459.29	103.51	103.48	1044	590.44	1045	590.61	590.61
Jan-77	5902.08	0	86.34	318.24	718.28	4779.22	0	4779.22	5340.65	101.33	578.09	0.13	73.42	0	4705.81	5332.42	101.32	973	974	5347.13	101.35	101.32	973	578.09	974	578.26	578.26
Feb-77	4705.81	0	85.11	358.94	701.23	3560.53	0	3560.53	4133.17	98.61	562.61	0.13	71.45	0	3489.08	4128.94	98.6	884	885	4141.08	98.63	98.6	884	562.61	885	562.78	562.78
Mar-77	3489.08	0	90.04	323.17	995.35	2080.52	0	2080.52	2784.8	94.94	541.57	0.2	110.05	0	1970.47	2775.72	94.92	763	764	2786.12	94.95	94.92	763	541.57	764	541.74	541.74
Apr-77	1970.47	0	88.81	347.84	1017.64	516.19	0	1142	1556.24	88.91	507.3	0.23	115.97	-27.16	1026.03	1555.57	88.91	567	568	1560.75	88.94	88.91	567	507.3	568	507.48	507.48
May-77	1026.03	0	90.04	379.91	855.9	-299.82	0	1142	1084.02	85.72	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-77	1017.78	1659	59.21	255.33	897.97	1464.27	0	1464.27	1241.03	86.87	495.65	0.2	100.72	0	1363.56	1239.97	86.87	500	501	1244.52	86.9	86.87	500	495.65	501	495.82	495.82
Jul-77	1363.56	1714.61	19.74	103.61	1033.21	1921.6	0	1921.6	1642.58	89.42	510.09	0.1	51.82	0	1869.78	1638.48	89.4	582	583	1643.66	89.43	89.4	582	510.09	583	510.26	510.26
Aug-77	1869.78	2859.78	74.01	398.41	659.13	3598.01	0	3598.01	2733.9	94.79	540.69	0.1	54.93	0	3543.08	2723.75	94.76	758	759	2734.15	94.79	94.76	758	540.69	759	540.87	540.87
Sep-77	3543.08	2975.71	61.67	310.83	436.41	5709.88	0	5709.88	4626.48	99.78	569.22	0.15	86.75	0	5623.13	4618.49	99.76	922	923	4631.85	99.79	99.76	922	569.22	923	569.39	569.39
Oct-77	5623.13	411.18	40.7	219.56	931.86	4842.19	0	4842.19	5232.66	101.11	576.87	0.2	117.22	0	4724.97	5229.45	101.1	966	967	5244.16	101.13	101.1	966	576.87	967	577.05	577.05
Nov-77	4724.97	216.21	74.01	252.86	733.35	3880.96	0	3880.96	4302.97	99.04	565.05	0.15	86.11	0	3794.85	4298.91	99.03	898	899	4311.05	99.06	99.03	898	565.05	899	565.22	565.22
Dec-77	3794.85	158.04	55.51	293.57	798.83	2804.98	0	2804.98	3299.92	96.42	550.09	0.13	69.86	0	2735.12	3293.97	96.41	812	813	3305.05	96.44	96.41	812	550.09	813	550.26	550.26
Jan-78	2735.12	0	86.34	318.24	698.77	1631.77	0	1631.77	2183.45	92.2	526.09	0.13	66.81	0	1564.96	2183.26	92.2	674	675	2189.86	92.23	92.2	674	526.09	675	526.26	526.26
Feb-78	1564.96	0	85.11	358.94	697.73	423.18	0	1142	1353.48	87.63	499.83	0.13	63.48	21.63	1078.52	1349.17	87.6	524	525	1353.72	87.63	87.6	524	499.83	525	500	500
Mar-78	1078.52	0	90.04	323.17	499.16	166.15	0	1142	1110.26	85.91	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Apr-78	1042.41	0	88.81	347.84	553.25	52.51	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
May-78	1030.12	0	90.04	379.91	888.52	-328.34	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-78	1017.78	803	59.21	255.33	573.99	932.25	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04

Table. 6.1 Basic Calculation (Continue)

Month	Initial Storage in starting of month	Inflow	ULBC Requirement	D/S irri. Requirement	Through Hydro	Final Storage at month end	Spill	Final Storage after spill at month end	Average Storage	R.L. with respect to average storage	Surface area with respect to R.L. Of average storage	Monthly Evaporation Rate	Evaporation losses	Demand Deficit	Final Storage after Evaporation losses at month end	Storage	RL Low	Storage Low Row No	Storage High Row No	Storage High	RL High	RL Low	RL Low Row No	Area Low	RL HI Row No	RL High	Area High
Jul-78	1042.66	2645.95	19.74	103.61	860.08	2705.18	0	2705.18	1873.92	90.69	517.39	0.1	52.57	0	2652.61	1872.47	90.68	624	625	1878.3	90.71	90.68	624	517.39	625	517.56	517.56
Aug-78	2652.61	5488.78	74.01	398.41	1703	5965.98	0	5965.98	4309.29	99.06	565.05	0.1	57.41	0	5908.57	4298.91	99.03	898	899	4311.05	99.06	99.03	898	565.05	899	565.22	565.22
Sep-78	5908.57	2576.88	61.67	310.83	1035.74	7077.21	0	7077.21	6492.89	103.57	590.96	0.15	90.06	0	6987.15	6491.65	103.57	1047	1048	6507.84	103.6	103.57	1047	590.96	1048	591.13	591.13
Oct-78	6987.15	149.14	40.7	219.56	0	6876.03	0	6876.03	6931.59	104.33	595.13	0.2	120.93	0	6755.1	6915.74	104.3	1071	1072	6933.54	104.33	104.3	1071	595.13	1072	595.3	595.3
Nov-78	6755.1	0	74.01	252.86	0	6428.23	0	6428.23	6591.66	103.75	591.82	0.15	90.19	0	6338.03	6577.44	103.72	1052	1053	6595.24	103.75	103.72	1052	591.82	1053	592	592
Dec-78	6338.03	0	55.51	293.57	0	5988.95	0	5988.95	6163.49	102.95	587.3	0.13	74.59	0	5914.36	6151.81	102.93	1026	1027	6167.99	102.96	102.93	1026	587.3	1027	587.48	587.48
Jan-79	5914.36	0	86.34	318.24	1011.06	4498.73	0	4498.73	5206.55	101.05	576.52	0.13	73.22	0	4425.51	5200.03	101.04	964	965	5214.74	101.07	101.04	964	576.52	965	576.7	576.7
Feb-79	4425.51	0	85.11	358.94	917.97	3063.49	0	3063.49	3744.5	97.64	557.04	0.13	70.74	0	2992.74	3740.42	97.63	852	853	3752.56	97.66	97.63	852	557.04	853	557.22	557.22
Mar-79	2992.74	0	90.04	323.17	966.94	1612.59	0	1612.59	2302.67	92.75	529.22	0.2	107.54	0	1505.05	2301.99	92.75	692	693	2308.59	92.78	92.75	692	529.22	693	529.39	529.39
Apr-79	1505.05	0	88.81	347.84	868.79	199.61	0	1142	1323.53	87.43	498.78	0.23	114.02	-25.21	1027.98	1321.87	87.42	518	519	1326.42	87.45	87.42	518	498.78	519	498.96	498.96
May-79	1027.98	0	90.04	379.91	829.23	-271.2	0	1142	1084.99	85.73	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-79	1017.78	1061	59.21	255.33	190.13	1574.12	0	1574.12	1295.95	87.24	497.74	0.2	101.14	0	1472.98	1294.57	87.23	512	513	1299.12	87.26	87.23	512	497.74	513	497.91	497.91
Jul-79	1472.98	1054.86	19.74	103.61	1119.97	1284.51	0	1284.51	1378.74	87.8	500.87	0.1	50.89	0	1233.63	1376.48	87.78	530	531	1381.03	87.81	87.78	530	500.87	531	501.04	501.04
Aug-79	1233.63	8658.87	74.01	398.41	1090.91	8329.17	0	8329.17	4781.4	100.13	571.31	0.1	58.04	0	8271.12	4778.89	100.13	934	935	4792.25	100.16	100.13	934	571.31	935	571.48	571.48
Sep-79	8271.12	1371.76	61.67	310.83	1080	8190.38	0	8190.38	8230.75	106.67	608.52	0.15	92.74	0	8097.64	8214.19	106.65	1148	1149	8235.19	106.68	106.65	1148	608.52	1149	608.7	608.7
Oct-79	8097.64	127.22	40.7	219.56	1084.37	6880.23	0	6880.23	7488.94	105.32	600.87	0.2	122.1	0	6758.13	7483.74	105.31	1104	1105	7497.63	105.34	105.31	1104	600.87	1105	601.04	601.04
Nov-79	6758.13	134.95	74.01	252.86	714.56	5851.65	0	5851.65	6304.89	103.22	588.87	0.15	89.74	0	5761.9	6297.46	103.21	1035	1036	6313.64	103.24	103.21	1035	588.87	1036	589.04	589.04
Dec-79	5761.9	255.84	55.51	293.57	895.3	4773.37	0	4773.37	5267.64	101.18	577.22	0.13	73.31	0	4700.06	5258.87	101.16	968	969	5273.58	101.19	101.16	968	577.22	969	577.39	577.39
Jan-80	4700.06	4.8	86.34	318.24	307.11	3993.17	0	3993.17	4346.62	99.14	565.57	0.13	71.83	0	3921.35	4337.78	99.12	901	902	4351.15	99.15	99.12	901	565.57	902	565.74	565.74
Feb-80	3921.35	1.23	85.11	358.94	615.61	2862.92	0	2862.92	3392.13	96.68	551.48	0.13	70.04	0	2792.88	3382.62	96.65	820	821	3393.7	96.68	96.65	820	551.48	821	551.65	551.65
Mar-80	2792.88	0	90.04	323.17	757.81	1621.87	0	1621.87	2207.37	92.31	526.61	0.2	107.01	0	1514.86	2203.05	92.29	677	678	2209.65	92.32	92.29	677	526.61	678	526.78	526.78
Apr-80	1514.86	0	88.81	347.84	970.25	107.96	0	1142	1328.43	87.46	498.96	0.23	114.06	-25.25	1027.94	1326.42	87.45	519	520	1330.97	87.48	87.45	519	498.96	520	499.13	499.13
May-80	1027.94	0	90.04	379.91	559.59	-1.6	0	1142	1084.97	85.73	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-80	1017.78	1538	59.21	255.33	540.56	1700.68	0	1700.68	1359.23	87.67	500.17	0.2	101.63	0	1599.04	1358.27	87.66	526	527	1362.82	87.69	87.66	526	500.17	527	500.35	500.35
Jul-80	1599.04	977.94	19.74	103.61	1529.55	924.09	0	1142	1370.52	87.74	500.52	0.1	50.85	-31.11	1091.15	1367.38	87.72	528	529	1371.93	87.75	87.72	528	500.52	529	500.7	500.7
Aug-80	1091.15	4522.66	74.01	398.41	1278.75	3862.63	0	3862.63	2476.89	93.66	534.26	0.1	54.28	0	3808.35	2472.26	93.64	721	722	2477.9	93.67	93.64	721	534.26	722	534.43	534.43
Sep-80	3808.35	1013.89	61.67	310.83	583.23	3866.52	0	3866.52	3837.43	97.87	558.26	0.15	85.08	0	3781.44	3825.41	97.84	859	860	3837.55	97.87	97.84	859	558.26	860	558.43	558.43
Oct-80	3781.44	130.26	40.7	219.56	945.72	2705.72	0	2705.72	3243.58	96.27	549.22	0.2	111.6	0	2594.11	3238.56	96.26	807	808	3249.64	96.29	96.26	807	549.22	808	549.39	549.39
Nov-80	2594.11	90.09	74.01	252.86	752.13	1605.2	0	1605.2	2099.66	91.82	523.83	0.15	79.83	0	1525.37	2097.51	91.81	661	662	2104.11	91.84	91.81	661	523.83	662	524	524
Dec-80	1525.37	93.97	55.51	293.57	413.75	856.51	0	1142	1333.68	87.5	499.13	0.13	63.39	-7.88	1078.61	1330.97	87.48	520	521	1335.52	87.51	87.48	520	499.13	521	499.3	499.3
Jan-81	1078.61	2.05	86.34	318.24	864.35	-188.27	0	1142	1110.31	85.92	490.09	0.13	62.24	24.1	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Feb-81	1079.76	0.7	85.11	358.94	888.94	-252.53	0	1142	1110.88	85.92	490.09	0.13	62.24	22.87	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Mar-81	1079.76	0	90.04	323.17	624.44	42.11	0	1142	1110.88	85.92	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Apr-81	1042.41	0	88.81	347.84	550.81	54.96	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
May-81	1030.12	0	90.04	379.91	247.73	312.44	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-81	1017.78	57	59.21	255.33	177.75	582.49	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
Jul-81	1042.66	1743.18	19.74	103.61	289.49	2373	0	2373	1707.83	89.81	512.35	0.1	52.05	0	2320.94	1705.84	89.79	595	596	1711.02	89.83	89.79	595	512.35	596	512.52	512.52
Aug-81	2320.94	6403.82	74.01	398.41	1208.11	7044.24	0	7044.24	4682.59	99.91	569.91	0.1	57.9	0	6986.33	4671.95	99.88	926	927	4685.32	99.91	99.88	926	569.91	927	570.08	570.08
Sep-81	6986.33	2213.4	61.67	310.83	1295.6	7531.63	0	7531.63	7258.98	104.89	598.44	0.15	91.2	0	7440.43	7254.04	104.88	1090	1091	7271.85	104.91	104.88	1090	598.44	1091	598.61	598.61
Oct-81	7440.43	612.3	40.7	219.56	1006.89	6785.58	0	6785.58	7113	104.64	597.04	0.2	121.32	0	6664.26	7111.6	104.64	1082	1083	7129.4	104.67	104.64	1082	597.04	1083	597.22	597.22

Table. 6.1 Basic Calculation (Continue)

Month	Initial Storage in starting of month	Inflow	ULBC Requirement	D/S irri. Requirement	Through Hydro	Final Storage at month end	Spill	Final Storage after spill at month end	Average Storage	R.L. with respect to average storage	Surface area with respect to R.L. Of average storage	Monthly Evaporation Rate	Evaporation losses	Demand Deficit	Final Storage after Evaporation losses at month end	Storage	RL Low	Storage Low Row No	Storage High Row No	Storage High	RL High	RL Low	RL Low Row No	Area Low	RL Hi Row No	RL High	Area High
Nov-81	6664.26	56.04	74.01	252.86	1079.94	5313.49	0	5313.49	5988.87	102.62	585.39	0.15	89.21	0	5224.27	5973.79	102.6	1015	1016	5989.97	102.63	102.6	1015	585.39	1016	585.56	585.56
Dec-81	5224.27	127.73	55.51	293.57	1008.84	3994.08	0	3994.08	4609.18	99.74	569.05	0.13	72.27	0	3921.81	4605.12	99.73	921	922	4618.49	99.76	99.73	921	569.05	922	569.22	569.22
Jan-82	3921.81	8.79	86.34	318.24	224.32	3301.7	0	3301.7	3611.76	97.28	554.96	0.13	70.48	0	3231.22	3604.26	97.26	840	841	3615.34	97.29	97.26	840	554.96	841	555.13	555.13
Feb-82	3231.22	3.07	85.11	358.94	425.62	2364.62	0	2364.62	2797.92	94.98	541.91	0.13	68.82	0	2295.8	2796.51	94.98	765	766	2806.9	95.01	94.98	765	541.91	766	542.09	542.09
Mar-82	2295.8	0	90.04	323.17	374.47	1508.12	0	1508.12	1901.96	90.83	518.26	0.2	105.31	0	1402.81	1901.64	90.83	629	630	1907.48	90.86	90.83	629	518.26	630	518.44	518.44
Apr-82	1402.81	0	88.81	347.84	394.48	571.67	0	1142	1272.4	87.08	496.87	0.23	113.58	-24.77	1028.42	1271.82	87.08	507	508	1276.37	87.11	87.08	507	496.87	508	497.04	497.04
May-82	1028.42	0	90.04	379.91	246.02	312.44	0	1142	1085.21	85.73	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-82	1017.78	527	59.21	255.33	569.16	661.08	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
Jul-82	1042.66	1181.3	19.74	103.61	601.03	1499.58	0	1499.58	1271.12	87.08	496.7	0.1	50.46	0	1449.12	1267.27	87.05	506	507	1271.82	87.08	87.05	506	496.7	507	496.87	496.87
Aug-82	1449.12	1261.36	74.01	398.41	841.31	1396.75	0	1396.75	1422.93	88.09	502.61	0.1	51.06	0	1345.68	1421.98	88.09	540	541	1426.53	88.12	88.09	540	502.61	541	502.78	502.78
Sep-82	1345.68	791.29	61.67	310.83	300.44	1464.03	0	1464.03	1404.86	87.97	501.91	0.15	76.49	0	1387.54	1403.78	87.97	536	537	1408.33	88	87.97	536	501.91	537	502.09	502.09
Oct-82	1387.54	205.24	40.7	219.56	290.49	1042.03	0	1142	1264.77	87.03	496.52	0.2	100.89	-60.19	1041.11	1262.72	87.02	505	506	1267.27	87.05	87.02	505	496.52	506	496.7	496.7
Nov-82	1041.11	94.85	74.01	252.86	63.41	745.68	0	1142	1091.55	85.78	489.39	0.15	74.58	-0.57	1067.42	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
Dec-82	1067.42	35.64	55.51	293.57	85.12	668.86	0	1142	1104.71	85.87	489.91	0.13	62.22	-6.71	1079.78	1103.08	85.86	467	468	1107.23	85.89	85.86	467	489.91	468	490.09	490.09
Jan-83	1079.78	0	86.34	318.24	893.65	-218.45	0	1142	1110.89	85.92	490.09	0.13	62.24	24.1	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Feb-83	1079.76	0	85.11	358.94	417.06	218.65	0	1142	1110.88	85.92	490.09	0.13	62.24	22.87	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Mar-83	1079.76	0	90.04	323.17	602.88	63.66	0	1142	1110.88	85.92	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Apr-83	1042.41	0	88.81	347.84	741.95	-136.19	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
May-83	1030.12	0	90.04	379.91	297.38	262.8	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-83	1017.78	98	59.21	255.33	88.22	713.02	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
Jul-83	1042.66	1304.95	19.74	103.61	15.43	2208.83	0	2208.83	1625.75	89.32	509.56	0.1	51.77	0	2157.06	1622.93	89.31	580	581	1633.3	89.37	89.31	580	509.56	581	509.91	509.91
Aug-83	2157.06	4403.6	74.01	398.41	1402.49	4685.76	0	4685.76	3421.41	96.76	552	0.1	56.08	0	4629.67	3415.87	96.74	823	824	3426.95	96.77	96.74	823	552	824	552.17	552.17
Sep-83	4629.67	5336.78	61.67	310.83	1402.49	8191.47	0	8191.47	6410.57	103.42	589.91	0.15	89.9	0	8101.56	6394.55	103.39	1041	1042	6410.74	103.42	103.39	1041	589.91	1042	590.09	590.09
Oct-83	8101.56	1614.77	40.7	219.56	1067.09	8388.99	0	8388.99	8245.28	106.69	608.7	0.2	123.69	0	8265.3	8235.19	106.68	1149	1150	8259.69	106.71	106.68	1149	608.7	1150	608.87	608.87
Nov-83	8265.3	79.29	74.01	252.86	537.92	7479.8	0	7479.8	7872.55	106.1	605.39	0.15	92.26	0	7387.54	7872.18	106.1	1130	1131	7889.18	106.13	106.1	1130	605.39	1131	605.56	605.56
Dec-83	7387.54	15.01	55.51	293.57	985.23	6068.24	0	6068.24	6727.89	103.98	593.22	0.13	75.34	0	5992.9	6719.88	103.97	1060	1061	6737.68	104	103.97	1060	593.22	1061	593.39	593.39
Jan-84	5992.9	6.11	86.34	318.24	29.01	5565.42	0	5565.42	5779.16	102.23	583.13	0.13	74.06	0	5491.37	5763.41	102.2	1002	1003	5779.59	102.23	102.2	1002	583.13	1003	583.3	583.3
Feb-84	5491.37	4.9	85.11	358.94	0	5052.22	0	5052.22	5271.79	101.19	577.22	0.13	73.31	0	4978.91	5258.87	101.16	968	969	5273.58	101.19	101.16	968	577.22	969	577.39	577.39
Mar-84	4978.91	1.2	90.04	323.17	301.5	4265.4	0	4265.4	4622.16	99.77	569.22	0.2	115.66	0	4149.74	4618.49	99.76	922	923	4631.85	99.79	99.76	922	569.22	923	569.39	569.39
Apr-84	4149.74	0.5	88.81	347.84	162.74	3550.85	0	3550.85	3850.29	97.9	558.61	0.23	127.7	0	3423.15	3849.69	97.9	861	862	3861.83	97.93	97.9	861	558.61	862	558.78	558.78
May-84	3423.15	0	90.04	379.91	89.58	2863.62	0	2863.62	3143.38	95.99	547.65	0.25	139.1	0	2724.51	3139.51	95.98	798	799	3149.9	96.01	95.98	798	547.65	799	547.83	547.83
Jun-84	2724.51	83	59.21	255.33	106.13	2386.85	0	2386.85	2555.68	94.09	536.69	0.2	109.06	0	2277.79	2551.24	94.06	735	736	2556.88	94.09	94.06	735	536.69	736	536.87	536.87
Jul-84	2277.79	662.4	19.74	103.61	175.98	2640.86	0	2640.86	2459.32	93.56	533.74	0.1	54.23	0	2586.63	2455.34	93.54	718	719	2460.98	93.57	93.54	718	533.74	719	533.92	533.92
Aug-84	2586.63	3998.25	74.01	398.41	250.77	5861.69	0	5861.69	4224.16	98.84	563.83	0.1	57.28	0	5804.41	4213.92	98.82	891	892	4226.06	98.85	98.82	891	563.83	892	564	564
Sep-84	5804.41	653.44	61.67	310.83	571.91	5513.44	0	5513.44	5658.92	101.99	581.91	0.15	88.68	0	5424.75	5656.02	101.99	995	996	5670.73	102.02	101.99	995	581.91	996	582.09	582.09
Oct-84	5424.75	461.84	40.7	219.56	903.39	4722.94	0	4722.94	5073.85	100.78	574.96	0.2	116.83	0	4606.11	5067.65	100.77	955	956	5082.36	100.8	100.77	955	574.96	956	575.13	575.13
Nov-84	4606.11	64.76	74.01	252.86	577.73	3766.26	0	3766.26	4186.19	98.75	563.31	0.15	85.85	0	3680.42	4177.5	98.73	888	889	4189.64	98.76	98.73	888	563.31	889	563.48	563.48
Dec-84	3680.42	76.83	55.51	293.57	458.64	2949.53	0	2949.53	3314.97	96.47	550.26	0.13	69.88	0	2879.64	3305.05	96.44	813	814	3316.13	96.47	96.44	813	550.26	814	550.43	550.43
Jan-85	2879.64	4.99	86.34	318.24	702.81	1777.25	0	1777.25	2328.44	92.87	529.92	0.13	67.3	0	1709.95	2328.37	92.87	696	697	2334.97	92.9	92.87	696	529.92	697	530.09	530.09
Feb-85	1709.95	0	85.11	358.94	1190.1	75.8	0	1142	1425.97	88.11	502.61	0.13	63.83	21.28	1078.17	1421.98	88.09	540	541	1426.53	88.12	88.09	540	502.61	541	502.78	502.78

Table. 6.1 Basic Calculation (Continue)

Month	Initial Storage in starting of month	Inflow	ULBC Requirement	D/S Irri. Requirement	Through Hydro	Final Storage at month end	Spill	Final Storage after spill at month end	Average Storage	R.L. with respect to average storage	Surface area with respect to R.L. Of average storage	Monthly Evaporation Rate	Evaporation losses	Demand Deficit	Final Storage after Evaporation losses at month end	Storage	RL Low	Storage Low Row No	Storage High Row No	Storage High	RL High	RL Low	RL Low Row No	Area Low	RL HI Row No	RL High	Area High
Mar-85	1078.17	0	90.04	323.17	866.3	-201.35	0	1142	1110.08	85.91	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Apr-85	1042.41	0	88.81	347.84	529.34	76.42	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
May-85	1030.12	0	90.04	379.91	264.27	295.9	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-85	1017.78	330	59.21	255.33	207.59	825.65	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
Jul-85	1042.66	505.71	19.74	103.61	0	1425.02	0	1425.02	1233.84	86.82	495.3	0.1	50.32	0	1374.7	1231.67	86.81	498	499	1235.82	86.84	86.81	498	495.3	499	495.48	495.48
Aug-85	1374.7	1991.74	74.01	398.41	271.59	2622.43	0	2622.43	1998.56	91.34	521.04	0.1	52.94	0	2569.49	1995.02	91.32	645	646	2000.85	91.35	91.32	645	521.04	646	521.22	521.22
Sep-85	2569.49	227.92	61.67	310.83	321.48	2103.43	0	2103.43	2336.46	92.91	530.09	0.15	80.79	0	2022.64	2334.97	92.9	697	698	2341.57	92.93	92.9	697	530.09	698	530.26	530.26
Oct-85	2022.64	321.97	40.7	219.56	247.48	1836.88	0	1836.88	1929.76	90.98	518.95	0.2	105.45	0	1731.42	1924.99	90.95	633	634	1930.82	90.98	90.95	633	518.95	634	519.13	519.13
Nov-85	1731.42	39.28	74.01	252.86	275.3	1168.53	0	1168.53	1449.98	88.27	503.65	0.15	76.76	23.79	1091.78	1449.28	88.27	546	547	1453.83	88.3	88.27	546	503.65	547	503.83	503.83
Dec-85	1091.78	20.86	55.51	293.57	149.65	613.91	0	1142	1116.89	85.96	490.44	0.13	62.29	-6.78	1079.71	1115.53	85.95	470	471	1119.68	85.98	85.95	470	490.44	471	490.61	490.61
Jan-86	1079.71	0	86.34	318.24	512.75	162.38	0	1142	1110.86	85.92	490.09	0.13	62.24	24.1	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Feb-86	1079.76	0	85.11	358.94	509.68	126.03	0	1142	1110.88	85.92	490.09	0.13	62.24	22.87	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Mar-86	1079.76	0	90.04	323.17	376.86	289.69	0	1142	1110.88	85.92	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Apr-86	1042.41	0	88.81	347.84	287.62	318.14	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
May-86	1030.12	0	90.04	379.91	235.09	325.09	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-86	1017.78	314	59.21	255.33	134.18	883.06	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
Jul-86	1042.66	2050.86	19.74	103.61	36.68	2933.49	0	2933.49	1988.08	91.28	520.69	0.1	52.9	0	2880.59	1983.35	91.26	643	644	1989.18	91.29	91.26	643	520.69	644	520.87	520.87
Aug-86	2880.59	4515.22	74.01	398.41	631.64	6291.75	0	6291.75	4586.17	99.69	568.7	0.1	57.78	0	6233.97	4578.39	99.67	919	920	4591.75	99.7	99.67	919	568.7	920	568.87	568.87
Sep-86	6233.97	158.82	61.67	310.83	959.78	5060.51	0	5060.51	5647.24	101.97	581.74	0.15	88.66	0	4971.85	5641.31	101.96	994	995	5656.02	101.99	101.96	994	581.74	995	581.91	581.91
Oct-86	4971.85	90.76	40.7	219.56	499.32	4303.04	0	4303.04	4637.44	99.8	569.39	0.2	115.7	0	4187.33	4631.85	99.79	923	924	4645.22	99.82	99.79	923	569.39	924	569.57	569.57
Nov-86	4187.33	19.58	74.01	252.86	239.99	3640.05	0	3640.05	3913.69	98.06	559.48	0.15	85.26	0	3554.79	3910.4	98.05	866	867	3922.54	98.09	98.05	866	559.48	867	559.65	559.65
Dec-86	3554.79	18.22	55.51	293.57	222.89	3001.04	0	3001.04	3277.91	96.36	549.74	0.13	69.82	0	2931.22	3271.8	96.35	810	811	3282.88	96.38	96.35	810	549.74	811	549.91	549.91
Jan-87	2931.22	0.33	86.34	318.24	146.94	2380.03	0	2380.03	2655.62	94.56	539.48	0.13	68.51	0	2311.51	2651	94.55	751	752	2661.39	94.58	94.55	751	539.48	752	539.65	539.65
Feb-87	2311.51	0	85.11	358.94	137.38	1730.09	0	1730.09	2020.8	91.45	521.74	0.13	66.26	0	1663.82	2018.36	91.44	649	650	2024.96	91.47	91.44	649	521.74	650	521.91	521.91
Mar-87	1663.82	0	90.04	323.17	124.1	1126.52	0	1142	1402.91	87.96	501.74	0.2	101.95	-11.91	1040.05	1399.23	87.94	535	536	1403.78	87.97	87.94	535	501.74	536	501.91	501.91
Apr-87	1040.05	0	88.81	347.84	142.74	460.65	0	1142	1091.02	85.77	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
May-87	1030.12	0	90.04	379.91	164.24	395.94	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-87	1017.78	660	59.21	255.33	517.42	845.83	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
Jul-87	1042.66	988.78	19.74	103.61	409.46	1498.64	0	1498.64	1270.65	87.07	496.7	0.1	50.46	0	1448.17	1267.27	87.05	506	507	1271.82	87.08	87.05	506	496.7	507	496.87	496.87
Aug-87	1448.17	1137.95	74.01	398.41	68.89	2044.81	0	2044.81	1746.49	90.02	513.56	0.1	52.18	0	1992.63	1744.08	90.01	602	603	1749.91	90.04	90.01	602	513.56	603	513.74	513.74
Sep-87	1992.63	257.24	61.67	310.83	345.74	1531.64	0	1531.64	1762.13	90.1	514.09	0.15	78.35	0	1453.29	1761.58	90.1	605	606	1767.42	90.13	90.1	605	514.09	606	514.26	514.26
Oct-87	1453.29	100.32	40.7	219.56	310.02	983.33	0	1142	1297.64	87.25	497.74	0.2	101.14	-60.44	1040.86	1294.57	87.23	512	513	1299.12	87.26	87.23	512	497.74	513	497.91	497.91
Nov-87	1040.86	59.94	74.01	252.86	172.12	601.81	0	1142	1091.43	85.78	489.39	0.15	74.58	-0.57	1067.42	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
Dec-87	1067.42	6.94	55.51	293.57	205.27	520	0	1142	1104.71	85.87	489.91	0.13	62.22	-6.71	1079.78	1103.08	85.86	467	468	1107.23	85.89	85.86	467	489.91	468	490.09	490.09
Jan-88	1079.78	0	86.34	318.24	283.46	391.75	0	1142	1110.89	85.92	490.09	0.13	62.24	24.1	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Feb-88	1079.76	0	85.11	358.94	277.24	358.47	0	1142	1110.88	85.92	490.09	0.13	62.24	22.87	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Mar-88	1079.76	0	90.04	323.17	270.21	396.34	0	1142	1110.88	85.92	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Apr-88	1042.41	0	88.81	347.84	367.89	237.88	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
May-88	1030.12	0	90.04	379.91	433.62	126.56	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-88	1017.78	487	59.21	255.33	138.65	1051.59	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04

Table. 6.1 Basic Calculation (Continue)

Month	Initial Storage in starting of month	Inflow	ULBC Requirement	D/S Irri. Requirement	Through Hydro	Final Storage at month end	Spill	Final Storage after spill at month end	Average Storage	R.L with respect to average storage	Surface area with respect to R.L. Of average storage	Monthly Evaporation Rate	Evaporation losses	Demand Deficit	Final Storage after Evaporation losses at month end	Storage	RL Low	Storage Low Row No	Storage High Row No	Storage High	RL High	RL Low	RL Low Row No	Area Low	RL HI Row No	RL High	Area High
Jul-88	1042.66	3795.65	19.74	103.61	10.23	4704.73	0	4704.73	2873.7	95.2	543.13	0.1	55.18	0	4649.55	2869.27	95.19	772	773	2879.66	95.22	95.19	772	543.13	773	543.31	543.31
Aug-88	4649.55	3504.26	74.01	398.41	1190.77	6490.62	0	6490.62	5570.08	101.81	580.87	0.1	59.02	0	6431.6	5567.77	101.8	989	990	5582.48	101.83	101.8	989	580.87	990	581.05	581.05
Sep-88	6431.6	5339	61.67	310.83	1464.76	9933.34	1422.3	8511	7471.3	105.28	600.7	0.15	91.55	0	8419.45	7469.85	105.28	1103	1104	7483.74	105.31	105.28	1103	600.7	1104	600.87	600.87
Oct-88	8419.45	3248.24	40.7	219.56	1321.18	10086.26	1575.3	8511	8465.23	106.97	610.26	0.2	124	0	8387	8455.68	106.95	1158	1159	8480.18	106.99	106.95	1158	610.26	1159	610.44	610.44
Nov-88	8387	82.34	74.01	252.86	502.26	7640.21	0	7640.21	8013.6	106.35	606.78	0.15	92.47	0	7547.74	8008.19	106.35	1138	1139	8025.19	106.38	106.35	1138	606.78	1139	606.96	606.96
Dec-88	7547.74	1.84	55.51	293.57	539.12	6661.38	0	6661.38	7104.56	104.63	596.87	0.13	75.8	0	6585.57	7093.79	104.61	1081	1082	7111.6	104.64	104.61	1081	596.87	1082	597.04	597.04
Jan-89	6585.57	0	86.34	318.24	101.28	6079.72	0	6079.72	6332.65	103.27	589.22	0.13	74.83	0	6004.89	6329.82	103.27	1037	1038	6346	103.3	103.27	1037	589.22	1038	589.39	589.39
Feb-89	6004.89	0.15	85.11	358.94	95.79	5465.2	0	5465.2	5735.04	102.15	582.78	0.13	74.01	0	5391.19	5731.04	102.14	1000	1001	5747.23	102.17	102.14	1000	582.78	1001	582.96	582.96
Mar-89	5391.19	0	90.04	323.17	185.12	4792.86	0	4792.86	5092.03	100.82	575.13	0.2	116.87	0	4676	5082.36	100.8	956	957	5097.07	100.83	100.8	956	575.13	957	575.31	575.31
Apr-89	4676	0	88.81	347.84	202.08	4037.27	0	4037.27	4356.63	99.16	565.74	0.23	129.33	0	3907.94	4351.15	99.15	902	903	4364.52	99.18	99.15	902	565.74	903	565.91	565.91
May-89	3907.94	0	90.04	379.91	209.45	3228.54	0	3228.54	3568.24	97.16	554.26	0.25	140.78	0	3087.76	3559.93	97.14	836	837	3571.02	97.17	97.14	836	554.26	837	554.43	554.43
Jun-89	3087.76	181	59.21	255.33	615.6	2338.62	0	2338.62	2713.19	94.73	540.35	0.2	109.8	0	2228.82	2702.97	94.7	756	757	2713.36	94.73	94.7	756	540.35	757	540.52	540.52
Jul-89	2228.82	1568.92	19.74	103.61	448.48	3225.91	0	3225.91	2727.37	94.77	540.69	0.1	54.93	0	3170.98	2723.75	94.76	758	759	2734.15	94.79	94.76	758	540.69	759	540.87	540.87
Aug-89	3170.98	3847.06	74.01	398.41	825.27	5720.34	0	5720.34	4445.66	99.37	566.96	0.1	57.6	0	5662.74	4444.72	99.37	909	910	4458.08	99.4	99.37	909	566.96	910	567.13	567.13
Sep-89	5662.74	920.44	61.67	310.83	1495.8	4714.88	0	4714.88	5188.81	101.02	576.35	0.15	87.84	0	4627.04	5185.32	101.01	963	964	5200.03	101.04	101.01	963	576.35	964	576.52	576.52
Oct-89	4627.04	110.97	40.7	219.56	966.89	3510.86	0	3510.86	4068.95	98.45	561.74	0.2	114.14	0	3396.72	4068.23	98.45	879	880	4080.37	98.48	98.45	879	561.74	880	561.91	561.91
Nov-89	3396.72	31.34	74.01	252.86	547.7	2553.49	0	2553.49	2975.11	95.5	544.87	0.15	83.04	0	2470.46	2973.21	95.49	782	783	2983.6	95.52	95.49	782	544.87	783	545.04	545.04
Dec-89	2470.46	0	55.51	293.57	384.52	1736.85	0	1736.85	2103.65	91.83	523.83	0.13	66.53	0	1670.32	2097.51	91.81	661	662	2104.11	91.84	91.81	661	523.83	662	524	524
Jan-90	1670.32	0	86.34	318.24	686.52	579.22	0	1142	1406.16	87.98	501.91	0.13	63.74	22.6	1078.26	1403.78	87.97	536	537	1408.33	88	87.97	536	501.91	537	502.09	502.09
Feb-90	1078.26	0	85.11	358.94	384.42	249.78	0	1142	1110.13	85.91	490.09	0.13	62.24	22.87	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Mar-90	1079.76	0	90.04	323.17	590.68	75.87	0	1142	1110.88	85.92	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Apr-90	1042.41	0	88.81	347.84	385.49	220.27	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
May-90	1030.12	0	90.04	379.91	803.96	-243.78	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-90	1017.78	1057	59.21	255.33	870.57	889.67	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
Jul-90	1042.66	2569.95	19.74	103.61	692.52	2796.74	0	2796.74	1919.7	90.92	518.78	0.1	52.71	0	2744.03	1919.15	90.92	632	633	1924.99	90.95	90.92	632	518.78	633	518.95	518.95
Aug-90	2744.03	8336.36	74.01	398.41	965.11	9642.86	1131.9	8511	5627.51	101.93	581.56	0.1	59.09	0	8451.91	5626.6	101.93	993	994	5641.31	101.96	101.93	993	581.56	994	581.74	581.74
Sep-90	8451.91	3529.97	61.67	310.83	1110.96	10498.43	1987.4	8511	8481.46	106.99	610.44	0.15	93.03	0	8417.97	8480.18	106.99	1159	1160	8498.73	107.02	106.99	1159	610.44	1160	610.52	610.52
Oct-90	8417.97	874.72	40.7	219.56	981.76	8050.67	0	8050.67	8234.32	106.68	608.52	0.2	123.65	0	7927.02	8214.19	106.65	1148	1149	8235.19	106.68	106.65	1148	608.52	1149	608.7	608.7
Nov-90	7927.02	88.96	74.01	252.86	999.57	6689.54	0	6689.54	7308.28	104.97	598.96	0.15	91.28	0	6598.26	7307.46	104.97	1093	1094	7325.26	105	104.97	1093	598.96	1094	599.13	599.13
Dec-90	6598.26	1.98	55.51	293.57	1077.08	5174.08	0	5174.08	5886.17	102.43	584.35	0.13	74.21	0	5099.87	5876.69	102.41	1009	1010	5892.88	102.44	102.41	1009	584.35	1010	584.52	584.52
Jan-91	5099.87	0	86.34	318.24	411.65	4283.64	0	4283.64	4691.75	99.93	570.08	0.13	72.4	0	4211.23	4685.32	99.91	927	928	4698.69	99.94	99.91	927	570.08	928	570.26	570.26
Feb-91	4211.23	0	85.11	358.94	303.44	3463.75	0	3463.75	3837.49	97.87	558.26	0.13	70.9	0	3392.85	3825.41	97.84	859	860	3837.55	97.87	97.84	859	558.26	860	558.43	558.43
Mar-91	3392.85	0	90.04	323.17	543.22	2436.42	0	2436.42	2914.63	95.32	543.83	0.2	110.51	0	2325.91	2910.84	95.31	776	777	2921.24	95.34	95.31	776	543.83	777	544	544
Apr-91	2325.91	0	88.81	347.84	572.19	1317.08	0	1317.08	1821.49	90.41	515.83	0.23	117.92	0	1199.16	1819.94	90.4	615	616	1825.78	90.43	90.4	615	515.83	616	516	516
May-91	1199.16	0	90.04	379.91	531.97	197.23	0	1142	1170.58	86.36	492.7	0.25	125.14	-35.1	1016.86	1169.45	86.35	483	484	1173.6	86.38	86.35	483	492.7	484	492.87	492.87
Jun-91	1016.86	393	59.21	255.33	353.58	741.73	0	1142	1079.43	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
Jul-91	1042.66	1588.36	19.74	103.61	312.99	2194.68	0	2194.68	1618.67	89.28	509.39	0.1	51.75	0	2142.93	1617.75	89.28	579	580	1622.93	89.31	89.28	579	509.39	580	509.56	509.56
Aug-91	2142.93	1892.98	74.01	398.41	970.58	2592.91	0	2592.91	2367.92	93.07	530.95	0.1	53.94	0	2538.96	2365.08	93.06	702	703	2370.73	93.09	93.06	702	530.95	703	531.13	531.13
Sep-91	2538.96	279.2	61.67	310.83	408.2	2037.47	0	2037.47	2288.22	92.69	528.69	0.15	80.57	0	1956.9	2282.2	92.66	689	690	2288.8	92.69	92.66	689	528.69	690	528.87	528.87
Oct-91	1956.9	99.92	40.7	219.56	476.17	1320.39	0	1320.39	1638.64	89.4	510.09	0.2	103.65	0	1216.74	1638.48	89.4	582	583	1643.66	89.43	89.4	582	510.09	583	510.26	510.26

Table. 6.1 Basic Calculation (Continue)

Month	Initial Storage in starting of month	Inflow	ULBC Requirement	D/S irri. Requirement	Through Hydro	Final Storage at month end	Spill	Final Storage after spill at month end	Average Storage	R.L. with respect to average storage	Surface area with respect to R.L. Of average storage	Monthly Evaporation Rate	Evaporation losses	Demand Deficit	Final Storage after Evaporation losses at month end	Storage	RL Low	Storage Low Row No	Storage High Row No	Storage High	RL High	RL Low	RL Low Row No	Area Low	RL HI Row No	RL High	Area High
Nov-91	1216.74	31.4	74.01	252.86	280.15	641.12	0	1142	1179.37	86.42	493.04	0.15	75.14	-1.13	1066.86	1177.75	86.41	485	486	1181.9	86.44	86.41	485	493.04	486	493.22	493.22
Dec-91	1066.86	8.75	55.51	293.57	249.97	476.56	0	1142	1104.43	85.87	489.91	0.13	62.22	-6.71	1079.78	1103.08	85.86	467	468	1107.23	85.89	85.86	467	489.91	468	490.09	490.09
Jan-92	1079.78	0	86.34	318.24	1142.49	-467.29	0	1142	1110.89	85.92	490.09	0.13	62.24	24.1	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Feb-92	1079.76	0	85.11	358.94	357.34	278.37	0	1142	1110.88	85.92	490.09	0.13	62.24	22.87	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Mar-92	1079.76	0	90.04	323.17	235.71	430.84	0	1142	1110.88	85.92	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Apr-92	1042.41	0	88.81	347.84	360.4	245.36	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
May-92	1030.12	0	90.04	379.91	376.29	183.88	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-92	1017.78	926	59.21	255.33	89.3	1539.94	0	1539.94	1278.86	87.13	497.04	0.2	101	0	1438.94	1276.37	87.11	508	509	1280.92	87.14	87.11	508	497.04	509	497.22	497.22
Jul-92	1438.94	170.48	19.74	103.61	187.64	1298.44	0	1298.44	1368.69	87.73	500.52	0.1	50.85	0	1247.58	1367.38	87.72	528	529	1371.93	87.75	87.72	528	500.52	529	500.7	500.7
Aug-92	1247.58	3308.44	74.01	398.41	50.93	4032.68	0	4032.68	2640.13	94.52	539.13	0.1	54.78	0	3977.9	2630.21	94.49	749	750	2640.6	94.52	94.49	749	539.13	750	539.3	539.3
Sep-92	3977.9	2048.44	61.67	310.83	382.01	5271.83	0	5271.83	4624.87	99.78	569.22	0.15	86.75	0	5185.08	4618.49	99.76	922	923	4631.85	99.79	99.76	922	569.22	923	569.39	569.39
Oct-92	5185.08	631.29	40.7	219.56	583.52	4972.59	0	4972.59	5078.84	100.79	574.96	0.2	116.83	0	4855.76	5067.65	100.77	955	956	5082.36	100.8	100.77	955	574.96	956	575.13	575.13
Nov-92	4855.76	257.91	74.01	252.86	326.38	4460.42	0	4460.42	4658.09	99.85	569.57	0.15	86.8	0	4373.61	4645.22	99.82	924	925	4658.59	99.85	99.82	924	569.57	925	569.74	569.74
Dec-92	4373.61	33.26	55.51	293.57	239.19	3818.61	0	3818.61	4096.11	98.52	562.08	0.13	71.38	0	3747.22	4092.51	98.51	881	882	4104.65	98.54	98.51	881	562.08	882	562.26	562.26
Jan-93	3747.22	0	86.34	318.24	240.77	3101.87	0	3101.87	3424.55	96.77	552	0.13	70.1	0	3031.77	3415.87	96.74	823	824	3426.95	96.77	96.74	823	552	824	552.17	552.17
Feb-93	3031.77	0	85.11	358.94	175.24	2412.48	0	2412.48	2722.12	94.76	540.52	0.13	68.65	0	2343.83	2713.36	94.73	757	758	2723.75	94.76	94.73	757	540.52	758	540.69	540.69
Mar-93	2343.83	0	90.04	323.17	210.84	1719.78	0	1719.78	2031.8	91.5	522.09	0.2	106.09	0	1613.69	2031.55	91.5	651	652	2038.15	91.53	91.5	651	522.09	652	522.26	522.26
Apr-93	1613.69	0	88.81	347.84	238.48	938.56	0	1142	1377.85	87.79	500.87	0.23	114.5	-25.69	1027.5	1376.48	87.78	530	531	1381.03	87.81	87.78	530	500.87	531	501.04	501.04
May-93	1027.5	0	90.04	379.91	244.93	312.62	0	1142	1084.75	85.73	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-93	1017.78	40.11	59.21	255.33	452.17	291.18	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
Jul-93	1042.66	3200.46	19.74	103.61	604.16	3515.61	0	3515.61	2279.14	92.65	528.52	0.1	53.7	0	3461.91	2275.61	92.63	688	689	2282.2	92.66	92.63	688	528.52	689	528.69	528.69
Aug-93	3461.91	1800.48	74.01	398.41	924.15	3865.82	0	3865.82	3663.87	97.43	555.83	0.1	56.47	0	3809.35	3659.67	97.41	845	846	3670.75	97.45	97.41	845	555.83	846	556	556
Sep-93	3809.35	2409.31	61.67	310.83	373.91	5472.26	0	5472.26	4640.8	99.81	569.39	0.15	86.78	0	5385.48	4631.85	99.79	923	924	4645.22	99.82	99.79	923	569.39	924	569.57	569.57
Oct-93	5385.48	1107.44	40.7	219.56	310.02	5922.64	0	5922.64	5654.06	101.98	581.74	0.2	118.21	0	5804.43	5641.31	101.96	994	995	5656.02	101.99	101.96	994	581.74	995	581.91	581.91
Nov-93	5804.43	29.09	74.01	252.86	172.12	5334.53	0	5334.53	5569.48	101.81	580.87	0.15	88.52	0	5246.01	5567.77	101.8	989	990	5582.48	101.83	101.8	989	580.87	990	581.05	581.05
Dec-93	5246.01	7.07	55.51	293.57	205.27	4698.73	0	4698.73	4972.37	100.57	573.74	0.13	72.87	0	4625.86	4966.02	100.55	948	949	4979.39	100.58	100.55	948	573.74	949	573.91	573.91
Jan-94	4625.86	0	86.34	318.24	375.36	3845.93	0	3845.93	4235.89	98.87	564	0.13	71.63	0	3774.3	4226.06	98.85	892	893	4238.2	98.88	98.85	892	564	893	564.17	564.17
Feb-94	3774.3	0	85.11	358.94	347.79	2982.46	0	2982.46	3378.38	96.64	551.31	0.13	70.02	0	2912.45	3371.54	96.62	819	820	3382.62	96.65	96.62	819	551.31	820	551.48	551.48
Mar-94	2912.45	0	90.04	323.17	331.54	2167.7	0	2167.7	2540.07	94	536.35	0.2	108.99	0	2058.71	2539.95	94	733	734	2545.6	94.03	94	733	536.35	734	536.52	536.52
Apr-94	2058.71	0	88.81	347.84	465.52	1156.55	0	1156.55	1607.63	89.22	509.04	0.23	116.37	-13.01	1040.18	1607.39	89.22	577	578	1612.57	89.25	89.22	577	509.04	578	509.21	509.21
May-94	1040.18	0	90.04	379.91	465.52	104.71	0	1142	1091.09	85.77	489.39	0.25	124.31	-34.27	1017.69	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
Jun-94	1017.69	520.88	59.21	255.33	763.31	460.72	0	1142	1079.85	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
Jul-94	1042.66	2937.46	19.74	103.61	614.23	3242.55	0	3242.55	2142.6	92.01	524.87	0.1	53.33	0	3189.22	2137.09	91.99	667	668	2143.68	92.02	91.99	667	524.87	668	525.04	525.04
Aug-94	3189.22	4383.8	74.01	398.41	513.77	6586.82	0	6586.82	4888.02	100.38	572.7	0.1	58.19	0	6528.64	4885.82	100.37	942	943	4899.19	100.4	100.37	942	572.7	943	572.87	572.87
Sep-94	6528.64	9694.3	61.67	310.83	1023.74	14826.7	6315.7	8511	7519.82	105.39	601.22	0.15	91.63	0	8419.37	7511.52	105.37	1106	1107	7525.41	105.4	105.37	1106	601.22	1107	601.39	601.39
Oct-94	8419.37	245.75	40.7	219.56	934.52	7470.35	0	7470.35	7944.86	106.23	606.09	0.2	123.16	0	7347.19	7940.19	106.22	1134	1135	7957.19	106.25	106.22	1134	606.09	1135	606.26	606.26
Nov-94	7347.19	17.11	74.01	252.86	385.44	6651.99	0	6651.99	6999.59	104.45	595.82	0.15	90.8	0	6561.18	6986.96	104.42	1075	1076	7004.77	104.46	104.42	1075	595.82	1076	596	596
Dec-94	6561.18	48.87	55.51	293.57	282.21	5978.76	0	5978.76	6269.97	103.15	588.52	0.13	74.74	0	5904.02	6265.09	103.14	1033	1034	6281.27	103.18	103.14	1033	588.52	1034	588.7	588.7
Jan-95	5904.02	0	86.34	318.24	406.54	5092.91	0	5092.91	5498.46	101.66	580	0.13	73.66	0	5019.25	5494.22	101.65	984	985	5508.93	101.68	101.65	984	580	985	580.17	580.17
Feb-95	5019.25	0	85.11	358.94	502.2	4073	0	4073	4546.12	99.6	568.17	0.13	72.16	0	4000.84	4538.29	99.58	916	917	4551.65	99.61	99.58	916	568.17	917	568.35	568.35

Table. 6.1 Basic Calculation (Continue)

Month	Initial Storage in starting of month	Inflow	ULBC Requirement	D/S irri. Requirement	Through Hydro	Final Storage at month end	Spill	Final Storage after spill at month end	Average Storage	R.L. with respect to average storage	Surface area with respect to R.L. Of average storage	Monthly Evaporation Rate	Evaporation losses	Demand Deficit	Final Storage after Evaporation losses at month end	Storage	RL Low	Storage Low Row No	Storage High Row No	Storage High	RL High	RL Low	RL Low Row No	Area Low	RL HI Row No	RL High	Area High
Mar-95	4000.84	0	90.04	323.17	412.29	3175.34	0	3175.34	3588.09	97.22	554.61	0.2	112.7	0	3062.64	3582.1	97.2	838	839	3593.18	97.23	97.2	838	554.61	839	554.78	554.78
Apr-95	3062.64	0	88.81	347.84	440.52	2185.48	0	2185.48	2624.06	94.46	538.78	0.23	123.17	0	2062.31	2618.93	94.43	747	748	2624.57	94.46	94.43	747	538.78	748	538.96	538.96
May-95	2062.31	0	90.04	379.91	370.21	1222.15	0	1222.15	1642.23	89.42	510.09	0.25	129.56	40.63	1092.59	1638.48	89.4	582	583	1643.66	89.43	89.4	582	510.09	583	510.26	510.26
Jun-95	1092.59	40.19	59.21	255.33	366.65	451.59	0	1142	1117.3	85.97	490.44	0.2	99.66	-40.45	1042.34	1115.53	85.95	470	471	1119.68	85.98	85.95	470	490.44	471	490.61	490.61
Jul-95	1042.34	2003.02	19.74	103.61	219.72	2702.29	0	2702.29	1872.32	90.68	517.22	0.1	52.55	0	2649.74	1866.63	90.65	623	624	1872.47	90.68	90.65	623	517.22	624	517.39	517.39
Aug-95	2649.74	621.85	74.01	398.41	256.17	2543	0	2543	2596.37	94.31	538.09	0.1	54.67	0	2488.33	2596.36	94.31	743	744	2602.01	94.34	94.31	743	538.09	744	538.26	538.26
Sep-95	2488.33	2195	61.67	310.83	310.46	4000.37	0	4000.37	3244.35	96.27	549.22	0.15	83.7	0	3916.67	3238.56	96.26	807	808	3249.64	96.29	96.26	807	549.22	808	549.39	549.39
Oct-95	3916.67	164.01	40.7	219.56	353.91	3466.51	0	3466.51	3691.59	97.5	556.17	0.2	113.01	0	3353.49	3681.84	97.48	847	848	3692.92	97.51	97.48	847	556.17	848	556.35	556.35
Nov-95	3353.49	2.67	74.01	252.86	328.23	2701.06	0	2701.06	3027.28	95.65	545.74	0.15	83.17	0	2617.89	3025.17	95.65	787	788	3035.57	95.68	95.65	787	545.74	788	545.91	545.91
Dec-95	2617.89	2.74	55.51	293.57	250.63	2020.92	0	2020.92	2319.41	92.83	529.57	0.13	67.26	0	1953.67	2315.18	92.81	694	695	2321.78	92.84	92.81	694	529.57	695	529.74	529.74
Jan-96	1953.67	0	86.34	318.24	474.07	1075.02	0	1142	1547.83	88.86	506.96	0.13	64.38	21.96	1077.62	1545.21	88.85	565	566	1550.39	88.88	88.85	565	506.96	566	507.13	507.13
Feb-96	1077.62	0	85.11	358.94	672.99	-39.42	0	1142	1109.81	85.91	490.09	0.13	62.24	22.87	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Mar-96	1079.76	0	90.04	323.17	695.42	-28.87	0	1142	1110.88	85.92	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Apr-96	1042.41	0	88.81	347.84	562.35	43.41	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
May-96	1030.12	0	90.04	379.91	526.63	33.55	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-96	1017.78	176.53	59.21	255.33	163.2	716.57	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
Jul-96	1042.66	1512.86	19.74	103.61	84.75	2347.42	0	2347.42	1695.04	89.73	511.83	0.1	52	0	2295.42	1690.3	89.7	592	593	1695.48	89.73	89.7	592	511.83	593	512	512
Aug-96	2295.42	2010.72	74.01	398.41	170.89	3662.83	0	3662.83	2979.12	95.51	544.87	0.1	55.36	0	3607.47	2973.21	95.49	782	783	2983.6	95.52	95.49	782	544.87	783	545.04	545.04
Sep-96	3607.47	2731.15	61.67	310.83	537.61	5428.51	0	5428.51	4517.99	99.53	567.82	0.15	86.54	0	5341.98	4511.55	99.52	914	915	4524.92	99.55	99.52	914	567.82	915	568	568
Oct-96	5341.98	687.4	40.7	219.56	749.05	5020.06	0	5020.06	5181.02	101	576.17	0.2	117.08	0	4902.98	5170.61	100.98	962	963	5185.32	101.01	100.98	962	576.17	963	576.35	576.35
Nov-96	4902.98	8.06	74.01	252.86	221.59	4362.58	0	4362.58	4632.78	99.79	569.39	0.15	86.78	0	4275.8	4631.85	99.79	923	924	4645.22	99.82	99.79	923	569.39	924	569.57	569.57
Dec-96	4275.8	9.84	55.51	293.57	226.45	3710.11	0	3710.11	3992.96	98.26	560.52	0.13	71.19	0	3638.93	3983.24	98.24	872	873	3995.38	98.27	98.24	872	560.52	873	560.7	560.7
Jan-97	3638.93	0	86.34	318.24	237.29	2997.06	0	2997.06	3317.99	96.47	550.43	0.13	69.91	0	2927.16	3316.13	96.47	814	815	3327.21	96.5	96.47	814	550.43	815	550.61	550.61
Feb-97	2927.16	0	85.11	358.94	247.98	2235.13	0	2235.13	2581.14	94.22	537.57	0.13	68.27	0	2166.86	2579.44	94.21	740	741	2585.08	94.24	94.21	740	537.57	741	537.74	537.74
Mar-97	2166.86	0	90.04	323.17	304.94	1448.71	0	1448.71	1807.79	90.34	515.3	0.2	104.71	0	1344	1802.44	90.31	612	613	1808.27	90.34	90.31	612	515.3	613	515.48	515.48
Apr-97	1344	0	88.81	347.84	281.25	626.11	0	1142	1243	86.89	495.65	0.23	113.31	-24.5	1028.69	1239.97	86.87	500	501	1244.52	86.9	86.87	500	495.65	501	495.82	495.82
May-97	1028.69	0	90.04	379.91	343.64	215.1	0	1142	1085.35	85.73	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-97	1017.78	519.64	59.21	255.33	199.8	1023.08	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
Jul-97	1042.66	106.03	19.74	103.61	268.44	756.9	0	1142	1092.33	85.78	489.39	0.1	49.72	-29.98	1092.28	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
Aug-97	1092.28	4038	74.01	398.41	316.02	4341.84	0	4341.84	2717.06	94.74	540.52	0.1	54.92	0	4286.92	2713.36	94.73	757	758	2723.75	94.76	94.73	757	540.52	758	540.69	540.69
Sep-97	4286.92	412	61.67	310.83	1117.12	3209.3	0	3209.3	3748.11	97.65	557.04	0.15	84.89	0	3124.41	3740.42	97.63	852	853	3752.56	97.66	97.63	852	557.04	853	557.22	557.22
Oct-97	3124.41	323	40.7	219.56	790.21	2396.94	0	2396.94	2760.67	94.87	541.22	0.2	109.98	0	2286.96	2754.94	94.85	761	762	2765.33	94.88	94.85	761	541.22	762	541.39	541.39
Nov-97	2286.96	88.96	74.01	252.86	376.31	1672.74	0	1672.74	1979.85	91.24	520.52	0.15	79.33	0	1593.41	1977.51	91.23	642	643	1983.35	91.26	91.23	642	520.52	643	520.69	520.69
Dec-97	1593.41	920.19	55.51	293.57	551.19	1613.33	0	1613.33	1603.37	89.19	508.87	0.13	64.63	0	1548.71	1602.21	89.18	576	577	1607.39	89.22	89.18	576	508.87	577	509.04	509.04
Jan-98	1548.71	0	86.34	318.24	259.6	884.53	0	1142	1345.35	87.57	499.65	0.13	63.46	22.88	1078.54	1344.62	87.57	523	524	1349.17	87.6	87.57	523	499.65	524	499.83	499.83
Feb-98	1078.54	0	85.11	358.94	270.79	363.71	0	1142	1110.27	85.91	490.09	0.13	62.24	22.87	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Mar-98	1079.76	0	90.04	323.17	371.61	294.94	0	1142	1110.88	85.92	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Apr-98	1042.41	0	88.81	347.84	492.22	113.54	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
May-98	1030.12	42.16	90.04	379.91	816.82	-214.49	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-98	1017.78	75.4	59.21	255.33	307.47	471.17	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04

Table. 6.1 Basic Calculation (Continue)

Month	Initial Storage in starting of month	Inflow	ULBC Requirement	D/S irri. Requirement	Through Hydro	Final Storage at month end	Spill	Final Storage after spill at month end	Average Storage	R.L. with respect to average storage	Surface area with respect to R.L. Of average storage	Monthly Evaporation Rate	Evaporation losses	Demand Deficit	Final Storage after Evaporation losses at month end	Storage	RL Low	Storage Low Row No	Storage High Row No	Storage High	RL High	RL Low	RL Low Row No	Area Low	RL HI Row No	RL High	Area High
Jul-98	1042.66	1013.17	19.74	103.61	213.64	1718.84	0	1718.84	1380.75	87.81	500.87	0.1	50.89	0	1667.95	1376.48	87.78	530	531	1381.03	87.81	87.78	530	500.87	531	501.04	501.04
Aug-98	1667.95	315.83	74.01	398.41	177.74	1333.62	0	1333.62	1500.79	88.59	505.39	0.1	51.35	0	1282.27	1498.57	88.58	556	557	1503.75	88.61	88.58	556	505.39	557	505.56	505.56
Sep-98	1282.27	8792.12	61.67	310.83	891.1	8810.79	299.79	8511	4896.64	100.4	572.7	0.15	87.28	0	8423.72	4885.82	100.37	942	943	4899.19	100.4	100.37	942	572.7	943	572.87	572.87
Oct-98	8423.72	1624.72	40.7	219.56	1352.3	8435.89	0	8435.89	8429.8	106.92	609.91	0.2	123.93	0	8311.95	8406.68	106.89	1156	1157	8431.18	106.92	106.89	1156	609.91	1157	610.09	610.09
Nov-98	8311.95	88.96	74.01	252.86	498.56	7575.49	0	7575.49	7943.72	106.23	606.09	0.15	92.37	0	7483.12	7940.19	106.22	1134	1135	7957.19	106.25	106.22	1134	606.09	1135	606.26	606.26
Dec-98	7483.12	0	55.51	293.57	516.57	6617.46	0	6617.46	7050.29	104.53	596.35	0.13	75.74	0	6541.73	7040.38	104.52	1078	1079	7058.18	104.55	104.52	1078	596.35	1079	596.52	596.52
Jan-99	6541.73	0	86.34	318.24	578.85	5558.29	0	5558.29	6050.01	102.74	586.09	0.13	74.43	0	5483.86	6038.52	102.72	1019	1020	6054.71	102.75	102.72	1019	586.09	1020	586.26	586.26
Feb-99	5483.86	0	85.11	358.94	394.97	4644.84	0	4644.84	5064.35	100.76	574.78	0.13	73	0	4571.84	5052.94	100.74	954	955	5067.65	100.77	100.74	954	574.78	955	574.96	574.96
Mar-99	4571.84	0	90.04	323.17	631.04	3527.6	0	3527.6	4049.72	98.4	561.39	0.2	114.07	0	3413.52	4043.95	98.39	877	878	4056.09	98.42	98.39	877	561.39	878	561.57	561.57
Apr-99	3413.52	0	88.81	347.84	922.8	2054.08	0	2054.08	2733.8	94.79	540.69	0.23	123.6	0	1930.47	2723.75	94.76	758	759	2734.15	94.79	94.76	758	540.69	759	540.87	540.87
May-99	1930.47	0	90.04	379.91	547.87	912.65	0	1142	1536.24	88.8	506.61	0.25	128.68	-38.64	1013.32	1534.84	88.79	563	564	1540.02	88.82	88.79	563	506.61	564	506.78	506.78
Jun-99	1013.32	1089.27	59.21	255.33	385.87	1402.68	0	1402.68	1208	86.63	494.26	0.2	100.43	0	1302.25	1206.79	86.62	492	493	1210.93	86.66	86.62	492	494.26	493	494.44	494.44
Jul-99	1302.25	1016.42	19.74	103.61	248.31	1947.01	0	1947.01	1624.63	89.32	509.56	0.1	51.77	0	1895.24	1622.93	89.31	580	581	1633.3	89.37	89.31	580	509.56	581	509.91	509.91
Aug-99	1895.24	2730.26	74.01	398.41	594.94	3558.14	0	3558.14	2726.69	94.77	540.69	0.1	54.93	0	3503.21	2723.75	94.76	758	759	2734.15	94.79	94.76	758	540.69	759	540.87	540.87
Sep-99	3503.21	1453.33	61.67	310.83	483.34	4100.7	0	4100.7	3801.95	97.78	557.91	0.15	85.03	0	4015.67	3801.13	97.78	857	858	3813.27	97.81	97.78	857	557.91	858	558.09	558.09
Oct-99	4015.67	1695.87	40.7	219.56	1143.63	4307.66	0	4307.66	4161.67	98.68	562.96	0.2	114.39	0	4193.27	4153.22	98.66	886	887	4165.36	98.69	98.66	886	562.96	887	563.13	563.13
Nov-99	4193.27	239.33	74.01	252.86	712.16	3393.56	0	3393.56	3793.41	97.76	557.74	0.15	85	0	3308.56	3788.99	97.75	856	857	3801.13	97.78	97.75	856	557.74	857	557.91	557.91
Dec-99	3308.56	0	55.51	293.57	384.16	2575.33	0	2575.33	2941.94	95.4	544.17	0.13	69.11	0	2506.22	2931.63	95.37	778	779	2942.02	95.4	95.37	778	544.17	779	544.35	544.35
Jan-00	2506.22	0	86.34	318.24	455.5	1646.14	0	1646.14	2076.18	91.71	523.13	0.13	66.44	0	1579.7	2071.13	91.68	657	658	2077.72	91.71	91.68	657	523.13	658	523.3	523.3
Feb-00	1579.7	0	85.11	358.94	461.87	673.78	0	1142	1360.85	87.68	500.17	0.13	63.52	21.59	1078.48	1358.27	87.66	526	527	1362.82	87.69	87.66	526	500.17	527	500.35	500.35
Mar-00	1078.48	0	90.04	323.17	629.42	35.85	0	1142	1110.24	85.91	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
Apr-00	1042.41	0	88.81	347.84	755.56	-149.79	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
May-00	1030.12	0	90.04	379.91	460.07	100.1	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
Jun-00	1017.78	684.82	59.21	255.33	337.14	1050.92	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
Jul-00	1042.66	2248.05	19.74	103.61	255.65	2911.72	0	2911.72	1977.19	91.23	520.35	0.1	52.87	0	2858.85	1971.67	91.2	641	642	1977.51	91.23	91.2	641	520.35	642	520.52	520.52
Aug-00	2858.85	446.99	74.01	398.41	335.37	2498.05	0	2498.05	2678.45	94.63	539.83	0.1	54.85	0	2443.2	2671.79	94.61	753	754	2682.18	94.64	94.61	753	539.83	754	540	540
Sep-00	2443.2	167.52	61.67	310.83	446.88	1791.34	0	1791.34	2117.27	91.9	524.18	0.15	79.88	0	1711.46	2110.7	91.87	663	664	2117.3	91.9	91.87	663	524.18	664	524.35	524.35
Oct-00	1711.46	20.97	40.7	219.56	358.62	1113.55	0	1142	1426.73	88.12	502.78	0.2	102.17	-61.47	1039.83	1426.53	88.12	541	542	1431.08	88.15	88.12	541	502.78	542	502.96	502.96
Nov-00	1039.83	0	74.01	252.86	254.29	458.67	0	1142	1090.92	85.77	489.39	0.15	74.58	-0.57	1067.42	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
Dec-00	1067.42	0	55.51	293.57	115.82	602.52	0	1142	1104.71	85.87	489.91	0.13	62.22	-6.71	1079.78	1103.08	85.86	467	468	1107.23	85.89	85.86	467	489.91	468	490.09	490.09
1-Jan	1079.78	0	86.34	318.24	445.19	230.01	0	1142	1110.89	85.92	490.09	0.13	62.24	24.1	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
1-Feb	1079.76	0	85.11	358.94	383	252.71	0	1142	1110.88	85.92	490.09	0.13	62.24	22.87	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
1-Mar	1079.76	0	90.04	323.17	420.8	245.75	0	1142	1110.88	85.92	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
1-Apr	1042.41	0	88.81	347.84	543.21	62.55	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
1-May	1030.12	0	90.04	379.91	450.07	110.1	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
1-Jun	1017.78	889.08	59.21	255.33	0	1592.32	0	1592.32	1305.05	87.3	498.09	0.2	101.21	0	1491.11	1303.67	87.3	514	515	1308.22	87.33	87.3	514	498.09	515	498.26	498.26
1-Jul	1491.11	485.33	19.74	103.61	45.93	1807.16	0	1807.16	1649.14	89.46	510.44	0.1	51.86	0	1755.3	1648.84	89.46	584	585	1654.02	89.49	89.46	584	510.44	585	510.61	510.61
1-Aug	1755.3	2622.24	74.01	398.41	62.47	3842.65	0	3842.65	2798.98	94.98	541.91	0.1	55.06	0	3787.59	2796.51	94.98	765	766	2806.9	95.01	94.98	765	541.91	766	542.09	542.09
1-Sep	3787.59	101.82	61.67	310.83	299.27	3217.64	0	3217.64	3502.62	96.98	553.22	0.15	84.31	0	3133.33	3493.44	96.96	830	831	3504.52	96.99	96.96	830	553.22	831	553.39	553.39
1-Oct	3133.33	663.58	40.7	219.56	223.37	3313.28	0	3313.28	3223.31	96.21	548.87	0.2	111.53	0	3201.75	3216.39	96.2	805	806	3227.47	96.23	96.2	805	548.87	806	549.04	549.04

Table. 6.1 Basic Calculation (Continue)

Month	Initial Storage in starting of month	Inflow	ULBC Requirement	D/S Irri. Requirement	Through Hydro	Final Storage at month end	Spill	Final Storage after spill at month end	Average Storage	R.L. with respect to average storage	Surface area with respect to R.L. Of average storage	Monthly Evaporation Rate	Evaporation losses	Demand Deficit	Final Storage after Evaporation losses at month end	Storage	RL Low	Storage Low Row No	Storage High Row No	Storage High	RL High	RL Low	RL Low Row No	Area Low	RL HI Row No	RL High	Area High
1-Nov	3201.75	0	74.01	252.86	291.19	2583.7	0	2583.7	2892.72	95.26	543.48	0.15	82.83	0	2500.87	2890.06	95.25	774	775	2900.45	95.28	95.25	774	543.48	775	543.65	543.65
1-Dec	2500.87	0	55.51	293.57	145.63	2006.16	0	2006.16	2253.51	92.53	527.83	0.13	67.03	0	1939.12	2249.22	92.51	684	685	2255.82	92.54	92.51	684	527.83	685	528	528
2-Jan	1939.12	0	86.34	318.24	9.96	1524.58	0	1524.58	1731.85	89.94	513.04	0.13	65.16	0	1459.42	1726.57	89.92	599	600	1732.41	89.95	89.92	599	513.04	600	513.21	513.21
2-Feb	1459.42	0	85.11	358.94	276.35	739.03	0	1142	1300.71	87.27	497.91	0.13	63.23	21.88	1078.77	1299.12	87.26	513	514	1303.67	87.3	87.26	513	497.91	514	498.09	498.09
2-Mar	1078.77	0	90.04	323.17	218.63	446.93	0	1142	1110.38	85.92	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
2-Apr	1042.41	0	88.81	347.84	259.61	346.16	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
2-May	1030.12	0	90.04	379.91	185.11	375.06	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
2-Jun	1017.78	1476.18	59.21	255.33	154.38	2025.04	0	2025.04	1521.41	88.71	506.09	0.2	102.84	0	1922.2	1519.3	88.7	560	561	1524.48	88.73	88.7	560	506.09	561	506.26	506.26
2-Jul	1922.2	141.45	19.74	103.61	255.27	1685.03	0	1685.03	1803.61	90.32	515.3	0.1	52.35	0	1632.67	1802.44	90.31	612	613	1808.27	90.34	90.31	612	515.3	613	515.48	515.48
2-Aug	1632.67	2599.72	74.01	398.41	90.98	3668.99	0	3668.99	2650.83	94.55	539.3	0.1	54.79	0	3614.19	2640.6	94.52	750	751	2651	94.55	94.52	750	539.3	751	539.48	539.48
2-Sep	3614.19	5891.8	61.67	310.83	1103.66	8029.83	0	8029.83	5822.01	102.31	583.65	0.15	88.95	0	7940.88	5811.96	102.29	1005	1006	5828.14	102.32	102.29	1005	583.65	1006	583.82	583.82
2-Oct	7940.88	107.54	40.7	219.56	789.88	6998.28	0	6998.28	7469.58	105.28	600.52	0.2	122.03	0	6876.25	7455.96	105.25	1102	1103	7469.85	105.28	105.25	1102	600.52	1103	600.7	600.7
2-Nov	6876.25	0	74.01	252.86	215.64	6333.74	0	6333.74	6605	103.77	592	0.15	90.22	0	6243.52	6595.24	103.75	1053	1054	6613.05	103.78	103.75	1053	592	1054	592.17	592.17
2-Dec	6243.52	9.72	55.51	293.57	234.7	5669.47	0	5669.47	5956.5	102.56	585.05	0.13	74.3	0	5595.17	5941.42	102.54	1013	1014	5957.61	102.57	102.54	1013	585.05	1014	585.22	585.22
3-Jan	5595.17	0	86.34	318.24	84.77	5105.82	0	5105.82	5350.49	101.35	578.26	0.13	73.44	0	5032.38	5347.13	101.35	974	975	5361.83	101.38	101.35	974	578.26	975	578.43	578.43
3-Feb	5032.38	0	85.11	358.94	270.44	4317.89	0	4317.89	4675.13	99.89	569.91	0.13	72.38	0	4245.51	4671.95	99.88	926	927	4685.32	99.91	99.88	926	569.91	927	570.08	570.08
3-Mar	4245.51	0	90.04	323.17	101.18	3731.12	0	3731.12	3988.31	98.25	560.52	0.2	113.9	0	3617.22	3983.24	98.24	872	873	3995.38	98.27	98.24	872	560.52	873	560.7	560.7
3-Apr	3617.22	0	88.81	347.84	307.93	2872.64	0	2872.64	3244.93	96.27	549.22	0.23	125.55	0	2747.09	3238.56	96.26	807	808	3249.64	96.29	96.26	807	549.22	808	549.39	549.39
3-May	2747.09	0	90.04	379.91	403.46	1873.67	0	1873.67	2310.38	92.79	529.39	0.25	134.47	0	1739.21	2308.59	92.78	693	694	2315.18	92.81	92.78	693	529.39	694	529.57	529.57
3-Jun	1739.21	910.49	59.21	255.33	240.61	2094.55	0	2094.55	1916.88	90.91	518.61	0.2	105.38	0	1989.17	1913.32	90.89	631	632	1919.15	90.92	90.89	631	518.61	632	518.78	518.78
3-Jul	1989.17	2295.01	19.74	103.61	113.28	4047.55	0	4047.55	3018.36	95.63	545.57	0.1	55.43	0	3992.12	3014.78	95.62	786	787	3025.17	95.65	95.62	786	545.57	787	545.74	545.74
3-Aug	3992.12	264.54	74.01	398.41	353.59	3430.65	0	3430.65	3711.39	97.55	556.52	0.1	56.54	0	3374.11	3704	97.54	849	850	3716.14	97.57	97.54	849	556.52	850	556.69	556.69
3-Sep	3374.11	2288.49	61.67	310.83	1214.91	4075.19	0	4075.19	3724.65	97.59	556.69	0.15	84.84	0	3990.35	3716.14	97.57	850	851	3728.28	97.6	97.57	850	556.69	851	556.87	556.87
3-Oct	3990.35	828.61	40.7	219.56	1701.88	2856.82	0	2856.82	3423.59	96.76	552	0.2	112.17	0	2744.66	3415.87	96.74	823	824	3426.95	96.77	96.74	823	552	824	552.17	552.17
3-Nov	2744.66	1.83	74.01	252.86	375.98	2043.64	0	2043.64	2394.15	93.21	531.83	0.15	81.05	0	1962.58	2393.29	93.21	707	708	2398.93	93.24	93.21	707	531.83	708	532	532
3-Dec	1962.58	11.48	55.51	293.57	288.65	1336.33	0	1336.33	1649.46	89.46	510.44	0.13	64.83	0	1271.51	1648.84	89.46	584	585	1654.02	89.49	89.46	584	510.44	585	510.61	510.61
4-Jan	1271.51	6.68	86.34	318.24	358.1	515.5	0	1142	1206.75	86.62	494.09	0.13	62.75	23.59	1079.25	1202.64	86.59	491	492	1206.79	86.62	86.59	491	494.09	492	494.26	494.26
4-Feb	1079.25	7.38	85.11	358.94	321.34	321.24	0	1142	1110.63	85.92	490.09	0.13	62.24	22.87	1079.76	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
4-Mar	1079.76	0	90.04	323.17	275.22	391.33	0	1142	1110.88	85.92	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
4-Apr	1042.41	0	88.81	347.84	331.04	274.73	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
4-May	1030.12	27.76	90.04	379.91	306.34	281.59	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
4-Jun	1017.78	64.47	59.21	255.33	308.88	458.83	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
4-Jul	1042.66	236.72	19.74	103.61	284.02	872.01	0	1142	1092.33	85.78	489.39	0.1	49.72	-29.98	1092.28	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
4-Aug	1092.28	4089.75	74.01	398.41	12.01	4697.6	0	4697.6	2894.94	95.26	543.48	0.1	55.22	0	4642.38	2890.06	95.25	774	775	2900.45	95.28	95.25	774	543.48	775	543.65	543.65
4-Sep	4642.38	445.75	61.67	310.83	436.41	4279.22	0	4279.22	4460.8	99.4	567.13	0.15	86.43	0	4192.79	4458.08	99.4	910	911	4471.45	99.43	99.4	910	567.13	911	567.31	567.31
4-Oct	4192.79	267.44	40.7	219.56	208.29	3991.68	0	3991.68	4092.23	98.51	561.91	0.2	114.18	0	3877.5	4080.37	98.48	880	881	4092.51	98.51	98.48	880	561.91	881	562.08	562.08
4-Nov	3877.5	0	74.01	252.86	345.1	3205.53	0	3205.53	3541.52	97.09	553.91	0.15	84.42	0	3121.12	3537.77	97.08	834	835	3548.85	97.11	97.08	834	553.91	835	554.09	554.09
4-Dec	3121.12	93.7	55.51	293.57	245.94	2619.8	0	2619.8	2870.46	95.19	543.13	0.13	68.98	0	2550.82	2869.27	95.19	772	773	2879.66	95.22	95.19	772	543.13	773	543.31	543.31
5-Jan	2550.82	0	86.34	318.24	313.19	1833.05	0	1833.05	2191.94	92.24	526.26	0.13	66.83	0	1766.22	2189.86	92.23	675	676	2196.45	92.26	92.23	675	526.26	676	526.44	526.44
5-Feb	1766.22	2.85	85.11	358.94	398.47	926.55	0	1142	1454.11	88.3	503.83	0.13	63.99	21.12	1078.01	1453.83	88.3	547	548	1458.38	88.33	88.3	547	503.83	548	504	504

Table. 6.1 Basic Calculation (Continue)

Month	Initial Storage in starting of month	Inflow	ULBC Requirement	D/S Irri. Requirement	Through Hydro	Final Storage at month end	Spill	Final Storage after spill at month end	Average Storage	R.L. with respect to average storage	Surface area with respect to R.L. Of average storage	Monthly Evaporation Rate	Evaporation losses	Demand Deficit	Final Storage after Evaporation losses at month end	Storage	RL Low	Storage Low Row No	Storage High Row No	Storage High	RL High	RL Low	RL Low Row No	Area Low	RL HI Row No	RL High	Area High
5-Mar	1078.01	0	90.04	323.17	366.33	298.47	0	1142	1110.01	85.91	490.09	0.2	99.59	-9.55	1042.41	1107.23	85.89	468	469	1111.38	85.92	85.89	468	490.09	469	490.26	490.26
5-Apr	1042.41	0	88.81	347.84	591.29	14.48	0	1142	1092.21	85.78	489.39	0.23	111.88	-23.07	1030.12	1090.64	85.77	464	465	1094.79	85.8	85.77	464	489.39	465	489.56	489.56
5-May	1030.12	2.09	90.04	379.91	284.8	277.46	0	1142	1086.06	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
5-Jun	1017.78	526.16	59.21	255.33	201.45	1027.95	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
5-Jul	1042.66	1746.69	19.74	103.61	145.6	2520.4	0	2520.4	1781.53	90.2	514.61	0.1	52.28	0	2468.12	1779.09	90.19	608	609	1784.98	90.22	90.19	608	514.61	609	514.78	514.78
5-Aug	2468.12	3179.17	74.01	398.41	144.9	5029.97	0	5029.97	3749.04	97.65	557.04	0.1	56.6	0	4973.37	3740.42	97.63	852	853	3752.56	97.66	97.63	852	557.04	853	557.22	557.22
5-Sep	4973.37	1881.03	61.67	310.83	741.09	5740.82	0	5740.82	5357.1	101.37	578.26	0.15	88.13	0	5652.69	5347.13	101.35	974	975	5361.83	101.38	101.35	974	578.26	975	578.43	578.43
5-Oct	5652.69	306.52	40.7	219.56	632.98	5065.97	0	5065.97	5359.33	101.37	578.26	0.2	117.5	0	4948.47	5347.13	101.35	974	975	5361.83	101.38	101.35	974	578.26	975	578.43	578.43
5-Nov	4948.47	5.79	74.01	252.86	288.37	4339.02	0	4339.02	4643.75	99.82	569.39	0.15	86.78	0	4252.25	4631.85	99.79	923	924	4645.22	99.82	99.79	923	569.39	924	569.57	569.57
5-Dec	4252.25	4.51	55.51	293.57	326.07	3581.6	0	3581.6	3916.93	98.07	559.48	0.13	71.05	0	3510.55	3910.4	98.05	866	867	3922.54	98.09	98.05	866	559.48	867	559.65	559.65
6-Jan	3510.55	3.59	86.34	318.24	301.07	2808.49	0	2808.49	3159.52	96.04	547.83	0.13	69.57	0	2738.91	3149.9	96.01	799	800	3160.98	96.04	96.01	799	547.83	800	548	548
6-Feb	2738.91	3.18	85.11	358.94	294.38	2003.67	0	2003.67	2371.29	93.09	531.13	0.13	67.45	0	1936.21	2370.73	93.09	703	704	2376.37	93.12	93.09	703	531.13	704	531.3	531.3
6-Mar	1936.21	8.58	90.04	323.17	415.64	1115.95	0	1142	1539.11	88.81	506.61	0.2	102.94	-12.9	1039.06	1534.84	88.79	563	564	1540.02	88.82	88.79	563	506.61	564	506.78	506.78
6-Apr	1039.06	8.85	88.81	347.84	474.58	136.68	0	1142	1090.53	85.77	489.22	0.23	111.83	-23.02	1030.17	1086.49	85.74	463	464	1090.64	85.77	85.74	463	489.22	464	489.39	489.39
6-May	1030.17	0	90.04	379.91	380.97	179.24	0	1142	1086.08	85.74	489.04	0.25	124.22	-34.18	1017.78	1082.34	85.71	462	463	1086.49	85.74	85.71	462	489.04	463	489.22	489.22
6-Jun	1017.78	9.07	59.21	255.33	235.9	476.41	0	1142	1079.89	85.69	488.87	0.2	99.34	-40.13	1042.66	1078.2	85.68	461	462	1082.34	85.71	85.68	461	488.87	462	489.04	489.04
6-Jul	1042.66	3508.84	19.74	103.61	81.73	4346.42	0	4346.42	2694.54	94.68	540.17	0.1	54.88	0	4291.54	2692.57	94.67	755	756	2702.97	94.7	94.67	755	540.17	756	540.35	540.35
6-Aug	4291.54	13905.96	74.01	398.41	1341.01	16384.07	7873.1	8511	6401.27	103.4	589.91	0.1	59.94	0	8451.06	6394.55	103.39	1041	1042	6410.74	103.42	103.39	1041	589.91	1042	590.09	590.09
6-Sep	8451.06	4090.98	61.67	310.83	971.7	11197.85	2686.9	8511	8481.03	106.99	610.44	0.15	93.03	0	8417.97	8480.18	106.99	1159	1160	8498.73	107.02	106.99	1159	610.44	1160	610.52	610.52
6-Oct	8417.97	1477.35	40.7	219.56	984.28	8650.78	139.78	8511	8464.48	106.97	610.26	0.2	124	0	8387	8455.68	106.95	1158	1159	8480.18	106.99	106.95	1158	610.26	1159	610.44	610.44
6-Nov	8387	31.34	74.01	252.86	0	8091.47	0	8091.47	8239.23	106.68	608.7	0.15	92.77	0	7998.7	8235.19	106.68	1149	1150	8259.69	106.71	106.68	1149	608.7	1150	608.87	608.87
6-Dec	7998.7	93.7	55.51	293.57	0	7743.32	0	7743.32	7871.01	106.1	605.22	0.13	76.86	0	7666.46	7855.18	106.07	1129	1130	7872.18	106.1	106.07	1129	605.22	1130	605.39	605.39
7-Jan	7666.46	5.95	86.34	318.24	318.1	6949.73	0	6949.73	7308.09	104.97	598.96	0.13	76.07	0	6873.66	7307.46	104.97	1093	1094	7325.26	105	104.97	1093	598.96	1094	599.13	599.13
7-Feb	6873.66	3.13	85.11	358.94	322.59	6110.15	0	6110.15	6491.91	103.57	590.96	0.13	75.05	0	6035.1	6491.65	103.57	1047	1048	6507.84	103.6	103.57	1047	590.96	1048	591.13	591.13
7-Mar	6035.1	0	90.04	323.17	404.17	5217.73	0	5217.73	5626.41	101.92	581.39	0.2	118.14	0	5099.59	5611.89	101.9	992	993	5626.6	101.93	101.9	992	581.39	993	581.56	581.56
7-Apr	5099.59	0	88.81	347.84	287.07	4375.87	0	4375.87	4737.73	100.03	570.61	0.23	130.44	0	4245.43	4725.42	100.01	930	931	4738.79	100.04	100.01	930	570.61	931	570.78	570.78
7-May	4245.43	0	90.04	379.91	425.36	3350.12	0	3350.12	3797.77	97.77	557.74	0.25	141.67	0	3208.45	3788.99	97.75	856	857	3801.13	97.78	97.75	856	557.74	857	557.91	557.91
7-Jun	3208.45	81.31	59.21	255.33		2975.22	0	2975.22	3091.84	95.84	546.78	0.2	111.11	0	2864.11	3087.54	95.83	793	794	3097.93	95.86	95.83	793	546.78	794	546.96	546.96
7-Jul	2864.11	7815.6	19.74	103.61		10556.36	2045.4	8511	5687.56	102.05	582.26	0.1	59.16	0	8451.84	5685.44	102.05	997	998	5700.15	102.08	102.05	997	582.26	998	582.44	582.44
7-Aug	8451.84	4013.13	74.01	398.41		11992.55	3481.6	8511	8481.42	106.99	610.44	0.1	62.02	0	8448.98	8480.18	106.99	1159	1160	8498.73	107.02	106.99	1159	610.44	1160	610.52	610.52
7-Sep	8448.98	3045.95	61.67	310.83		11122.43	2611.4	8511	8479.99	106.98	610.26	0.15	93	0	8418	8455.68	106.95	1158	1159	8480.18	106.99	106.95	1158	610.26	1159	610.44	610.44
7-Oct	8418	153.57	40.7	219.56		8311.31	0	8311.31	8364.65	106.84	609.56	0.2	123.86	0	8187.44	8357.68	106.83	1154	1155	8382.18	106.86	106.83	1154	609.56	1155	609.74	609.74
7-Nov	8187.44	0	74.01	252.86		7860.57	0	7860.57	8024.01	106.37	606.78	0.15	92.47	0	7768.1	8008.19	106.35	1138	1139	8025.19	106.38	106.35	1138	606.78	1139	606.96	606.96
7-Dec	7768.1	0.18	55.51	293.57		7419.2	0	7419.2	7593.65	105.55	602.09	0.13	76.47	0	7342.73	7581.99	105.52	1111	1112	7596.39	105.55	105.52	1111	602.09	1112	602.26	602.26
8-Jan	7342.73	0	86.34	318.24		6938.15	0	6938.15	7140.44	104.69	597.22	0.13	75.85	0	6862.31	7129.4	104.67	1083	1084	7147.21	104.7	104.67	1083	597.22	1084	597.39	597.39
8-Feb	6862.31	4.6	85.11	358.94		6422.86	0	6422.86	6642.58	103.83	592.35	0.13	75.23	0	6347.63	6630.85	103.82	1055	1056	6648.66	103.85	103.82	1055	592.35	1056	592.52	592.52
8-Mar	6347.63	0	90.04	323.17		5934.42	0	5934.42	6141.02	102.91	587.13	0.2	119.3	0	5815.12	6135.62	102.9	1025	1026	6151.81	102.93	102.9	1025	587.13	1026	587.3	587.3
8-Apr	5815.12	0	88.81	347.84		5378.47	0	5378.47	5596.79	101.86	581.05	0.23	132.83	0	5245.64	5582.48	101.83	990	991	5597.18	101.86	101.83	990	581.05	991	581.22	581.22
8-May	5245.64	0	90.04	379.91		4775.69	0	4775.69	5010.66	100.65	574.26	0.25	145.86	0	4629.83	5008.81	100.65	951	952	5023.52	100.68	100.65	951	574.26	952	574.43	574.43
8-Jun	4629.83	86.33	59.21	255.33		4401.62	0	4401.62	4515.72	99.53	567.82	0.2	115.38	0	4286.23	4511.55	99.52	914	915	4524.92	99.55	99.52	914	567.82	915	568	568

Table. 6.1 Basic Calculation (Continue)

Month	Initial Storage in starting of month	Inflow	ULBC Requirement	D/S irri. Requirement	Through Hydro	Final Storage at month end	Spill	Final Storage after spill at month end	Average Storage	R.L. with respect to average storage	Surface area with respect to R.L. Of average storage	Monthly Evaporation Rate	Evaporation losses	Demand Deficit	Final Storage after Evaporation losses at month end	Storage	RL Low	Storage Low Row No	Storage High Row No	Storage High	RL High	RL Low	RL Low Row No	Area Low	RL HI Row No	RL High	Area High
8-Jul	4286.23	240.18	19.74	103.61		4403.06	0	4403.06	4344.65	99.14	565.57	0.1	57.46	0	4345.6	4337.78	99.12	901	902	4351.15	99.15	99.12	901	565.57	902	565.74	565.74
8-Aug	4345.6	1951	74.01	398.41		5824.18	0	5824.18	5084.89	100.8	575.13	0.1	58.43	0	5765.75	5082.36	100.8	956	957	5097.07	100.83	100.8	956	575.13	957	575.31	575.31
8-Sep	5765.75	2417.32	61.67	310.83		7810.57	0	7810.57	6788.16	104.08	593.74	0.15	90.49	0	7720.08	6773.3	104.06	1063	1064	6791.1	104.09	104.06	1063	593.74	1064	593.91	593.91
8-Oct	7720.08	237.27	40.7	219.56		7697.09	0	7697.09	7708.59	105.79	603.48	0.2	122.63	0	7574.47	7697.2	105.77	1119	1120	7713	105.8	105.77	1119	603.48	1120	603.65	603.65
8-Nov	7574.47	237.27	74.01	252.86		7484.87	0	7484.87	7529.67	105.41	601.39	0.15	91.65	0	7393.21	7525.41	105.4	1107	1108	7539.3	105.43	105.4	1107	601.39	1108	601.56	601.56
8-Dec	7393.21	5.08	55.51	293.57		7049.21	0	7049.21	7221.21	104.83	598.09	0.13	75.96	0	6973.26	7218.43	104.82	1088	1089	7236.24	104.85	104.82	1088	598.09	1089	598.26	598.26
9-Jan	6973.26	0	86.34	318.24		6568.68	0	6568.68	6770.97	104.05	593.56	0.13	75.38	0	6493.29	6755.49	104.03	1062	1063	6773.3	104.06	104.03	1062	593.56	1063	593.74	593.74
9-Feb	6493.29	0	85.11	358.94		6049.24	0	6049.24	6271.27	103.16	588.52	0.13	74.74	0	5974.5	6265.09	103.14	1033	1034	6281.27	103.18	103.14	1033	588.52	1034	588.7	588.7
9-Mar	5974.5	0	90.04	323.17		5561.29	0	5561.29	5767.9	102.21	583.13	0.2	118.49	0	5442.8	5763.41	102.2	1002	1003	5779.59	102.23	102.2	1002	583.13	1003	583.3	583.3
9-Apr	5442.8	0	88.81	347.84		5006.15	0	5006.15	5224.48	101.09	576.7	0.23	131.83	0	4874.32	5214.74	101.07	965	966	5229.45	101.1	101.07	965	576.7	966	576.87	576.87
9-May	4874.32	0	90.04	379.91		4404.37	0	4404.37	4639.34	99.81	569.39	0.25	144.63	0	4259.74	4631.85	99.79	923	924	4645.22	99.82	99.79	923	569.39	924	569.57	569.57

Table.6.2 Mean Monthly Inflow

Month June	Initial storage Average	Final Storage	inflow	Through Hydro	Spill	Month July	Initial storage Average	Final Storage	Inflow	Through Hydro	Spill	Month August	Initial storage Average	Final Storage	Inflow	Through Hydro	Spill
Jun-75	1142.00	880.73	406.80	353.53	0	Jul-75	1042.13	1941.64	1380.030896	357.1719804	0	Aug-75	2438.41	5737.78	4184.29648	412.5035169	0
Jun-76	1017.78	1886.34	2013.00	829.90	0	Jul-76	1784.00	4562.70	3849.27	947.2123567	0	Aug-76	4507.01	8554.87	5321.86	801.5837353	43.8665251
Jun-77	1017.78	1464.27	1659.00	897.97	0	Jul-77	1363.56	1921.60	1714.61	1033.213588	0	Aug-77	1869.78	3598.01	2859.78	659.1258466	0
Jun-78	1017.78	932.25	803.00	573.99	0	Jul-78	1042.66	2705.18	2645.95	860.0832644	0	Aug-78	2652.61	5965.98	5488.78	1702.99662	0
Jun-79	1017.78	1574.12	1061.00	190.13	0	Jul-79	1472.98	1284.51	1054.86	1119.970804	0	Aug-79	1233.63	8329.17	8658.87	1090.910648	0
Jun-80	1017.78	1700.68	1538.00	540.56	0	Jul-80	1599.04	924.09	977.94	1529.547314	0	Aug-80	1091.15	3862.63	4522.66	1278.754541	0
Jun-81	1017.78	582.49	57.00	177.75	0	Jul-81	1042.66	2373.00	1743.18	289.4932781	0	Aug-81	2320.94	7044.24	6403.82	1208.107877	0
Jun-82	1017.78	661.08	527.00	569.16	0	Jul-82	1042.66	1499.58	1181.3	601.0299988	0	Aug-82	1449.12	1396.75	1261.36	841.3108631	0
Jun-83	1017.78	713.02	98.00	88.22	0	Jul-83	1042.66	2208.83	1304.95	15.42796329	0	Aug-83	2157.06	4685.76	4403.6	1402.486513	0
Jun-84	2724.51	2386.85	83.00	106.13	0	Jul-84	2277.79	2640.86	662.4	175.9820749	0	Aug-84	2586.63	5861.69	3998.25	250.7667905	0
Jun-85	1017.78	825.65	330.00	207.59	0	Jul-85	1042.66	1425.02	505.71	0	0	Aug-85	1374.70	2622.43	1991.74	271.5894032	0
Jun-86	1017.78	883.06	314.00	134.18	0	Jul-86	1042.66	2933.49	2050.86	36.68361584	0	Aug-86	2880.59	6291.75	4515.22	631.6388235	0
Jun-87	1017.78	845.83	660.00	517.42	0	Jul-87	1042.66	1498.64	988.78	409.4551119	0	Aug-87	1448.17	2044.81	1137.95	68.89248623	0
Jun-88	1017.78	1051.59	487.00	138.65	0	Jul-88	1042.66	4704.73	3795.65	10.23393124	0	Aug-88	4649.55	6490.62	3504.26	1190.769155	0
Jun-89	3087.76	2338.62	181.00	615.60	0	Jul-89	2228.82	3225.91	1568.92	448.4800789	0	Aug-89	3170.98	5720.34	3847.06	825.2737081	0
Jun-90	1017.78	889.67	1057.00	870.57	0	Jul-90	1042.66	2796.74	2569.95	692.5237418	0	Aug-90	2744.03	9642.86	8336.36	965.1113385	1131.85854
Jun-91	1016.86	741.73	393.00	353.58	0	Jul-91	1042.66	2194.68	1588.36	312.9924198	0	Aug-91	2142.93	2592.91	1892.98	970.576938	0
Jun-92	1017.78	1539.94	926.00	89.30	0	Jul-92	1438.94	1298.44	170.48	187.6383832	0	Aug-92	1247.58	4032.68	3308.44	50.92744747	0
Jun-93	1017.78	291.18	40.11	452.17	0	Jul-93	1042.66	3515.61	3200.46	604.1640332	0	Aug-93	3461.91	3865.82	1800.48	924.1462549	0
Jun-94	1017.69	460.72	520.88	763.31	0	Jul-94	1042.66	3242.55	2937.46	614.2267058	0	Aug-94	3189.22	6586.82	4383.8	513.7736857	0
Jun-95	1092.59	451.59	40.19	366.65	0	Jul-95	1042.34	2702.29	2003.02	219.7200328	0	Aug-95	2649.74	2543.00	621.85	256.1736726	0
Jun-96	1017.78	716.57	176.53	163.20	0	Jul-96	1042.66	2347.42	1512.86	84.7534894	0	Aug-96	2295.42	3662.83	2010.72	170.8892812	0
Jun-97	1017.78	1023.08	519.64	199.80	0	Jul-97	1042.66	756.90	106.03	268.4382429	0	Aug-97	1092.28	4341.84	4038	316.0188058	0
Jun-98	1017.78	471.17	75.40	307.47	0	Jul-98	1042.66	1718.84	1013.17	213.6427951	0	Aug-98	1667.95	1333.62	315.83	177.7396297	0
Jun-99	1013.32	1402.68	1089.27	385.37	0	Jul-99	1302.25	1947.01	1016.42	248.3080047	0	Aug-99	1895.24	3558.14	2730.26	594.9356353	0
Jun-00	1017.78	1050.92	684.82	337.14	0	Jul-00	1042.66	2911.72	2248.05	255.6452172	0	Aug-00	2858.85	2498.05	446.99	335.3734867	0
Jun-01	1017.78	1592.32	889.08	0.00	0	Jul-01	1491.11	1807.16	485.33	45.92913967	0	Aug-01	1755.30	3842.65	2622.24	62.47028457	0
Jun-02	1017.78	2025.04	1476.18	154.38	0	Jul-02	1922.20	1685.03	141.45	255.2733411	0	Aug-02	1632.67	3668.99	2599.72	90.98485991	0
Jun-03	1739.21	2094.55	910.49	240.61	0	Jul-03	1989.17	4047.55	2295.01	113.2754044	0	Aug-03	3992.12	3430.65	264.54	353.5905204	0
Jun-04	1017.78	458.83	64.47	308.88	0	Jul-04	1042.66	872.01	236.72	284.0227856	0	Aug-04	1092.28	4697.60	4089.75	12.01257528	0
Jun-05	1017.78	1027.95	526.16	201.45	0	Jul-05	1042.66	2520.40	1746.69	145.6017093	0	Aug-05	2468.12	5029.97	3179.17	144.8971021	0
Jun-06	1017.78	476.41	9.07	235.90	0	Jul-06	1042.66	4346.42	3508.84	81.72954988	0	Aug-06	4291.54	16384.07	13905.96	1341.007083	7873.07366
Jun-07	3208.45	2975.22	81.31	0.00	0	Jul-07	2864.11	10556.36	7815.6	0	2045.36405	Aug-07	8451.84	11992.55	4013.13	0	3481.55232
Jun-08	4629.83	4401.62	86.33	0.00	0	Jul-08	4286.23	4403.06	240.18	0	0	Aug-08	4345.60	5824.18	1951	0	0
June Mean	**1326.44**	**1259.35**	**581.87**	**334.43**	**0.00**	**July Mean**	**1409.27**	**2691.76**	**1772.37**	**366.53**	**60.16**	**Aug Mean**	**2620.73**	**5227.53**	**3665.02**	**585.80**	**368.54**

Table. 6.2 Mean Monthly Inflow (Continue)

Month September	Initial storage Average	Final Storage	inflow	Through Hydro	Spill	Month October	Initial storage Average	Final Storage	Inflow	Through Hydro	Spill	Month Nov	Initial storage Avg	Final Storage	Inflow	Through Hydro	Spill
Sep-75	5680.69	7588.32	4093.798169	1813.673785	0	Oct-75	7498.04	7301.84	406.5146854	342.4611508	0	Nov-75	7179.95	6667.49	106.96	292.5466	0
Sep-76	8450.94	12216.11	5002.7	865.027748	3705.11312	Oct-76	8417.97	7535.17	194.89	817.4251661	0	Nov-76	7411.95	7029.22	510.56	566.4137	0
Sep-77	3543.08	5709.88	2975.71	436.4087864	0	Oct-77	5623.13	4842.19	411.18	931.85779	0	Nov-77	4724.97	3880.96	216.21	733.3518	0
Sep-78	5908.57	7077.21	2576.88	1035.738431	0	Oct-78	6987.15	6876.03	149.14	0	0	Nov-78	6755.10	6428.23	0	0	0
Sep-79	8271.12	8190.38	1371.76	1079.999021	0	Oct-79	8097.64	6880.23	127.22	1084.373458	0	Nov-79	6758.13	5851.65	134.95	714.5647	0
Sep-80	3808.35	3866.52	1013.89	583.2264326	0	Oct-80	3781.44	2705.72	130.26	945.7199594	0	Nov-80	2594.11	1605.20	90.09	752.134	0
Sep-81	6986.33	7531.63	2213.4	1295.603952	0	Oct-81	7440.43	6785.58	612.3	1006.888678	0	Nov-81	6664.26	5313.49	56.04	1079.943	0
Sep-82	1345.68	1464.03	791.29	300.4391563	0	Oct-82	1387.54	1042.03	205.24	290.4890252	0	Nov-82	1041.11	745.68	94.85	63.41221	0
Sep-83	4629.67	8191.47	5336.78	1402.486513	0	Oct-83	8101.56	8388.99	1614.77	1067.086115	0	Nov-83	8265.30	7479.80	79.29	537.9212	0
Sep-84	5804.41	5513.44	653.44	571.9135714	0	Oct-84	5424.75	4722.94	461.84	903.3921457	0	Nov-84	4606.11	3766.26	64.76	577.7339	0
Sep-85	2569.49	2103.43	227.92	321.4844053	0	Oct-85	2022.64	1836.88	321.97	247.4761767	0	Nov-85	1731.42	1168.53	39.28	275.3008	0
Sep-86	6233.97	5060.51	158.82	959.777853	0	Oct-86	4971.85	4303.04	90.76	499.317004	0	Nov-86	4187.33	3640.05	19.58	239.9922	0
Sep-87	1992.63	1531.64	257.24	345.7370853	0	Oct-87	1453.29	983.33	100.32	310.0198579	0	Nov-87	1040.86	601.81	59.94	172.115	0
Sep-88	6431.60	9933.34	5339	1464.758627	1422.34205	Oct-88	8419.45	10086.26	3248.24	1321.175324	1575.25859	Nov-88	8387.00	7640.21	82.34	502.2553	0
Sep-89	5662.74	4714.88	920.44	1495.802938	0	Oct-89	4627.04	3510.86	110.97	966.887536	0	Nov-89	3396.72	2553.49	31.34	547.6951	0
Sep-90	8451.91	10498.43	3529.97	1110.957703	1987.42534	Oct-90	8417.97	8050.67	874.72	981.7576852	0	Nov-90	7927.02	6689.54	88.96	999.5661	0
Sep-91	2538.96	2037.47	279.2	408.1951371	0	Oct-91	1956.90	1320.39	99.92	476.1652728	0	Nov-91	1216.74	641.12	31.4	280.1474	0
Sep-92	3977.90	5271.83	2048.44	382.0072336	0	Oct-92	5185.08	4972.59	631.29	583.524912	0	Nov-92	4855.76	4460.42	257.91	326.3824	0
Sep-93	3809.35	5472.26	2409.31	373.9066966	0	Oct-93	5385.48	5922.64	1107.44	310.0198579	0	Nov-93	5804.43	5334.53	29.09	172.115	0
Sep-94	6528.64	14826.70	9694.3	1023.735642	6315.70295	Oct-94	8419.37	7470.35	245.75	934.5171932	0	Nov-94	7347.19	6651.99	17.11	385.4446	0
Sep-95	2488.33	4000.37	2195	310.462684	0	Oct-95	3916.67	3466.51	164.01	353.9085723	0	Nov-95	3353.49	2701.06	2.67	328.2344	0
Sep-96	3607.47	5428.51	2731.15	537.6055586	0	Oct-96	5341.98	5020.06	687.4	749.0537956	0	Nov-96	4902.98	4362.58	8.06	221.5941	0
Sep-97	4286.92	3209.30	412	1117.118124	0	Oct-97	3124.41	2396.94	323	790.2146035	0	Nov-97	2286.96	1672.74	88.96	376.3092	0
Sep-98	1282.27	8810.79	8792.12	891.10311	299.790549	Oct-98	8423.72	8435.89	1624.72	1352.295478	0	Nov-98	8311.95	7575.49	88.96	498.5561	0
Sep-99	3503.21	4100.70	1453.33	483.3361197	0	Oct-99	4015.67	4307.66	1695.87	1143.626526	0	Nov-99	4193.27	3393.56	239.33	712.1647	0
Sep-00	2443.20	1791.34	167.52	446.8751402	0	Oct-00	1711.46	1113.55	20.97	358.6206334	0	Nov-00	1039.83	458.67	0	254.2947	0
Sep-01	3787.59	3217.64	101.82	299.2697039	0	Oct-01	3133.33	3313.28	663.58	223.3678433	0	Nov-01	3201.75	2583.70	0	291.1887	0
Sep-02	3614.19	8029.83	5891.8	1103.662082	0	Oct-02	7940.88	6998.28	107.54	789.8843188	0	Nov-02	6876.25	6333.74	0	215.6392	0
Sep-03	3374.11	4075.19	2288.49	1214.906847	0	Oct-03	3990.35	2856.82	828.61	1701.878545	0	Nov-03	2744.66	2043.64	1.83	375.9814	0
Sep-04	4642.38	4279.22	445.75	436.4087864	0	Oct-04	4192.79	3991.68	267.44	208.2872906	0	Nov-04	3877.50	3205.53	0	345.0985	0
Sep-05	4973.37	5740.82	1881.03	741.0853725	0	Oct-05	5652.69	5065.97	306.52	632.9795346	0	Nov-05	4948.47	4339.02	5.79	288.3654	0
Sep-06	8451.06	11197.85	4090.98	971.6999058	2686.84502	Oct-06	8417.97	8650.78	1477.35	984.2800814	139.779484	Nov-06	8387.00	8091.47	31.34	0	0
Sep-07	8448.98	11122.43	3045.95	0	2611.42971	Oct-07	8418.00	8311.31	153.57	0	0	Nov-07	8187.44	7860.57	0	0	0
Sep-08	5765.75	7810.57	2417.32	0	0	Oct-08	7720.08	7697.09	237.27	0	0	Nov-08	7574.47	7484.87	237.27	0	0
Sept Mean	**4802.79**	**6223.94**	**2553.19**	**759.54**	**559.67**	**Oct Mean**	**5577.02**	**5210.69**	**579.49**	**685.56**	**50.44**	**Nov Mean**	**5052.40**	**4419.30**	**79.85**	**386.07**	**0.00**

Table. 6.2 Mean Monthly Inflow (Continue)

Month December	Initial storage Average	Final Storage	Inflow	Through Hydro	Spill	Month Jan	Initial storage Average	Final Storage	Inflow	Through Hydro	Spill	Month Feb	Initial storage Average	Final Storage	Inflow	Through Hydro	Spill
Dec-75	6576.80	5880.78	182.06	528.993692	0	Jan-76	5806.11	4709.58	30.26	722.210216	0	Feb-76	4636.29	3568.35	0	623.8930367	0
Dec-76	6938.07	5977.07	33.37	645.2954824	0	Jan-77	5902.08	4779.22	0	718.2786053	0	Feb-77	4705.81	3560.53	0	701.2285774	0
Dec-77	3794.85	2804.98	158.04	798.8264701	0	Jan-78	2735.12	1631.77	0	698.7697916	0	Feb-78	1564.96	423.18	0	697.7300066	0
Dec-78	6338.03	5988.95	0	0	0	Jan-79	5914.36	4498.73	0	1011.055158	0	Feb-79	4425.51	3063.49	0	917.9736017	0
Dec-79	5761.90	4773.37	255.84	895.2989484	0	Jan-80	4700.06	3993.17	4.8	307.1060132	0	Feb-80	3921.35	2862.92	1.23	615.6065617	0
Dec-80	1525.37	856.51	93.97	413.7519929	0	Jan-81	1078.61	-188.27	2.05	864.3500528	0	Feb-81	1079.76	-252.53	0.7	888.935464	0
Dec-81	5224.27	3994.08	127.73	1008.841027	0	Jan-82	3921.81	3301.70	8.79	224.321999	0	Feb-82	3231.22	2364.62	3.07	425.6170411	0
Dec-82	1067.42	668.86	35.64	85.11802579	0	Jan-83	1079.78	-218.45	0	893.6520268	0	Feb-83	1079.76	218.65	0	417.0565521	0
Dec-83	7387.54	6068.24	15.01	985.229344	0	Jan-84	5992.90	5565.42	6.11	29.00633249	0	Feb-84	5491.37	5052.22	4.9	0	0
Dec-84	3680.42	2949.53	76.83	458.6406136	0	Jan-85	2879.64	1777.25	4.99	702.8061881	0	Feb-85	1709.95	75.80	0	1190.101247	0
Dec-85	1091.78	613.91	20.86	149.648308	0	Jan-86	1079.71	162.38	0	512.7510265	0	Feb-86	1079.76	126.03	0	509.678156	0
Dec-86	3554.79	3001.04	18.22	222.8907655	0	Jan-87	2931.22	2380.03	0.33	146.9424204	0	Feb-87	2311.51	1730.09	0	137.3788447	0
Dec-87	1067.42	520.00	6.94	205.2731373	0	Jan-88	1079.78	391.75	0	283.4551853	0	Feb-88	1079.76	358.47	0	277.2433872	0
Dec-88	7547.74	6661.38	1.84	539.1199749	0	Jan-89	6585.57	6079.72	0	101.2750619	0	Feb-89	6004.89	5465.20	0.15	95.78744347	0
Dec-89	2470.46	1736.85	0	384.5247367	0	Jan-90	1670.32	579.22	0	686.5199007	0	Feb-90	1078.26	249.78	0	384.424428	0
Dec-90	6598.26	5174.08	1.98	1077.08273	0	Jan-91	5099.87	4283.64	0	411.6521165	0	Feb-91	4211.23	3463.75	0	303.4361837	0
Dec-91	1066.86	476.56	8.75	249.9667677	0	Jan-92	1079.78	-467.29	0	1142.488878	0	Feb-92	1079.76	278.37	0	357.3435327	0
Dec-92	4373.61	3818.61	33.26	239.1872551	0	Jan-93	3747.22	3101.87	0	240.7701749	0	Feb-93	3031.77	2412.48	0	175.241699	0
Dec-93	5246.01	4698.73	7.07	205.2731373	0	Jan-94	4625.86	3845.93	0	375.355056	0	Feb-94	3774.30	2982.46	0	347.7872967	0
Dec-94	6561.18	5978.76	48.87	282.2074432	0	Jan-95	5904.02	5092.91	0	406.5363741	0	Feb-95	5019.25	4073.00	0	502.1990434	0
Dec-95	2617.89	2020.92	2.74	250.627337	0	Jan-96	1953.67	1075.02	0	474.0661303	0	Feb-96	1077.62	-39.42	0	672.9904625	0
Dec-96	4275.80	3710.11	9.84	226.4505001	0	Jan-97	3638.93	2997.06	0	237.2862834	0	Feb-97	2927.16	2235.13	0	247.9752735	0
Dec-97	1593.41	1613.33	920.19	551.1888209	0	Jan-98	1548.71	884.53	0	259.5988469	0	Feb-98	1078.54	363.71	0	270.7869338	0
Dec-98	7483.12	6617.46	0	516.5725423	0	Jan-99	6541.73	5558.29	0	578.8544423	0	Feb-99	5483.86	4644.84	0	394.971518	0
Dec-99	3308.56	2575.33	0	384.1553072	0	Jan-00	2506.22	1646.14	0	455.496793	0	Feb-00	1579.70	673.78	0	461.8725101	0
Dec-00	1067.42	602.52	0	115.817373	0	Jan-01	1079.78	230.01	0	445.1919117	0	Feb-01	1079.76	252.71	0	383.0029807	0
Dec-01	2500.87	2006.16	0	145.6335145	0	Jan-02	1939.12	1524.58	0	9.964810413	0	Feb-02	1459.42	739.03	0	276.3455022	0
Dec-02	6243.52	5669.47	9.72	234.6978303	0	Jan-03	5595.17	5105.82	0	84.76816871	0	Feb-03	5032.38	4317.89	0	270.4419698	0
Dec-03	1962.58	1336.33	11.48	288.6541104	0	Jan-04	1271.51	515.50	6.68	358.1019642	0	Feb-04	1079.25	321.24	7.38	321.3425052	0
Dec-04	3121.12	2619.80	93.7	245.9372948	0	Jan-05	2550.82	1833.05	0	313.1905906	0	Feb-05	1766.22	926.55	2.85	398.4676423	0
Dec-05	4252.25	3581.60	4.51	326.0741387	0	Jan-06	3510.55	2808.49	3.59	301.0728135	0	Feb-06	2738.91	2003.67	3.18	294.3765979	0
Dec-06	7998.70	7743.32	93.7	0	0	Jan-07	7666.46	6949.73	5.95	318.1008224	0	Feb-07	6873.66	6110.15	3.13	322.5853541	0
Dec-07	7768.10	7419.20	0.18	0	0	Jan-08	7342.73	6938.15	0	0	0	Feb-08	6862.31	6422.86	4.6	0	0
Dec-08	7393.21	7049.21	5.08	0	0	Jan-09	6973.26	6568.68	0	0	0	Feb-09	6493.29	6049.24	0	0	0
Dec Mean	**4395.86**	**3741.38**	**66.98**	**372.38**	**0.00**	**Jan Mean**	**3762.72**	**2939.27**	**2.16**	**421.03**	**0.00**	**Feb Mean**	**3119.07**	**2267.59**	**0.92**	**408.35**	**0.00**

Table. 6.2 Mean Monthly Inflow (Continue)

Month March	Initial storage Average	Final Storage	Inflow	Through Hydro	Spill	Month April	Initial storage Average	Final Storage	Inflow	Through Hydro	Spill	Month May	Initial storage Average	Final Storage	Inflow	Through Hydro	Spill
Mar-76	3496.96	2370.64	0	713.1139319	0	Apr-76	2260.06	1103.06	0	720.3557288	0	May-76	1024.92	-224.90	0	779.8632377	0
Mar-77	3489.08	2080.52	0	995.3482872	0	Apr-77	1970.47	516.19	0	1017.636385	0	May-77	1026.03	-299.82	0	855.8996587	0
Mar-78	1078.52	166.15	0	499.1604246	0	Apr-78	1042.41	52.51	0	553.2537116	0	May-78	1030.12	-328.34	0	888.51955	0
Mar-79	2992.74	1612.59	0	966.9438068	0	Apr-79	1505.05	199.61	0	868.7881	0	May-79	1027.98	-271.20	0	829.2273378	0
Mar-80	2792.88	1621.87	0	757.8051157	0	Apr-80	1514.86	107.96	0	970.253993	0	May-80	1027.94	-1.60	0	559.5853908	0
Mar-81	1079.76	42.11	0	624.4361715	0	Apr-81	1042.41	54.96	0	550.8071586	0	May-81	1030.12	312.44	0	247.7348997	0
Mar-82	2295.80	1508.12	0	374.4742969	0	Apr-82	1402.81	571.67	0	394.4822074	0	May-82	1028.42	312.44	0	246.0229242	0
Mar-83	1079.76	63.66	0	602.884486	0	Apr-83	1042.41	-136.19	0	741.9514522	0	May-83	1030.12	262.80	0	297.3785184	0
Mar-84	4978.91	4265.40	1.2	301.4960672	0	Apr-84	4149.74	3550.85	0.5	162.7398132	0	May-84	3423.15	2863.62	0	89.58298504	0
Mar-85	1078.17	-201.35	0	866.3048487	0	Apr-85	1042.41	76.42	0	529.3435491	0	May-85	1030.12	295.90	0	264.2717631	0
Mar-86	1079.76	289.69	0	376.8621327	0	Apr-86	1042.41	318.14	0	287.6241116	0	May-86	1030.12	325.09	0	235.0868322	0
Mar-87	1663.82	1126.52	0	124.0965084	0	Apr-87	1040.05	460.65	0	142.7416889	0	May-87	1030.12	395.94	0	164.2395502	0
Mar-88	1079.76	396.34	0	270.2071007	0	Apr-88	1042.41	237.88	0	367.8857297	0	May-88	1030.12	126.56	0	433.619716	0
Mar-89	5391.19	4792.86	0	185.115987	0	Apr-89	4676.00	4037.27	0	202.077939	0	May-89	3907.94	3228.54	0	209.4469567	0
Mar-90	1079.76	75.87	0	590.6761865	0	Apr-90	1042.41	220.27	0	385.4911251	0	May-90	1030.12	-243.78	0	803.9593383	0
Mar-91	3392.85	2436.42	0	543.2203977	0	Apr-91	2325.91	1317.08	0	572.1875854	0	May-91	1199.16	197.23	0	531.9735935	0
Mar-92	1079.76	430.84	0	235.7082567	0	Apr-92	1042.41	245.36	0	360.3992775	0	May-92	1030.12	183.88	0	376.2920858	0
Mar-93	2343.83	1719.78	0	210.8390454	0	Apr-93	1613.69	938.56	0	238.4826478	0	May-93	1027.50	312.62	0	244.929315	0
Mar-94	2912.45	2167.70	0	331.5372916	0	Apr-94	2058.71	1156.55	0	465.5154276	0	May-94	1040.18	104.71	0	465.5227672	0
Mar-95	4000.84	3175.34	0	412.2882203	0	Apr-95	3062.64	2185.48	0	440.5165489	0	May-95	2062.31	1222.15	0	370.2075085	0
Mar-96	1079.76	-28.87	0	695.4229071	0	Apr-96	1042.41	43.41	0	562.3499957	0	May-96	1030.12	33.55	0	526.6278752	0
Mar-97	2166.86	1448.71	0	304.9359207	0	Apr-97	1344.00	626.11	0	281.2459479	0	May-97	1028.69	215.10	0	343.6428359	0
Mar-98	1079.76	294.94	0	371.6118299	0	Apr-98	1042.41	113.54	0	492.2220002	0	May-98	1030.12	-214.49	42.16	816.8208675	0
Mar-99	4571.84	3527.60	0	631.0369715	0	Apr-99	3413.52	2054.08	0	922.7957577	0	May-99	1930.47	912.65	0	547.8737416	0
Mar-00	1078.48	35.85	0	629.4173534	0	Apr-00	1042.41	-149.79	0	755.5567335	0	May-00	1030.12	100.10	0	460.0718471	0
Mar-01	1079.76	245.75	0	420.8022247	0	Apr-01	1042.41	62.55	0	543.2130581	0	May-01	1030.12	110.10	0	450.0703384	0
Mar-02	1078.77	446.93	0	218.6288701	0	Apr-02	1042.41	346.16	0	259.6061865	0	May-02	1030.12	375.06	0	185.1110939	0
Mar-03	4245.51	3731.12	0	101.1771998	0	Apr-03	3617.22	2872.64	0	307.9329481	0	May-03	2747.09	1873.67	0	403.4635035	0
Mar-04	1079.76	391.33	0	275.2225344	0	Apr-04	1042.41	274.73	0	331.0357482	0	May-04	1030.12	281.59	27.76	306.3426887	0
Mar-05	1078.01	298.47	0	366.3321685	0	Apr-05	1042.41	14.48	0	591.2878247	0	May-05	1030.12	277.46	2.09	284.8012053	0
Mar-06	1936.21	1115.95	8.58	415.6351048	0	Apr-06	1039.06	136.68	8.85	474.582353	0	May-06	1030.17	179.24	0	380.9723417	0
Mar-07	6035.10	5217.73	0	404.1656643	0	Apr-07	5099.59	4375.87	0	287.0711906	0	May-07	4245.43	3350.12	0	425.360153	0
Mar-08	6347.63	5934.42	0	0	0	Apr-08	5815.12	5378.47	0	0	0	May-08	5245.64	4775.69	0	0	0
Mar-09	5974.50	5561.29	0	0	0	Apr-09	5442.80	5006.15	0	0	0	May-09	4874.32	4404.37	0	0	0
March Mean	**2565.25**	**1716.54**	**0.29**	**435.79**	**0.00**	**April Mean**	**2029.04**	**1128.51**	**0.28**	**464.16**	**0.00**	**May Mean**	**1628.80**	**748.49**	**2.12**	**412.49**	**0.00**

Table. 6.2 Mean Monthly Inflow (Continue)

Mean for 34 Month (1973-2008)	AVG Initial storage	Inflow (Mm^3)	Total	Inflow Level (M)	D/S irri. Requirement (Mm^3)	Total	Irrigation Level(M)	Through Hydro (Mm^3)	Total	Hydro Level(M)	Spill (Mm^3)	Spill (Mm^3)	Spill Level(M)	ULBC Require-ment	ULBC TOTAL Mm^3	ULBC LEVEL (Mt)	Final Storage	Suggested Rule Level In Mt	Rule level in 2000 by Task Mgr Mt	Rule Level Mt(By Task Mgr)	Difference Mt (AC-AB)	Flood absorption Volume Mm^3
JUNE	1326.44	581.87	1908.32	90.87	255.33	1581.77	89.06	334.43	1660.87	89.53	0.00	7414.29	105.16	59.21	1385.65	87.843	1259.347	89.92	90	89.92	0.08	484.73
JULY	1409.27	1772.37	3181.64	96.10	103.61	1512.88	88.66	366.53	1775.80	90.17	60.16	7474.45	105.29	19.74	1429.01	88.134	2691.764	94.67	97.86	94.90	3.19	1145.79
AUG	2620.73	3665.02	6285.75	103.18	398.41	3019.14	95.63	585.80	3206.54	96.17	368.54	7782.83	105.93	74.01	2694.74	94.677	5227.531	101.10	101.52	99.49	0.42	207.85
SEPT	4802.79	2553.19	7355.98	105.06	310.83	5113.62	100.86	759.54	5562.33	101.79	559.67	7973.96	106.28	61.67	4864.46	100.322	6223.942	103.07	104.55	99.17	1.48	834.24
OCT	5577.02	579.49	6156.51	102.94	219.56	5796.58	102.26	685.56	6262.58	103.14	50.44	7464.73	105.27	40.70	5617.72	101.907	5210.692	101.06	105.18	98.39	4.12	2217.49
NOV	5052.40	79.85	5132.25	100.90	252.86	5305.26	101.26	386.07	5438.47	101.54	0.00	7414.29	105.16	74.01	5126.41	100.889	4419.303	99.31		97.39		
DEC	4395.86	66.98	4462.85	99.41	293.57	4689.43	99.92	372.38	4768.24	100.10	0.00	7414.29	105.16	55.51	4451.37	99.380	3741.384	97.63		96.31		
JAN	3762.72	2.16	3764.88	97.69	318.24	4080.96	98.48	421.03	4183.75	98.74	0.00	7414.29	105.16	86.34	3849.06	97.900	2939.274	95.39		95.03		
FEB	3119.07	0.92	3119.99	95.92	358.94	3478.01	96.91	408.35	3527.42	97.05	0.00	7414.29	105.16	85.11	3204.18	96.161	2267.594	92.59		93.52		
MARCH	2565.25	0.29	2565.54	94.14	323.17	2888.42	95.25	435.79	3001.04	95.58	0.00	7414.29	105.16	90.04	2655.29	94.561	1716.538	89.86		91.95		
APRIL	2029.04	0.28	2029.32	91.49	347.84	2376.88	93.12	464.16	2493.20	93.75	0.00	7414.29	105.16	88.81	2117.85	91.900	1128.51	89.92		90.01		
MAY	1628.80	2.12	1630.92	89.35	379.91	2008.71	91.39	412.49	2041.29	91.55	0.00	7414.29	105.16	90.04	1718.84	89.871	748.4855	89.92		87.48		

Note: Reservoir cap = 7414.29 (Mm^3) and Reservoir level for Spill to start = 105.16 (Mt)

6.2 Real Time Microsoft Excel Program for Different Flood Situations (For Release Decision)

In this study forecast based reservoir operation is prepared for real time different flood situations for release decision by using Microsoft excel program.

6.2.1 Forecast Based Reservoir Operation (FBRO)

- This method is adopted for major reservoirs
- Generally catchment area of such river is situated in more than one state
- Forecast based, reservoir operation is based on rule books
- Routing of reservoir on forecast based is carried out as per set norms and rule books
- There are formulas, tables, charts available to calculate the outflow

6.2.2 Methodology for FBRO

In this program flood inflow of Tapi River at Surat calculated by following equation for better prediction.

$$Q = Q_1 + Q_2 + Q_3 + Q_4 + Q_5$$

Where,

Q_1 = Discharge released from Ukai dam

Q_2 = Discharge from tributaries

Q_3 = Discharge lead by Varekhadi watershed

Q_4 = Runoff by heavy precipitation on Surat city

Q_5 = Back water flooding from Arabian Sea (Tide effect)

Hence, Q_1, the discharge released from Ukai dam directly depends on the inflow upstream. In existing system, this inflow is estimated based on hydro-meteorological data of base station Gidhade and available condition of intermediate catchment between Gidhade and Ukai.

Instead of it, Q_1 estimated exactly by establishing automatic rain gauge station at Suitable location viz. in Upper Tapi Basin at Dedtalai and Burhanpur, in Middle Tapi Basin at Darpuri, Savkheda, Malkheda, Morne, Gidhaade and Sarangkheda. It is remarkable that the catchment

area between Gidhade and Ukai is very large and there is nor a single rain gauge station which is connected through Satellite.

Q_2, the discharge lead by several tributaries D/S to the Ukai and Upstream to Kakrapar weir calculated by either developing hydrological network or by preparing SWAT model.

Q_3 is the discharge from Varekhadi and its group of mini washed. it is predicted by using SWAT model.

Q_4, the runoff lead by heavy rainfall on the entire Surat city. It is comparatively low with respect to other inflow and by establishing temporary rain gauge stations.

Q_5, the backwater flow from the Arabian Sea (Tidal effect), experienced by Surat during last flood event of 2006. In order to determine it, Tidal flood modeling can be developed.

In the easting system, river is gauged at Kakrapar weir, Mandvi, Ghala, Kathor Singapur weir and at Hoper Bridge. It is suggested to establish more rain gauge stations at Amlidam, Godadha dam, Godsamba village and at Luharpur. All these stations should be interlinked with each other through satellite.Thus, by networking of whole Tapi basin through satellite, in assistantship of computer, hydrologically rich information can be available on hand. Above information along with the two ways system should be used for operation of Ukai Dam. The flood cell at Gandhinagar and the dam authority at Ukai shall remain interlinked. For that, initially, high-tech network of personal computers with appropriate software, analog-to-digital converters, pressure or liquid-level sensors should be established at each recording stations as well as at decision taking offices.

Surat has been frequently hit by big floods and suffered from flood disasters. Hydrological information and forecasting, as one important non-structural measure, plays an important role in flood control and disaster relief and therefore, the advance flood forecasting system should be established by removing deficiency of such system. To remove this deficiency of such system, Microsoft excel program is prepared. From this program, by entering reservoir level as input, anybody can operate releases decision as directed. Plate.No.6.1 shows Forecast Based Reservoir Operation. (FBRO).

Proforma For Forecast Based Reservoir Operation

Date	: 30/08/11	FRL	345.00 ft.
Forecast No.	:TU- 20	Capicity	7414.29 MCM
Time of forecast.	: 10.00 **Received at: 10.40**	HFL	351.00 ft.
Reservoir level at time of forecast	: 400.00	Permissible Upper Limit :	334.87
Corres. Capicity in MCM (X) :	8480.18	Capicity at Permissible Upper Limit (Y) in MCM:	5695.74
Expected trend of inflow	: **Falling**		

TABLE A : FORCAST INFORMATION

Sr. No.	Forecast period	Duration of forecast	Volume of inflow forecasted	Avg. inflow col 4/col 3 * .0981	Expected capacity after forecast period (X) + col 4	Expected level after forecast period	Excess capacity above permissible level col(6-y	Avg. outflow col.8/col.3*0.0981	
	hrs.	hrs.	MCM	lac. Cusec	MCM	ft	MCM	lac. Cusec	
1	2	3	4	5	6	7	8	9	
1	0 - 6	6	110	1.80	8590.18	351.00	2894.44	(A)	47.40
2	0 - 12	12	215	1.76	8695.18	351.00	2999.44	(B)	24.60
3	12 - 24	12	160	1.31	8855.18	351.00	3159.44	(C) =2*(B)	49.20
4	0 - 24	24	375	1.53	8855.18	351.00	3159.44	(D)	13.00
5	0 - 36/48	36	.	.	.	.	.	$(1.1*Q)_{Emer}$	.
								$(1.05*P)_{Emergency}$	.

Note : Condition N 2 applies

START RELEASING WATER @ 5.00 Lac-cusecs

MAX. DISCH. CAPACITY AT RWL 400.00 ft. is 16.780 Lac-cusecs

TABLE B: REAL TIME RESERVOIR PERFORMANCE

Time hrs	Exp. RWL ft	Time hrs	Exp. RWL ft	24-48 RWL at end of
2	3	4	5	6
11.00	351.00	23.00	351.00	27th Hour
12.00	351.00	24.00	351.00	not applicable
13.00	351.00	1.00	351.00	30th Hour
14.00	351.00	2.00	351.00	not applicable
15.00	351.00	3.00	351.00	33rd Hour
16.00	351.00	4.00	351.00	not applicable
17.00	351.00	5.00	351.00	36th Hour
18.00	351.00	6.00	351.00	not applicable
19.00	351.00	7.00	351.00	39th Hour
20.00	351.00	8.00	351.00	not applicable
21.00	351.00	9.00	351.00	42nd Hour
22.00	351.00	10.00	351.00	not applicable
				45th Hour
				not applicable
				48th Hour
				not applicable

Considerations for release Recommended:

Releases Recommended as per prevailing Res. Op. Policy:

From 0 to 1	hrs wrt. comm.	18800 cusecs
From 1 to 2	hrs wrt. comm.	18800 cusecs
From 2 to 3	hrs wrt. comm.	18800 cusecs
From 3 to 6	hrs wrt. comm.	18800 cusecs
From 6 to 9	hrs wrt. comm.	18800 cusecs
From 9 to 12	hrs wrt. comm.	180000 cusecs

Note: 1 If the release decided is the first release for this event than it must commence after 3 hour intimation and intimation by FAX shall be sent immediately to Down stream authorities (Provision of Chapter 7, Para 7.7, Page 87 of Disaster Management Plan - 11-12. Provision of Para 7.8 must also be kept in mind prior to finalisation of any release more than 6.8 or 10 Lac-cusecs)

2 (for condition No, "Gates not to be operated")

Plate.6.1 Forecast Based Reservoir Operation

6.3 Analysis of Tapi River: Flood Risk Assessment for Surat City by using GIS

The flood risk assessment is done for the Surat city by using the Geographical Information System (GIS) and Image processing tools. The water levels data from the model results for the river bank profile, changes in land use, construction of embankment and changes in the flood scenarios after the release of water from the Ukai dam was used to simulate the risk to the city. The areas under the risk were identified using the two stage scenarios, prior to the construction of embankments or protection structures along the river bank and after the construction. The results are spatially represented to assess the areal changes over the Surat city.

A flood risk map has been developed using a multi-parametric approach using hydrological, geomorphologic as well as demographic data. Although, this map broadly matches with the MODIS-derived map, it is distinctly different in terms of risk assessment. High and low risk zones correspond well with the river migration histories and hydrological characteristics. Such efforts should be a part of non-structural measures of flood management to reduce short term and long-term damages and to bring awareness among the scientific community on the potential need of this research.

6.3.1 Methodology

High-resolution remote sensing images from Google-Earth and Cartosat-1 are combined with river hydraulic analysis and digital elevation model (DEM) to identify the flood susceptible areas.

The step-wise methodology adopted for generation of flood simulation, flood mapping and zone-level flood hazard assessment is described below:

1. Collection of high-resolution remote sensing images for Cartosat-1 and Google-earth.
2. Collection of topographical features such as contours, river channel sections, and water level and discharge data.
3. Inter-linking of spatial and temporal data using GIS software and customized DBMS tools.
4. Generation of thematic maps.
5. The analysis of results and delineation of areas under various degrees of flood.

This methodology has been applied to prepare a flood potential and risk map for Surat city. Generation of Digital Elevation Models (DEMs) from satellite stereo data has been an important field from last few decades, started with the launch of the first civilian remote sensing satellite. Digital Elevation Models (DEMs) are a type of raster GIS layer. Raster GIS represents the world as a regular arrangement of locations. In a DEM, each cell has a value corresponding to its elevation. There is always a question mark how quickly and accurately the DEM's can be generated especially using satellite stereo data.

To overcome the time difference problem between two stereo scenes the vibrant Indian remote sensing satellite programme had launched advanced satellite, known as IRS-P5 (Cartosat-1) on March 20th, 2012 aims to provide data with higher resolution for cartographic purpose. This satellite has two identical panchromatic sensors (camera) with 2.5 meters resolution kept on the platform with fore, +26° and aft, -5° tilt respectively. This system is capable to provide stereo data without any time difference between two scenes.

6.3.2 Software Used Open Source

MicroDEM for Image Processing and DEM processing/Eshayal Smart for GIS Map Window 4.5 for Stereo Data Processing and Watershed Delineation and Morphometric Analysis Online Tools for data conversion to shape files etc. For Dem generation of Cartosat – 1 data[1], data of Surat City was used. Fore and after scenes of town, dated 20th March 2012 were used. The detained information of fore and after scenes already mentioned earlier (Mentioned in Para research study area 1.8.3 of chapter -1 Introduction).

6.3.3 Data Processing

The Fore and Aft scenes of Cartosat–1 data were provided with Rational functions (RFs) coefficients. Rational Functions (RFs) have been applied in photogrammetry and remote sensing to represent the transformation between the image space and object space whenever the rigorous model is made unavailable intentionally or unintentionally. It attracts more attention now because high-resolution images are being released to users with only RF coefficients.

6.3.4 Auto generation of Contour

The following steps were used in MicroDEM software for the image processing to generate the Contour and Digital Elevation Model (DEM) for the study area.

- File New: type a block name in any desired path and save.

- Model setup dialog box choose rational function in the geometric model category choose Cartosat RPC in the geometric model and click ok.
- In the block property dialog box specify both horizontal and vertical co-ordinates and click ok.
- Click add list button in the standard tool bar add the imagery.
- Double click on the pry red box to build pyramid. Green button indicates the pyramid layer is generated.
- Double click on int. (Interior orientation) red box. Select the RPC coefficient and click ok e.g. bandra_rpc.txt. Both interior orientation and exterior will be generated.
- Click on Start automatic tie button.
- Clicks on Start triangulation.
- Click Start DTM Extractions.
- Click single DTM Mosaic radio button and give the o/p name. Check on the make pixels square.
- Click on advance properties button in the General tab check crate contour map. Click on the accuracy tab. Check use block tie points also give the interval of contours to be generated.

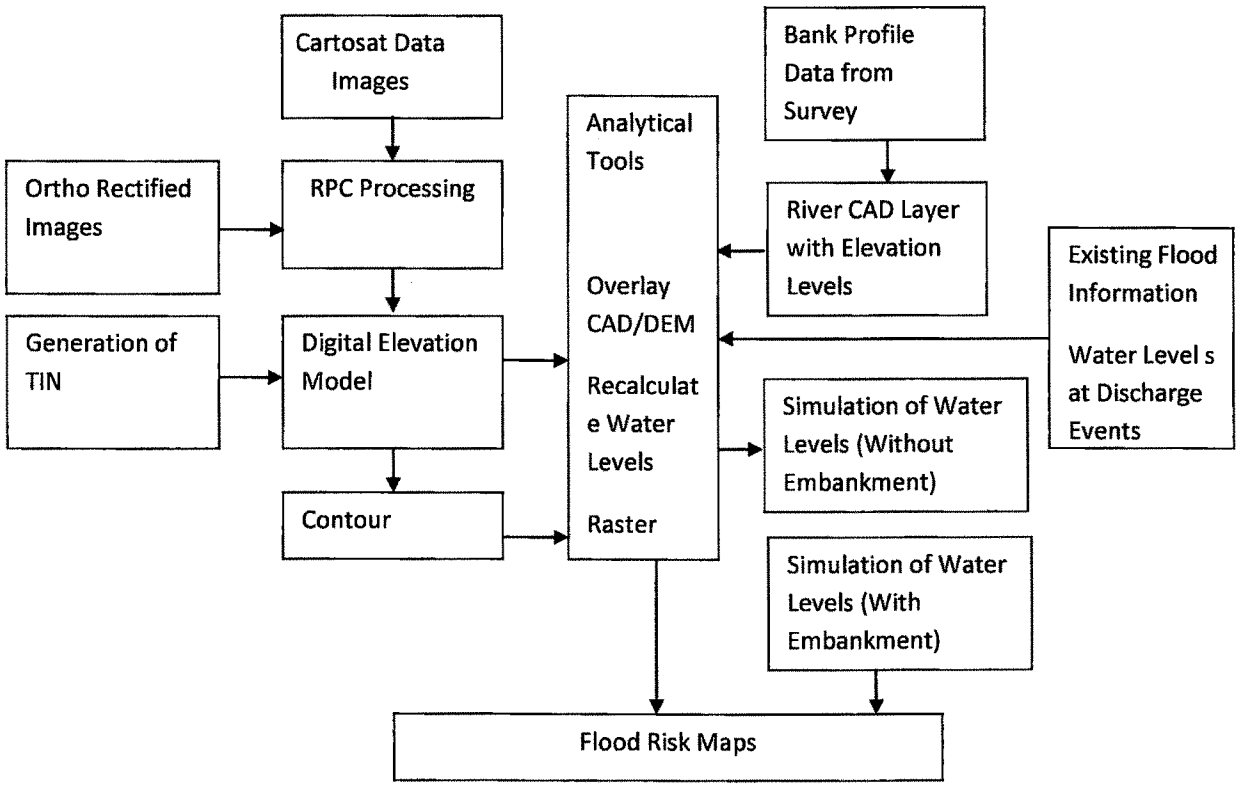
Note: Actual contour elevation at the micro levels cannot be shared due to restrictive data usage.

Image.6.1 Orthorectified Image output from Stereo Data of Cartosat-I

The safe carrying capacity of the Tapi River is significantly reduced due to encroachment in flood plain area, silting in the river bed, and afflux created by Singanpur weir constructed on the river very close to Surat city. With the help of the software developed in Microsoft Excel, it is assessed that the river at Surat can now carry only up to 5663 m^3/s without causing significant damages. The dam generated for Surat city at 0.5 m contour interval, gives idea about the reduced level of each zone and the flood hazard map shows the possible submergence area when water level rise to 7.5 m at hope Bridge.

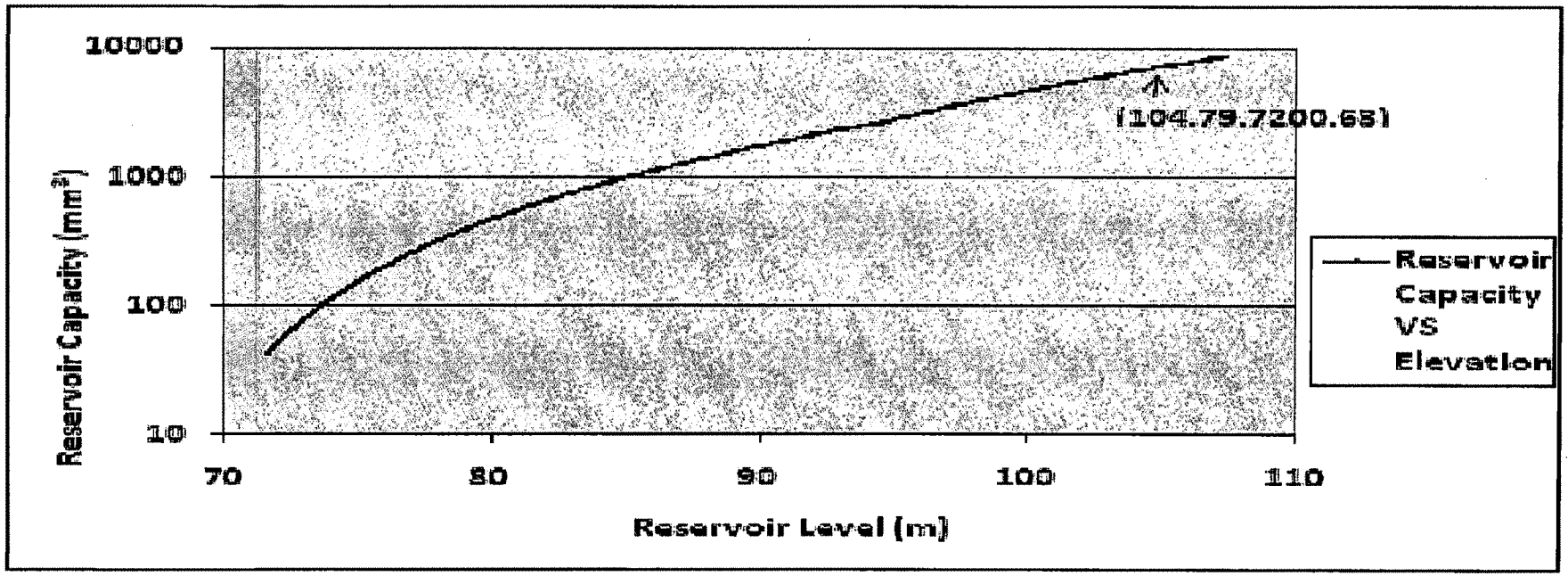
Methodology for preparation of flood risk map is shown below in form of flow diagram.

Flow Diagram

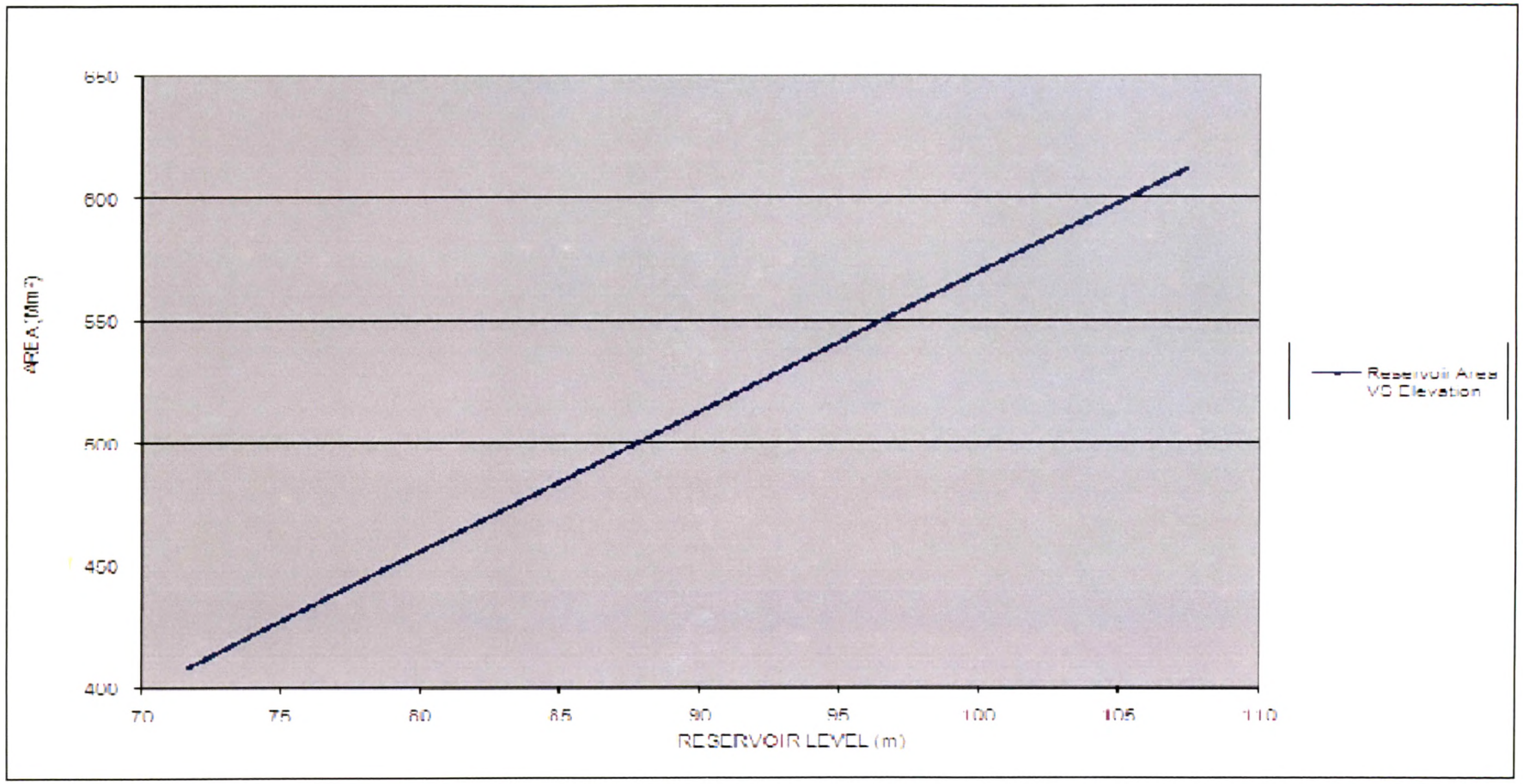


6.4 Analysis for Simulation Model

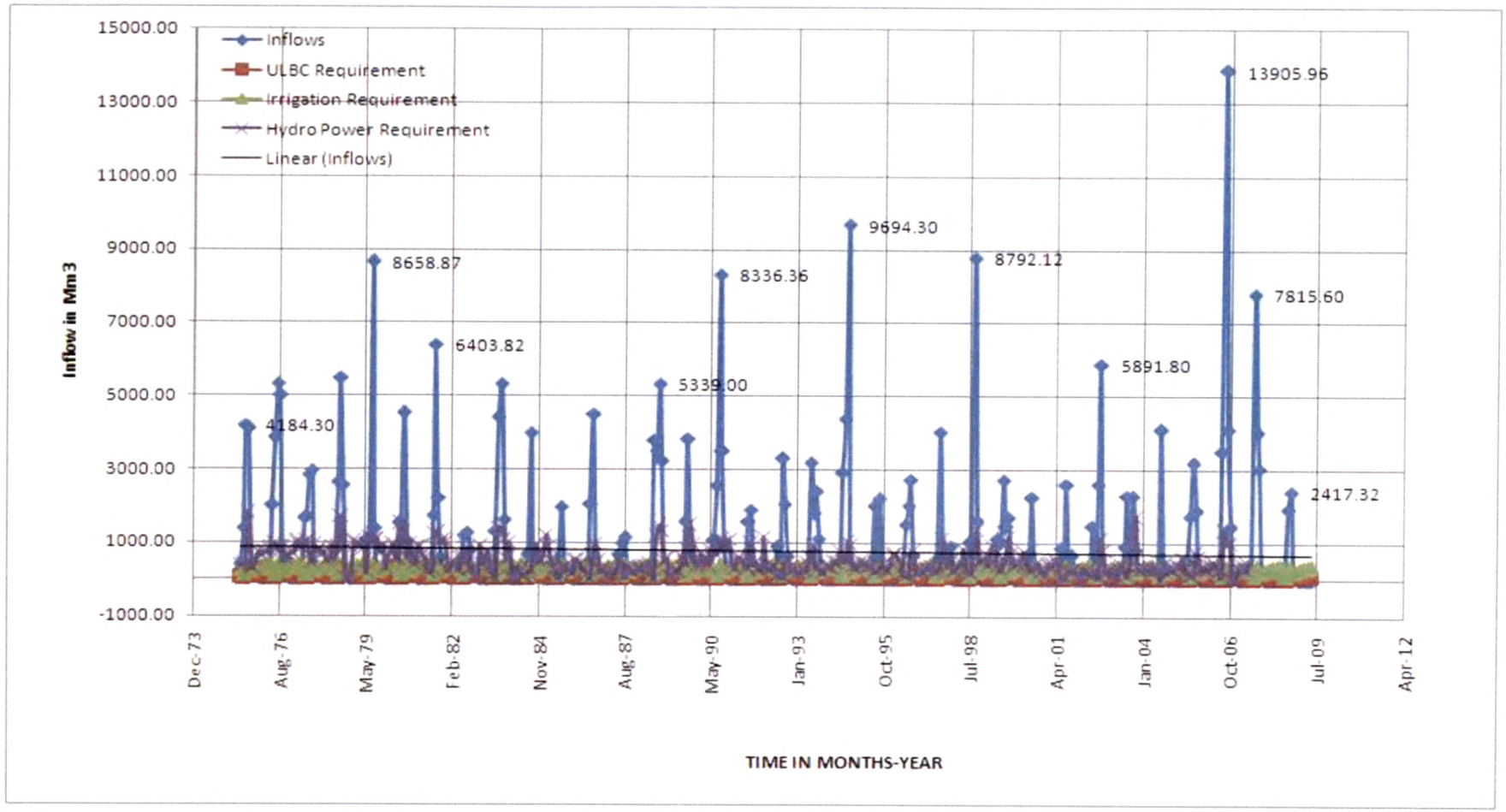
Analysis of simulation model for reservoir operation shown in Graph.No.6.1 to 6.4. This comparison clearly indicates that rule level kept very high for July month as per existing reservoir operation policy even though all demand satisfied, while in suggested rule level on monthly basis shows space for quantum of flood absorption in mm. Graph.No.6.1 shows reservoir capacity v/s elevation chart, Graph.No.6.2 shows reservoir area vs. elevation chart, Graph. No.6.3 shows inflow v/s time, Graph. No.6.4 shows suggested rule levels for Ukai reservoir operation.



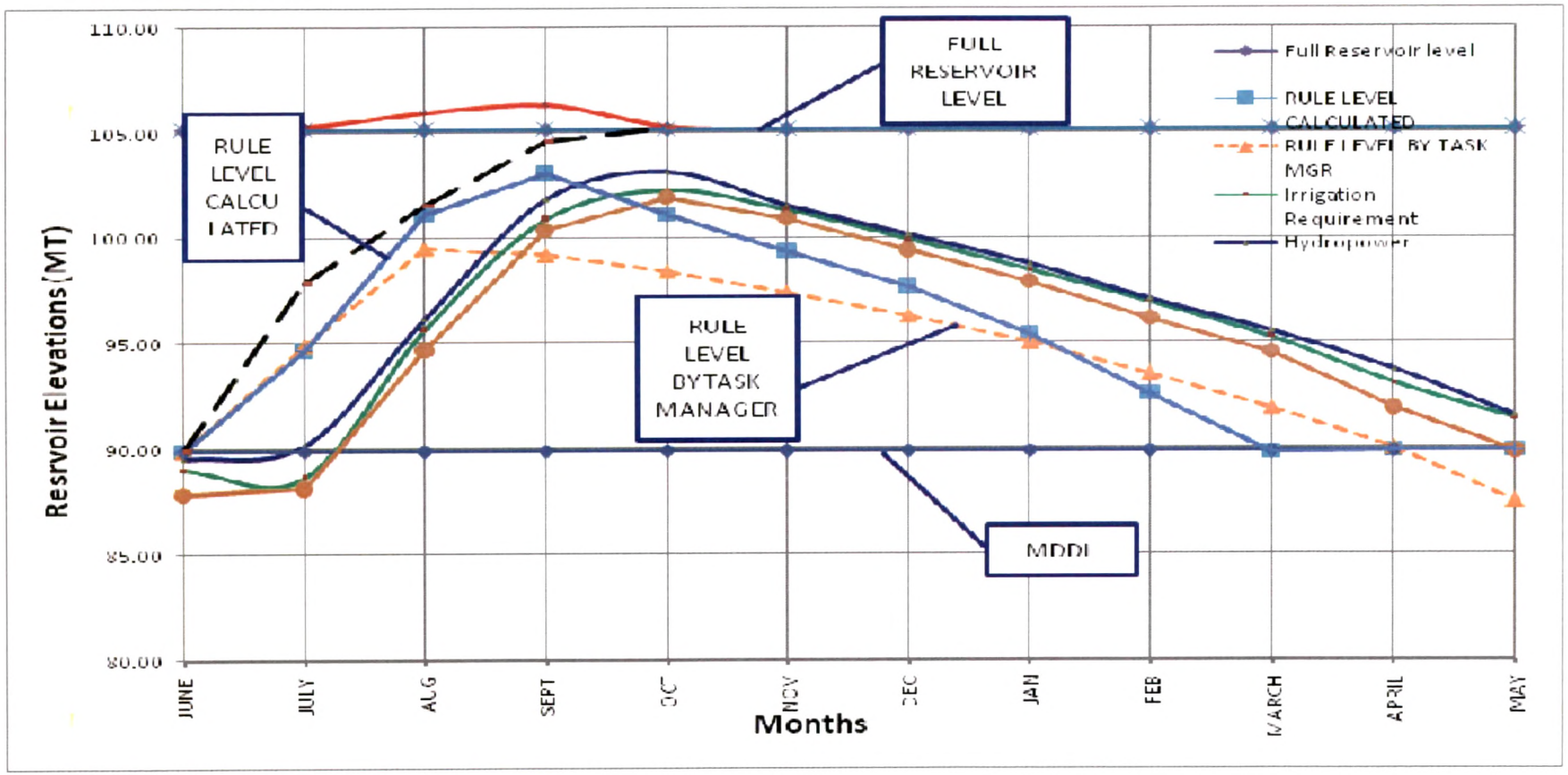
Graph.6.1 Reservoir Capacity Vs Elevation Chart



Graph.6.2 Reservoir Area vs. Elevation Chart



Graph.6.3 Inflow v/s Time



Graph.6.4 Suggested Rule Levels for Ukai Reservoir Operation

6.5 Analysis for Forecast Based Reservoir Operation (FBRO)

The interlinked computers in this system shall convert the raw data into desired forms, store data for later use and communicate with other computers in networks. Such custom designed computer system will make the officers free from filling different forms like N, H and E indicating normal, high alert and emergency situation based on FBRO indicating threshold value of Ukai dam reservoir level. It describes the emergency warning start and more importantly at the same time, the decision makers will well aware with the latest update. The available information from the different rain gauge, discharge and river gauge stations can be collected through Satellite and should be analyzed properly by experts of the hydrology or by special cell like flood cell at Gandhinagar and forecasted directly to the dam authority at Surat. From available information at D/S of Ukai dam, the dam authority will take decision about the quantum of discharge to be released, keeping the river carrying capacity of river Tapi near Surat, in mind. Under the circumstances, when the water level many cross the danger level of 106.98 m (351 ft), the Ukai dam authority will send the information to flood cell at Gandhinagar about the occurrence of flood and its extremities.

The flood cell at Gandhinagar will convey the information to collector of Surat, disaster management body of the state and central government for the evacuation/rescue. In the evacuation route, the top priority will be given to the low lying area for shifting people to safer places. To prepare evacuation route, readily available digital elevation model showing reduced level of entire Surat city, shall be used.

6.6 Analysis of Flood Risk Map by Using GIS

6.6.1 Digital Elevation Model (DEM) Generation

A DEM can be represented as a raster (a grid of squares, also known as a height map when representing elevation) or as a vector-based triangular (TIN). The TIN DEM dataset is also referred to as a primary (measured) DEM, whereas the Raster DEM is referred to as a secondary (computed) DEM. The DEM could be acquired through techniques such as photogrammetric, LIDAR, land surveying, etc. DEMs are commonly built by using data collected using remote sensing techniques, but they may also be built from land surveying. DEMs are used often in geographic information systems, and are the most common basis for digitally-produced relief maps.

The Orthorectified images were used to generate the DEM for the Surat City representing the elevation and height variations in various parts of the study area.

Image.6.2 Orthorectified DEM Image Surat City Region

6.6.2 Triangulated Irregular Network (TIN)

A triangulated irregular network (TIN) is a digital data structure used in a geographic information system (GIS) for the representation of a surface. A TIN is a vector-based representation of the physical land surface or sea bottom, made up of irregularly distributed nodes and lines with three-dimensional coordinates (*x*, *y*, and *z*) that are arranged in a network of no overlapping triangles. TINs are often derived from the elevation data of a rasterized digital elevation model (DEM).

Image.6.3 Surat Triangular Irregular Network (TIN)

An advantage of using a TIN over a raster DEM in mapping and analysis is that the points of a TIN are distributed variably based on an algorithm that determines which points are most necessary to an accurate representation of the terrain. Data input is therefore flexible and fewer points need to be stored than in a raster DEM, with regularly distributed points.

6.6.3 Contour Generation

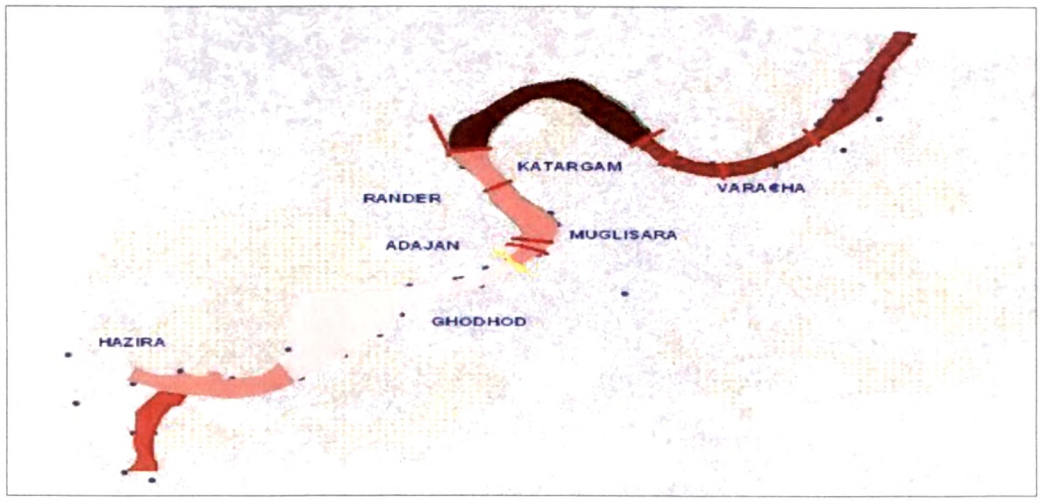


Image.6.4 Contour Generation (Density of Contour)

TIN data was utilized for the generation of the contour maps. The contour of values ranging from 0-294. The density of the contour here indicates the steepness of the study area. The sparse distribution of the contour represents the gentle slope in the Surat city. The bank profiles on the counters are overplayed to generate the flood plain zones along the river and on the city fringes.

6.6.4 Slope

The slope image from the contours indicates the slope levels from gentle to steep in the study areas. The river boundaries and creeks in the study region in visible. The general slope is from North –East to South and South West. The river Tapi flows from the NE to SW direction with sub channels meeting from North-West to East and East to South-West directions. The flow of water channels in the regions can also be visualized and demarcated for the further analysis of the area for flood simulation. The slope map was prepared from SRTM and contour map. 3D analyst tool is then used to convert digitized contours into Triangulated Irregular Network (TIN) model and then to DEM. From this DEM, slope map was generated using this process: Arc GIS-3D Analyst tool-Surface analysis-Slope-Percentage Function. Slopes are classified on the basis of the basis of the guidelines mentioned in Integrated Mission for Sustainable Development (IMSD) document, Department of Space, India, http://www.ncap.res.in/upload_files/workshop/. In the study area, slopes were categorized as: low slope (1-3%), moderate slope (3-8%) and high slope (8-15%). Slope map of the area suggested that

most of the terrain in the North-East was characterized by a higher slope, may be responsible for a higher runoff in this region, while the South and West part of the terrain comes under lower slope category may be responsible for a higher water logging in this area. Most of the moderate slope category can be seen in North side of the area, responsible for intermediate rate of runoff.

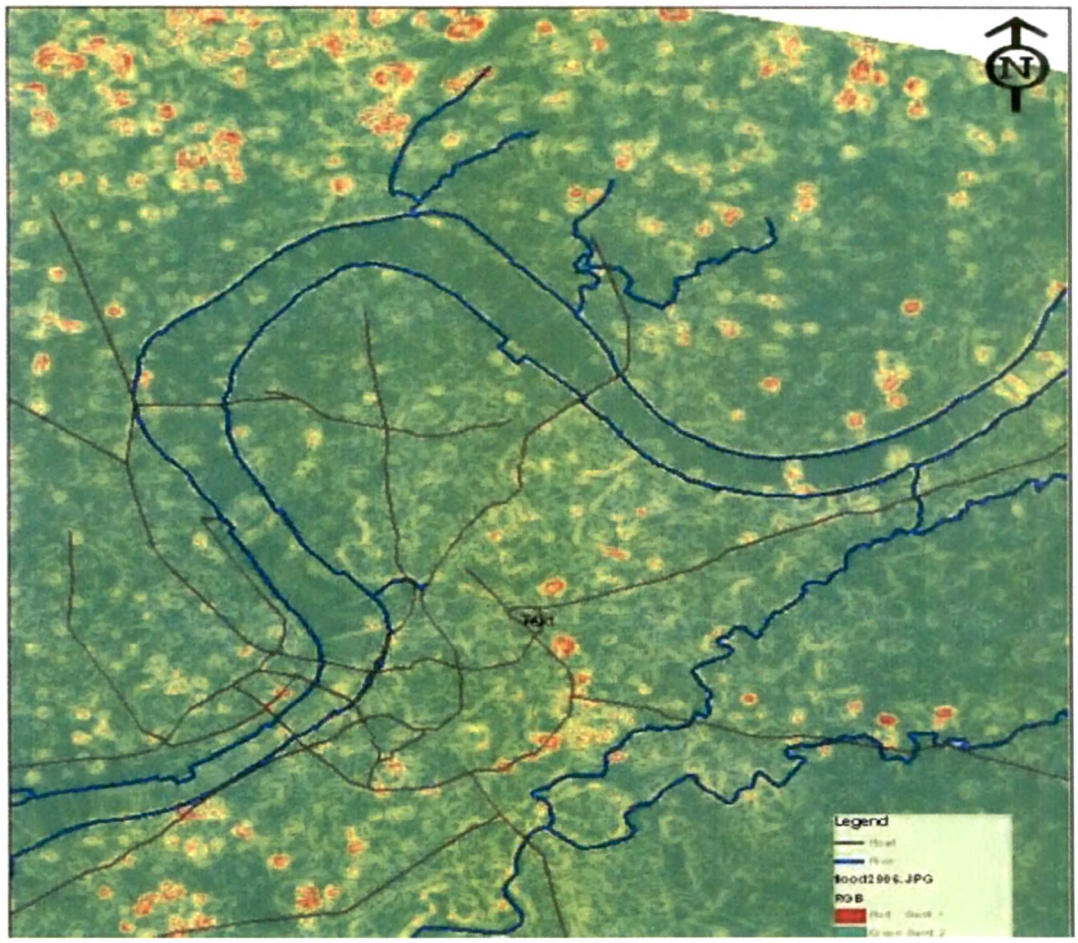


Image.6.5 Surat City Slope Map

6.6.5 Aspect Map

The aspect image in the study area presents the slope directions which helps in predicting the flow direction in case of rainfall. The water with the study area follows a runoff pattern towards South West and majority of segments are sloping towards South and West. The bank profiling using aspect data is overlaid to generate the impact of the embankments (artificial) on the flood retention.

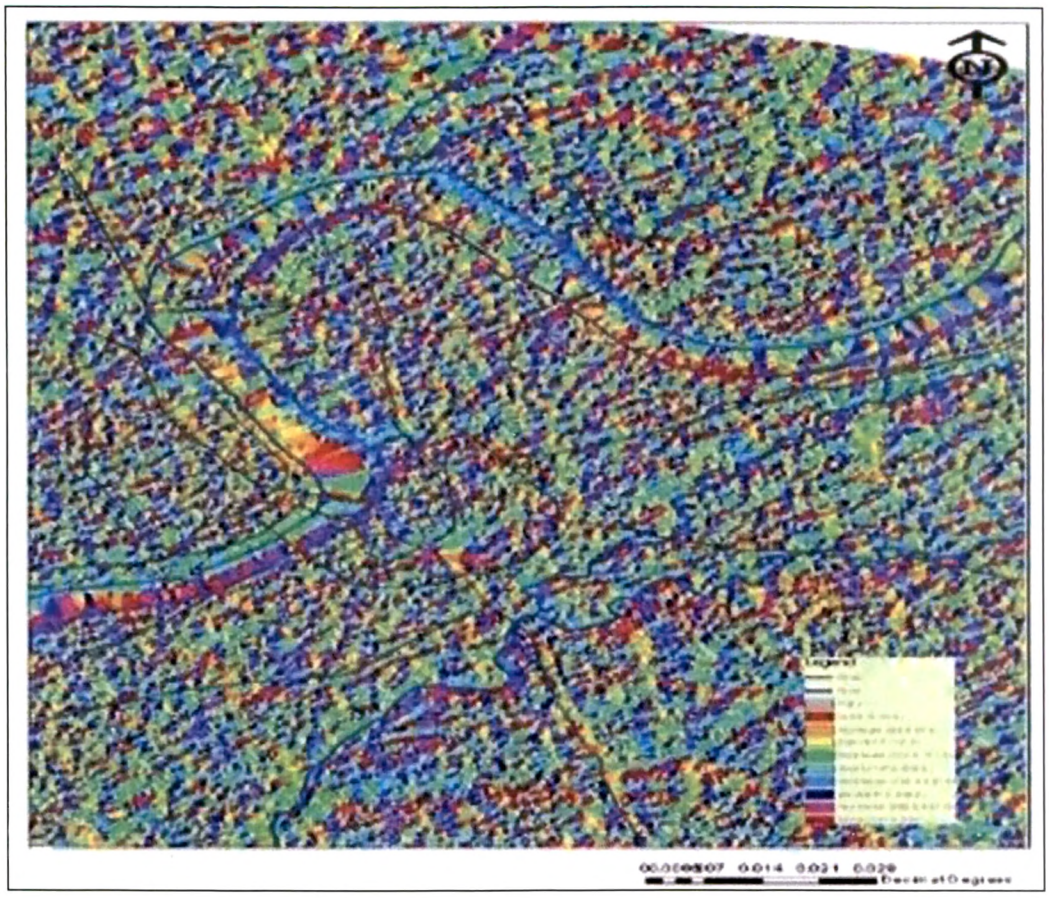


Image.6.6 Surat City Aspect Map

6.6.6 Hydrological Feature Extraction

Open Source Map Window 4.8 (GIS package) software was used to generate the hydrological features extraction based on the Hydrology.

Watershed Delineation

The water sub zone within city can only be estimated by studying the existing watershed. The Surat city falls under the watershed zone (lower Gala Watershed) as demarcated by the Government of India. The present analysis does not attempt to delineate the watershed based on the current Tapi basin characteristics. Very few marginal streams are meeting Tapi with in Surat City. However there are creeks which also act as water detention points within the study area.

The analysis and simulation of flood only takes the sub-channels within the city limit to construct the scenario for the flood overflow within the region.

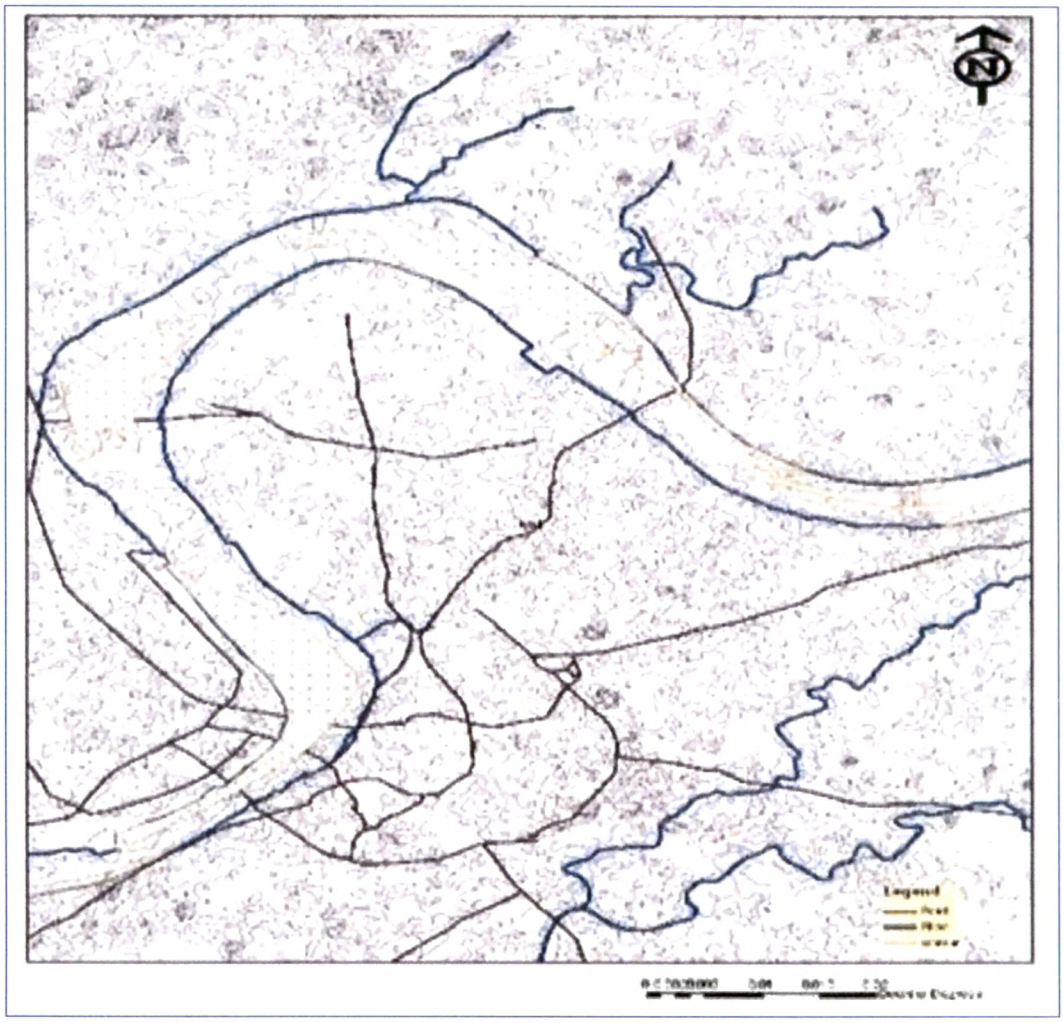


Image.6.7 Contour with Drainage Network

6.6.7 Flood Risk Assessment

The Flood risk assessment study was carried out to understand the impact due to two types of floods. Flood due to Tapi River (releases from Ukai reservoir) discharges ranging from 11,326 to 33,980 cumec (0.4 to 1.2 million cusec). The outputs of the study are presented in the Figures.6.8. The second type of flood is caused by the two streams passing through the city. These floods (also called Khadi floods) are more frequent but cause comparatively less damage.

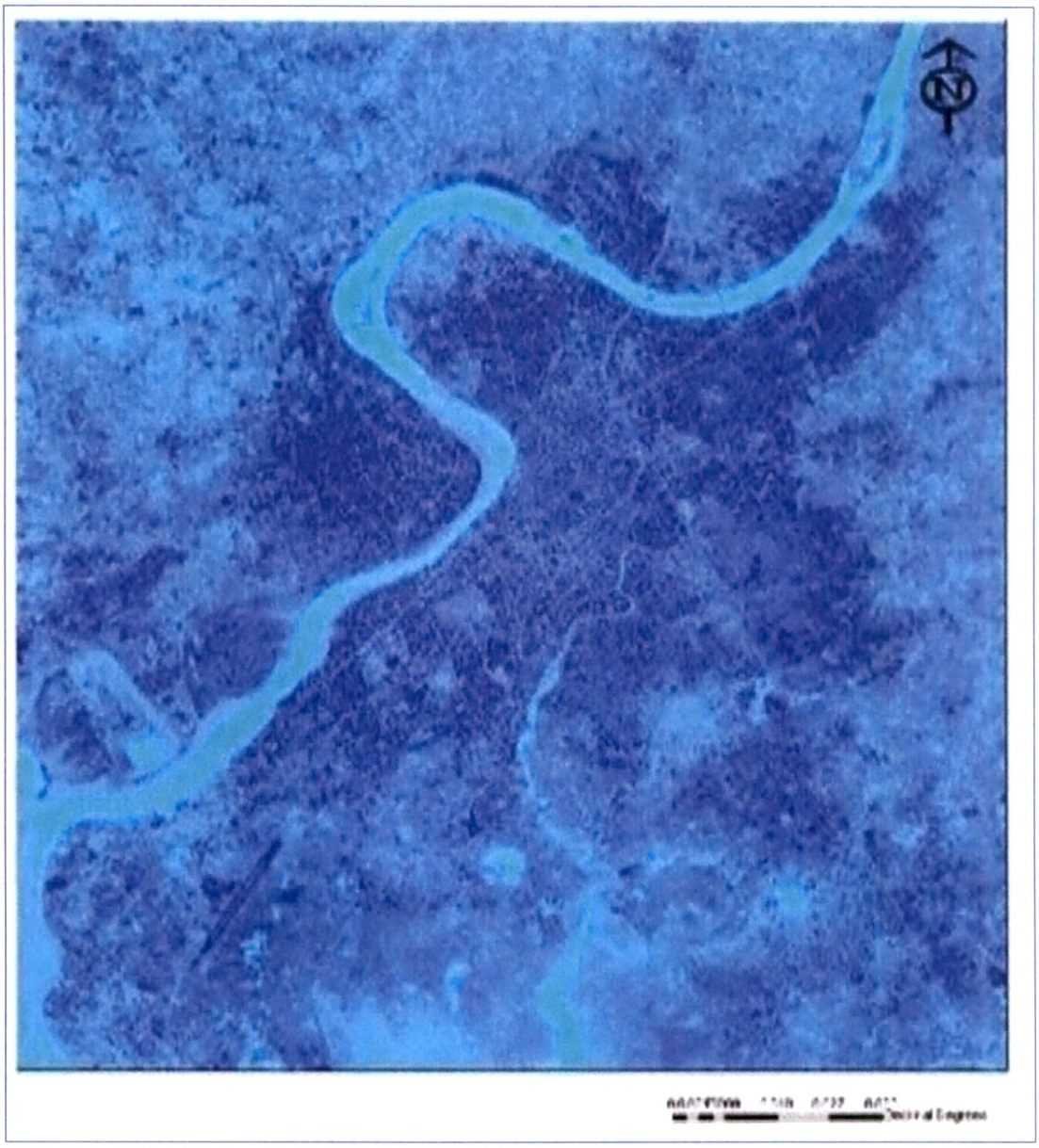


Image.6.8 Low Lying Areas in Study Area

The low lying map of the Surat is extracted from using the contour and built-up information. The image shows the probable areas having risk of water logging in case of excess discharge in the river Tapi. The bank profile data was used to generate the similar images and later vectorised to generate the flood risk maps.

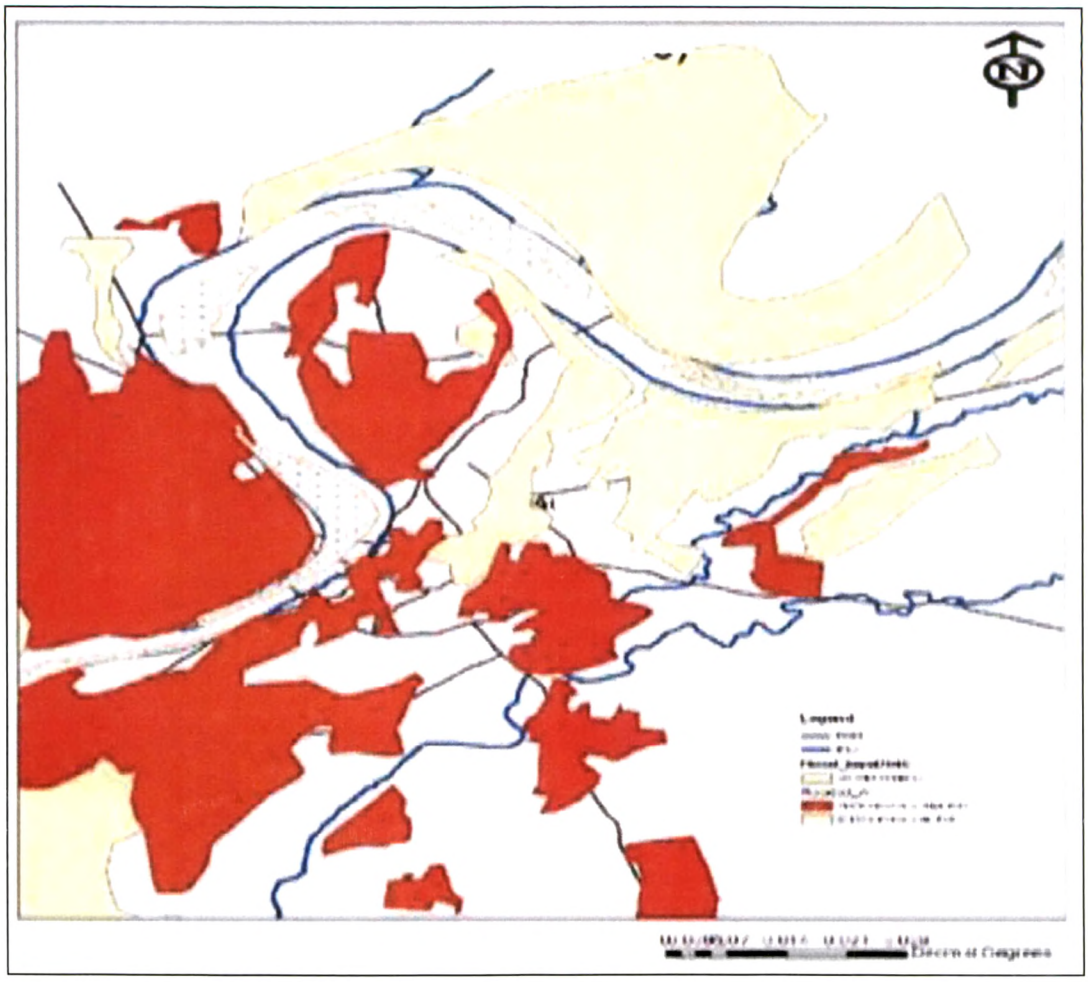


Image.6.9 Flooding in Surat (2006): Actual Zones

Surat City (2006): The map depicts the flood areas within the Surat city based on the data gathered by the Surat Municipal Corporation. Actual data of the submergence areas are shows (in red and yellow) spatial spread of flood water. The regions closer to the river banks have high intensity of the flooding. The areas in the south and South –west shows greater accumulation of water. The water flooded the city areas mainly due to conditions and encroachments on the river bed by the human settlements. The spill over as understand from the analysis (flow from Ukai) is due to mismanagement of the flood water. The section deals more closely on the likely change that has happened over last forty year in the flood management.

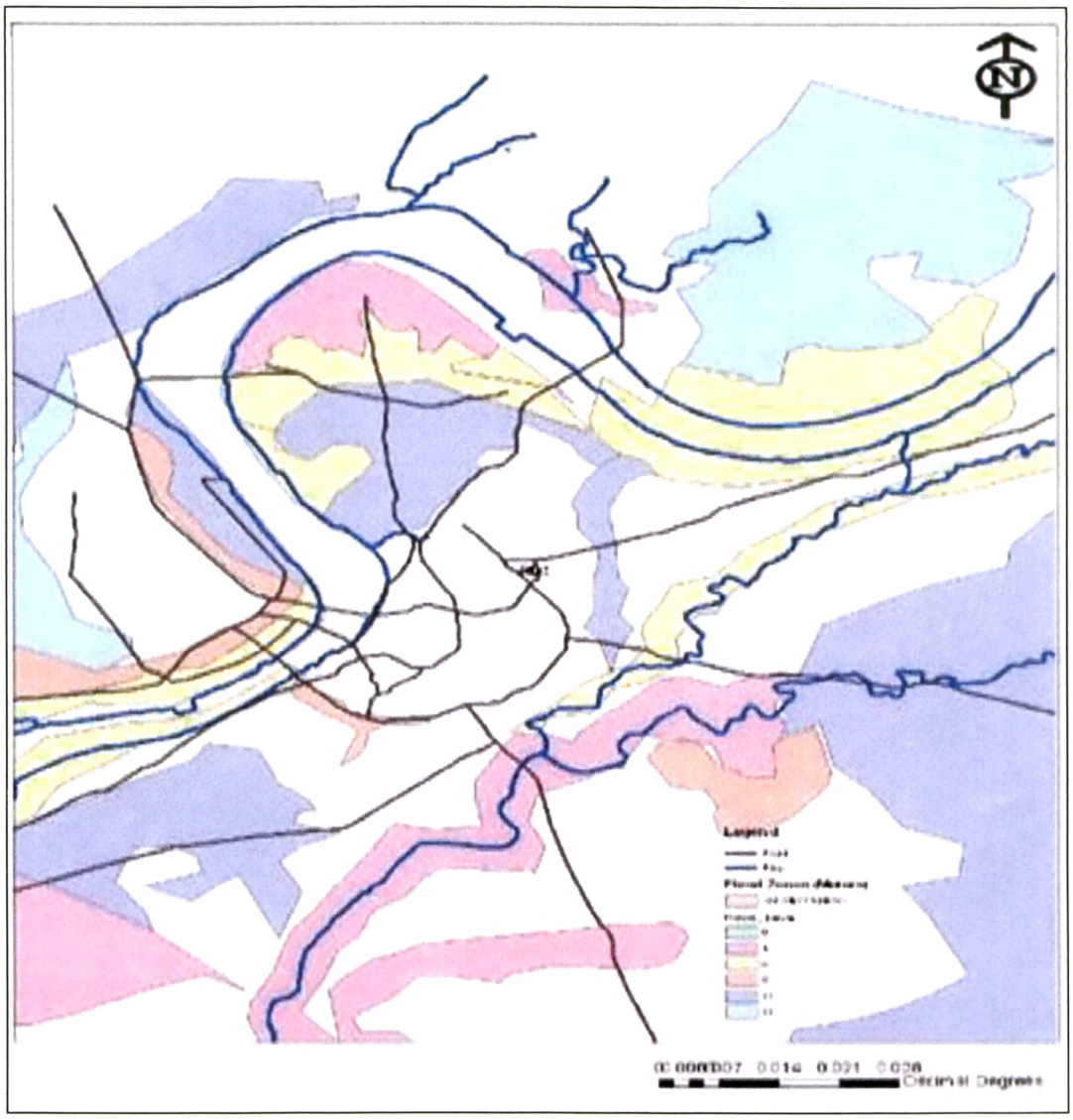


Image.6.10 Simulated Flood (Without Embankment), 2012

6.6.8 Impact on High Density areas

Any increase in the spillover due to discharge from the Ukai dam above 1.5 cusecs in going to have impact of flood water in the Surat city. The scenario generated from the overlay method gives the result of water logging closer to the high density areas. Source: Cartosat, 2012, Processed in MicroDEM 1, O, Image Statistics.

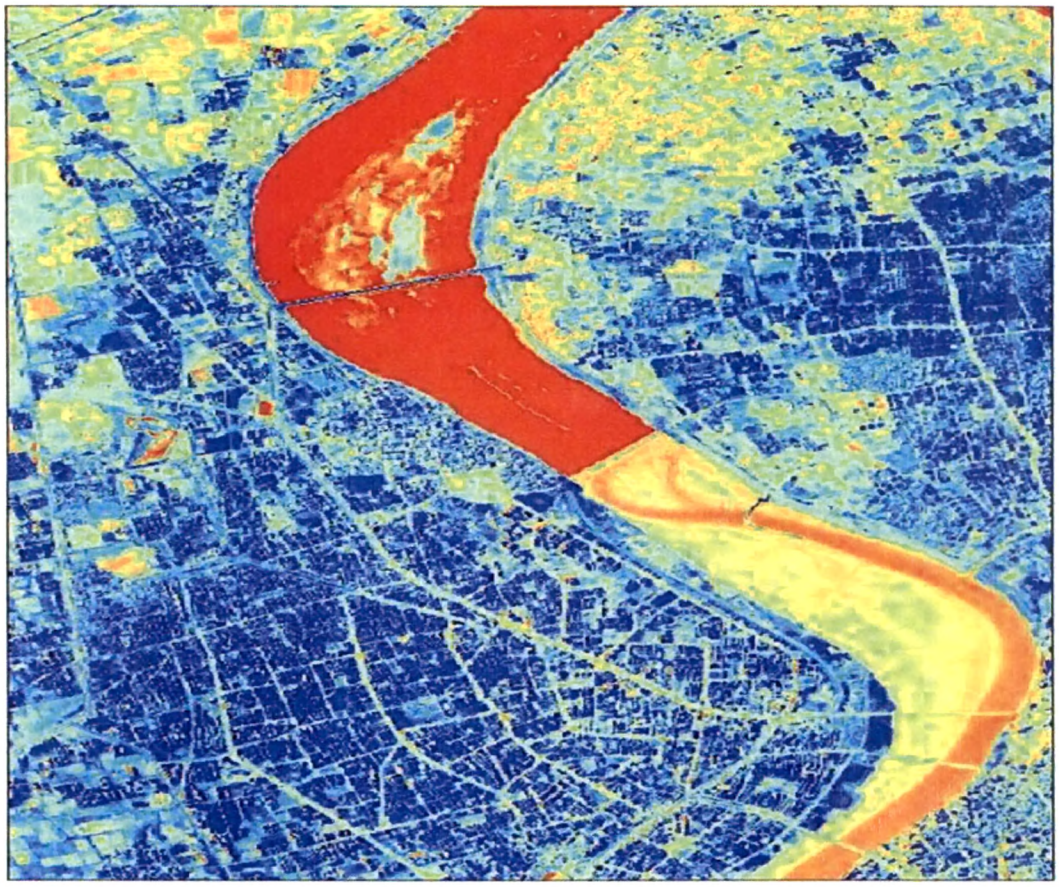


Image.6.11 Flooding Scenario with Built-Open Relationships

(Red –Orange River Water Levels and Light blue low areas often water accumulation areas)

6.6.9 Impact on Katargam

The Katargam areas were worst hit during the previous floods. The river along the area used to spread water during the flood in more than 10 sq.km area. With the construction of the embankment there less chances of spread of flood water in the immediate and moderate scenario. However, the spread of the flood plain in vast in the region and any excess flood scenario, the region may experience large area under flood water. The levels observed in the Weir and Nehru Bridge might be sustained up to 5 cusec of the water discharge but this may also create trouble in the areas to the South and South West region of the city.

Image.6.12 Image of Katargam – Surat

6.6.10 Impact on Adajan

The urban development along the Adajan, Adajan-Hazira area would be more suffering even during the normal flood event of 1.2 to 3.0 cusec discharge in the river. The residential areas and some commercial areas along the main road in going to be affected. The construction of fly over's on this road might reduce the damage to the road but still the water is going to spread over in the residential areas.

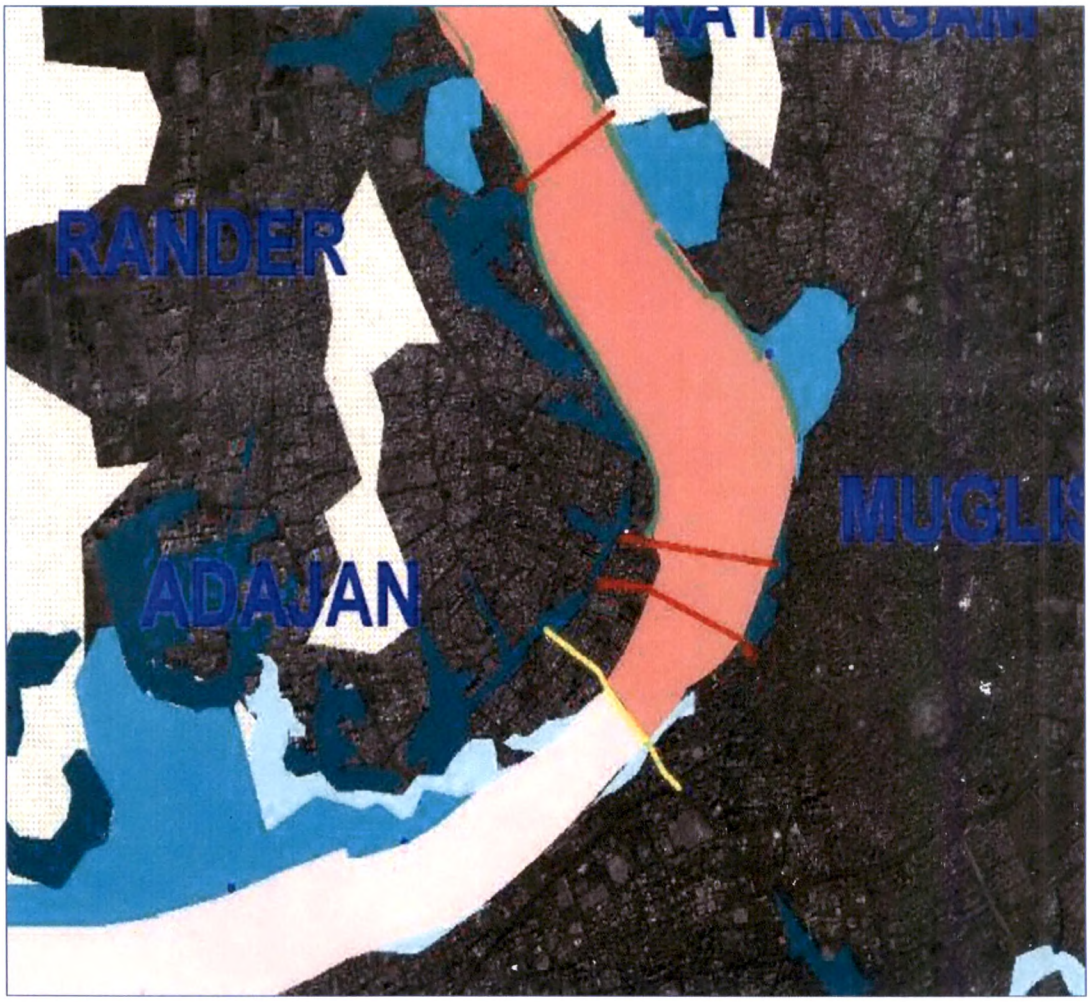


Image.6.13 Image of Adajan Region – Surat

6.6.11 Impact on Hazira

The flood levels in the Hazira region has increased due to high intensity development of industries and there is initial assessment of blockage and obstruction to the water flow through creeks and main water channels. The mouth of river has also seen loss of mangroves and other vegetation levels. The spread of water within the Hazira region has increased in moderate to High flooding scenario (i.e. 3.5 to 7.0 cusec discharge in river). The levels of water reach between 6-10 feet within moderate to high scenario at the sample point.

Image.6.14 Flood Levels at Hazira

6.6.12 Impact on Urban Development

The flooding in the Tapi river plain has increased during the last two instance i.e. 1998 and 2006 due to encroachment on the flood plain. The above figure shows the plot boundaries market in the river island mostly formed due to sediment deposits on the river bed. The channel on the west of the island is being blocked due to major development in the region. The human settlements extending to the island, there are needed to restrict the development on this island. No human activity apart from agriculture should be allowed which would detrimental to future floods in the city.

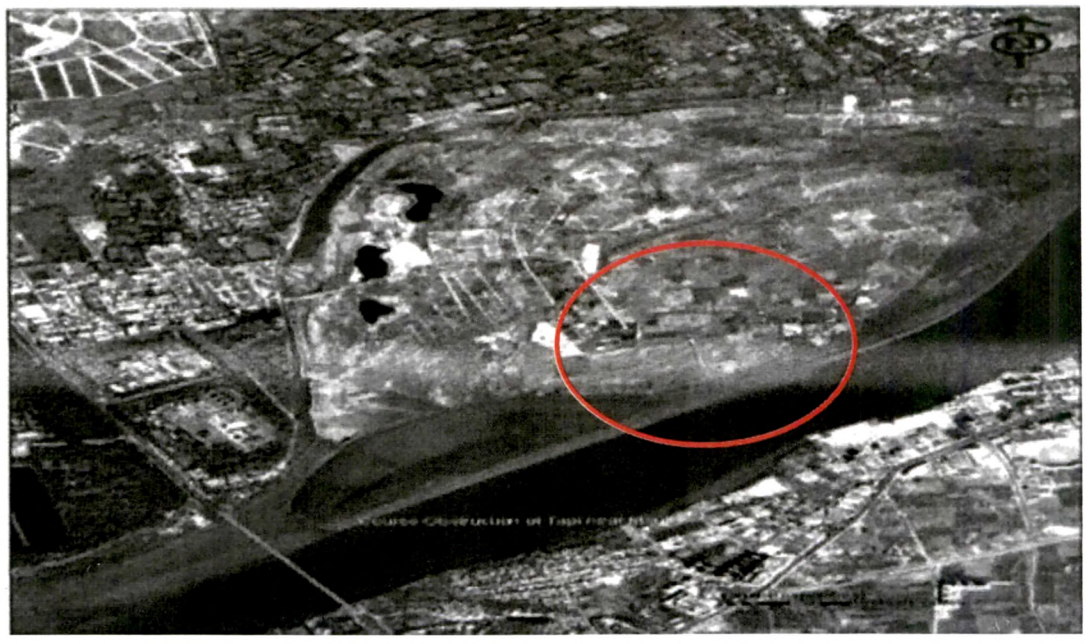


Image.6.15 Construction sites Causes Obstruction at Tapi - Surat

Image.6.16 Tapi at Surat Encroachment on River Island near Confluence with Sea

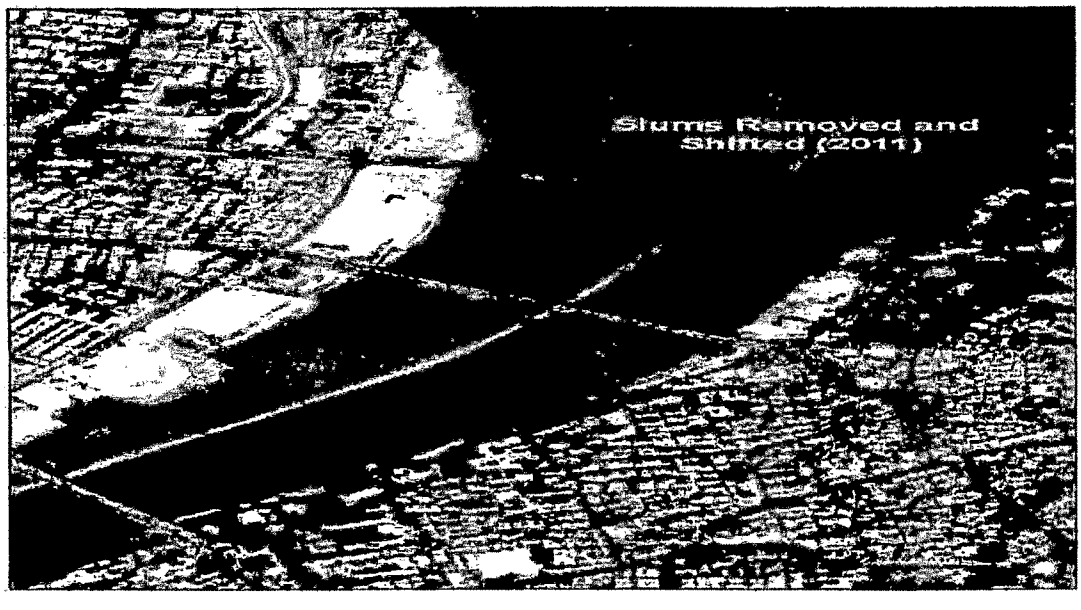


Image.6.17 Tapi at Surat Slums Removed from Flood Zones

Surat Municipal Corporation during 2010-2011 removed the slums located on the fringe and bank of river Tapi, to reduce the loss of life and property. However, there is poor management of settlements which are permanent in nature south of Sardar Bridge, which may also face further loss of property during the flood levels similar to in year 2006. The construction activities at the mouth of river near Hazira where industrial activities might also obstruct the course of river by deposition and blockage of the creeks located in the region.

It is therefore desirable to reduce the loss of property by not allowing any construction within 30 meters of the river bank and on the flood plains. Very sections on the eastern bank can be protected due to its bank height. The old city can be better protected by installing proper functioning drainage system with gates (automated) to function during the excess flow of water in the river Tapi.

6.6.13 Development of River Front

The SMC has also initiated the development river front with some public infrastructure, though design should be considering likely velocity water and erosion of the banks which might lead to loss of properties. Minimum construction up to 10% of the total area can be allotted to public facilities. The construction of roads should be for limited traffic. No thorough fare should be planned on the

flood plains, and early warning systems should be developed to restrict and divert the incoming traffic in case of disaster.

6.6.14 Flood Risk Assessment: A Methodological Framework

The concepts of hazard, vulnerability and risk have been extensively used in various disciplines with a different meaning, impeding cross-disciplinary cooperation for facing hazardous events. The methodology aims to assist water managers and stakeholders in devising rational flood protecting strategies.

In addition to economic and social damage, floods can have severe consequences, where cultural sites of significant archeological value are inundated or where protected wetland areas are destroyed. Regarding floods in Europe, two trends point to an increased flood risk and to greater economic damage from floods. First, the scale and frequency of floods are likely to increase in the future as a result of climate change, inappropriate river management and infrastructure development in flood risk areas. Second, an increase in vulnerability has been noted due to the number of people and economic assets located in flood risk zones. Therefore, the coming decades are likely to see a higher flood risk in Europe and greater economic damage.

On 18th of January 2006 the European Commission proposed a Directive on the assessment and management of floods (COM, 2006). Its aim is to manage and ultimately to reduce the risks that floods pose to human health, environment, infrastructure and property. Under the proposed Directive, the Member States are obliged to deliver the following for river basins and sub-basins:

- Preliminary flood risk assessment
- Flood risk maps
- Flood risk management plans

The provision of structural measures on flood can have a major impact on the environment and there has been an expression of concern by many members of the public for the degradation of river corridors. Therefore, it is becoming common practice for central and local government to subject flood management plans to public discussion (COM, 2006).

It is obvious from the above that concepts such as hazard, risk and vulnerability are the most commonly used terms to describe the potential threats that natural disasters pose to human life, the environment and the infrastructure. Additionally, these terms are used to question the capacity of various structural and non-structural measures, which are applied for protection from these threats. In the absence of regulatory establishment of a common accepted terminology platform, the confusion on the context of these terms grows. Furthermore quantification of the terms is not an easy task. It is possible that some parameters affecting the above concepts are beyond quantification and also that these parameters vary in space and time. To clarify these concepts and to highlight a methodology for the assessment of flood hazard and flood risk. Particular attention is also given to the concept of vulnerability with regards to its social nature and the factors on which it depends.

6.6.15 Discussion

Though the Surat Municipal Corporation constructed series of the embankment on the river banks the feasibility of its success was not tested. The present exercise also documented two scenarios (a) without embankment and (b) with Embankment along with various discharge scenarios from Ukai.

6.6.16 Without Embankment

The peak discharge of 7 cusec water from the reservoir was tabulated with water levels at various locations along the river. The bank overflow data was supplied along with the height of bank, flow in the river, depth of existing water and spill point. These data resulted in the calculation of spill over areas at different levels at the designated points.

6.6.17 With Embankment

During period 2006-2012, the Surat Municipal Corporation has strengthened the embankments by constructing protection walls. Since the varied length and structures are available along the river bank there is likely chance of having different impact on the spillover scenario.

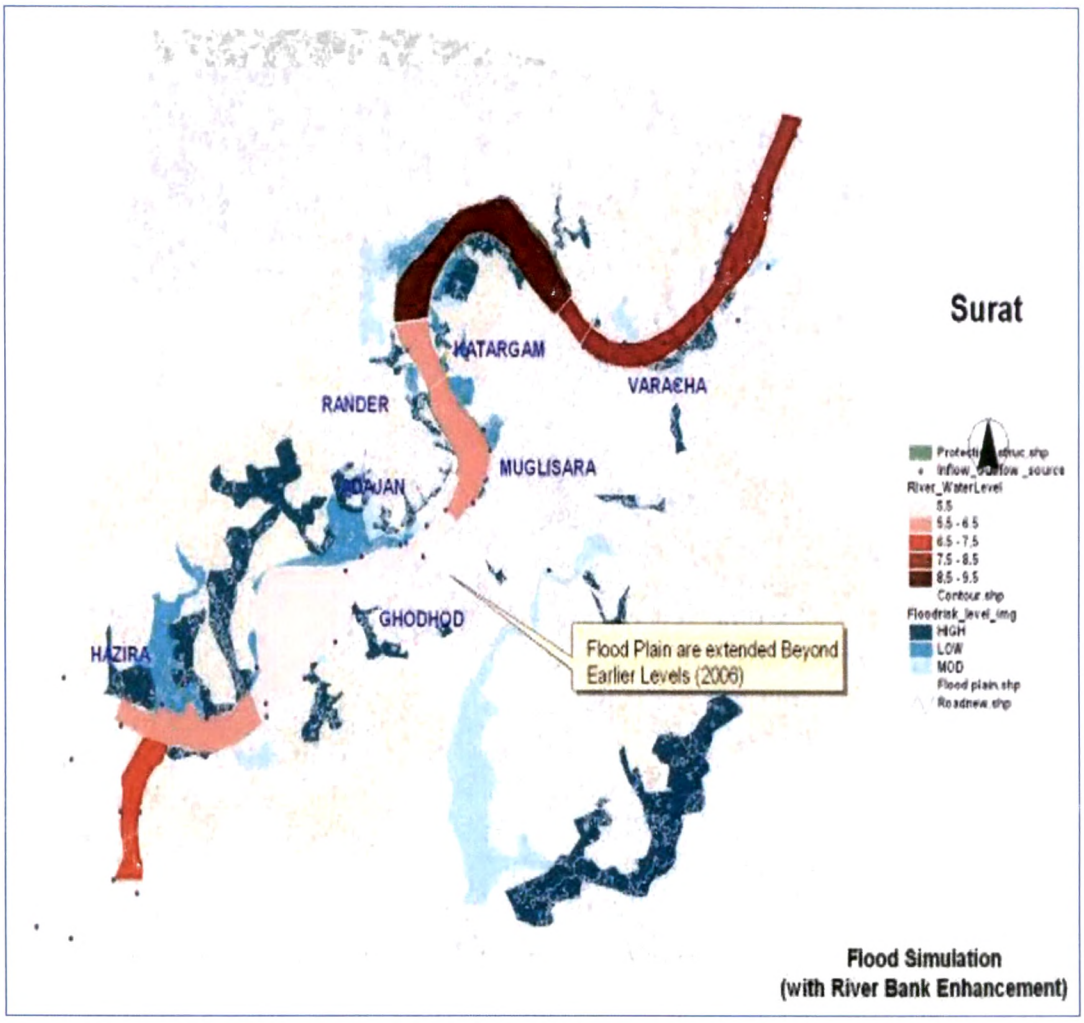


Image.6.18 Water Levels during Flood (with Embankment or Protective Structure)

Three scenarios with water discharge between (a) 3401.36 to 7086.17 Cumecs (1.2 to 2.5 Lacs Cusecs) (Low) (b) 9070.29 to 14172.33 Cumecs (3.2 to 5.0 Cusecs) (Medium) and (c) 15589.56 to 19841.26 Cumecs (5.5 to 7.0 Cusecs) (High). The river bank profile data from the survey was overlaid on the embankment levels and water levels assumed at various sections with the river. Data was simulated for 10 section points divided into the sections in river. The table on the estimated levels at locations from Digital Elevation Model (DEM) was estimated after simulation of the flood levels using the overlay analysis techniques in GIS shown in below Table.No.6.3.

Table.6.3 Estimated Levels at Locations in Study Area

ID	River Section	WL_NORMAL	Water Levels at Discharge (including Bank Height)*			
			FE_2_5	FE 3_2	FE5	FE_7
1	NH 8 Bridge	6.00	8.50	9.20	11.00	13.00
2	Railway Bridge	6.00	8.50	9.20	11.00	13.00
3	Kosad Bridge	7.00	9.50	10.20	12.00	14.00
4	Wier	4.00	6.50	7.20	9.00	11.00
5	Nehru Bridge	4.00	6.50	7.20	9.00	11.00
7	Low Level	3.00	5.50	6.20	8.00	10.00
8	Sardar Bridge	3.00	5.50	6.20	8.00	10.00
9	ONGC Bridge	4.00	6.50	7.20	9.00	11.00
10	Hazira Point	5.00	7.50	8.20	10.00	12.00

*Data Estimated from the Digital Elevation Model Image and Discharge Simulation Results, FE=Flood Discharge Elevation

The above results are being validated with the actual data of the water levels in the last floods and probability if such occurrences cannot be ruled out.

6.6.18 Validation of Flood hazard mapping using RS and GIS

Based on the contour levels supplied by SMC, a digital elevation model (DEM) for the west zone was developed. After combining the DEM with river bank levels, a flood risk map for various water-level scenarios at 0.5 m intervals was prepared. The sample flood mapping potential areas for the west zone have been demarcated. The possible areas under each water level height are depicted with different colors in the flood hazard map. After generating the flood risk map, the water levels of the 2006 flood were compared with Hope (Nehru) Bridge. It was found that Hope Bridge has a bank level of 4.1 m; therefore there will be about 3–4 m water over the right-bank area. Hence, the major parts of the Adajan area will be submerged. Rander area will also be submerged by 1–2 m depth of water, as was experienced during the August 2006 flood. This shows the accuracy of our hydraulic and GIS model for flood risk mapping.

Reliability calculations have been used to validate the models. The model results have been compared depth of flood 2006 at Nehru Bridge and various other location of Surat city which is obtained from official report of CWC & SMC. Table.No.6.4 shows Flood Depth Comparison for Flood 2006 and its flood effect shown in Plate.No.6.2.

Table.6.4 Flood Depth Comparison for Flood 2006

Sr. No.	Point Name	Actual water depth during flood 2006 in m.	Water depth computed by GIS and RS in m.
1	Shyamdham Society	2.89	3.10
2	Rameshvar Industries	5.80	6.00
3	Dabholi Road	3.15	3.35
4	Diomond Park	5.70	6.10
5	Bust stand	3.60	3.86
6	Shigma School Kadarsaninal	4.72	5.10
7	Khoja Masjid	2.13	2.23
8	S. T. Compound Wall Nr. Gat	1.20	1.30

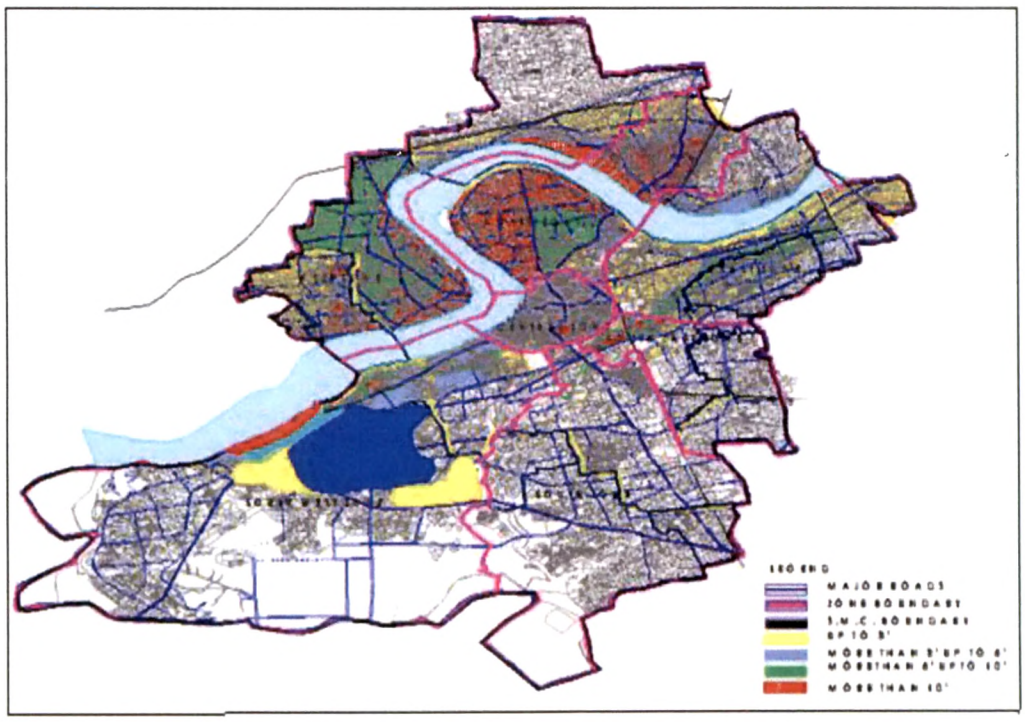


Plate.6.2 Effect of flood water level

Results obtained from above study reflected in Plate.No.6.3 for TIN (DEM) of whole Surat City. The graph of submerge area versus water level of different zone is shown in Graph.No.6.5.

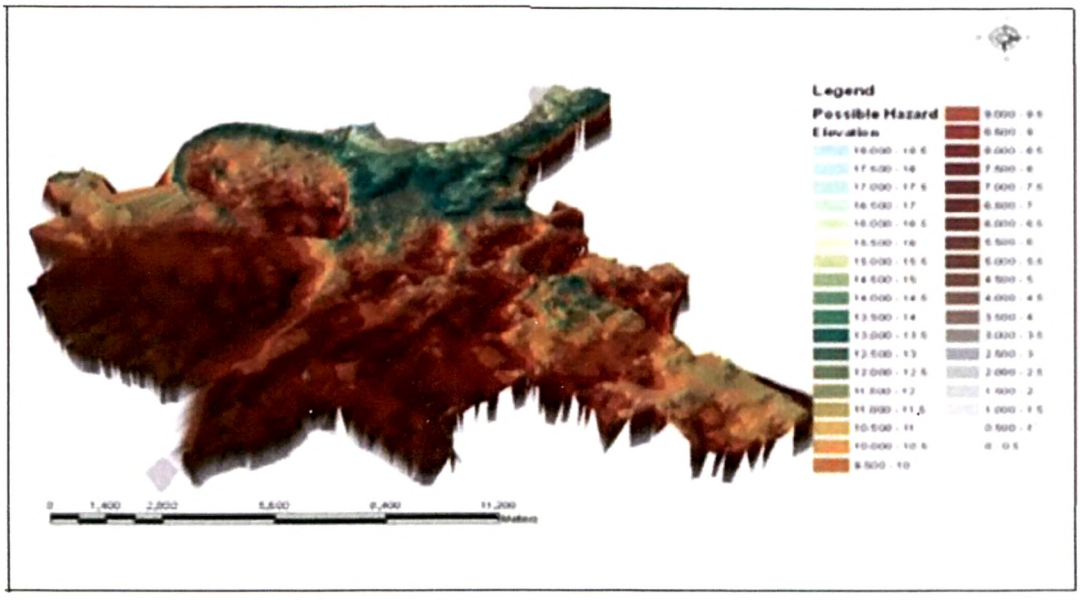
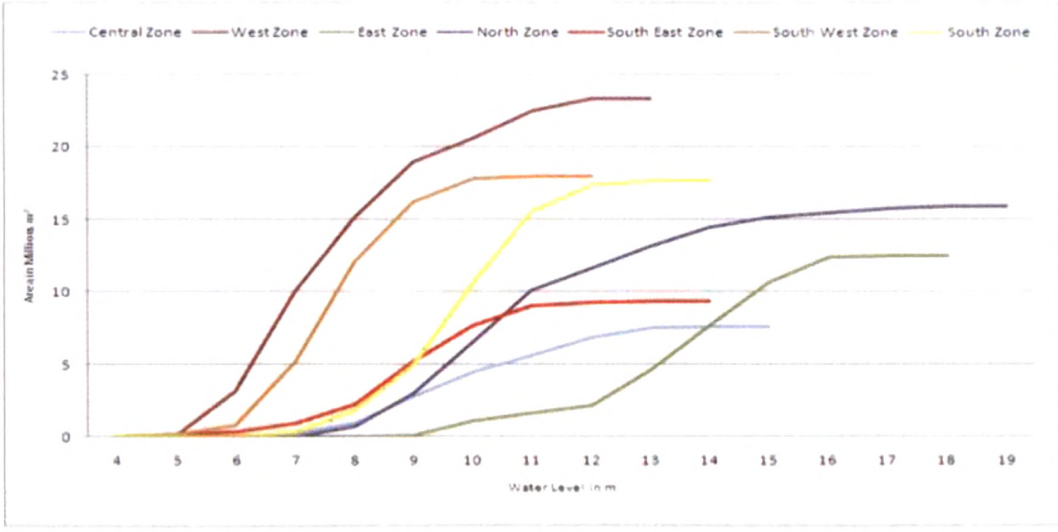


Plate.6.3 TIN (DEM) of Surat City



Graph.6.5 Different zones of Surat city submerged in water