7-3 TRAINING PLAN IN SRI LANKA

DISPATCH OF TRAINING EXPERTS

Dispatching of experts for the following technology transfer is proposed.

a. Water Quality Analysis and Treatment Theory

To comprehend the theory and unit process operation of the water treatment facilities and to be able to relate water quality with aeration, coagulation, flocculation sedimentation, filtration, and disinfection, the staff may be trained by experts on treatment processes and water quality standards.

b. Operation and Maintenance Standards of Facilities and Equipment

The experts may assist in preparation of the operation and maintenance standards for the plants through the actual training for operation and maintenance of reservoirs/dams, treatment plants, clear water tanks, distribution systems and mechanical/electrical equipment etc.

7-4 TECHNICAL STAFF TRAINING IN JAPAN

Because the impounded water is difficult to treat compared with river water directly supplied, selected technical staff to be assigned at the two plants may have training in Japan including inspection of similar plants with dams and reservoirs.

7-5 WATER SUPPLY SYSTEM OPERATION

According to the water levels recorded at the reservoirs along with the precipitation records, it has been demonstrated that one drought has occurred every ten years. To produce a consistently good quality of water even during low reservoir water level conditions, an optimum combination of chemicals is necessary to be applied with careful dosage adjustments when needed. In the extreme case when the two plants are not able to treat and supply enough water during a prolonged drought, the Ambatale Plant will be called upon to replenish the shortage. Also under these water shortage conditions the cooperation of the consumers will be solicited to conserve water use.

7-6 REVIEW OF THE MASTER PLAN (S.W.C.A.)

The Master Plan upon which this rehabilitation project is based was made in 1972 more than ten years ago. There are some gaps between the plan and current data on population and water supply indicating a need to review and update the Master Plan when this rehabilitation project is being implemented. Optimized operation of these two treatment plants is the basis of the current master plan. Following review, the updated Master Plan would clearly show the role of the rehabilitated treatment plants at Kalatuwawa and Labugama as well as the multi-staged expansion of the Albatale plant.

APPENDIX

CONTENTS OF APPENDIX

JICA MISSION TEAM MEMBERS

TITLE	NAME OF PROFESSIONAL	ASSIGNMENT
Team Leader	Yoshihiro TAMAI Director Water Supply Service Dept. Osaka City Waterworks Bureau	Water Supply System Engineering
Assistant Leader	Makoto MATSUSHITA Waterworks Division Water Supply and Environment Sanitation Bureau, Ministry of Health and Welfare	Water Supply Facilities Engineering
Coordinator	Junji YOKOKURA Basic Design Division Grant Aid Department Japan International Cooperation Agency (JICA)	Coordination of the Project
Technical Experts	Takeshi UENO Deputy Manager, Overseas Services Department Nihon Suido Consultants Co., Ltd,	Water Treatment Engineering
	Kasutomo HATTA Technical Advisor Overseas Services Department Nihon Suido Consultants Co., Ltd.	Water Treatment, Mechanical System Engineering
	Takashi UEDA Technical Services Department Overseas Services Department Nihon Suido Consultants Co., Ltd.	Water Treatment, Mechanical, Electrical Engineering

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

JICA MISSION FIELD SURVEY PROGRAMME

(MAY 19, 1984 - JUNE 10, 1984)

DATE	ACTIVITY
May 19	- Departure (TKY-BKK) TG 609 10:45
May 20	- Shift (BKK-CMO) TG307 10:30 (BKK)
May 21	- Japanese Embassy; explanation of purpose
	- Department of External Resources, explanation of purpose
	- National Water Supply and Drainage Board (NWSDB); discussion of inception report
May 22	- Investigation of water supply in the city area and urban area of Colombo
	- Investigation of treatment plant and intake at Ambatale
May 23	- NWSDB; investigation of projects
	- Collection of data
	- Courtesy visit to chairman
	- Investigation of Kalatuwawa, Labugama
May 24	- Investigation of Kalatuwawa, Labugama
May 25	- NWSDB : discussion of rehabilitation
May 26	- Team discussion of rehabilitation
May 27	- Holiday
May 28	- NWSDB : discussion of rehabilitation
	- Urban Development Agency; investigation of urban development
May 29	- NWSDB : discussion of rehabilitation
	- Investigation of Kalatuwawa, Labugama
May 30	- NWSDB: discussion of rehabilitation,
	- Minutes of discussion was signed
June 2	- Mr. Tamai, Matsushita left for Bangkok
	- Team discussion of rehabilitation
	- Arrangement of data collected

DATE	ACTIVITY
June 3	- Holiday
June 4	- Mr. Yokokura left for Bangkok
	- NWSDB : investigation of projects
June 5	- NWSDB : investigation of facilities and staff training
	- Ceylon Chamber of Commerce; investigation of materials produced in Sri Lanka
	- Arrangement of data collected
June 6	- NWSDB: investigation of facilities
	- Arrangement of data collected
June 7	- NWSDB : investigation of facilities
	- Ceylon Chamber of Commerce; investigation of materials produced in Sri Lanka
	- Mitsui Construction Company ; investigation of construction work
	- Arrangement of data collected
June 8	- NWSDB : report to chairman
	- Japanese Embassy : report of progress
June 9	- Mr. Ueno, Hatta, Ueda left for Bangkok UL-422, 08:00
June 10	- Shift (BKK-TKY) arrived at Narita

MINUTES OF DISCUSSION
ON
REHABILITATION PROJECT OF TREATMENT PLANTS
AT KALATUWAWA AND LABUGAMA
IN
THE DEMOCRATIC SOCIALIST REPUBLIC OF SRI LANKA

In response to the request made by the Government of the Democratic Socialist Republic of Sri Lanka for the Rehabilitation Project of Treatment Plants at Kalatuwawa and Labugama (hereinafter referred to as "the Project"), the Government of Japan has sent, through the Japan International Cooperation Agency (hereinafter referred to as "JICA") which is an official agency implementing the technical cooperation of the Government of Japan, the team headed Mr. Yoshihiro Tamai, the Director of Water Supply Department, Bureau of Waterworks, Osaka City, to conduct the survey for 21 days from May 20th to June 9th, 1984.

The team carried out a field survey, held a series of discussions and exchanged views with the authorities concerned of the Government of the Democratic Socialist Republic of Sri Lanka.

Both parties have agreed to recommend to their respective Governments and the authorities concerned to examine the result of the survey attached herewith toward the realization of the Project.

31st June, 1984

.....

YOSHIHIRO TAMAI
Head, Japanese Survey Team

.....

N.D. PERIS
CHAIRMAN, NATIONAL WATER
Supply & Drainage Board,
Sri Lanka.

ATTACHEMENT

1. The objective of the Project is to rehabilitate the treatment plants at Kalatuwawa and Labugama in order to ensure the uninterrupted potable water supply from the plants when the water levels of reservoirs are adequate.

2. The Japanese Survey Team will convey the Government of Japan the desire of the Government of the Democratic Socialist Republic of Sri Lanka that the former takes necessary measures to cooperate in implementing the project and bears the cost of the items requested by the latter shown in Annex. I within the scope of Japanese economic cooperation programme in grant form.

3. The Government of the Democratic Socialist Republic of Sri Lanka will take necessary measures listed in Annex II under the condition that the grant aid assistance by the Government of Japan is extended to the Project.

4. Both parties confirmed that the Survey Team explained Japan's grant aid programme and the Sri Lanka side has understood it.

ANNEX. I

The following items are requested by the Government of the Democratic Socialist Republic of Sri Lanka as grant aid assistance.

1. KALATUWAWA

1) Replace :

a. turbine generator (D.C. to A.C.)
b. equipment that are working on D.C. power
c. inlet sluice valve
d. filter media
e. valves belonging to filters
f. lime and alum dosing installation
g. air compressor
h. pumps of waste water recovery system
i. flow meter
j. chlorinator

2) Repair :

a. float operated inlet control gear
b. siphon control units of filters
c. hydraulic control system of filters

3) Modify :

a. aeration
b. dosing and flash mixing
c. flocculation
d. sedimentation
e. electric power receiving

2. LABUGAMA

1) Replace :

a. chemical dosing equipment
b. filter media, valves and strainers of filters
c. chlorinator
d. flow meters

2) Repair :

a. filter rake drive and others

3) Modify :

a. aeration
b. sedimentation
c. pre-chlorination

ANNEX. II

Following arrangements are requested to be taken by the Government of the Democratic Socialist Republic ofSSri Lanka.

1. To secure lots of land necessary for the Project when needed and to clear, fill and level the sites as needed before the start of the works.

2. To provide facilities for distribution line of electricity, water supply and drainage and other incidental facilities to the site.

3. To provide data and information to a Japanese Consultant and a contractor necessary for the detailed engineering services and construction.

4. To ensure prompt unloading, tax exemption, customs clearance, and prompt internal transportation therein of the products purchased under the grant.

5. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in Sri Lanka with respect to the supply of the products and services under the verified contracts.

6. To provide and use properly and effectively the facilities purchased, installed and constructed/rehabilitated under the grant, and to arrange the budget for maintenance and operation.

7. To provide and accord necessary permission, licenses and other authorisation required for the execution of the project.

8. Provision of equipped offices, stock yards, working area, etc. necessary for the construction.

4. Sri Lanka General Economic Information

a. Net Receipts of Foreign Assistance

b. Total and per capita product at Current and Constant prices.

c. Balance of Trade

NET RECEIPTS OF FOREIGN ASSISTANCE

(Rs Millions)

TYPE OF SOURCE	1977	1978	1979	1980	1981	1982
LOANS :	880.7	3,215.3	2,379.4	3,516.0	4,880.1	5,027.7
(a) A.D.B.	88.6	412.1	128.2	50.9	147.7	266.3
(b) I.B.R.D.	-5.8	-7.9	2.9	-21.9	-27.1	-19.2
(c) I.D.A.	120.2	166.4	180.6	359.6	515.9	1,096.1
(d) Canada	4.32	143.7	113.0	365.3	605.6	257.5
(e) People's Republic of China	-135.3	-40.0	-75.7	-142.6	252.6	61.5
(f) U.K.	276.2	-35.4	-2.5	-2.8	-2.6	-
(g) U.S.A.	219.9	524.8	553.1	625.0	486.1	850.3
(h) U.S.S.R.	-11.1	2.2	-14.0	-22.0	-24.5	-23.5
(i) Federal Republic of Germany	28.9	318.6	240.7	117.0	-29.6	-41.7
(j) Yugoslavia	-	-	-	-	-	0.6
(k) Poland	-	-	44.1	67.8	-	41.8
(l) France	-	-22.2	36.6	37.1	307.5	180.0
(m) Japan	83.2	433.2	352.5	258.1	316.5	938.9
(n) India	50.3	130.4	83.5	82.7	-45.5	-10.5
(o) German Democratic Republic	-25.6	-31.3	-33.2	-5.9	-5.3	-4.8
(p) Denmark	-0.1	9.0	1.5	51.5	41.8	0.4
(q) Italy	2.4	-3.4	-	-	-	-2.8
(r) Hungary	0.7	0.1	-1.3	-1.3	-1.3	-1.2
(s) Netherlands	34.7	348.4	188.3	139.1	551.8	161.4
(t) Kuwait	43.6	61.3	25.9	46.4	13.6	-13.9
(u) U.A.E.	-	-	-	0.6	-4.8	-10.2
(v) O.P.E.C.	64.8	16.3	-	22.1	183.6	110.8
(w) I.M.F.	-	789.2	599.3	520.6	8.2	-
(x) Euro Currency	-	-	-	897.5	1,517.7	836.4
(y) Iraq	-	-	-	94.9	-	6.5
(z) Switzerland	-	-	-	-	4.3	-

NET RECEIPTS OF FOREIGN ASSISTANCE (Cont'd)

(Rs Millions)

TYPE OF SOURCE	1977	1978	1979	1980	1981	1982
Grants :	500.5	660.7	1,390.4	2,619.5	2,721.3	3,376.1
(a) Colombo Plan	75.3	128.4	40.2	52.1	-	-
(i) Australia	-	-	-	-	-	-
(ii) Canada	75.3	128.4	40.2	52.1	-	-
(iii) New Zealand	-	-	-	-	-	-
(b) Other	425.2	532.3	1,350.2	2,567.4	2,721.3	3,376.1
(i) United Nations	99.0	19.9	33.8	86.3	27/7	214.6
(ii) People's Republic of China	-	-	1.7	-	-	-
(iii) U.S.A.	0.1	0.1	0.3	4.9	-	3.6
(iv) Federal Republic of Germany	33.0	29.0	8.2	85.8	137.3	13.1
(v) Yugoslavia	20.0	7.2	3.8	-	-	-
(vi) United Kingdom	50.9	66.0	498.1	1,108.3	836.4	1,319.8
(vii) German Democratic Republic	-	-	-	-	-	-
(vii) France	19.5	15.5	-	-	39.7	-
(ix) U.S.S.R.	-	-	40.0	-	-	-
(x) Sweden	109.2	203.1	101.0	599.8	497.2	865.7
(xi) Switzerland	-	-	-	-	-	-
(xii) Italy	-	-	-	-	-	2.1
(xiii) European Economic Community	19.7	32.7	51.4	95.4	294.4	135.3
(xiv) Netherlands	41.0	68.9	42.6	15.9	359.3	157.6

NET RECEIPTS OF FOREIGN ASSISTANCE (Cont'd)

(Rs. Millions)

TYPE OF SOURCE	1977	1978	1979	1980	1981	1982 (1)
(xv) Iraq	-	-	-	-	-	-
(xxi) Algeria	-	-	-	-	-	-
(xvii) Saudi Arabia	-	-	-	-	-	-
(xviii) Kuwait	-	-	-	-	-	
(xix) Republic of Korea	-	0.6	-	-	-	-
(xix) Libya	-	-	-	-	-	-
(xx) Quartar	-	-	-	-	-	-
(xxii) Australia	12.0	25.9	30.6	38.2	79.3	173.4
(xxiii) I.M.F.	-	37.0	74.4	102.8	-	-
(xxiv) Norway	-	5.1	139.3	46.4	174.6	128.2
(xxv) Hong Kong	-	-	-	-	-	-
(xxvi) Japan	-	3.3	230.8	198.2	222.2	206.3
(xxvii) India	-	0.5	-	-	-	-
(xxviii) New Zealand	-	0.2	-	-	0.1	0.1
(xxix) Canada	-	0.6	75.1	22.8	-	143.2
(xxx) Others	20.8	16.7	19.2	163.2	37.6	1.0
(xxxi) Finland	-	-	-	-	15.5	5.2
Total of loans and grants	1,381.2	3,876.0	3,769.8	6,135.5	7,601.5	8,403.8

(1) Provisional

Note : The figures in the above table indicate the actual amount of the loans/grants utilised by Sri Lanka and not the total amount pledged by the donor countries at the time of signing the agreement. Further in the case of commodity Loans/Grants, the total amount utilized is indicated only after the completion of the Programme. Technical assistance in the form of services of experts, scholarships and training facilities are also not included.

TOTAL AND PER CAPITA PRODUCT AT CURRENT AND CONSTANT PRICES

ITEM	1979	1980	1981	1982(1)
G.D.P. at current market prices (Rs. million)	54,910.0	68,337.7	84,526.6	98,268.4
Net factor income from abroad (Rs. million)	-239.5	-431.8	-1,712.4	-1,982.8
G.N.P. at current market prices				
(a) Total (Rs. million)	54,680.5	67,905.9	82,814.2	96,285.6
(b) Per capita (Rupees)	3,779.0	4,608.0	5,525.4	6,318.0
G.N.P. at 1975 constant prices				
(a) Total (Rs. million)	33,304.8	35,138.5	36,300.4	38,506.2
(b) Per capita (Rupees)	2,301.0	2,384.0	2,440.0	2,526.7

(1) Provisional

Note - Figures are according to a revised series of estimates which have been prepared commencing in 1975, and are therefore not strictly comparable with figures perviously published.
The Principal changes in methods in the revised series have been : -

(a) The valuations of components of G.D.P. at producer prices and not as factor cost as done earlier, and
(b) The use of 1975 (instead of the EARLIER 1963) as the base year for computing the constant price estimates.

BALANCE OF TRADE

	Customs Data (1)			Customs Data Adjusted (2)		
	Total Exports (f.o.b.)	Total Imports (c.i.f.)	Balance of Trade	Total Exports (f.o.b.)	Total Imports (c.i.f.)	Balance of Trade
1973	2,617	2,715	- 98	2,629	2,765	- 133
1974	3,472	4,554	- 1,082	3,503	4,770	- 1,267
1975	3,933	5,251	- 1,318	3,968	5,196	- 1,288
1976	4,185	4,689	+ 126	4,840	4,945	- 105
1977	6,638	6,007	+ 631	6,570	6,061	+ 509
1978	13,206	14,663	- 1,457	13,193	14,687	- 1,494
1979	15,273	22,560	- 7,287	15,282	22,560	- 7,278
1980	17,288	33,637	- 16,249	17,630	33,637	- 16,007
1981	20,199	35,530	- 15,331	20,585	35,351	- 14,666
1982	21,124	36,876	- 15,752	21,454	41,946	- 20,492

Source : Customs Returns Dept. of Census and Statistics

(1) Trade data complied from export and import entries. There is a considerable timing between the actual data of export/import and the date on which the entries are passed.

(2) Adjusted for actual imports of Food Commissioner and Petroleum Corporation.

5. Proposed Rural Water Supply and Sanitation Programe

a. Summary of Facilities

b. Summary of Estimated Cost

c. Population in 1981 and Projected for 1990

PROPOSED RURAL WATER SUPPLY AND SANITATION PROGRAM

SUMMARY OF FACILITIES

District	Piped Systems (Persons Servoed)		Shallow Wells (No. of Wells)		Deep Boreholes
	To be upgraded	New systems	To be upgraded	New Wells	New Wells (No.)
Amparai	23,000	5,000	150	192	1,325
Batticalen	3,000	3,000	133	133	1,025
Kurunegala	13,000	13,000	558	558	4,258
Mannar	16,000	1,000	58	58	292
Moneragala	11,000	4,000	158	158	1,125
Puttalam	17,000	6,000	233	233	1,650
Irincomalee	2,000	2,000	100	100	758
Badulla	89,000	22,000	375	375	183
Galle	7,000	7,000	858	1,717	175
Gampaha	47,000	12,000	1,450	2,908	450
Kalutara	7,000	7,000	842	1,408	450
Kandy	104,000	26,000	725	1,442	358
Kegalla	24,000	6,000	750	1,242	250
Matara	18,000	6,000	750	1,250	250
Nuwara Eliya	50,000	13,000	75	150	-
Ratnapurn	58,000	15,000	917	1,217	308
Colombo	10,000	5,000	600	1,192	83
TOTAL	499,000	153,000	8,732	14,333	12,490

Data Source : Sri Lanka Rural Water Supply & Sanitation Program Identification Report (Copy) from NWSDB, June 1984

PROPOSED RURAL WATER SUPPLY AND SANITATION PROGRAM

SUMMARY OF ESTIMATED COST

(Rupees million)

District	Piped Systems		Shallow Wells		Deep Boreholes	Total Water Supply
	To be upgraded	New systems	To be upgraded	New Wells	New Wells	
Amparai	11.5	10.0	1.8	3.5	46.1	72.9
Batticalen	1.5	6.0	1.6	2.4	35.7	47.2
Kurunegala	6.5	26.0	6.7	10.0	148.2	197.4
Mannar	8.0	2.0	0.7	1.1	10.0	21.8
Moneragala	5.5	8.0	1.9	2.8	39.1	57.3
Puttalam	8.5	12.0	2.8	4.2	57.4	84.9
Irincomalee	1.0	4.0	1.2	1.8	26.4	34.4
Badulla	44.5	44.0	4.5	6.8	6.4	106.2
Galle	3.5	14.0	10.3	30.9	6.1	64.8
Gampaha	23.5	24.0	17.4	52.4	-	117.3
Kalutara	3.5	14.0	10.1	25.4	15.7	68.7
Kandy	52.0	52.0	8.7	26.0	12.5	151.2
Kegalla	12.0	12.0	9.0	22.4	8.7	64.1
Matara	9.0	12.0	9.0	22.5	5.7	58.2
Nuwara Eliya	25.0	26.0	0.9	2.7	-	54.6
Ratnapurn	29.0	30.0	11.0	21.9	10.7	102.6
Colombo	5.0	10.0	7.2	21.5	2.9	46.6
TOTAL	249.5	306.0	104.8	258.3	431.6	1,350.2

Data Source: Sri Lanka Rural Water Supply & Sanitation Program Identification Report (copy) from NWSDB, July 1984

SRI LANKA
PROPOSED RURAL WATER SUPPLY AND SANITATION PROGRAM
Population in 1981 and Projected for 1990

District and Area		1981 Population 0000 1/				1981 Rural Population supplied by in 000		
	Total	Total	Urban	Rural	Estate	Piped water	Protect Well	Other
Amparai	4,539.3	388.8	53.8	335.2	-	17.4	228.3	117.0
Anuradhapura	7,129.1	587.8	11.7	544.6	1.5	20.9	320.5	172.0
Batticaloa	2,464.8	330.9	79.5	251.2	0.1	8.6	198.9	56.5
Hanbanotota	2,593.2	424.1	41.4	381.2	1.5	29.7	180.4	165.8
Jaxna	7,072.3	831.1	170.8	560.5	-	35.3	474.7	77.4
Kurunekale	4,772.7	1,212.8	43.9	1,157.9	11.0	16.5	798.7	382.7
Wannar	2,002.1	106.9	14.4	91.7	0.8	11.4	65.8	7.2
Watela	1,993.3	357.4	37.9	289.1	0.8	11.4	65.8	7.2
Woneragale	3,580.9	279.7	8.0	265.1	8.6	9.3	90.8	149.2
Wullattivu	1,960.0	77.5	7.2	70.2	0.1	2.1	27.6	21.8
Polasnaru	3,403.7	262.7	20.8	240.1	1.8	2.3	113.3	113.5
Putralas	2,976.9	493.3	61.8	428.6	2.9	13.2	300.9	116.6
Innconalco	2,618.2	256.8	83.3	169.7	3.8	1.7	105.1	63.6
Vavuniya	2,615.2	95.9	16.5	77.4	-	1.5	38.6	17.4
Badulia	2,218.1	812.9	51.5	430.1	181.3	83.7	145.9	175.5
Coloabs	652.4	1,698.3	1,262.0	427.4	8.9	9.1	308.2	92.3
Galla	1,673.8	814.6	168.1	625.6	10.9	7.7	359.8	214.2
Campaha	1,398.7	1,389.5	386.1	1,001.4	2.0	15.6	679.6	301.4
Kalutara	1,606.5	827.2	176.9	605.7	44.6	8.6	343.9	255.9
Kandy	2,157.3	1,126.3	147.4	848.4	130.5	101.2	430.2	245.4
Kegalle	1,662.8	682.4	53.3	566.7	62.2	23.2	321.2	245.4
Watara	1,246.4	644.2	71.5	552.6	20.1	15.6	285.7	257.5
Nuwara Eilya	1,437.2	522.2	37.9	171.7	312.6	47.8	50.8	65.4
Ratnapura	3,238.8	796.5	59.2	629.7	107.6	48.2	249.5	325.5
GRAND TOTAL	64,831.6	14,850.0	3,194.8	10,721.8	933.2	572.0	8,887.7	3,782.9

District and Area		1981 Rural Population with 3/ in 000				1981 Population 000'			
	Total	Flush Toilet	Water Seal	Pit Latrina	Other	Total	Urban 8/	Rural 8/	Estate 7/
Amparai	4,539.3	12.1	34.3	58.8	258.1	831	80	454	-
Anuradhapura	7,129.1	7.3	39.0	159.8	303.1	451	18	902	1
Batticaloa	2,464.8	2.5	13.1	12.5	224.4	415	92	323	-
Hanbanotota	2,593.2	5.2	22.3	278.2	85.7	318	48	466	2
Jaxna	2,072.3	39.7	159.7	78.3	305.0	972	318	656	-
Kurunekale	4,772.7	17.1	198.9	459.0	534.5	1,407	51	1,345	11
Wannar	2,002.1	2.6	4.1	7.1	70.2	148	17	130	1
Watal	1,995.3	3.1	15.9	190.7	70.5	400	44	328	30
Woneragale	3,580.9	1.5	8.4	133.7	103.8	390	7	375	8
Wullattivu	1,960.0	1.2	3.8	3.5	32.8	130	8	122	-
Polasnaru	3,403.7	5.1	28.4	142.4	52.2	401	24	375	2
Putralas	2,976.9	5.9	108.5	41.8	271.8	625	71	551	3
Innconalco	2,618.2	3.2	7.9	39.4	119.0	339	96	239	4
Vavuniya	2,615.2	1.3	1.4	9.3	64.8	145	21	124	-
Badulia	2,218.1	15.5	50.3	233.7	104.7	667	61	446	160
Coloabs	652.4	12.9	140.0	233.1	29.8	1,989	1,411	478	8
Galla	1,673.8	6.9	165.7	254.0	150.9	802	168	885	21
Campaha	1,398.7	32.1	317.8	520.8	152.8	1,611	449	1,163	2
Kalutara	1,606.5	12.7	226.8	217.1	248.3	871	203	676	45
Kandy	2,157.3	30.8	97.2	561.8	84.4	1,151	154	887	130
Kegalle	1,662.8	15.3	98.7	398.8	75.5	719	60	597	62
Watara	1,246.4	4.2	1210.	342.3	88.8	700	80	600	20
Nuwara Eilya	1,437.2	6.3	32.8	74.9	40.4	505	35	180	290
Ratnapura	3,238.8	11.8	84.3	289.0	135.3	924	98	730	108
GRAND TOTAL	64,831.6	256.3	1,978.1	4,827.4	3,544.4	17,267	3,648	12,710	909

IDENTIFICATION REPORT (1984) Source : SRI LANKA RURAL WATER SUPPLY & SANITATION PROGRAM

POPULATION SERVED AND NAMES OF THE LOCAL AUTHORITIES IN GREATER COLOMBO

a. Colombo South Local Authorities :

1. Kotikawatta T.C.
2. Kolonnawa U.C.
3. Kotte U.C.
4. Dehiwela-Mt. Lavinia M.C.
5. Maharagama T.C.
6. Moratuwa U.C.
7. Panadura U.C.
8. Kenelwatta T.C.
9. Piliyandala T.C.
10. Battaramulla T.C.

Total population = 679,125
as per 1981 census

Population served = 532,410
as per 1981 census

b. Colombo Municipal Area :

Population as per 1981 census = 585,776
Population served as per 1981 census = 585,776

c. Towns North of Colombo :

Name of Local Authorities

1. Kelaniya T.C.
2. Dalugama T.C.
3. Wattala-Mabole U.C.
4. Peliyagoda T.C.
5. Kandana T.C.
6. Jaela U.C.

Population as per 1981 census = 198,260
Population served = Nil
Total population in Greater Colombo area in 1981 (as per 1981 census) = 1,463,161
Total population served in Greater Colombo area in 1981 (as per 1981 census) = 1,188,186
Average annual rate of growth in G.C. area = 1.8 %
Average annual rate of growth in Sri Lanka = 1.5 %

WATER CONSUMPTION RATE IN GREATER COLOMBO

(When the intakes are normal)

Local Authority	Present Supply 1983 MGD	Population as per Census 1981	Rate of Consumption (Supply) gcd
1) Colombo M.C.	58.98	585,776	100.67
2) Kolonnawa	1.28	41,149	31.11
3) Kotikawatta	0.12	48,513	
4) Mulleriyawa	0.02	22,017	
5) Kotte	6.63	101,563	65.28
6) Dehiwela/Mt. Lavinia	7.13	174,385	40.89
7) Moratuwa	4.33	135,610	31.93
8) Panadura	1.85	31,190	59.31
Total	80.34	1,140,203	--

Summary

Total Supply = 80.34 mgd. (365,500 m3/day)

Total Population = 1,410,203
(as per 1981 census)

Average per capita consumption = 70.46 gls/day.
= 320 l/day
= 300 l/day (based on the estimated population in 1983)

8. Water Quality Data

a. Table of Water Quality Tests by the Team

b. Biological Examination by the Team

c. Water Quality Record

d. Bacteriological Examination of Water

e. Drinking Water Quality Surveillance Data

TABLE OF WATER QUALITY TESTS

Source : Labugama Treatment Plant

Sampling Date : 30 May, 1984 Cloudy, occasionally heavy rain

Item	SAMPLING POINT		
	Tank (reservoir)	Settling	Tap water at meter station
Water Temp. °C	27.0	26.5	26.5
pH	5.8	5.8	5.7
Turbidity, degree unit	10	9	9
Alkalinity, ppm as CaCo3	12	13	11
Chloride ion, ppm	13.3	12.3	12.4
Iron, ppm	0.25	-	0.25
Manganese, ppm	0.03	-	0.03
Dissolved O_2, ppm	8.46	9.46	-
Residual chlorine, ppm			
Free	-	-	trace
Combined	-	-	0.25
Coliform Group/ml	15	-	neg
General Bacteria/ml	numerous	-	31
Colour, degree unit	45		45

TABLE OF WATER QUALITY TESTS

Source : Kalatuwawa Treatment Plant

Sampling Date : 29, May, 1984 Cloudy, occasionally heavy rain

ITEM	SAMPLING POINT				
	Tank (reser-voir	Outfall of cascade	End of settling	Top of filter	Tap of the plant
Water Temp. °C	29.	28.7	28.8	28.5	28.
pH	6.1	5.9	6.0	-	5.9
Turbidity, degree unit	6.6	6.6	4.5	-	4.6
Alkalinity, ppm as CaCo3	10	9	8	8	14
Chloride ion, ppm	7.8	-	7.6	-	8.0
Iron, ppm	ND	-	ND	-	ND
Manganese, ppm	0.25	-	0.03	0	0.05
Dissolved O_2 ppm	9.55	8.64	8.20	9.25	8.82
Residual chlorine					
Free, ppm	-	after pre Cl_2 0.2	0.2	0.2	less than 0.1
Combined, ppm	-	0.3	0.3	0.3	0.1
Coliform Group/ml	6	7	neg	1	neg
General Bacteria/ml	150	205	8	7	neg
Colour, degree unit	25	-	-	-	20

Remarks ; ND - none detective; neg - negative.

Biological Examination

Classification

Number : counts/ml

Classification	Species (Genus)	No.1 Kalatuwawa Reservoir	No.2 Filtration Basin	No.3 Labugama Reservoir	No.4 Sedimentation
Diatoms	Phizosolenia sp.	1,300		1,100	530
	Navicula sp.	10		10	
	Gomphonema sp.	10			
	Achnanthes sp.			20	20
	Nitzschia sp.			10	20
	Cyclotella sp.			10	
	Cymbella sp.			10	10
Green-Algae	Elakatothrix sp.	120	100	80	40
	Ankistrodesmus spp.	260	250	250	250
	Staurastrum sp.	80	60	10	10
	Actinastrum sp.	10		10	
	Tetraedron spp.	90	120	20	20
	Oocystis sp.	10			
	Seenedesmus sp.		10		
	Cosmarium sp.			10	
	Closterium sp.			10	
Flugellates	Dinobryon sp.	70	50	10	30
	Peridinium sp	40	30	20	
Total		2,000	620	1,580	920

WATER QUALITY RECORD

ITEM	KALATUWAWA			
Sampling Date	18 July '83	18 July '83	24 Nov. '83	24 Nov '83
Source of sample	Reservoir	Final water	Reservoir	Final water
Appearance	Turbid	Clear	Clear	Clear
Turbidity (J.T.U.)	12.5	2	2.8	3.0
pH	6.5	6.1	6.6	6.0
Electrical Conductivity	25	70	24	47
Chloride, mg/l	10	16	10	10
Total Alkalinity, mg/l	6	8	8	6
Total Hardness	12	20	8	16
Total Dissolved Solids, mg/l	21	45	20	31
Nitrates, mg/l	minute trace	minute trace	minute trace	minute trace
Nitrates, mg/l	do.	do.	do.	do.
Free Ammonia	-	-	-	-
Albuminoid Ammonia	-	-	-	-
Iron (total), mg/l	2.2	0.4	0.4	0.08
Colour (Hazen Scale), mg/l		20	15	10 10
Aluminum, mg/l	-	-	trace	0.45
Fluoride. mg/l	0.4	0.4	-	-
Water Level of Tank *	38	-	19	-

Data source; Laboratory, National Water Supply & Drainage Board, Ratmalana.

Remark: * Data from daily record of the treatment plant

WATER QUALITY RECORD

ITEM	KALATUWAWA		LABUGAMA	
Sampling Date	19 Aug.'83	19 Aug,'83	19 Aug,'83	19 Aug.'83
Source of sample	Raw water Reservoir	Final water	Raw water	Final water
Appearance	Turbid	Clear	Coloured	More coloured
Turbidity (J.T.U.)	18	7.0	8	14
pH	6.8	6.4	6.6	6.4
Electrical Conductivity	30	80	20	20.5
Chloride, mg/l	8	12	8	14
Total Alkalinity, mh/l	16	8	36	6
Total Hardness, mg/l	6	32	12	24
Total Dissolved Solids	-	-	-	-
Nitrates	minute trace	minute trace	minute trace	minute trace
Nitrites	do.	do.	do.	do.
Free Ammonia	-	-	-	-
Albuminoid Ammonia	-	-	-	-
Iron (total), mg/l	1.4	0.32	0.5	1.4
Colour (Hazen Scale)	80	5	25	30
Alminum	-	-	-	-
Fluoride	-	-	-	-

Water Level of Tank* 36.5

Data source; Laboratory, National Water Supply & Drainage Board, Ratmalana.

Remarks: * Data from daily record of the treatment plant

BACTERIOLOGICAL EXAMINATION OF WATER

(Outside of the Plant)

Data, Time Collected	Sampling Point	No. of Colonies /ml, 24 hrs 37 °C	Coli-form MPN/ 100 ml	E.Coli (Fecal) MPN/ 100 ml	Residual Cl_2, ppm	Remarks
8.50 am 15,08, '83	Waga Post Office	Nil	Nil	Nil	0.3	Satis-factory
9.05 am 15,08, '83	Hanwella Rest House	Nil	Nil	Nil	0.1	do.
15,08, '83	Panagoda Camp	Nil	Nil	Nil	-	do.
10.00 am 15,08, '83	Rukmalagama Housing scheme	Nil	Nil	Nil	0.4	do.
10.30 am 15,08, '83	Cancer Hospital Maharagama	Nil	Nil	Nil	Nil	do.
10.35 am 15,08, '83	Bellanwila Temple	Nil	Nil	Nil	0.6	do.
11.25 am 15,08, '83	Dehiwela Reservoir	Nil	Nil	Nil	more than 1ppm	do.
10.00 am 27,08 '83	Waga Post Office	Nil	Nil	Nil	0.4	do.
10.20 am 27,08, '83	Hanwella Rest House	Nil	Nil	Nil	0.2	do.
10.50 am 29,08, '83	Panagoda Army Camp	Nil	Nil	Nil	0.4	do.
12.40 am 29,08, '83	Cancer Hospital, Maharagama	Nil	Nil	Nil	0.1	do.
12.10 pm 29,08, '83	Rukmalgama Scheme	Nil	Nil	Nil	0.6	do.
1.00 pm 29,08, '83	Bellanwila Temple	Nil	Nil	Nil	0.2	do.
1.15 pm 29,08, '83	Dehiwela Reservoir	Nil	Nil	Nil	1.0	do.

BACTERIOLOGICAL EXAMINATION OF WATER

(Outside of the Plant)

Data, Time Collected	Sampling Point	No. of Colonies /ml, 24 hrs 37 °C	Coli-form MPN/ 100 ml	E.Coli (Fecal) MPN/ 100 ml	Residual Cl_2, ppm	Remarks
12.15 pm 25,09, '83	Panagoda Army Camp	Nil	Nil	Nil	0.2	Satis-factory
12.35 pm 25,09, '83	Rukmalagama	Nil	Nil	Nil	0.1	do.
1.15 pm 25,09,'83	General Hospital Maharagama	Nil	nil	nil	0.1	do.
1.25 pm 25,09, '83	Bellanwila Temple	Nil	Nil	Nil	Nil	do.
1.35 pm 25,09, '83	Dehiwela Reservoir	Nil	Nil	Nil	more than 1ppm	do.

Data Source; Records from Bacteriological Laboratory,
National Water Supply & Drainage Board, Ratmalana

BACTERIOLOGICAL EXAMINATION OF WATER

(Outside of the Plant)

Data, Time Collected	Sampling Point	No. of Colonies /ml, 24 hrs 37 °C	Coli-form MPN/ 100 ml	E.Coli (Fecal) MPN/ 100 ml	Residual Cl_2, ppm	Remarks
8.20 10,08, '83	Kalatuwawa (before post Cl2)	Nil	Nil	Nil	0.1	Satis-factory
7.55 am 17,08, '83	Kalatuwawa	Nil	Nil	Nil	0.6	do.
22,08, '83	Kalatuwawa	Nil	nil	nil	1.8	do.
24,08, '83	Kalatuwawa (Inlet water)	Nil	nil	nil	0.8	do.
8.45 am 26,08, '83	Kalatuwawa	Nil	Nil	Nil	1.0	do.
8.40 am 27,08, '83	Kalatuwawa	Nil	Nil	Nil	0.4	do.
8.20 am 31,08, '83	Kalatuwawa	Nil	Nil	Nil	0.6	do.
8.10 am 05,09, '83	Kalatuwawa	Nil	Nil	Nil	0.5	do.
14,09, '83	Kalatuwawa	Nil	Nil	Nil	0.6	do.
8.40am 07,09, '83	Kalatuwawa	Nil	Nil	Nil	0.8	do.
8.00 am 16,09, '83	Kalatuwawa	Nil	Nil	Nil	0.3	do.
7.35 am 16,09, '83	Kalatuwawa	Nil	Nil	Nil	0.4	do.
7.35 am 05,10, '83	Kalatuwawa	Nil	Nil	Nil	2.0	do.
8.30 am 05,10, '83	Kalatuwawa	Nil	Nil	Nil	2.0	do.
8.15 am 17,10, '83	Kalatuwawa	Nil	Nil	Nil	2.0	do.
9.20 am 26,10,'83	Kalatuwawa	Nil	Nil	Nil	2.4	do.

BACTERIOLOGICAL EXAMINATION OF WATER

(Outside of the Plant)

Data, Time Collected	Sampling Point	No. of Colonies /ml, 24 hrs 37 °C	Coli-form MPN/ 100 ml	E.Coli (Fecal) MPN/ 100 ml	Residual Cl_2, ppm	Remarks
8.05 am 24,10, '83	Kalatuwawa	Nil	Nil	Nil	2.0	Satis-factory
8.30 am 02,11, '83	Kalatuwawa	Nil	Nil	Nil	2.0	do.
8.15 am 14,11, '83	Kalatuwawa	Nil	Nil	Nil	2.5	do.
8.00 am 01,11, '83	Kalatuwawa	Too Numerous	8	Nil	2.2	Shows Coliform but F-c not detected
7,11, '83	Kalatuwawa	Nil	Nil	Nil	-	Satis-factory
7.20 am 16,11, '83	Kalatuwawa	Nil	Nil	Nil	2.4	do.
6.20 am 21,11, '83	Kalatuwawa	Nil	Nil	Nil	1.4	do.

Data Source ; Records from Bacteriological Laboratory,
National Water Supply & Drainage Board, Ratmalana

BACTERIOLOGICAL EXAMINATION OF WATER

(Outside of the Plant)

Data, Time Collected	Sampling Point	No. of Colonies /ml, 24 hrs 37 °C	Coli-form MPN/ 100 ml	E.Coli (Fecal) MPN/ 100 ml	Residual Cl_2, ppm	Remarks
8.40 am 10,08, '83	Labugama	Nil	Nil	Nil	0.5	Satis-factory
8.25 am 15,08, '83	Labugama	Nil	Nil	Nil	0.5	do.
9.00 am 17,08, '83	Labugama	Nil	Nil	Nil	0.7	do.
22,08, '83	Labugama	Nil	Nil	Nil	0.5	do.
24,08, '83	Labugama	Nil	Nil	Nil	1.2	do.
9.20 am 26,08, '83	Labugama	Nil	Nil	Nil	2.0	do.
9.25 am 27,08, '83	Labugama	Nil	Nil	Nil	0.5	do.
9.25 am 31,08, '83	Labugama	Nil	Nil	Nil	1.2	do.
9.45 am 05,09, '83	Labugama	Nil	Nil	Nil	0.4	do.
8.40 am 07,09, '83	Labugama	Nil	Nil	Nil	0.6	do.
14,09, '83	Labugama	Nil	Nil	Nil	0.5	do
8.25 am 26,09, '83	Labugama	Nil	Nil	Nil	1.2	do.
8.10 am 03,10, '83	Labugama	Nil	Nil	Nil	1.2	do.
8.20 am 05,10, '83	Labugama	Nil	Nil	Nil	1.2	do.
8.35 am 12,10, '83	Labugama	71	5	Nil	0.1	Shows coliform but F-c not detected

BACTERIOLOGICAL EXAMINATION OF WATER

(Outside of the Plant)

Data, Time Collected	Sampling Point	No. of Colonies /ml, 24 hrs 37 °C	Coli-form MPN/ 100 ml	E.Coli (Fecal) MPN/ 100 ml	Residual Cl_2, ppm	Remarks
8.35 am 17,10 '83	Labugama	Nil	Nil	Nil	0.5	Satis-factory
10,30 am 26,10, '83	Labugama	Nil	Nil	Nil	1.0	do.
9.30 am 24,10, '83	Labugama	Nil	Nil	Nil	0.7	Satis-factory
9.10 am 02,11, '83	Labugama	Nil	Nil	Nil	1.0	do.
9.10 am 14,11, '83	Labugama	Nil	Nil	Nil	0.8	do.
8.35 am 01,11, '83	Labugama	Nil	Nil	Nil	1.2	do.
7,11, '83	Labugama	Nil	Nil	Nil	-	do.
9.15 am 16,11, '83	Labugama	Nil	Nil	Nil	0.3	do.
5.45 am 21,11 '83	Labugama	Nil	Nil	Nil	1.0	do.

Data Source ; Records from Bactoriological Laboratory,
National Water Supply & Drainage Board, Ratmalana

DRINKING WATER QUALITY SURVEILLANCE DATA
(Level of some indices by Regions for 1981)

DESCRIPTION	TOTAL	WESTERN		NORTHERN	NORTH CENTRAL	CENTRAL	SOUTH	GAMUWA	EASTERN
		COLOMBO MUNICIPALAITY	OUTSIDE MUNICIPALITY						
1. Number of water systems under surveillance	187	3	23	21	12	69	25	21	13
2. Number of water testing laboratories	2	1(a)	1(b)	-	-	-	-	-	-
3. Professional Staff									
Chief Chemist	1	-	1	-	-	-	-	-	-
Chemist	7	2	2	-	1	1	1	-	-
Bacteriologist	2	1	1	-	-	-	-	-	-
4. Bacteriological Examination									
Number of Analyses	1399	480	105	76	131	323	172	60	52
Unsatisfactory results %	351 (43%)	45	40	41	45	55	50	20	55
5. Chemical Examination									
Number of Analysis	920	250	100	120	45	207	75	84	39
Unsatisfactory results %	175(22%)	20	20	30	30	20	25	10	20
6. Residual Chlorine Tests	A B	A B	A B	A B	A B	A B	A B	A B	A B
Number of tests	245910 8626	3240 600	3720 104	1260 102	1130 40	9120 5000	5660 2000	504 504	276 276
Number of tests with no residual Chlorine	3865 1657	850 200	1200 45	650 45	400 20	300 250	856 900	200 165	105 97
Residual Chlorine less than 0.2 mg/l Results	610 485	25 80	100 20	75 20	40 5	200 110	100 200	40 20	20 30
Total Number of Unsatisfactory Results	4475 2145	875 280	1300 65	725 65	440 25	500 360	950 900	240 125	130 122

NOTES : a) Colombo Municipal Laboratory serves only Colombo Water Supply Schemes
b) N.W.S. & D.B. Laboratory situated in Ratmalana outside Colombo
c) Water entering distribution system after treatment
d) Analysis of water in the distribution system

Source : Review of the Sri Lanka Water Supply and Sanitation Programme for the International Drinking Water Supply and Sanitation Decade.

By Government of Sri Lanka in Cooperation with WHO & UNICEF
November 1983

Kalatuwawa Treatment Plant

1. Analysis of water before & after treatment

Description	Before treatment	After treatment
Color	clear	clear
Turbidity	6.8	3.2
pH	6.0	7.6
Odour	Fishy	Nil

(additional reports are annexed.)

2. Organization for Maintenance and Operation

Plant is designed to supply 20 m.g.d. and is operated throughout 24 hours of the day in three shifts of 8 hour duration each.

Shift staff

Shift officer (Technical Asst.)	01
Generator Plant Operator	01
Generator Plant Assistant	01
Chemical Plant Operator	01
Chemical Plant Assistant	01
Filter Plant Operator	01
Filter Plant Assistant	01

3. (i) Organization Chart

The organization chart is as follows.

Officer-in-Charge

Shift Officer — Non shift officer — Store Keeper

Operators, Fitter, Electrician, Drivers, Labourers — Stores Labourers

3. (ii) Number of Personnel and their Academic career

(a) Administrative Staff : In addition to the overall supervision, the administration of the schemes are executed by the O.I.CC. assisted by 3 Technical Assistants and 2 Supervisors who are mainly attached to Water Works staff as stated below.

(b) Water works staff :

Designation		Academic Standard
Officer-in-charge		Departmental Inspector's (Civil) Examination
Technical Assistants	03	G.C.E. (A.L.)
Supervisors	02	G.C.E. (O.L.)
Store Keeper	01	G.C.E. (O.L.)
Plant Operators	04	7th Standard
Filter	01	7th Standard
Labourers Gr. III	30	7th Standard

(c) Electrical Staff :

Electrician	01	Upto G.C.E. & Tech. College Trade Certificate

(d) Mechanical Staff :
Attended to by General Mechanical staff of the Board as and when necessary.

(e) Financial Staff :
There is no separate staff. O.I.C. attends to payment and other accounting matters.

(f) Other staff :

Driver	02	
Security Guards	07	
Casual labourers	07	
Ad Hoc casual labourers	46	(to attend to various repair & maintenance work)

4. Training Programmes for the staff :

Short-duration training programmes are organized by the Training Centre of the Board to improve the ability of the staff.

However, it is felt that the training given to technical staff is inadequate. Hence, further extensive training is desirable.

Labugama Treatment Plant

1. Analysis of Water

Please refer to the reports attached.

2. Organization for Maintenance and Operation

Plant is designed to supply 16 MGD and is operated throughout 24 hours of the day in three shifts of 8 hours duration each.

3. (i) Organization Chart

The organization chart is as follows:

Officer-in-Charge

Shift Officer	Supervisor	Minor Supervisor	Store-keeper
Operators	Fitter Labourer	Mechanic	Stores Labourer

(ii) Number of Personnel and their Academic Career

(a) Administative Staff: In addition to the overall supervision the administration of the scheme is executed by the O.I.C. assisted by one Engineering Assistant, 2 Technical Assistants and 2 Supervisors who are mainly attached to Water Works Staff.

(b) Water Works Staff

Designation		Academic Standard
Officer-in-Charge		Departmental Sub-Inspectors (Civil) Examination
Engineering Assistant	- 01	G.C.E. (O.L) Technical Training Course
Technical Assistants	- 02	G.C.E. (A.L)
Supervisors	- 01	G.C.E. (O.L)
Fitters	- 03	7th Standard
Labourers	- 33	7th Standard

G.C.E. = General Certificate of Education
O.L = Ordinary Level
A.L = Advanced Level

(c) Electrical Staff

Electrician	- 01	7th Standard

(d) Mechanical Staff

Supervisor	- 01	7th Standard

(e) Financial Staff

There is no separate staff O.I.C. attends to payment and other accounting matters.

(f) Other Staff

Mason	- 01	7th Standard
Painter	- 01	8th Standard
Carpenter	- 01	8th Standard
Watcher	- 11	7th Standard
Driver	- 01	G.C.E. (O.L)
Lorry Cleaner	- 01	Upto G.C.E. (O.L)

4. Training Programme for the Staff

Short-duration training programmes are organized by the Training Centre of the Board to improve the ability of the staff.

However, it is felt that the training given to technical staff is inadequate. Hence, further extensive training is desirable.

11. Data on Rainfall and Reservoirs

a. Rainfall at Reservoir

b. Frequencu Distribution of Preciptiation and Reservoirs

c. Frequency Distribution of Water level at Reservoirs

d. Water Level and Volume

e. Related Graphs

RAINFALL AT RESERVOIR (KALATUWAWA) (mm)

MONTH	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	Average
Jan.	4	95	22	4	105	59	1	228	59	104	103
Feb.	273	95	6	213	147	147	1	71	0	49	111
Mar.	365	373	123	456	195	142	122	271	126	69	229
Apr.	610	660	438	487	253	499	310	390	277	140	430
May	442	738	192	921	973	305	511	529	700	304	523
Jun.	369	533	139	472	147	478	260	391	589	254	393
Jul.	513	214	242	49	213	226	234	180	287	232	252
Aug.	177	250	348	146	162	83	293	199	317	360	264
Sept.	451	652	104	194	178	866	282	373	152	477	397
Oct.	195	460	419	827	413	460	518	420	591	218	519
Nov.	106	995	528	334	478	522	614	584	639	450	423
Dec.	141	139	623	221	125	425	199	221	157	586	288
Total	3646	5204	3184	4324	3389	4033	3345	3857	3894	3243	3832

FREQUENCY DISTRIBUTION OF PRECIPITATIONS AND RESERVOIRS

ITEM	OBSERVATION PERIOD	FREQUENCY DISTRIBUTION PRECIPITATIONS (mm)											
RESERVOIR		0-10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100-	Total
KALATUWAWA	July 1964	1802	786	437	281	163	122	83	44	38	28	66	3850
	Dec. 1983	(46.8)	(20.4)	(11.4)	(7.3)	(4.2)	(3.2)	(2.2)	(1.1)	(1.0)	(0.7)	(1.7)	(100)
LABUGAMA	July 1964	1869	717	418	253	171	107	71	60	31	13	68	3778
	Dec. 1983	(49.5)	(19.0)	(11.1)	(6.7)	(4.5)	(2.8)	(1.9)	(1.6)	(0.8)	(0.3)	(1.8)	(100)

Note: ( ) percentage to total amount

FREQUENCY DISTRIBUTION OF WATER LEVEL AT RESERVOIRS

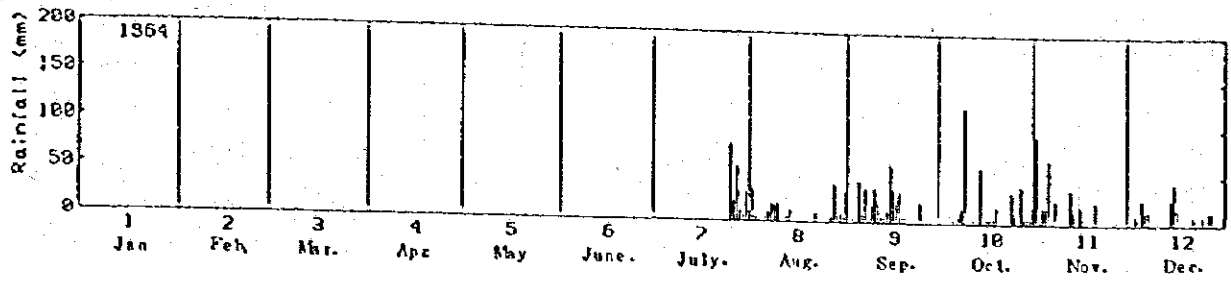
		WATER LEVEL IN ORDER											
		I	II	III	IV	V	VI	VII	VIII	IX	X	TOTAL	PERIOD
KALATUWAWA	Range of Water Level (m)	100.0 -101.3	101.3 -102.5	102.5 -103.8	103.8 -105.1	105.1 -106.4	106.4 -107.7	107.7 -109.0	109.0 -110.2	110.2 -111.5	111.5 -112.8	-	Jan. 1965 - Dec. 1982
	Frequency	2 (0.5)	13 (3.0)	23 (5.4)	31 (7.3)	47 (11.0)	53 (12.4)	77 (18.1)	65 (15.3)	73 (17.1)	42 (9.9)	426 (100)	
LABUGAMA	Range of Water Level (m)	99.1 -110.5	100.5 -102.0	102.0 -103.5	103.5 -105.0	105.0 -106.5	106.5 -108.0	108.0 -109.5	109.5 -111.0	111.0 -112.5	112.5 -114.0		Jan. 1965 - Dec. 1982
	Frequency	1 (0.2)	5 (1.2)	12 (2.8)	23 (5.5)	33 (7.9)	50 (11.9)	52 (12.4)	67 (16.0)	69 (16.4)	108 (25.7)	420 (100)	

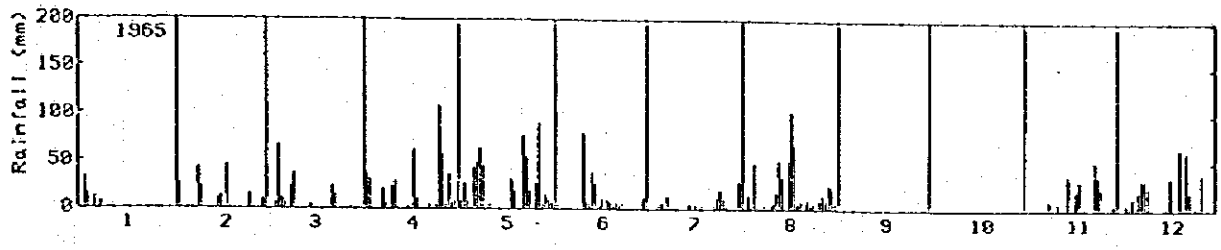
WATER LEVEL AND VOLUME

	KALATUWAWA			LABUGAMA	
	W.L (m)	Vol. (m3)		W.L (m)	Vol. (m3)
HL	112.9	15.38	HL	114.1	8.92
	112.6	14.70		113.8	8.62
	112.2	14.01		113.5	8.33
	111.9	13.33		113.2	8.03
	111.6	12.65		112.9	7.74
	111.3	12.12		112.6	7.54
	111.0	11.59		112.2	7.34
	110.7	11.07		111.9	7.13
	110.4	10.54		111.6	6.93
	110.1	10.01		111.3	6.73
	109.8	9.56		111.0	6.51
	109.5	9.12		110.7	6.28
	109.2	8.67		110.4	6.05
	108.9	8.23		110.1	5.82
	108.6	7.78		109.8	5.60
	108.3	7.40		109.5	5.39
	108.0	7.02		109.2	5.18
	107.7	6.63		108.9	4.97
	107.4	6.25		108.6	4.76
	107.1	5.87		108.3	4.55
	106.8	5.52		108.0	4.35
	106.5	5.18		107.7	4.15
	106.1	4.83		107.4	3.95
	105.8	4.49		107.1	3.75
	105.5	4.14		106.8	3.55
	105.2	3.89		106.5	3.37
	104.9	3.63		106.1	3.19
	104.6	3.38		105.8	3.00
	104.3	3.12		105.5	2.82
	104.0	2.87		105.2	2.64
	103.7	2.68		104.9	2.48
	103.4	2.48		104.6	2.31
	103.1	2.29		104.3	2.15
	102.8	2.10		104.0	1.98
	102.5	1.91		103.7	1.82
LW	100.0		LW	99.1	

Related Graphs

Records on Water Level and Rainfall at Kalatuwawa and Labugama Reservoirs


1964
Rainfall (mm)
200
150
100
50
0
1 Jan
2 Feb
3 Mar.
4 Apr
5 May
6 June.
7 July.
8 Aug.
9 Sep.
10 Oct.
11 Nov.
12 Dec.


1965
Rainfall (mm)
200
150
100
50
0
1
2
3
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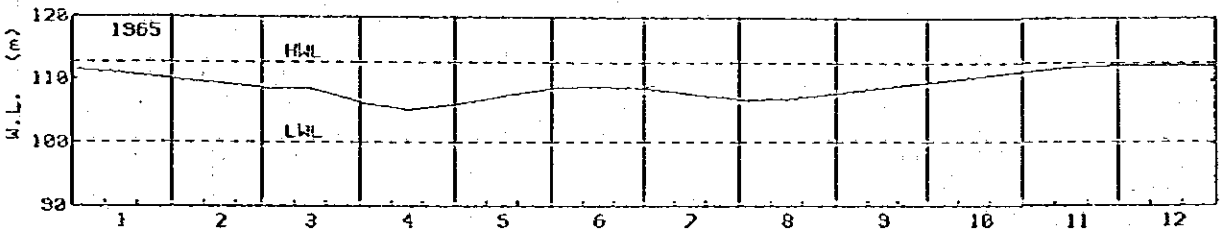
12


1965
W.L. (m)
120
110
100
90
HWL
LWL
1
2
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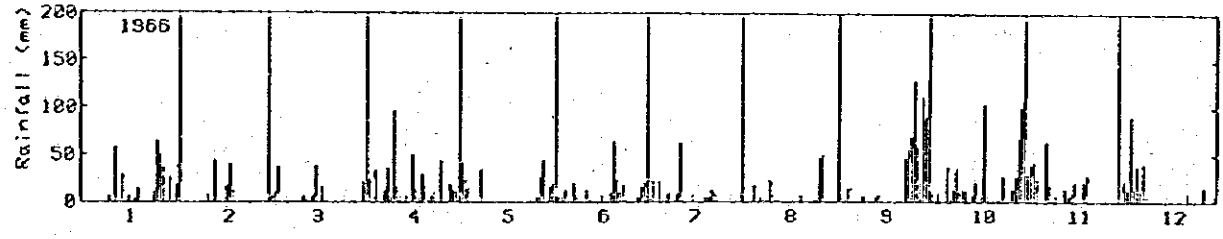
12


1966
Rainfall (mm)
200
150
100
50
0
1
2
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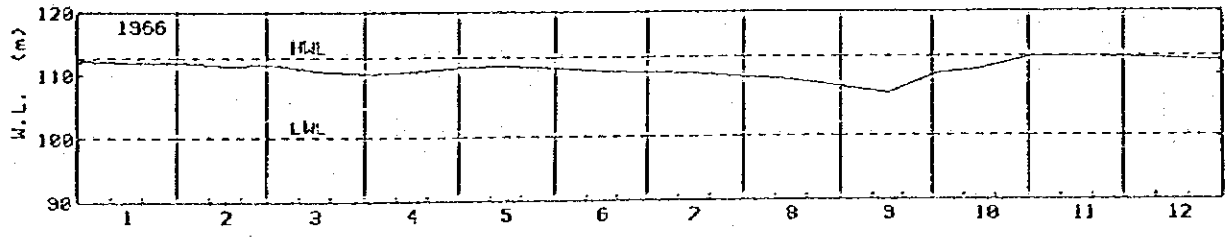
12


1966
W.L. (m)
120
110
100
90
HWL
LWL
1
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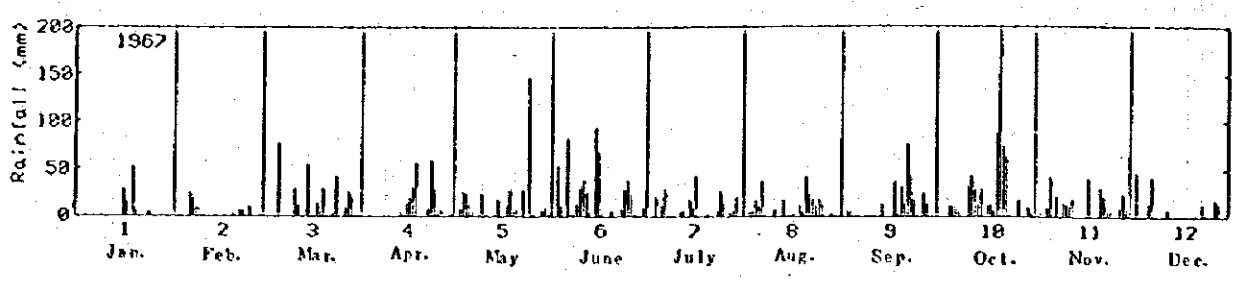
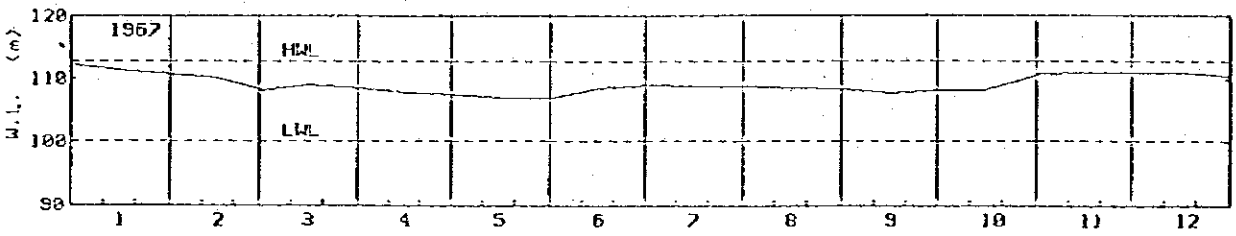
11
12

KALATUWAWA


1967
Rainfall (mm)
200
150
100
50
0
1 Jan.
2 Feb.
3 Mar.
4 Apr.
5 May
6 June
7 July
8 Aug.
9 Sep.
10 Oct.
11 Nov.
12 Dec.


1967
W.L. (m)
120
110
100
90
HWL
LWL
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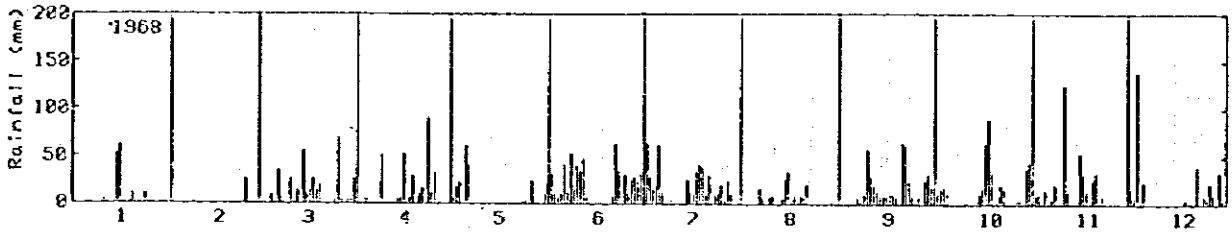
1968
Rainfall (mm)
200
150
100
50
0
1
2
3
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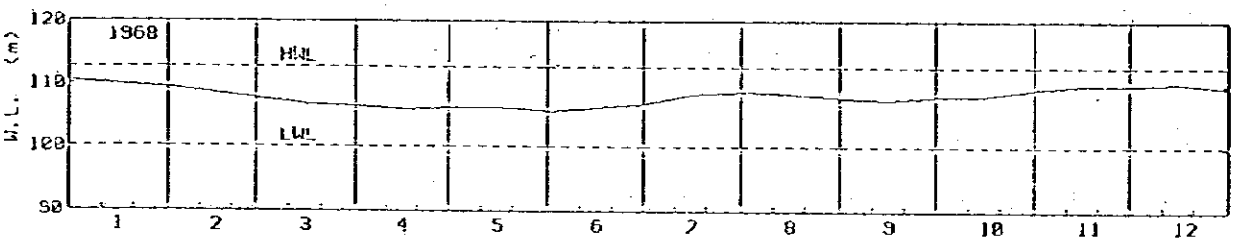
12


1968
W.L. (m)
120
110
100
90
HWL
LWL
1
2
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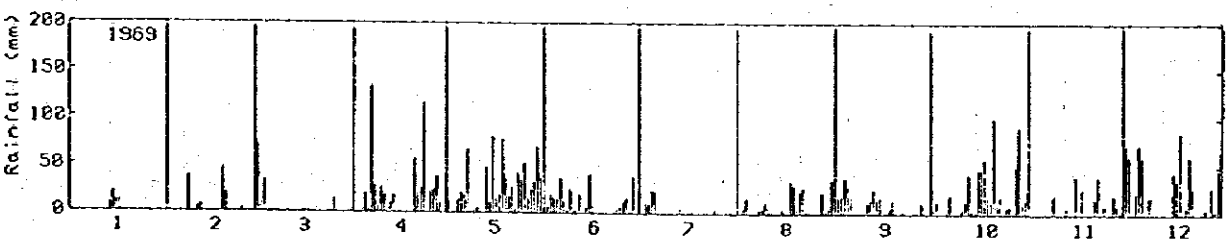
11
12


1969
Rainfall (mm)
200
150
100
50
0
1
2
3
4
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6
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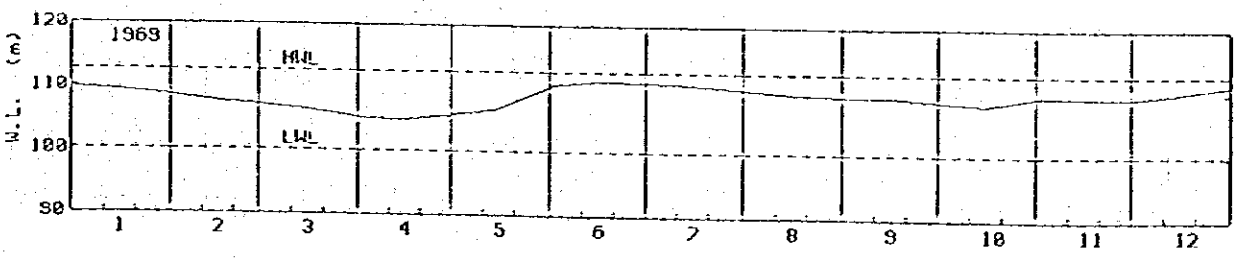
12


1969
W.L. (m)
120
110
100
90
HWL
LWL
1
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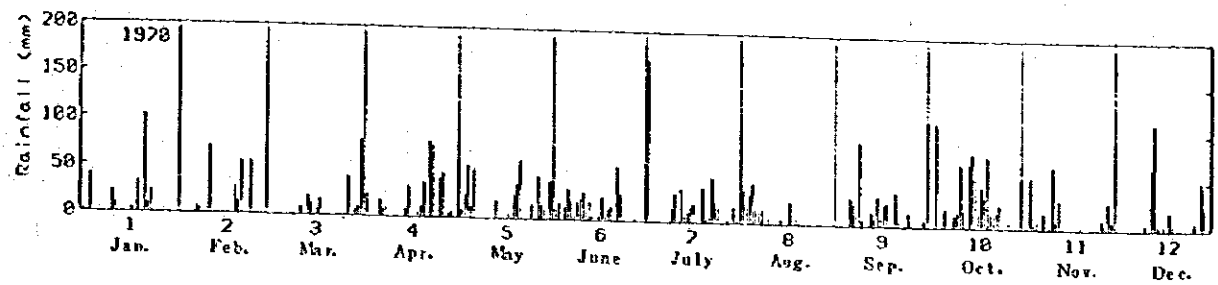
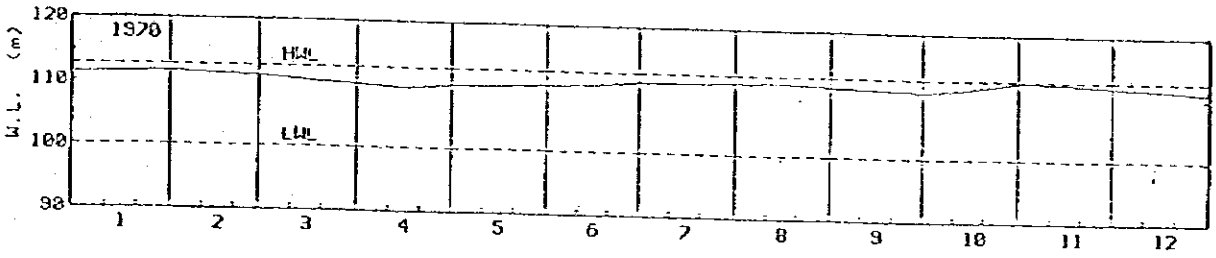
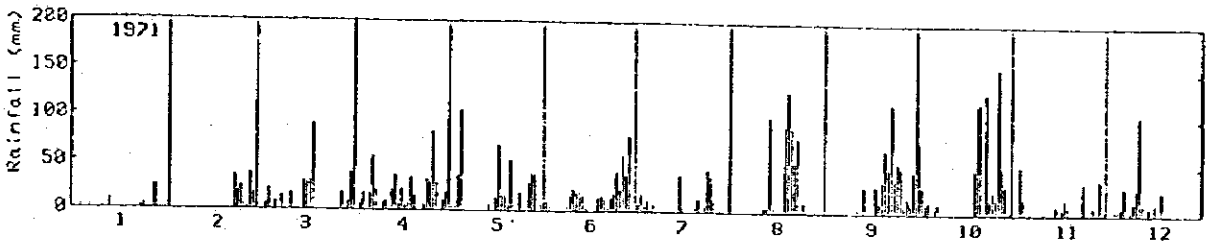
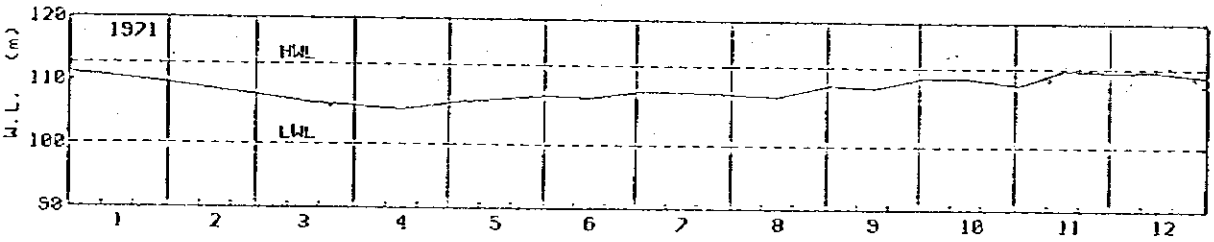
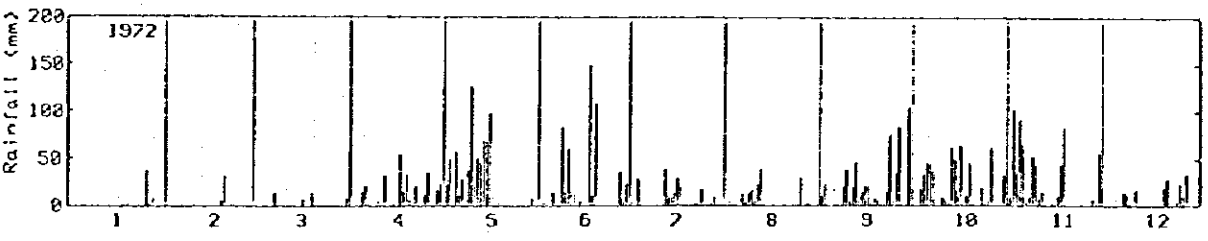
KALATUWAWA

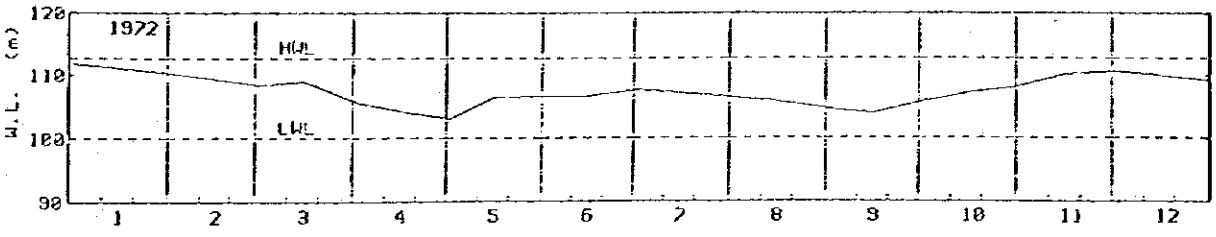

1970
Rainfall (mm)
200
150
100
50
0
1 Jan.
2 Feb.
3 Mar.
4 Apr.
5 May
6 June
7 July
8 Aug.
9 Sep.
10 Oct.
11 Nov.
12 Dec.


1970
W.L. (m)
120
110
100
90
HWL
LWL
1 2 3 4 5 6 7 8 9 10 11 12

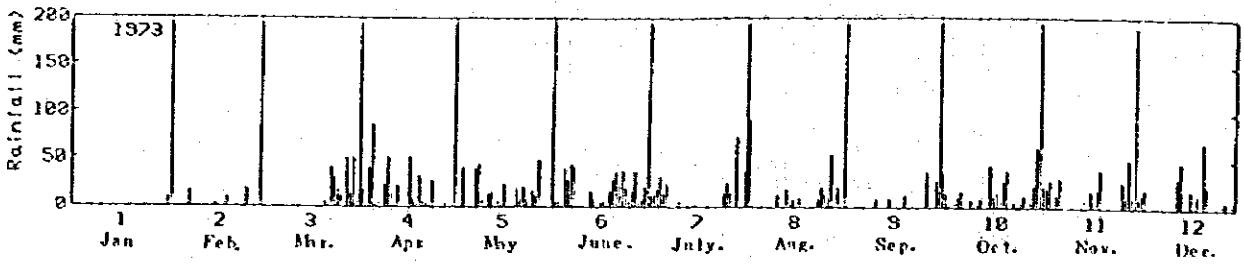

1971
Rainfall (mm)
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12

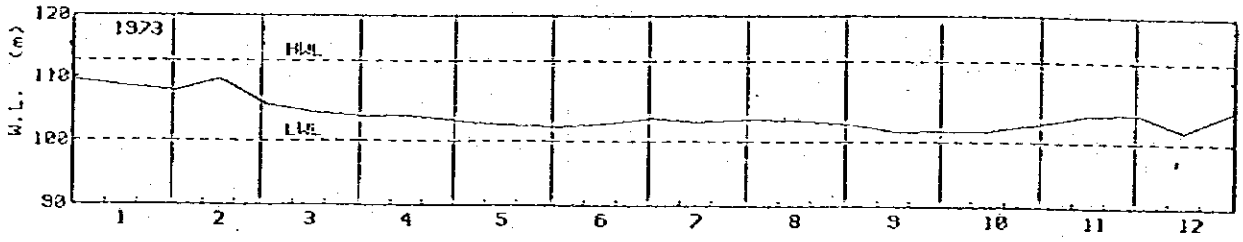

1971
W.L. (m)
120
110
100
90
HWL
LWL
1 2 3 4 5 6 7 8 9 10 11 12


1972
Rainfall (mm)
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12


1972
W.L. (m)
120
110
100
90
HWL
LWL
1 2 3 4 5 6 7 8 9 10 11 12

KALATUWAWA


1973
Rainfall (mm)
200
150
100
50
0
1 Jan
2 Feb.
3 Mar.
4 Apr.
5 May
6 June.
7 July.
8 Aug.
9 Sep.
10 Oct.
11 Nov.
12 Dec.


1973
W.L. (m)
120
110
100
90
HWL
LWL
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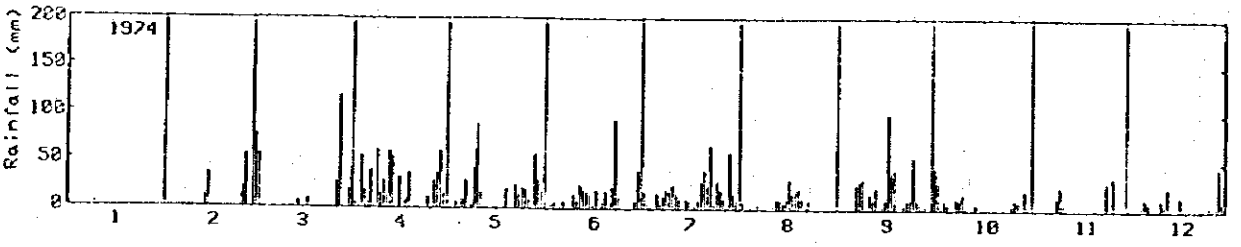
1974
Rainfall (mm)
200
150
100
50
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1
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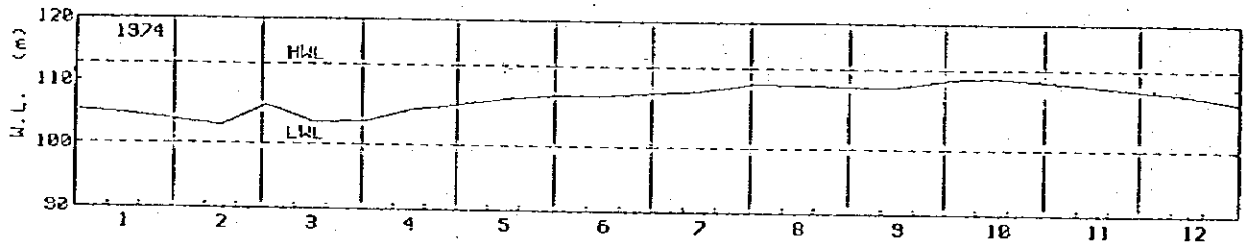
1974
W.L. (m)
120
110
100
90
HWL
LWL
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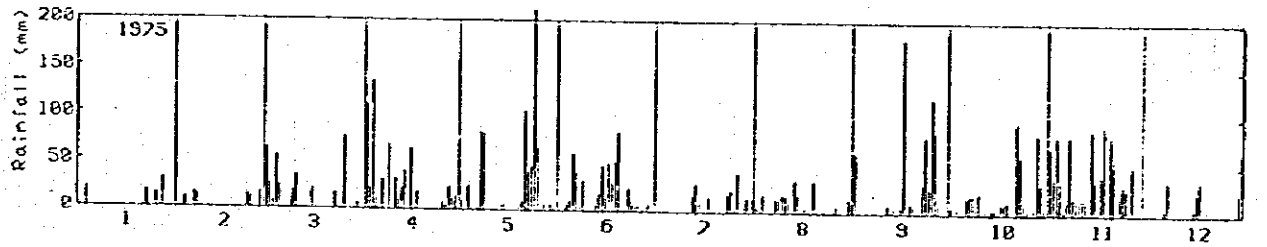
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Rainfall (mm)
200
150
100
50
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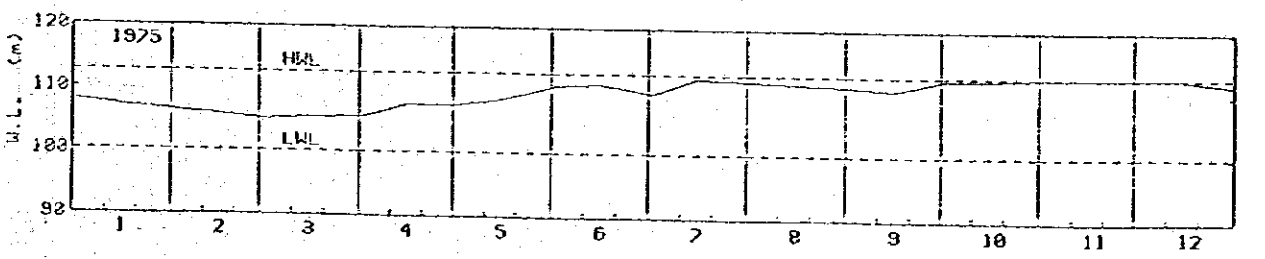
1975
W.L. (m)
120
110
100
90
HWL
LWL
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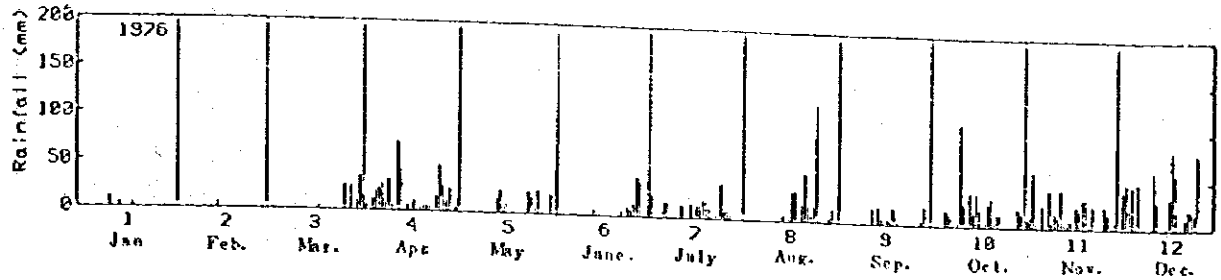
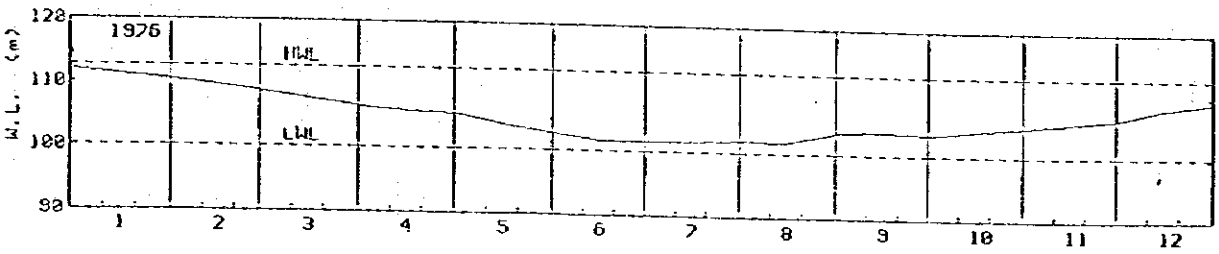
KALATUWAWA


1976
Rainfall (mm)
200
150
100
50
0
1 Jan
2 Feb.
3 Mar.
4 Apr
5 May
6 June.
7 July
8 Aug.
9 Sep.
10 Oct.
11 Nov.
12 Dec.


1976
W.L. (m)
120
110
100
90
HWL
LWL
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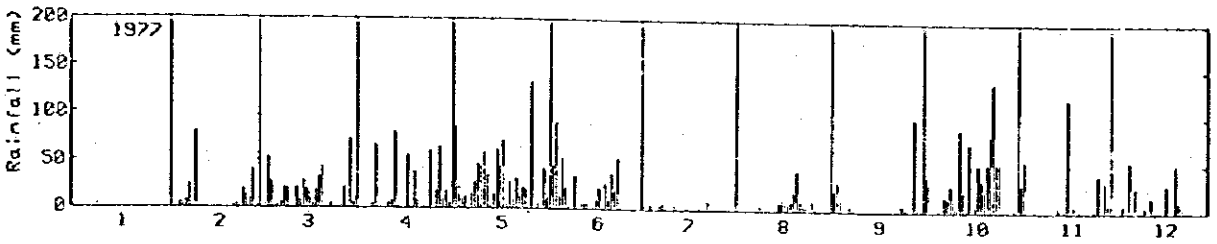
1977
Rainfall (mm)
200
150
100
50
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1
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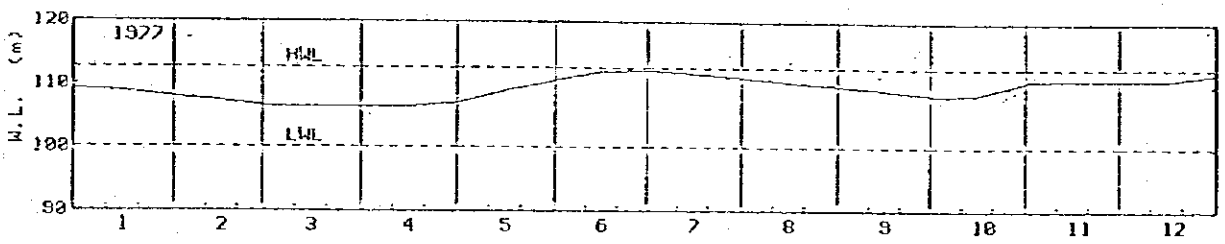
11
12


1977
W.L. (m)
120
110
100
90
HWL
LWL
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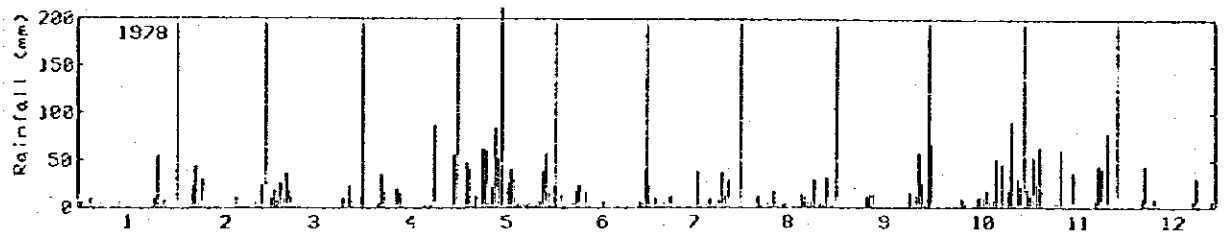
1978
Rainfall (mm)
200
150
100
50
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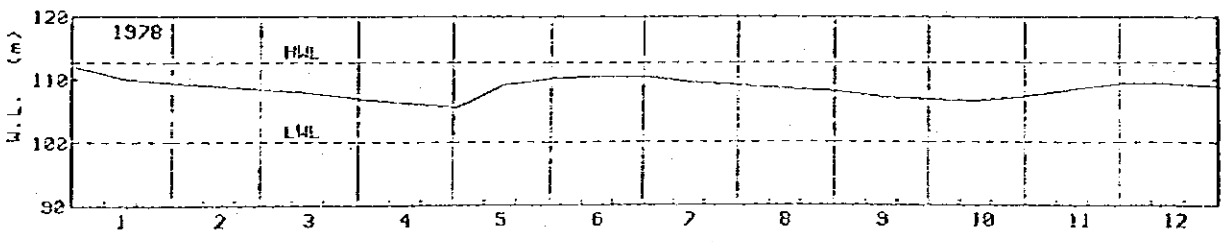
12


1978
W.L. (m)
120
110
100
90
HWL
LWL
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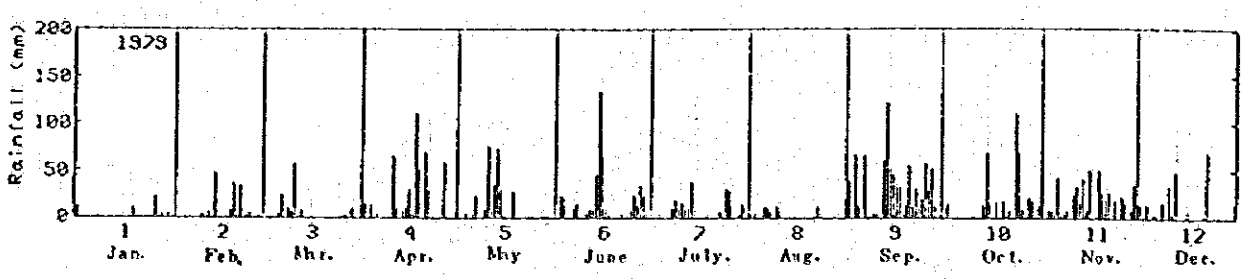
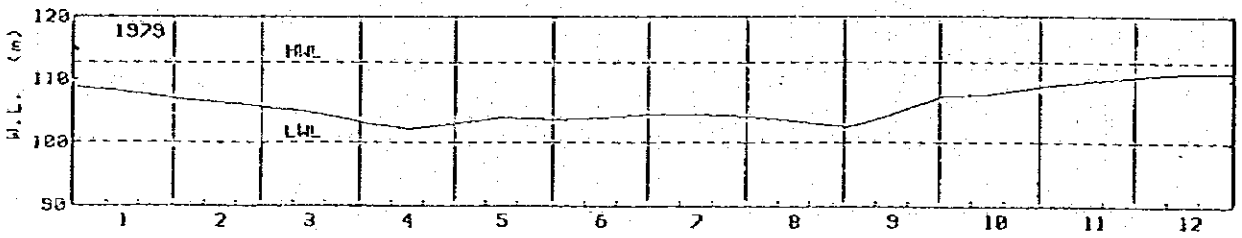
KALATUWAWA


1979
Rainfall (mm)
200
150
100
50
0
1 Jan.
2 Feb.
3 Mar.
4 Apr.
5 May
6 June
7 July.
8 Aug.
9 Sep.
10 Oct.
11 Nov.
12 Dec.


1979
W.L. (m)
120
110
100
90
HWL
LWL
1
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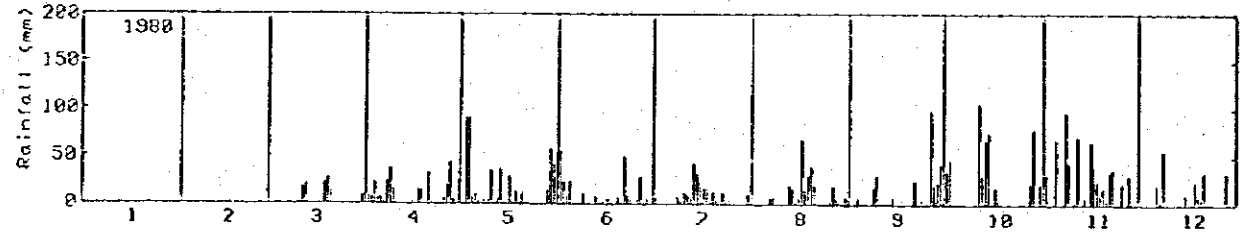
12


1980
Rainfall (mm)
200
150
100
50
0
1
2
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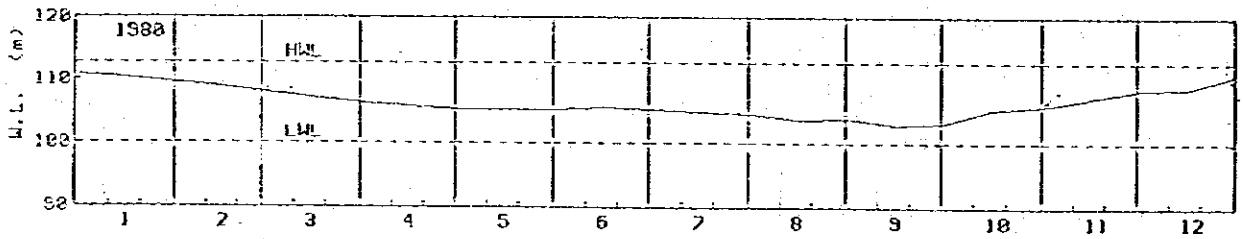
12


1980
W.L. (m)
120
110
100
90
HWL
LWL
1
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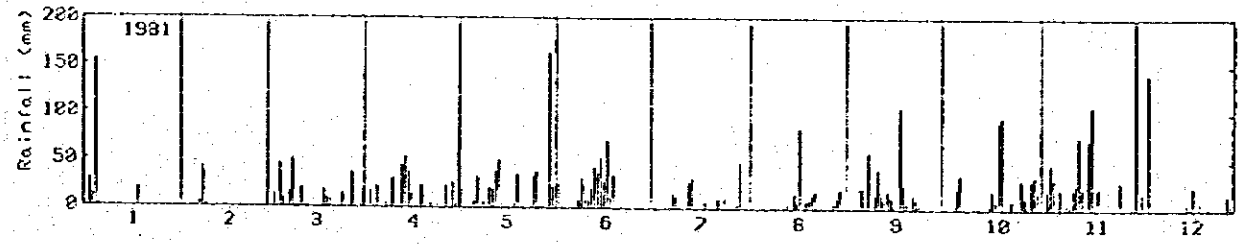
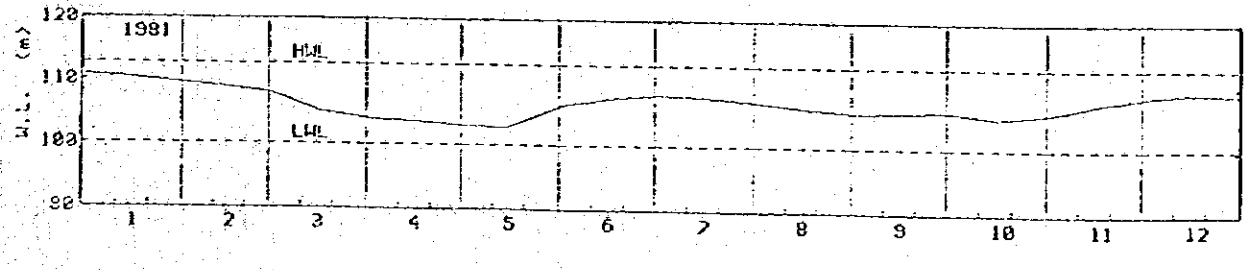
10
11
12


1981
Rainfall (mm)
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12


1981
W.L. (m)
120
110
100
90
HWL
LWL
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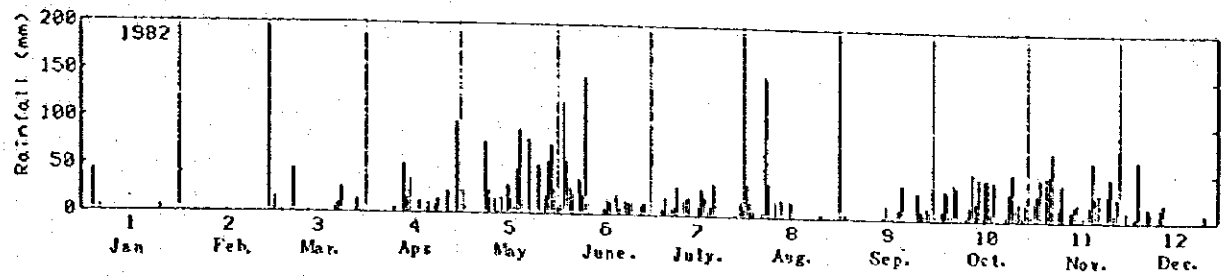
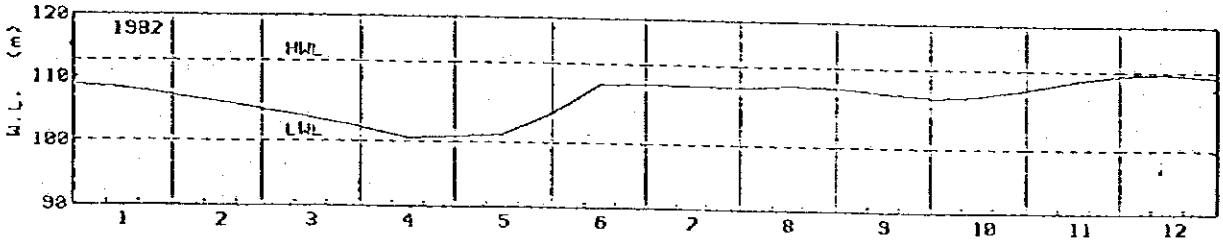
KALATUWAWA


1982
Rainfall (mm)
200
150
100
50
0
1 Jan
2 Feb.
3 Mar.
4 Apr
5 May
6 June.
7 July.
8 Aug.
9 Sep.
10 Oct.
11 Nov.
12 Dec.


1982
W.L. (m)
HWL
LWL
120
110
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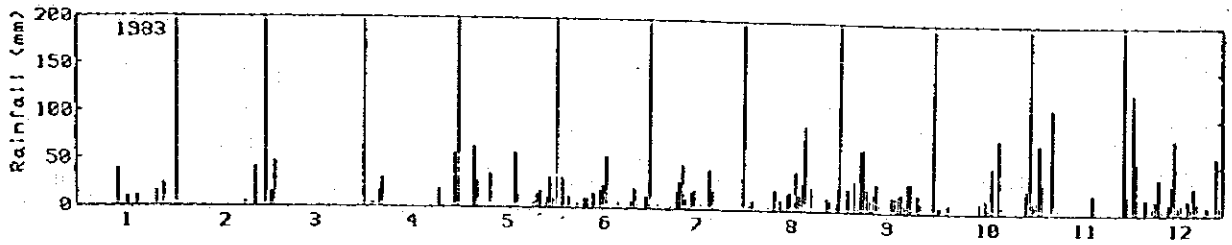
1983
Rainfall (mm)
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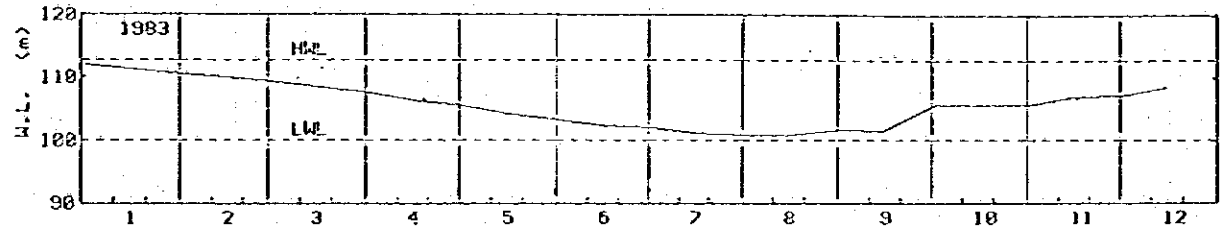
1983
W.L. (m)
HWL
LWL
120
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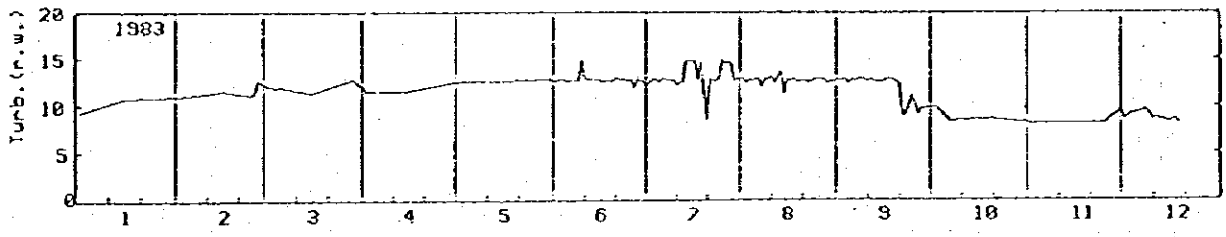
1983
Turb.(r.w.)
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15
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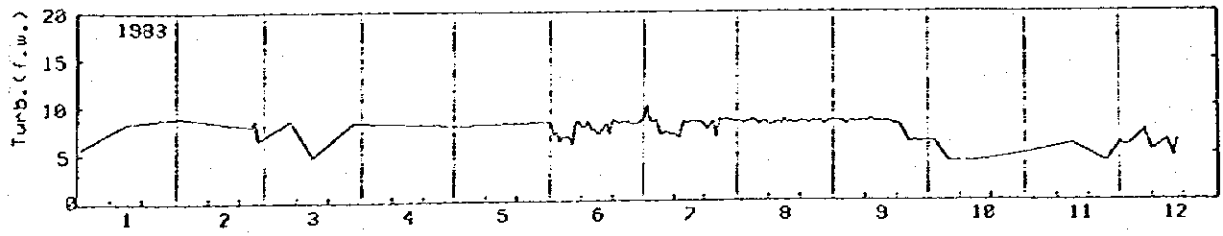
1983
Turb.(f.w.)
20
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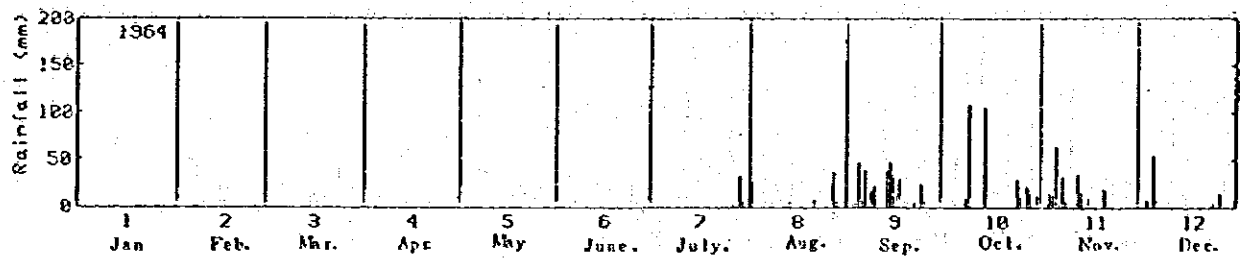
KALATUWAWA


1964
Rainfall (mm)
200
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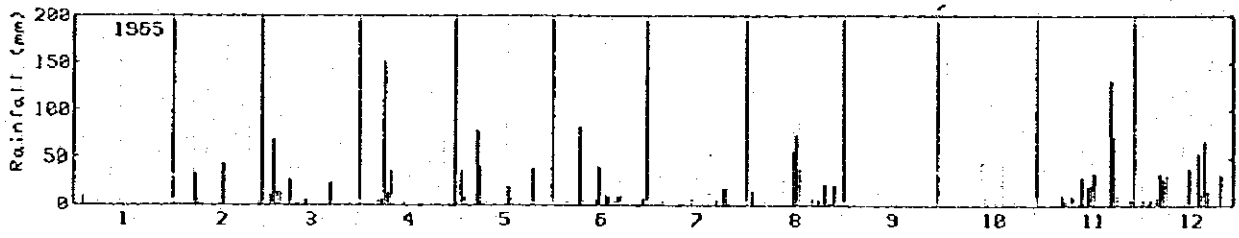
1 Jan
2 Feb.
3 Mar.
4 Apr
5 May
6 June.
7 July.
8 Aug.
9 Sep.
10 Oct.
11 Nov.
12 Dec.


1965
Rainfall (mm)
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150
100
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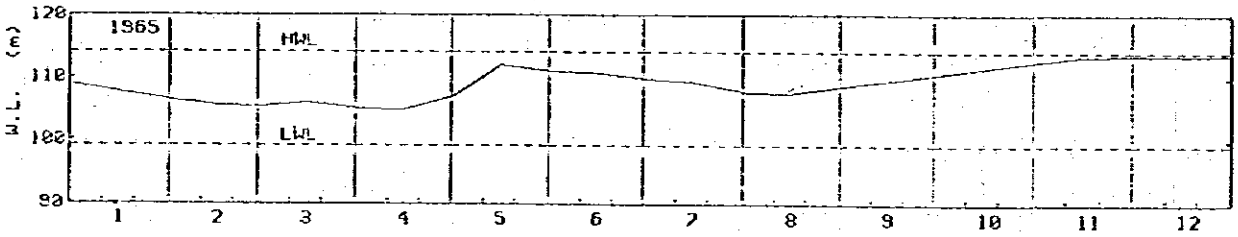
1965
W.L. (m)
120
110
100
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HWL
LWL
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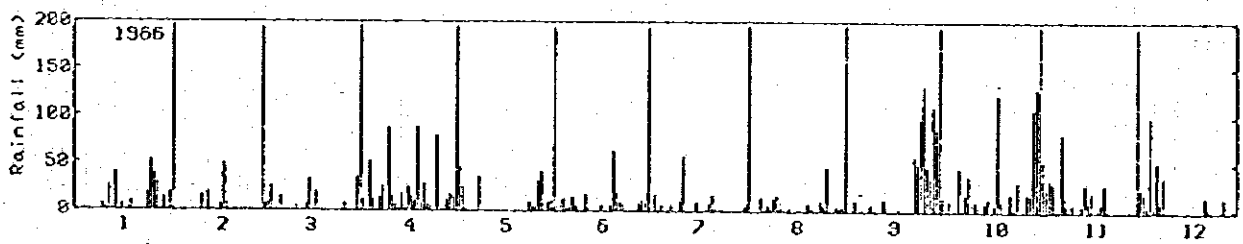
1966
Rainfall (mm)
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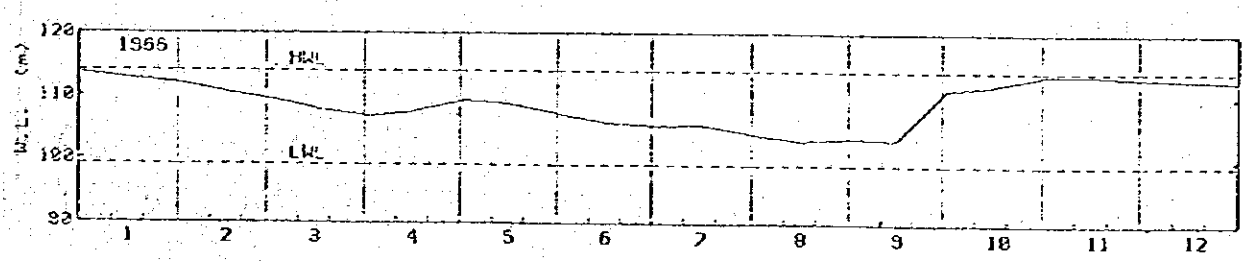
1966
W.L. (m)
120
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HWL
LWL
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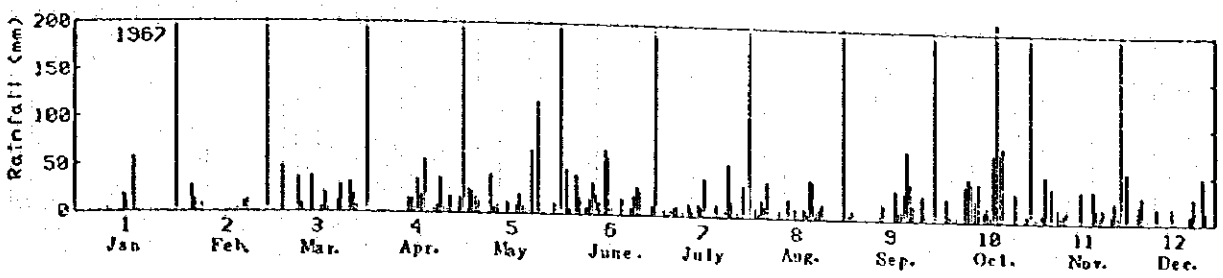
1967
Rainfall (mm)
200
150
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1 Jan
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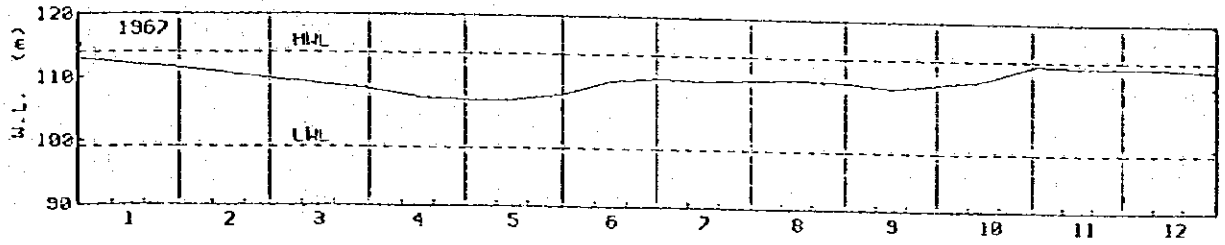
12 Dec.


1967
W.L. (m)
120
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HWL
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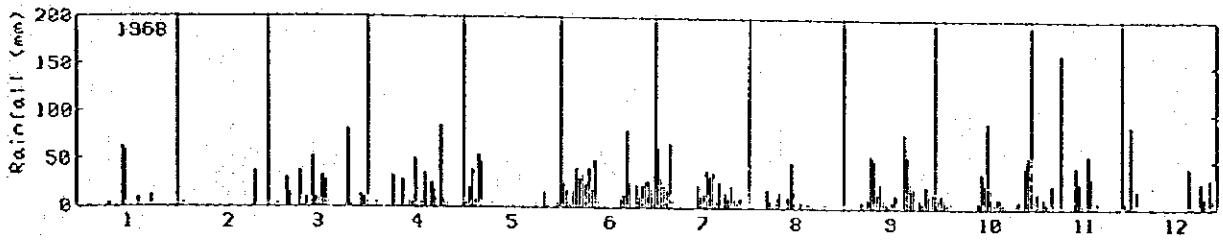
1968
Rainfall (mm)
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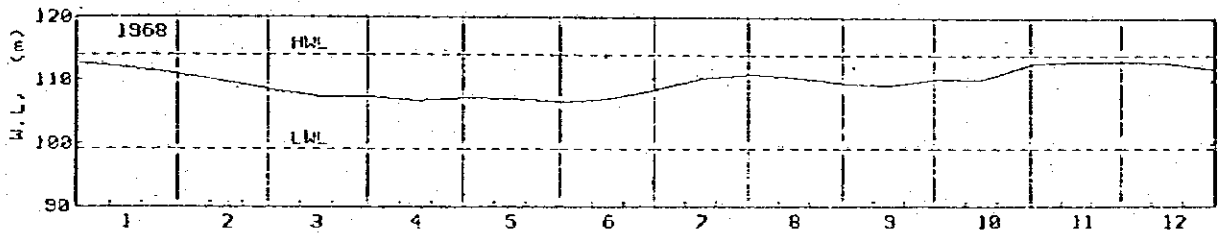
1968
W.L. (m)
120
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HWL
LWL
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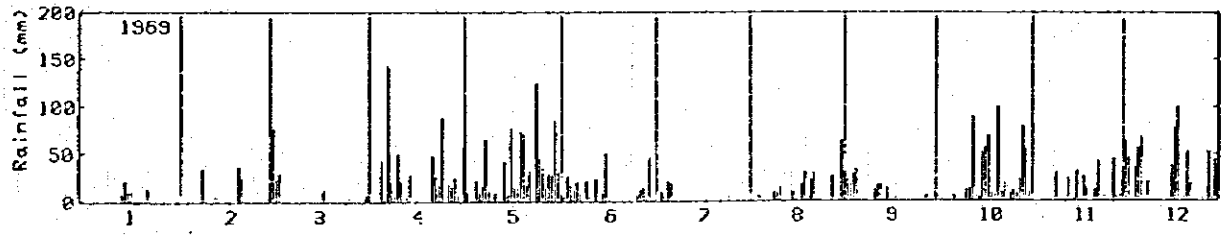
1969
Rainfall (mm)
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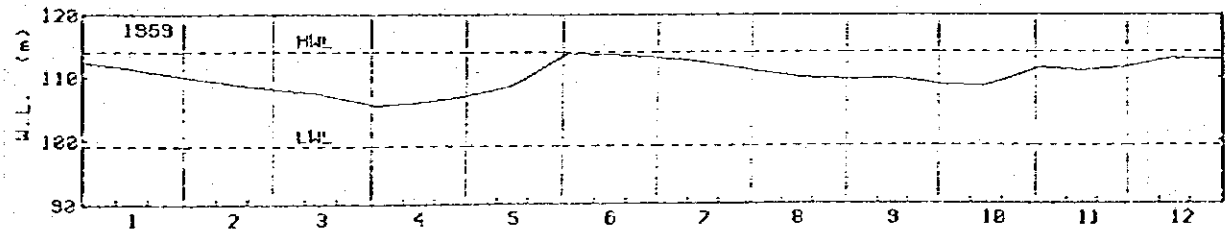
1969
W.L. (m)
120
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HWL
LWL
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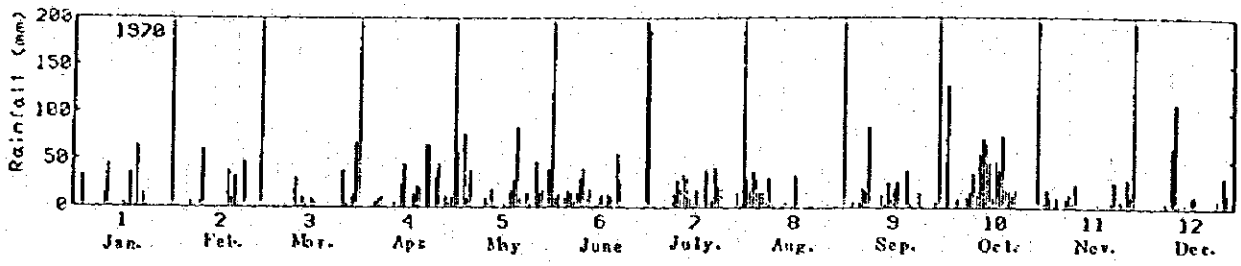
LABUGAMA


1978
Rainfall (mm)
200
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100
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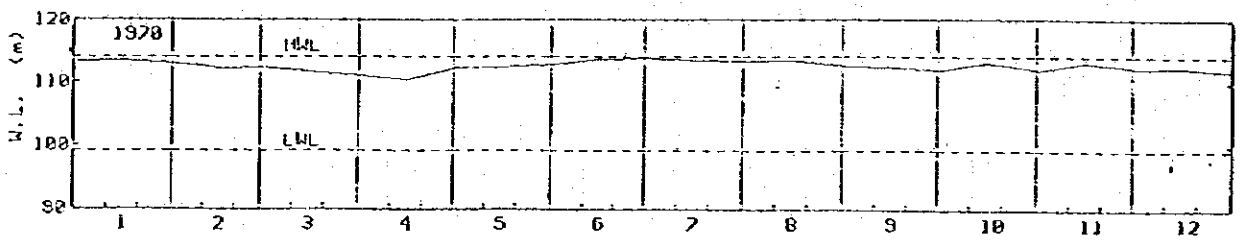
1 Jan.
2 Feb.
3 Mar.
4 Apr
5 May
6 June
7 July.
8 Aug.
9 Sep.
10 Oct.
11 Nov.
12 Dec.


1978
W.L. (m)
120
110
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HWL
LWL
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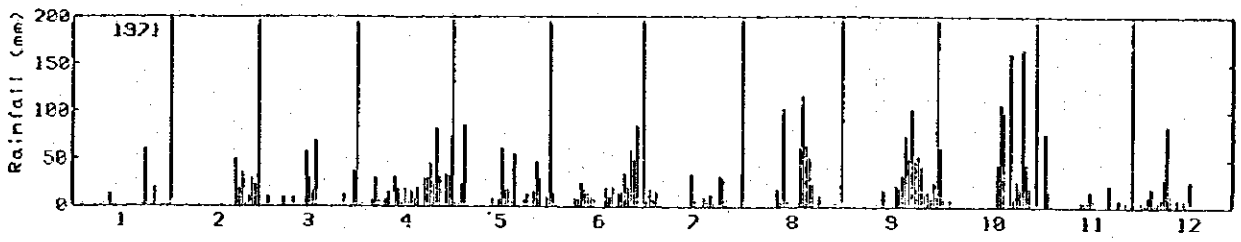
1971
Rainfall (mm)
200
150
100
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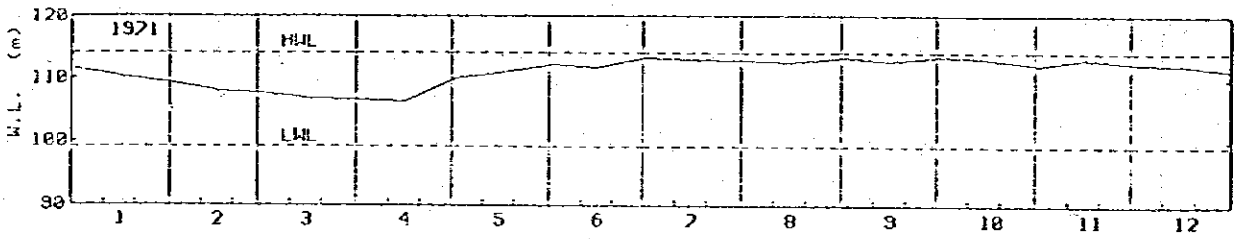
1971
W.L. (m)
120
110
100
90
HWL
LWL
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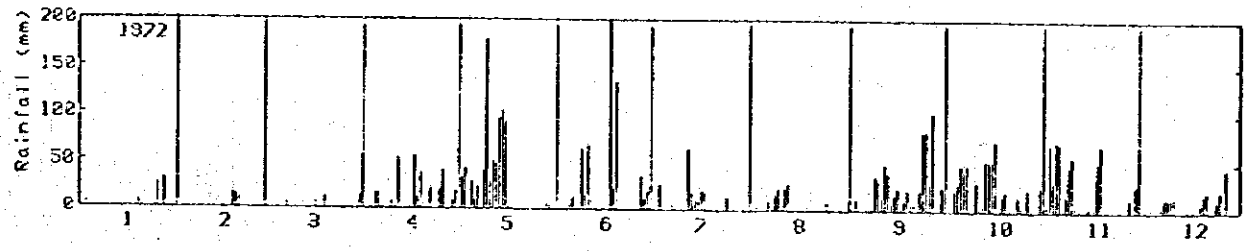
1972
Rainfall (mm)
200
150
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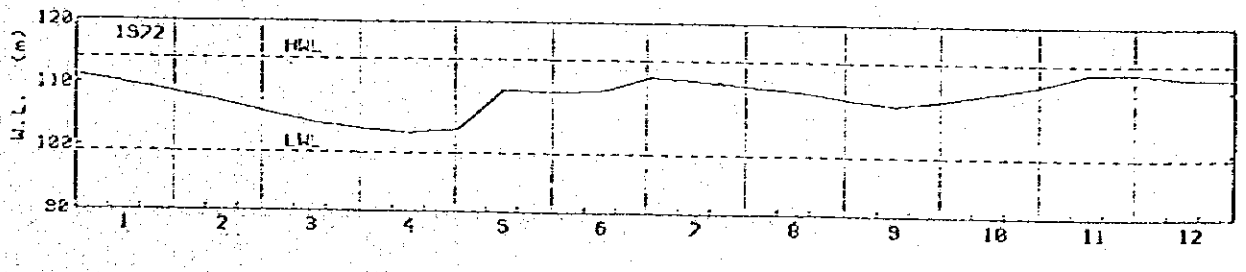
1972
W.L. (m)
120
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HWL
LWL
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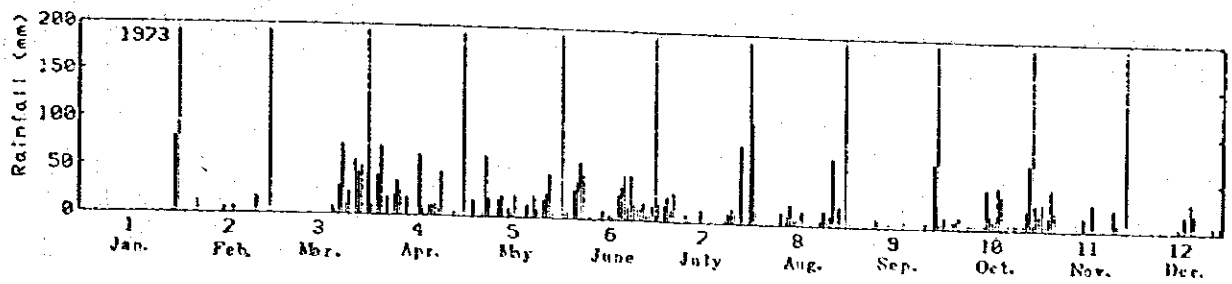
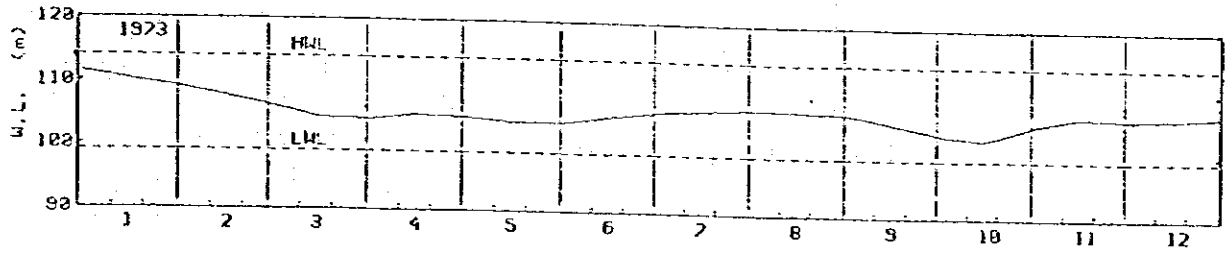
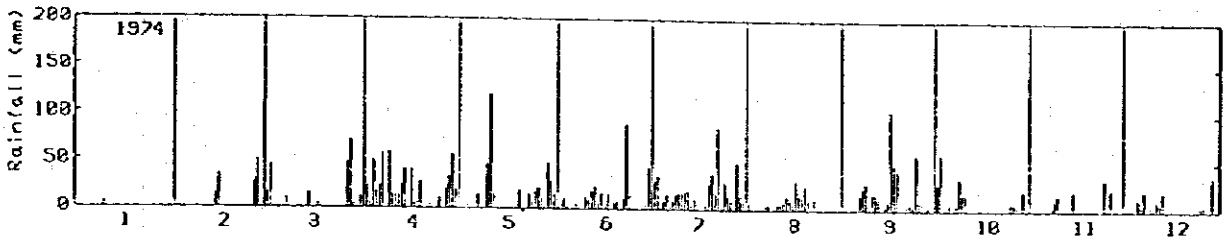
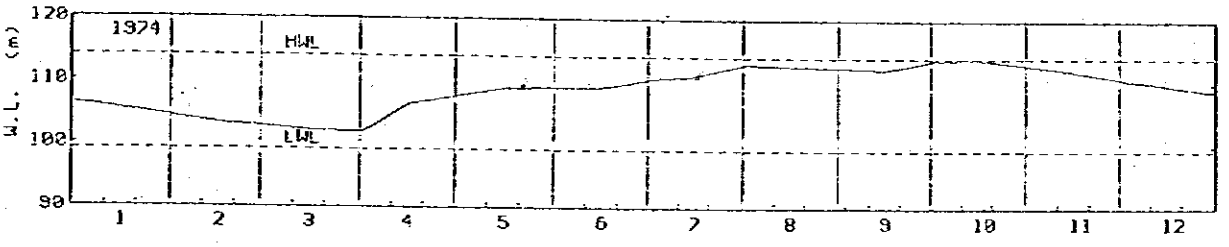
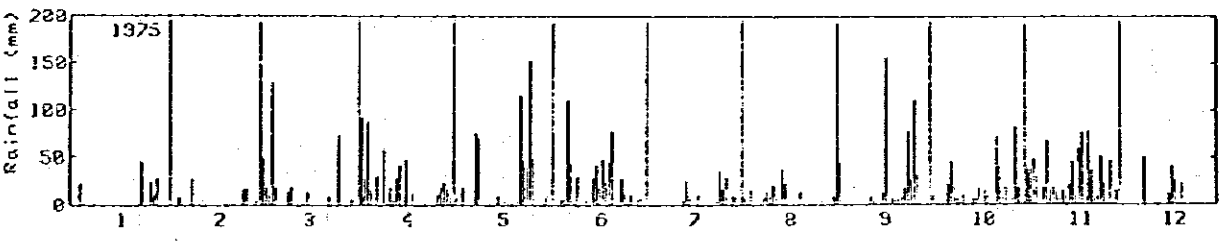
LABUGAMA

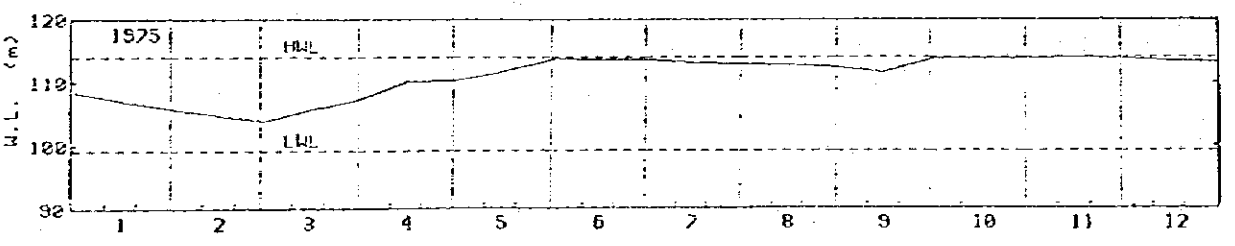

1973
Rainfall (mm)
200
150
100
50
0
1 Jan.
2 Feb.
3 Mar.
4 Apr.
5 May
6 June
7 July
8 Aug.
9 Sep.
10 Oct.
11 Nov.
12 Dec.


1973
W.L. (m)
120
110
100
90
HWL
LWL
1 2 3 4 5 6 7 8 9 10 11 12


1974
Rainfall (mm)
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12


1974
W.L. (m)
120
110
100
90
HWL
LWL
1 2 3 4 5 6 7 8 9 10 11 12


1975
Rainfall (mm)
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12


1975
W.L. (m)
120
110
100
90
HWL
LWL
1 2 3 4 5 6 7 8 9 10 11 12

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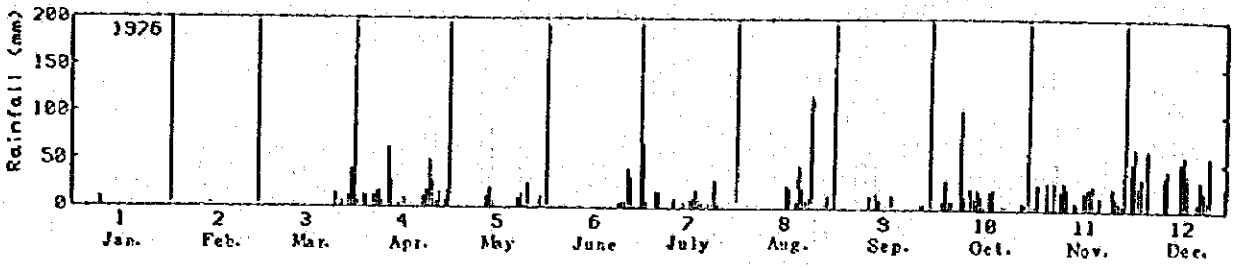
1976
Rainfall (mm)
200
150
100
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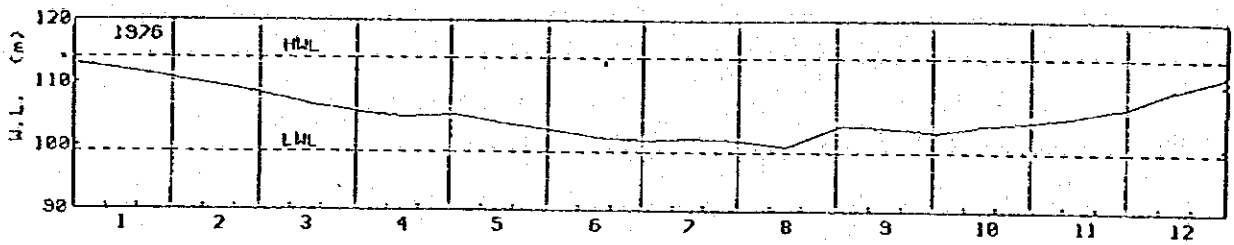
0
1 Jan.
2 Feb.
3 Mar.
4 Apr.
5 May
6 June
7 July
8 Aug.
9 Sep.
10 Oct.
11 Nov.
12 Dec.


1976
W.L. (m)
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HWL
LWL
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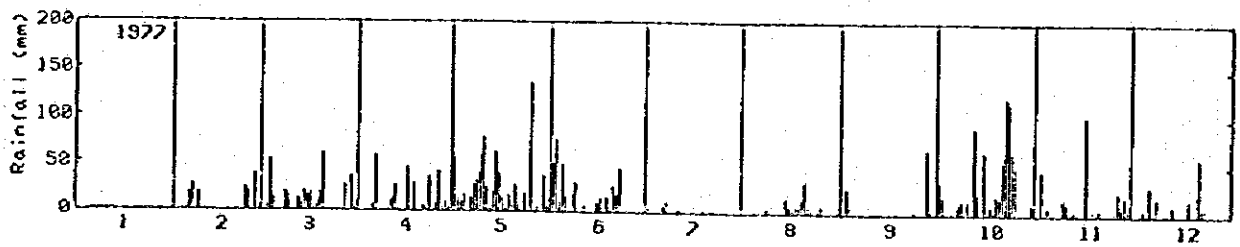
1977
Rainfall (mm)
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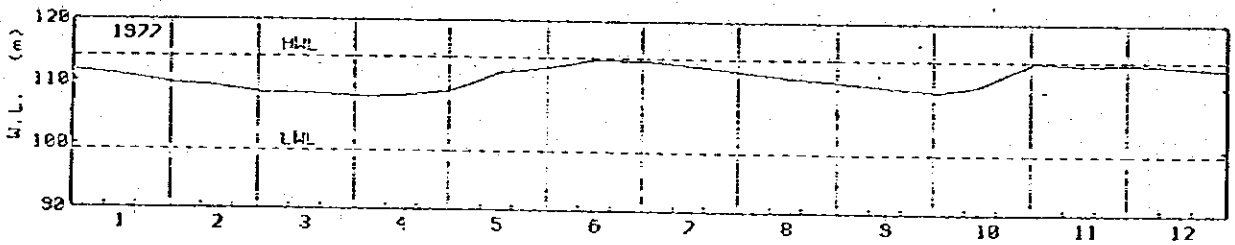
1977
W.L. (m)
120
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HWL
LWL
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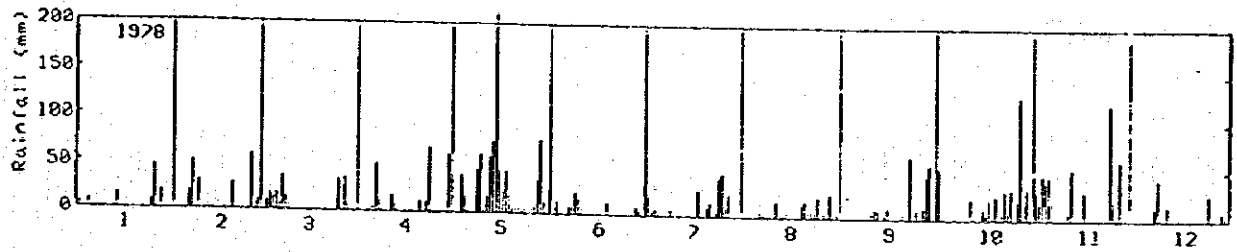
1978
Rainfall (mm)
200
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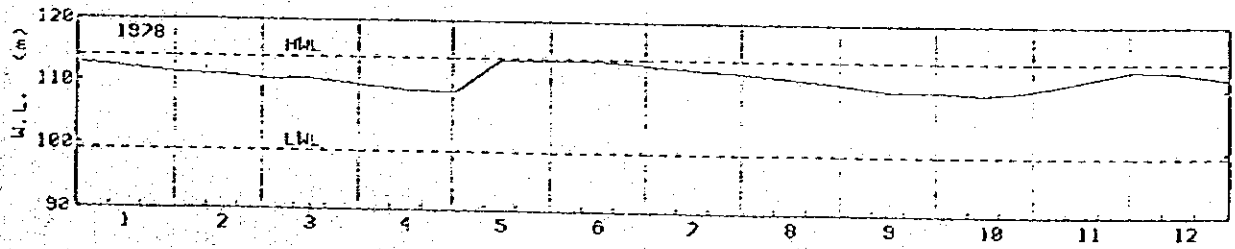
1978
W.L. (m)
120
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HWL
LWL
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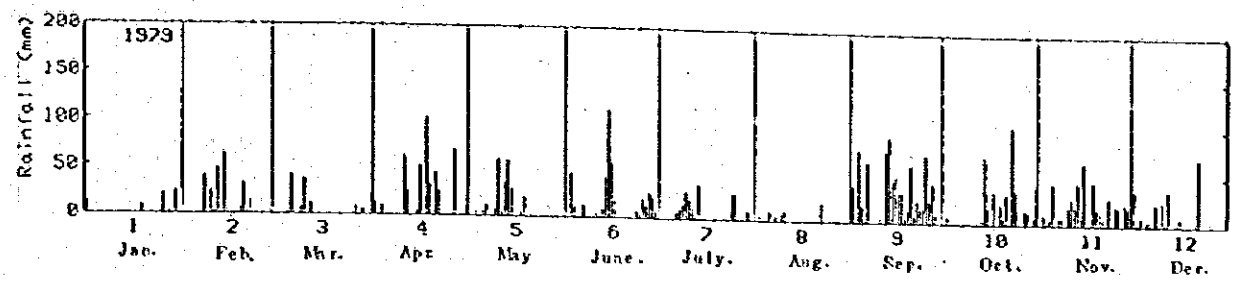
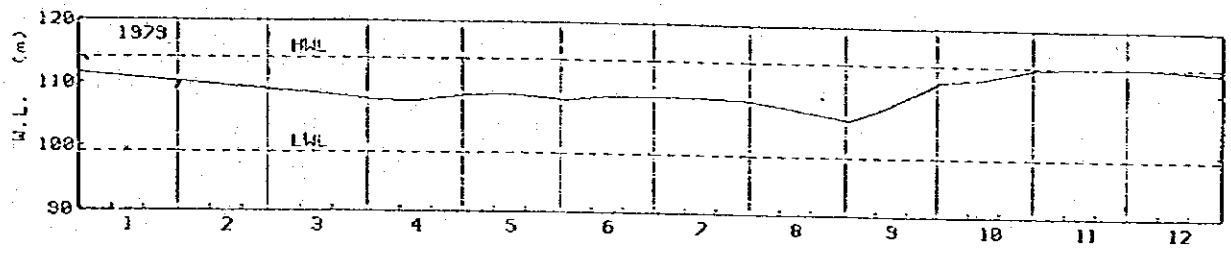
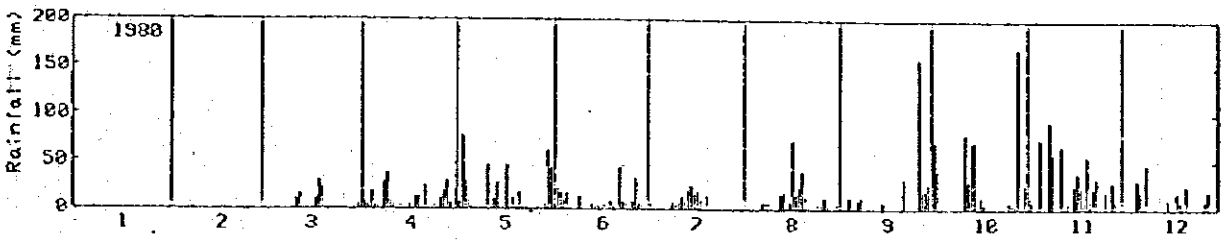
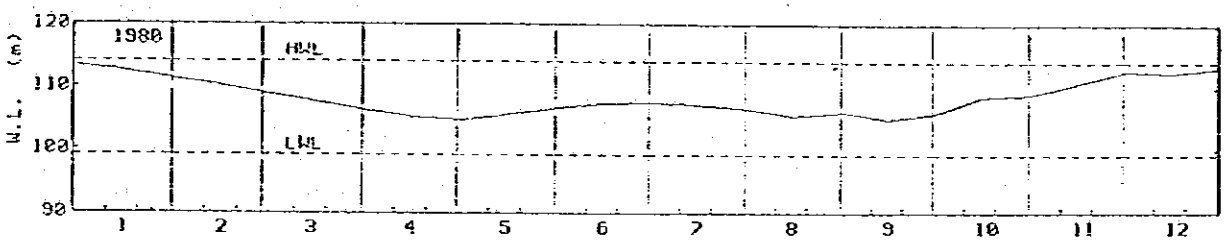
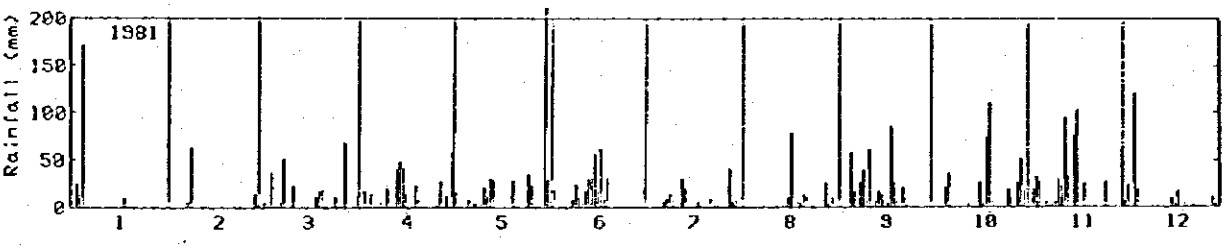

1979
Rainfall (mm)
200
150
100
50
0
1 Jan.
2 Feb.
3 Mar.
4 Apr.
5 May
6 June.
7 July.
8 Aug.
9 Sep.
10 Oct.
11 Nov.
12 Dec.


1979
W.L. (m)
120
110
100
90
HWL
LWL
1 2 3 4 5 6 7 8 9 10 11 12


1980
Rainfall (mm)
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12


1980
W.L. (m)
120
110
100
90
HWL
LWL
1 2 3 4 5 6 7 8 9 10 11 12


1981
Rainfall (mm)
200
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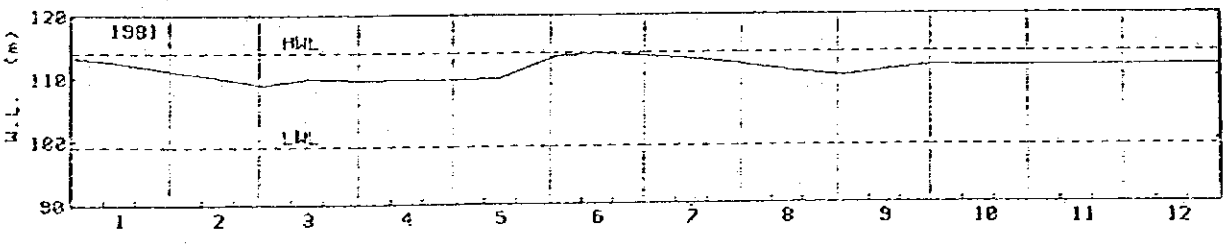
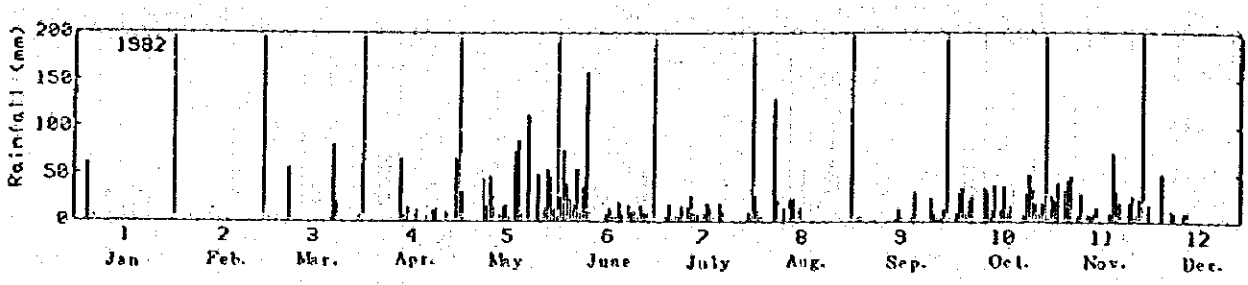
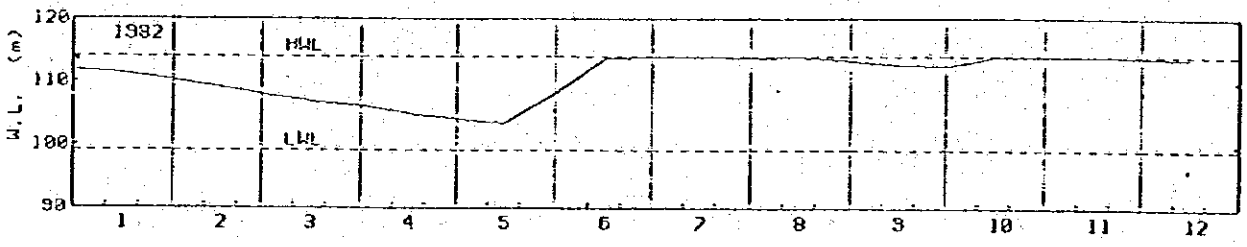
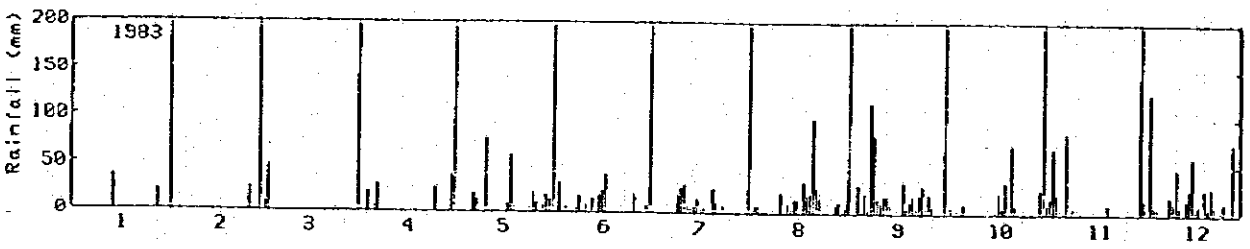
1 2 3 4 5 6 7 8 9 10 11 12


1981
W.L. (m)
120
110
100
90
HWL
LWL
1 2 3 4 5 6 7 8 9 10 11 12

LABUGAMA


1982
Rainfall (mm)
200
150
100
50
0
1 Jan
2 Feb.
3 Mar.
4 Apr.
5 May
6 June
7 July
8 Aug.
9 Sep.
10 Oct.
11 Nov.
12 Dec.


1982
W.L. (m)
120
110
100
90
HWL
LWL
1
2
3
4
5
6
7
8
9
10
11
12


1983
Rainfall (mm)
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12

LABUGAMA

TREATMENT PLANTS REHABILITATION PLAN

1. KALATUWAWA PLANT

This plant has treatment problems re: odor, colour, flocculation and sedimentation when the water level of the reservoir is low, during drought periods. Therefore the following shall be studies for the rehabilitation plan.

(1) Aeration facilities
(2) Flocculation facility
(3) Sedimentation basin
(4) Collector trough
(5) Sludge collector

The study shall cover conceptual technical design only.

Design Basis

Flow quantity 20 MGD = 91,000 m3/d = 3,792 m3/H = 63.2 m3/min

Criteria ---- Japanese Design Criteria For Water Supply Facilities

(1) Aeration facility

The capacity of the existing facility is less than the required criteria, therefore expansion is necessary for the following pruposes:

(a) Removal of iron and manganese
(b) Removal of H_2S which occurs when the reservoir water level is low
(c) Reduction of chlorine demand and usage

(d) Increase of DO.

Considering (1) location and existing conditions, (2) conservation of energy, and (3) ease of operation and maintenance, the aeration method shall be selected as shown on the following drawings.

Upon completion of expansion, the facility is proposed to have about 1.5 times the existing capacity.

(2) Flocculation

The flocculation is generally achieved by machines or natural up-down flow techniques. Considering the ease of operation and maintenance energy conservation, the natural up-down flow type of floccuation shall be adopted for this Plant.

System

Design Basis - Flow quantity 63.2 m3/min; detention time 20 min.
Capacity - V = 63.2 m3/min x 20 min = 1,264 m3
(Existing sedimentation capacity 59m (L) x 3.5m (W) x 2 basins = 6,112 m3, Effective capacity = 6,000 m3)

Because the flocculation basin will be constructed in the existing sedimentation basin due to the limited space at existing sedimentation basin area, the width and depth are already fixed. Therefore the length will be determined as follows.

L = Volume/Width x Depth = 1,264 m3/14.8 x 4.8 x 2 lasions = 8.9 m

A flocculation basin had to be constructed in the existing basin.

The capacity of the flocculation tank shall be based on an assumed average depth of 4.5 m.

9.5m (L) x 14.8m (B) x 4.5m (H) x 2basins = 1,265 m3

Four 20 cm thick interior basin walls will be constructed and the space before entering the sedimentation basin of 1.5 m is necessary.

Therefore the dimensions of the basin are as follows.

Length (11.8m) x Depth (4.5 m) x Width (14.8) x 2 basins.

Four up-down flow walls are considered appropriate for this wide basin.

(3) Sedimentation basin

The existing sedimentation basin capacity is about
6,000 m3 (L(59m) x Average H (3.5m) x W(14.8m) x 2 basin = 6,112 m3
Efficient Capacity 6,000 m3)

The detention time is 95 min (T = 6,000 m3/63.2 m3/min)

Moreover part of the existing basin will be used for flocculation, resulting is lower sedimentation efficiency from this reduced short detention time. Therefore a multiple inclined plantes system shall be used for sedimentation.

Design criteria - plate efficiency 75%, sedimentation velocity plate 0.55 m/H, pitch 100 mm, flow quantity for one basin 1,896 m3/H

(a) Minimum sedimentation area A = 1.896 m3/0.55 m/H = 3,447 m2
(b) one plate area a = 1m x 0.92m = 0.92 m2
(c) 60° linked efficient area a'= 0.92 m2 x Cos 60° = 0.46 m2
(d) Number of plates required N = 3,447 m2/0.46 m2 x 0.75 = 9,991 plates/basin
(e) array Width = 14.8m, pitch = 100 mm, 3 stories
(f) Number of plates in a story 14,800mm/100mm - 2 = 146
(g) Number of rowns 9,991/146 x 3 stories = 22.4 24
(Total plates 146 x 3 x 24 x 2 = 21,024)

Detention time and velocity

(a) In plates

Area 14.8m (W) x 25.1 m (Actural depth of plates) = 37.15m2

Velicity V = 1,896 m3/H/37.15 m2 = 51 m/H = 0.85 m/min

Detention time

T = 14.8m x 1.51m x (24 x 1.05)/1,896 m3/H

= 0.496Hr = 29.6 min

B) Sedimentation basin

Considering total plate length (25.2m), spaces before and after plates (1.5m x 2), and spaces between plates (1m x 3 places), the total length of sed sedimentation basin was calculated as 31.2 m. Average depth is 2.8 m. Therefore,

Volume V= 14.8m (W) x 31.2 m (L) x 2.8 m(H) = 1,293 m3

Detention time T = 1,293 m2/1,896 m3/H = 0.68 = 40.9 min

(4) Collector trough

The existing water collection weirs are overloaded. Therefore the collector trough shall be installed within proper collector load.

(a) Trough length 91,000 m3/d/380m3/d/m x 2 basin = 120m

(b) Number of trough (Assumed a unit length is 6 m)

120m/6m x 2 basin = 10 trough/basin

(5) Sludge collector

For easy collection of sludge, the bottom of basin preferablly should be formed by concrete. The desludging and clearning of the basin shall be done properly and frequently.

2. LABUGAMA PLANT

The treatment capability is low due to the outworn facilities, therefore the following shall be considered for rehabilitation plan.

(1) New construction of aeration facility
(2) Chemical mixing channels
(3) Flocculation basin
(4) Sedimentation basin
(5) Collector trough
(6) Sludge collector

Design Basis

Flow quantity - 13 MGD = 59,150 m3/d = 2,465 m3/H = 41.1 m3/min
Criteria - Japanese Design Criteria For Water Supply Facilities

(1) Aeration facility

The aeration system will follow the Kalatuwawa's design basis as previously described.

(2) Chemical mixing channels

Chemical mixing channels are not provided at this plant. For efficient mixing with chemicals without any electric powers, the system used at the Kalatuwawa Plant shall be adopted. Using natural flow in channels with buffle plates followed by the aeration facility, chemical will be mixed properly. Alum and line will be mixed in the channel before the aeration facility and chlorine will be added followig aeration.

(3) Flocculation

No flocculation facilities are provided now. For efficient sedimentation, flocculation facilities shall be constructed. The same system proposed for Kalatuwawa Plant, namely a natural up-down flow system, will be constructed here.

System

Design Basis flow quantity 41.1 m3/min,
Detention time 20 min

Capacity V = 41.1 m3/min x 20 = 822 m3

(Existing sedimentation capacity 40m (L) x 4 m(H) x 12 m(W) x 1 basin = 19.20m Efficient volume 1,800 m2)

Due to no available land space around the existing sedimentation basin, flocculation facilities shall be constructed in the existing sedimentation basin. For Operation and Maintenance of the basin, the existing basin will be divided by a newly constructed concrete wall.

The width of the basin will be 5.8m where the dividing walls thickness takes 40cm. For effective flocculation at short width basin, a six steps up-down flow flocculation system was selected. The total length of the flocculation basin will be about 12 m which is proper, considering the sedimentation basin discribed below and the space for trough.

Depth (H) = 822 m3/12m (L) x 5.8 (W) x 2 basin = 5.9m

Considering 30 cm from the water level to the top of the wall, about 2.2m to 2.5 m of additional walls shall be constructed on the existing walls which have 4 m in hights.

Flocculation basin 5.8 (W) x 6.5 (H) x 12m (L)
(Include 1m of space before entering the sedimentation basin)

(4) Sedimentation basin

The existing capacity is approximately 1,800 m3 (40m(L)) x 4m (H) x 12m (W) 1 basin = 1,920 m3, Efficient capacity = 1,800m)

Previous detention time is T = 1,800m3/41.1m3/min = 43 min which is substantially less than the criteria. To increase the sedimentation efficiency in in an existing small basin, the inclined plates sedimentation system is recommended.

Design criteria - Plate efficiency 75%, sedimentation volocity 0.55m/H

Plate pitch 80mm, flow capacity for one basin 1,232.5 m3/H

(a) Minimum sedimentation area A = 1,232.5 m3/H/0.55m/H = 2.24m2
(b) One plate area a = 1m x 0.92m = 0.92 m2
(c) 60° linked efficient area a'= 0.92m2 x Cos 60° = 0.46 m2
(d) Necessary plates number N = 2,241 m2/0.46m2 x 0.75
= 6,496
(e) Array Width = 5.8m, pitch = 80mm, 5 stories
(f) Number of plates in a story 5,800mm/80mm - 2 = 70
(g) Number of rows 6,496/70 x 5 stories = 18.56 - 18 rows
(Total number of plates 70 x 5 x 18 x 2 = 12,600)

Detention time and velocity

(a) Inside plates
Area 5.8 m (W) x 4.19m (Average depth of plates) = 24.3 m2
Velocity V = 1,232.5m3/H/24.3m2 = 50.7m/H = 0.845m/min
Detention time T = 5.8 x 4.19 x (18 x 1.05)/1,232.5 m3/H
= 0.373H = 22.4 H

(b) Whole Sedimentation basin

Considering the total plate length (18.9m), spaces before and after plates (1.5 m x 2) and spaces between places (0.6m x 1place), the total length of sedimentation basin was figured as 22.5 m.

Average depth is 4.4m. Therefore,

Volume V = 5.8 (B) x 22.5m (L) x 4.4m (H) = 574.2 m3

Detention time T = 574.2 m3/1,232.5 m3/H = 0.466H = 28 min

(5) Collector trough

This existing water collector weirs are overloaded. Therefore the collector trough shall be installed with a proper collector loading rate.

(a) Trough length (Max load is 500 m3/d/m)

29,575 m3/d/500 m3/d/m = 59.15 m 60 m

(b) Number of troughs

Assumed minin=mum space between troughs is 60 cm

Therefore the number of troughs is calculated as 6.

Unit length = 60 m/2(both sides) x 6 = 5 m/unit

(6) Sludge Collectors

The capacity, systems and efficiency etc. of the existing sludge collectors are unknown. Therefore, sludge collector pits preferablly should be constructed by concrete and also collecting pipes with valves should be installed.

SRI LANKA WATER QUALITY STANDARD

Sri Lanka Standard

SPECIFICATION FOR POTABLE WATER

PART 2 - BACTERIOGICAL REQUIRMENTS

PROCEDURE

This Sri Lanka Standard was authorized for adoption and publication by the Council of the Bureau of Ceylon Standards on 83-12-20 after the draft, finalized by the Drafting Committee on Potable Water had been approved by the Agricultural and Food Products Divisional Committee.

This specification covers the quality of water used for drinking purposes. The specification consists of two parts, Part 1 Dealing with the physical and chemical requirements and Part 2 Dealing with the bacteriological requirements of drinking water. Bacteriological examination of water is necessary in determining its fitness for use for human consumption, and for use in food processing industries.

For the purpose of deciding whether a particular requirment of this specification is complied with, the final value, observed or calculated expressing the result of a test or analysis shall be rounded off in accordance with CS 102. The number of significant places retained in the rounded off value should be the same as that of the specified value in this specification.

In the preparation of this specification the valuable assistance obtained from the relevant publications of the Worl Health Organization and the Department of Health and Social Security of the Ministry of Housing and Local Government of the United Kingdom, is gratefully acknolwedge.

1 SCOPE

This part of the specification prescribes the bacteriological requirements and the methods of sampling and testing drinking water.

2 REFERENCES

CS 102 Presentation of numerical values.

3 REQUIREMENTS

The bacteriological requrements for potable water are based on the examination of several samples taken from the supply source under different conditions. The samples obtained as prescribed in 4, when examined by the methods given in Appendix A, shall comply with the following requirements:

3.1 Pipe borne public water supplies

3.1.1 Throughout any year, 95 per cent of the samples shall not contain any coliform organisms in 100 ml.

3.1.2 None of the samples examined shall contain more than 10 coliform organisms per 100 ml.

3.1.3 Coliform organisms shall not be detectable in 100 ml of any two consecutive samples.

3.1.4 None of the samples examined shall contain E. coli in 100 ml.

3.2 Indivisual or small community supplies

3.2.1 None of the samples examined shall contain more than 20 coliform organisms per 100 ml on repeated examination.

3.2.2 No sample shall contain E. coli in 100 ml.

NOTE - Individual or small community supplies include wells, bores and springs.

4. SAMPLING

4.1 General requirements of smapling

4.1.1 Sample containers
When a number of samples for various purposes are being collected from the same sampling point, the sample for bacteriological examination shall be collected first.

4.1.2 Sample containers
These shall be sterilized glass bottles (see 4.1.3). They shall be fitted with ground glass stoppers or metal screw caps and the stopper and neck of the bottle shall be protected from contamination by a suitable cover either of Aruminium foil or other suitable material, alternatively screw-capped bottles may be protected by fixing to the cap an aluminium test tube cover slightly larger than the cap. Silicone rubber linors, which will withstand repeated sterilization at 170°C shall be used inside the screw-cap.

4.1.3 Sterilization of containers
All bottles shall be wrapped in Aluminium foil or other suitable material and sterilized before use, wither by exposure to hot air in an oven (see A.2.2.2) or by exposure to saturated steam in an autoclave (see A.2.2.). The bottle shall be maintained in a sterile condition until used.

4.1.4 Opening and filling the bottles
The bottle shall be kept unopened until the moment it is required for filling. During sampling, the bottle shall be held by the base in one hand, while with the other hand the stopper and cover are removed together. The bottles shall be filled, without rinsing, and the stopper shall be replaced immediately. The stopper shall finally be secured by capping with a piece of clean linen or parchment paper.

4.1.5 Sampling instruments
Suitable sampling instruments shall be used for taking samples from different locations and sources. Sampling instruments shall be sterilized (See 4.1.3 before taking the samle.

4.1.6 Nutralization of chlorine and chloramine

If the water to be sampled contains, or is likely to contair, traces of chlorine, chloramine, or ozone it is necessary to add to the sampling bottles, before sterilization a sufficient quantity of sodium thiosulphate ($Na_2S_2O_3 \cdot H_2O$) to neutralize these substances. It has been shwon that 0.1 ml of a 3 per cent solution of crystalline sodium thiosulphate in a 170-ml bottle has no signficant effect on the coliform of E. coli content of unchlorinated water during 6 hours store. This amount of sodium thiosulphate is sufficient to neutralize up to at least 5 mg 1 of residual chlorine, and it is therefore recommended that it should be added to all bottles used for the collection of samples for bacteriological examination. If samples of chlorine water are taken, it is desirable to determine the content of chlorine at the sampling point.

4.1.7 Preservation of sample

4.1.7.1 Examination for bacteriological quality shall preferably be started within one hour of collection of the sample. In any case the interval between collection of the sample and beginning of the examination shall not exceed 24 hours.

4.1.7.2 If the time interval between collection and examination is to exceed one hour the sample shall be transported to the loboratory in iced collers (ideally samples should be held at 4 + 2°C). Samples shall not be drozen.

4.1.8 Labelling

An identification number shall be marked on each container and the following information shall be provided with the sample.

4.1.8.1 Name and address of person requesting the examination;

4.1.8.2 Reason for examination, whether routine sample or otherwise.

4.1.8.3 Source, for example, wells, bores or piped supply;

4.1.8.4 Exact place from which the sample was taken. If from a house-tap whether drawn through a storage tank or directly from the main line;

4.1.8.5 Whether water has been filtered, chlorinated or otherwise treated;

4.1.8.6 If from a well, approximate depth of well and of water surface from ground level, whether covered or uncovered and whether recently constructed or altered:

4.1.8.7 Observation on any possible sources of pollution in the vicinity and their appropriate distance from the sampling point

4.1.8.8 Data and time when sample was taken and despatched; and

4.1.8.9 Name, address and signature of person drawing samples

4.1.9 Frequency of sampling for maintenance water

The recommended maximum intervals between successive samples and minimum numbers of samples to be examined each month are given in Table-1.

Table-1 Frequency of Sampling for pipe borne water

Population served	Maximum interval between successive samples	Minimum number of smaples to be taken from whole distribution system each month
Less than 20,000	1 month	1 sample per 5,000 population
20,001 to 50,000	2 weeks	
50,001 to 100,000	4 days	
More than 100,000	1 day	1 sample per 10,000 population

TABLE 1 - Physical requirements

Characte-ristir (1)	Maximum desirable level (2)	Maximum permiss-ible level (3)	Method of test (ref. to publi-cation in Caluse 5) (4)	Technique of the method (5)
Colour	5 units	30 units	1	Colorimetry - Tristimulus filter method (Reference method) Colorimetry - Visual comparision method Colorimetry - Soectrophotometric method
Odour	Unobject-ionable	Unobject-ionable		Sensory evaluation
Taste	Unobject-ionbale	Unobject-ionable		Sensory evaluation
Turbidity	2 Jackson turbidity units	8 Jackson turbidity units	1	Visual methods - Candle turbidimeter (Reference method)

NOTE - Sevelral methods of test have been given for each parameter in colum 5 of Tables 1,2,3 & 4. One method has been indicated as the reference method which is to be used in case of dispute.

3.2 Chemical requirements

3.2.1 Water shall conform to the chemical requirements specified in Table 2.3 and 4. Ths characteristics speficied in Table 3 and 4 shall be tested only if considered appropriate for a particular location or on request.

TABLE 2 - Chemical requirements (Basic)

Substance or Characteristic	Maximum desirable level	Maximum permissible level	Method of test (Ref. to publications in Clause 5 and relevant Appendices	Technique of the method
(1)	(2)	(3)	(4)	(5)
PH range	7.0-8.5	6.5-9.0	1	Electrometry - By means of pH meter with glass electrodes (Reference method)
			2	Colorimetry
Electrical conductivity	750 s/l	3,500 s/l	1	Conductometry (Reference method)
Chloride (as Cl)	200 mg/l	1,200 mg/l	1	Titrimetry - Silver nitrate method (Reference method)
			1	Titrimetry - Mercuric nitrate method
Free residual chlorine (as Cl_2)		0.2 mg/l	1	Colorimetry - DPD colorimetric method (Reference method)
Alkalinity (total as $CaCO_3$)	200 mg/l	400 mg/l	1	Titrimetry - Visual titration (Reference)
			2	Titrimetry - Electrometric titration
Free Ammonia		0.06 mg/l	Appendix B	Colorimetry - Nesslerization (Reference method)
			1	
			2	Colorimetry - Phenate method
Albuminoid ammonia		0.15 mg/l	Appendix B	Colorimetry - Nesslerization (Reference method)
Nitrate (as N)		10 mg/l	1	Ultraviolet spectrophotometric method (Reference method)
			1	
			2	Colorimetry - Brucine method
			Appendix C	Colorimetry - Phenoldisulphonic cid method

Cont'd ..... Table 2.

Substance or Characteristic	Maximum desirable level	Maximum permissible level	Method of test (Ref. to publications in Clause 5 and relevant Appendices	Technique of the method
(1)	(2)	(3)	(4)	(5)
Nitrite (as N)		0.01 mg/l	1 2	Colorimetry - Diazotization method (Reference method)
Fluoride	0.6 mg/l	1.5 mg/l	1	Selective ion electrode method (Reference method)
			1	Colorimetry - Alizarin visual metthod.
Total phosphates (as PO_4)		2.0 mg/l	1	Colorimetry - Vanadomolybdophosphoric acid colorimetric method (Reference method)
Total residue	500 mg/l	2,000 mg/l	2	Gravimetric method (Reference method)
Total hardness (as Fe)	250 mg/l	600 mg/l	1	Titrimetry - EFTA titrimetric method (Reference method)
Total iron (as $CaCO_3$)	0.3 mg/l	1.0 mg/l	1	Colorimetry - Phenanthroline mtehod (Reference method)
Sulphate (as SO_4)	200 mg/l	400 mg/l	1	Gravimetric method, ignition of residue (Reference method)
			1	Gravimetric method, drying of residue
			1	Turbidimetry - Turbidimetric method

TABLE 3 - Chemical Requirement (Optional)

Substance or Characteristic	Maximum desirable level	Maximum permissible level	Method of test (Ref. to publications in Clause 5 and relevant Appendices	Technique of the method
(1)	(2)	(3)	(4)	(5)
Anionic detergents	0.2 mg/l	1 mg/l	1	Colorimetry - Methylene blue method for methylene blue active substances (Reference method)
Phenolic compounds (as phenolic OH)	0.001 mg/l	0.002 mg/l	1	Colorimetry - Chloroform extration method (Reference method)
Grease and oil		1.0 mg/l	1	Gravimetric method (Reference method)
Calcium (as Ca)	100 mg/l	240 mg/l	1	A.A* spectrophotometric method (Reference method)
			1	Titrimetry - EDTA titrimetric method
Magnesium (as Mg)	Not more than 30 mg/l if there are 250 mg/l of sulphate. If there is less sulphate, magnesium upto 150 mg/l may be allowed	140 mg/l	1	A.A spectrophotometric method (Reference method)
			1	Titrimetry - Magnesium by clculation (EDTA calcium and hardness titration)
Copper (as Cu)	0.05 mg/l	1.5 mg/l	1	A.A Spectrophotometric method (Reference method)
			1	Colorimetry - Bathocuproine method (Reference method)

Cont'd ..... Table 3.

Substance or Characteristic	Maximum desirable level	Maximum permissible level	Method of test (Ref. to publications in Clause 5 and relevant Appendices	Technique of the method
(1)	(2)	(3)	(4)	(5)
Manganese (as Mn)	0.05 mg/l	0.5 mg/l	1	A.A Spectrophotometric method (Reference method)
			1	Colorimetry - Periodiate method for potable water
Zinc (as Zn)	5.0 mg/l	15 mg/l	1	A.A Spectrophotometric method (Reference method)
			1	Colorimetry - Dithizone method II
Aluminium (as Al)		0.2 mg/l	1	A.A Spectrophotometric method (Reference method)
Pesticide residue		As per WHO FAO requirements	2	Gaschromatography (Reference method)
COD (Chemical oxygen demand)		10 mg/l	1	Titrimetry (Reference method)