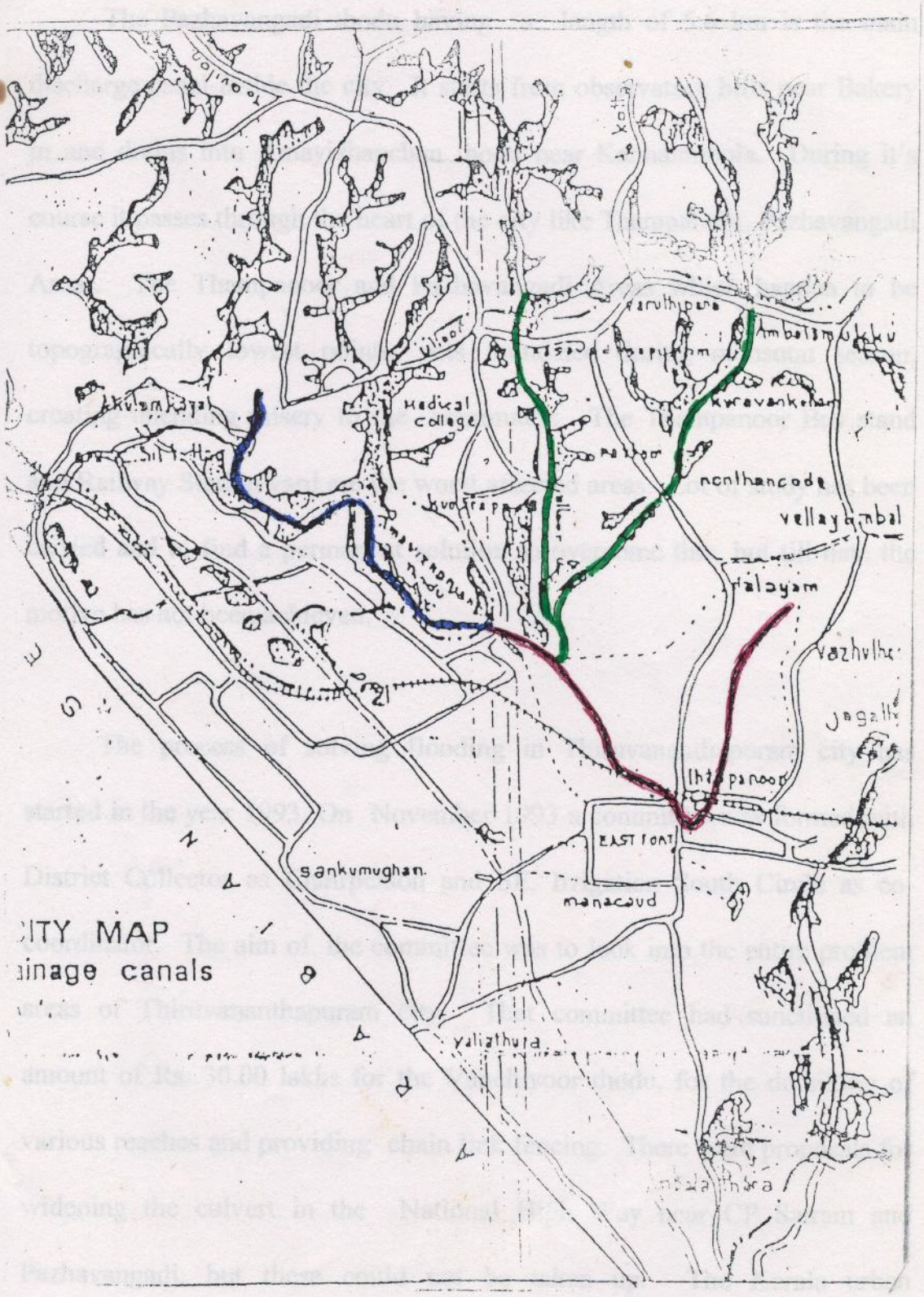
GOVERNMENT OF KERALA



NOTE ON THIRUVANANTHAPURAM CITY FLOOD

Introduction

The Pazhavangadi thodu having a length of 5.6 km is the main discharge canal inside the city. It starts from observatory hills near Bakery jn and drains into Amayizhanchan thodu near Kannanmoola. During it's course it passes through the heart of the city like Thampanoor, Pazhavangadi Areas. The Thampanoor and Pazhavangadi Areas which happen to be topographically lowest points, gets inundated during monsoon season, creating unending misery to the commuters. The Thampanoor Bus stand and Railway Station yard are the worst affected areas. Lot of study has been carried and to find a permanent solution to overcome this, but till date the motive has not been achieved.

The process of solving flooding in Thiruvananthapuram city has started in the year 1993. On November 1993 a committee was formed with District Collector as Chairperson and SE, Irrigation South Circle as co-coordinator. The aim of. the committee was to look into the entire problem areas of Thiruvananthapuram city. That committee had sanctioned an amount of Rs. 30.00 lakhs for the Vanchiyoor thodu, for the de silting of various reaches and providing chain link fencing. There were proposals for widening the culvert in the National High Way near CP Satram and Pazhavangadi, but these could not be taken up. The Kerala urban

Development project had conducted a study of flooding in Thampanoor and East fort areas with the help of MS Kirloskar Consultants and they have suggested certain remedial measures.

Since the problem continued, a committee was constituted with SE, Irrigation south circle as convener in the year 2001. The aim of the Committee was to go in to all the proposals of controlling flooding in Thampanoor and Pazhavangadi areas. .

The Committee entrusted Irrigation Department to conduct certain studies of existing situation of the Pazhavangadi thodu on the data provided by MS. Kirlosker consultants.

In the study conducted by the Irrigation Department, the inadequacy of the existing went way of Pazhavangadi thodu was revealed. The Committee submitted the report on 14-6-2001 and it contained the major recommendations.

(1) The reconstruction of culvert at National Highway near CP satram at Thampanoor.

(2) Reconstruction of culverts at power House Road, Pazhavangadi and Thakaraparmbu Jn.

(3) Desilting, repairs to chain link fencing, construction of a trash track near KSRTC Bus stand and Pazhavangadi, widening of Pazhavangadi thodu from Pazhavangadi to Thakaraparambu and

providing covering slab to Thodu at Thampanoor to prevent daily garbage dumping from local shops etc.

(4) Removal of old masonry structure and other debris inside the culvert in the railway yard.

(5) Allied works of BSNL, KWA in connection with reconstruction of Pazhavangadi of Thakampandu culverts.

Government has accorded Administrative sanction for the proposal for an amount of Rs 358 lakhs and as such works were commenced.

Of the work entrusted to Water Resources dept. all the works were completed except the covering of Pazhavangadi Thodu from KSRTC Bus Stand to the upstream of Thampanoor Culvert, and providing trash track at Pazhavangadi and Thampanoor.

Of the works entrusted to the PWD wing, be reconstruction of Thampanoor and Power house has been completed. They are yet to commence the reconstruction of Pazhavangadi and Thakaraparambu culverts. Also in spite of the efforts taken by the Railway authorities they could not clear the debris inside the Railway culvert.

In the year 2004, the Construction Corporation was entrusted with the entire de silting of the thodu from Keerthy Hotel to tail end of the thodu at an amount of 212 lakhs funded by Kerala road fund Board.

The Hon'ble Chief Minister conveyed a meeting of the all concerned in the light of flooding occurred in the capital city during the flash flood in the month of March 2005 and issued necessary directions to provide urgent short term remedial measures to tackle the problem

SHORT TERM REMEDIAL MEASURES TO PREVENT FLOODING

1. To prevent flash floods at Thampanoor, the Railway culvert should be desilted effectively to make available a cross section of 4.70mx2.10m throughout its length and the open canal u/s and d/s of the Railway culvert should be desilted periodically.

2. An Officer should be entrusted with suitable funds to carry out the emergent works in anticipation of floods in the places wherever required whether road or thodu or culvert

3. National Highway drains around the Ponnara Sreedhar Park and the connecting drains to the canal should be desilted.

4. Culvert at Pazhavangadi should be desilted to make available an opening of 4.40mx1.60m

5. Before proceeding with the reconstruction of Pattoor culvert, the hydraulic particulars should be checked.

6. Islands formed on the portion d/s of Kannammoola bridge should be cleared.

Superintending Engineer

Irrigation South Circle

Thiruvananthapuram

DISCHARGE CALCULATION

A. THAMPANOOR AREA

1. CALCULATION OF FLOOD DISCHARGE

Area covering Observatory hills, Vazhuthacaud, Mettukkada, and Pulimmodu regions contribute to the flood discharge at Thampanoor. This area is calculated as 10.5 Sq. km from the contour map.

Rainfall data for the past 10 years (1994 to 2003) has been collected from the meteorology department and the maximum daily rainfall of 189mm on 05-11-1998 is taken for the calculations.

Rational formula for limited area which is more reliable than the conventional Ryve's formula is used for computing the flood discharge.

Formula used is $\mathbf{Q} = \mathbf{0.028\ P\ f\ A\ I_0 \left(\frac{2}{t_0+1}\right)}$

where Q = Maximum run off in m^3/sec

P = Percentage coefficient of run off for the catchment depending on the nature of catchment
= 0.32 for loamy area

f = a correction factor for the size catchment
= 0.90 for 1050 Ha

A = area of catchment in Ha
= 1050 Ha

I_0 = one hour rainfall for the region in cm/hr given by the formula $I_0 = \frac{F\,(1+1/T)}{2}$

where F = Total precipitation of the storm in cm
= 7.80 cm

T = Duration of the storm in hours
= 24 Hrs

Hence $I_0 = \frac{7.80(1+1/24)}{2} = \mathbf{4.056}$

t_0 = concentration time in hours given by the formula $t_0 = (0.87 \times L^3/H)^{0.385}$

where L = distance from the farther most point in the periphery of the catchment to the cross drainage site in Km

= 2.50Km

H = Fall from farther most point to the c/d site in m
= 10m

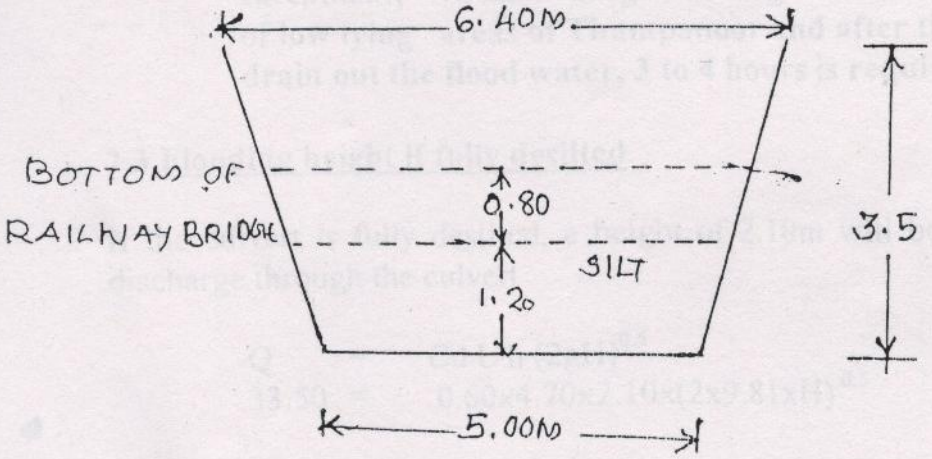
t_0 = $(0.87 \times 2.5^3/10)^{0.385}$ = 1.125

Q = 0.028x0.32x0.90x1050x4.056x(2/1.125+1)
= **32.32m^3/sec**

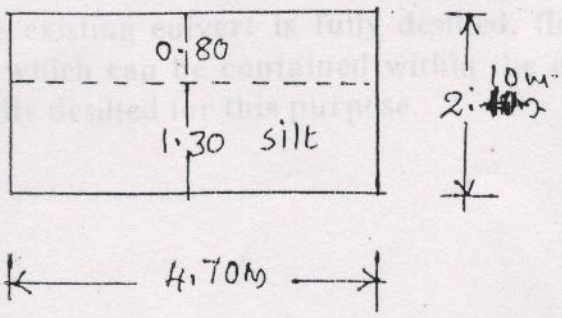
Assuming KWA flushing = 0.38m^3/sec
From Hotels & Bus stand = 0.80 m^3/sec
Total = **33.50 m^3/sec**

2. Adequacy calculation

Existing Drain at Thampanoor



Existing Railway Culvert



2.1 Discharge through the existing Railway culvert at Thampanoor

Discharge is calculated using the formula for rectangular orifice

$$Q = Cd\ L\ h\ (2\ g\ H)^{0.5}$$

Where h = height of opening available due to siltation
L = Length of orifice
H = Total head from center of opening to surface
Cd = Coefficient of discharge
Q = $0.60 \times 4.70 \times 0.80 \times (2 \times 9.81 \times 4.26)^{0.5}$
= **20.62 m^3/sec**

2.2 Surplus water causing flooding

Surplus water = 33.50 - 20.62 = **12.88 m^3/sec**

ie. **With six hour continuous raining in Thampanoor catchment, 70 cm average flooding can occur in 0.40 Km2 of low lying areas of Thampanoor and after the rain, to drain out the flood water, 3 to 4 hours is required.**

2.3 Flooding height if fully desilted

If the culvert is fully desilted, a height of 2.10m will be available for discharge through the culvert

$Q = Cd\ L\ h\ (2gH)^{0.5}$
$33.50 = 0.60 \times 4.70 \times 2.10 \times (2 \times 9.81 \times H)^{0.5}$

Hence, **H** = **1.63m** which is the total head from center of opening to surface
Flooding height = 1.63 - 1.05
= **0.58m.** from the culvert top which is 76cm below the top of the retaining wall of the U/S thodu.

Hence, if the existing culvert is fully desilted, flooding will be less than 60 cm, which can be contained within the open canal itself, if this also is fully desilted for this purpose.

B.PAZHAVANGADI AREA

1.Flood discharge calculation

In the case of Pazhavangadi, additional flood water expected to join the canal is calculated considering catchment areas of Padma Nagar, East Fort and Thakaraparambu, with an area of 3.50 Sq. Km

Formula used is $Q = 0.028\ P\ f\ A\ I_0 \left(\frac{2}{t_0+1}\right)$

Here,

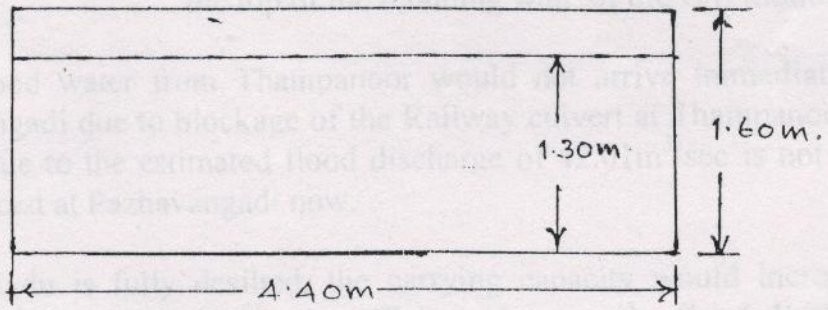
A = area of catchment in Ha
= 350 Ha

$I_0 = \frac{7.80(1+1/24)}{2} = \mathbf{4.056}$

$t_0 = (0.87 \times 2.5^3/10)^{0.385} = \mathbf{1.125}$

$Q = 0.028 \times 0.32 \times 0.90 \times 350 \times 4.056 \times (2/1+1.69)$
$= \mathbf{8.51 m^3/sec}$

Total Flood discharge = 33.50+8.51=42.01 m^3/sec



1.1 Discharge through the existing culvert

Existing culvert at Pazhavangadi has three cross sections

1. 6.00mx2.00m
2. 4.40mx1.60m
3. 5.00mx2.00m

Discharge is calculated using the formula for rectangular orifice

$$Q = Cd\ L\ h\ (2\ g\ H)^{0.5}$$

Where h = height of opening available due to siltation
L = Length of orifice
H = Total head from center of opening to surface
Cd = Coefficient of discharge
Q = $0.60 \times 4.40 \times 0.30 \times (2 \times 9.81 \times 1.50)^{0.5}$
= **4.296 m^3/sec**

Flooding height if fully desilted

If the culvert is fully desilted, a height of 1.60m will be available for discharge through the culvert

$Q = Cd\ L\ h\ (2gH)^{0.5}$
$42.01 = 0.60 \times 4.40 \times 1.60 \times (2 \times 9.81 \times H)^{0.5}$

Hence, **H** = **5.03m** which is the total head from center of opening to surface
Flooding height = 5.03 – 2.30
= **2.73m.** from the culvert top which is 1.50m below the top of the retaining wall of the U/S thodu.

Since flood water from Thampanoor would not arrive immediately at Pazhavangadi due to blockage of the Railway culvert at Thampanoor, the impact due to the estimated flood discharge of 42.01m^3/sec is not being experienced at Pazhavangadi now.

If the th du is fully desilted, the carrying capacity would increase to **22.910_m^3/sec, which is also insufficient to carry the flood discharge. It is suggested that the culvert should be reconstructed with 10.00mx2.50m cross section.**

C. UPPIDAMMOODU & PATTOOR AREA

Cross section of the Railway culvert available at d/s of Iron bridge would be just sufficient to carry the flood discharge once the obstructions to flow at Thampanoor and Pazhavangadi are cleared.

1. New Pattoor Culvert

Hydraulic particulars related to the culvert being constructed by Road Fund Board at Pattoor is not known

D.KANNAMMOOLA AND D/S

Level difference of the canal available from Kannammoola to Akkulam kayal,(for a length of 4.20Km) where the canal discharges, is only 0.70m. Although the slope available is small, flooding is not expected since the canal has an average width of 30m in this reach

E. ANAMUGHOM BRIDGE (U/S OF KIMS HOSPITAL)

Main bottle neck in the d/s reach of the canal is the bridge having a span of only 15m which reduces the canal width abruptly from more than 30m to 15m. This has also resulted in large scale encroachment.

F.EMERGENT MEASURES TO PREVENT FLOODING

1. To prevent flash floods at Thampanoor, the Railway culvert should be desilted effectively to make available a cross section of 4.70mx2.10m throughout its length and the open canal u/s and d/s of the Railway culvert should be desilted periodically.
2. An Officer should be entrusted with suitable funds to carry out the emergent works in anticipation of floods in the places wherever required whether road or thodu or culvert.
3. National Highway drains around the Ponnara Sreedhar Park and the connecting drains to the canal should be desilted.
4. Culvert at Pazhavangadi should be desilted to make available an opening of 4.40mx1.60m
5. Before proceeding with the reconstruction of Pattoor culvert, the hydraulic particulars should be checked.
6. Islands formed on the portion d/s of Kannammoola bridge should be cleared.

G. LONG TERM MEASURES

1. Railway culvert should be reconstructed with a cross section of 10mx2.50m to ensure free flow
2. National Highway ~~culverts~~ drains should be re constructed with sufficient capacity
3. Portion of the canal running by the side of the KSRTC Bus stand should be covered
4. Pazhavangadi culvert should be reconstructed with a cross section of 10m x 2.50m
5. An additional drain should be constructed in front of the bus shelter and Ganapathy kovil at East Fort to drain out the rain water
6. Foot bridges crossing the canal should be reconstructed without center piers
7. An additional span of 15m should be added to the Anamughom bridge and encroachments cleared

Abstract of estimate for short term measures to be undertaken by WRD

Earth work excavation for deepening the Pazhavangadi thodu in or under water or in liquid mud including all leads,lifts,including clearing the culvert portion by providing Suitable lighting and air circulation arrangements and depositng the silt at far away places as directed by the departmental officers at site etc complete

Chenkachoola to Keerthi Hotel

1x440x 4.00(av)x0.90 =1584m3

Keerthi to Thampanoor Railway culvert

1x340x 4.50(av)x0.90 =1377m3

Powerhouse to Pazhavangadi

1x270x 6.00(av)x1.00 =1620m3

Pazhavangadi to Thakaraparambu

1x130x 8.00(av)x0.80 =832m3

Thakaraparambu to Iron Bridge

1x390x 5.00(av)x0.80 =1560m3

Iron bridge to Vanchiyoor

1x900x 5.00(av)x0.80 =3600m3

Vanchiyoor to tailend

1x1000x 5.50(av)x0.80 =4400m3

Railway Culvert

1x130x 4.70x1.30 =794m3

Pahavangadi Culvert

1x72x (5.65+5.10)/2x(1.30+0.80)/2 =406m3

Thakaraparambu Culvert

1x60x 4.50x0.80 =216m3

Total **=16389m3 @ Rs 250/m3**

=Rs 40,97,250

(Rupees forty lakhs ninety seven thousand two hundred and fifty only)

ANNUAL RAINFALL DATA FOR THE LAST 10 YEARS IS FURNISHED HEREWITH

DAILY RAINFALL (in mm)

STATION : THIRUVANANTHAPURAM CITY YEAR : 1994

DATE	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.0	0.0	0.0	1.5	0.0	19.6	0.0	32.5	24.0	8.5	62.1	21.2
2	0.0	0.0	0.0	0.0	0.0	14.0	1.0	79.3	7.8	0.0	0.0	7.2
3	0.0	0.0	0.0	0.0	0.0	23.3	2.4	21.6	8.3	8.0	0.0	0.0
4	0.0	0.0	0.0	24.2	0.0	3.1	3.6	8.7	0.8	18.8	2.2	0.0
5	0.0	0.4	0.0	4.6	0.0	19.7	1.8	0.3	8.6	33.4	1.6	0.0
6	0.0	0.0	0.0	1.6	1.0	39.9	0.0	0.0	9.9	103.9	6.4	0.0
7	0.0	0.0	0.0	26.3	0.0	15.8	0.6	0.0	15.6	13.6	1.1	0.0
8	0.2	0.0	1.6	0.1	0.0	1.8	0.0	0.0	1.0	0.0	0.0	0.0
9	0.0	1.1	0.0	10.3	0.0	19.2	0.0	0.0	0.0	0.0	0.5	0.0
10	0.0	3.4	0.0	0.0	0.0	24.2	0.0	3.1	0.1	0.0	0.0	0.0
11	0.0	29.2	0.0	0.0	0.0	16.9	0.0	0.0	0.0	0.4	0.0	0.0
12	0.0	0.0	0.0	43.8	0.0	10.7	0.0	0.0	0.0	22.8	12.3	0.0
13	0.0	5.9	0.0	0.4	0.0	0.0	8.0	0.0	0.0	0.1	7.3	0.0
14	1.4	0.0	0.0	0.0	0.0	0.4	9.2	0.0	0.0	0.6	0.1	0.0
15	0.0	1.9	0.0	0.0	0.0	4.1	33.3	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.1	0.0	12.1	7.6	0.0	1.7	95.4	0.0	0.0
17	0.0	0.0	1.6	4.8	0.0	15.1	43.5	0.2	5.4	7.7	0.0	0.0
18	23.6	0.0	1.3	0.0	0.0	0.8	0.4	7.0	3.0	0.9	0.0	0.0
19	0.0	1.0	0.0	2.2	0.0	0.0	37.9	1.8	0.2	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	8.5	2.3	0.2	0.0	0.0	0.0
21	0.9	0.0	0.0	0.0	0.0	0.0	11.3	0.0	0.0	0.0	2.2	0.0
22	0.0	24.0	0.0	0.0	46.3	0.0	3.4	0.0	0.0	10.7	0.0	0.0
23	0.0	0.0	0.0	0.0	11.9	0.0	0.0	0.0	0.0	4.1	0.0	0.0
24	0.0	0.0	0.0	0.1	18.5	0.2	0.1	0.0	3.4	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	10.2	0.0	1.2	2.8	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	8.7	1.9	4.6	6.1	0.0	1.3	0.0	0.0
27	0.0	0.0	0.0	0.0	0.1	0.1	16.3	0.1	0.0	30.8	0.4	0.0
28	0.0	0.0	0.0	0.0	71.3	0.6	17.7	3.0	0.0	0.0	11.4	0.0
29	0.0		0.6	1.8	35.8	4.0	41.6	5.0	1.1	6.0	0.0	0.0
30	0.0		0.5	0.0	12.9	2.7	5.5	1.6	5.7	7.1	0.5	0.0
31	0.0		1.2		33.6		27.1	14.0		11.6		0.0
TOTAL	26.1	66.9	6.8	181.8	250.3	250.2	286.6	189.4	96.8	385.7	108.1	28.4

DAILY RAINFALL (in mm)

STATION : THIRUVANANTHAPURAM CITY

YEAR : 1995

DATE	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.0	0.0	0.0	0.0	18.4	3.5	5.4	0.0	5.2	0.0	0.3	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	6.1	0.0	0.4	0.0
3	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.3	0.0	5.4	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	6.1	13.2	27.0	0.0
5	0.0	0.3	0.0	0.9	49.9	0.0	0.4	0.8	6.9	9.9	3.6	0.0
6	0.0	0.0	0.0	0.4	3.4	0.0	0.2	0.5	0.9	1.1	20.5	0.0
7	0.0	0.0	0.0	33.0	92.2	0.0	6.1	4.2	0.2	3.4	0.0	0.0
8	0.0	0.0	0.0	1.2	77.5	8.2	13.4	0.0	0.0	60.8	4.9	0.0
9	0.0	0.0	0.0	19.7	21.8	8.6	10.7	0.3	0.0	4.2	1.2	0.0
10	0.0	0.0	0.0	15.0	28.7	55.6	9.2	0.0	0.0	7.4	0.6	0.0
11	0.9	0.0	0.5	4.6	23.3	37.2	5.8	0.0	0.0	16.2	0.0	0.0
12	0.0	0.0	0.8	0.0	12.7	10.9	5.0	0.0	0.0	3.0	0.0	0.0
13	0.0	0.0	5.0	0.0	0.0	6.4	0.5	0.0	0.0	0.2	37.3	0.0
14	0.0	0.0	0.0	0.0	5.5	30.4	0.0	0.0	1.9	3.6	0.1	0.0
15	0.0	0.0	0.0	0.0	7.4	2.2	0.0	0.0	0.2	0.0	125.3	0.0
16	0.0	0.0	0.0	0.0	0.2	27.7	15.5	2.4	13.0	0.0	2.8	0.0
17	0.0	0.0	0.0	0.0	0.0	0.9	15.0	1.0	14.6	0.0	0.0	0.0
18	0.0	0.0	0.0	37.2	0.0	1.5	0.1	11.2	19.0	0.0	0.1	0.0
19	0.0	0.0	0.0	17.8	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
20	0.3	0.0	0.0	0.0	1.1	0.0	4.1	0.2	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.8	24.2	11.8	0.0	0.0	26.7	1.8	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	1.2	0.0	3.5	0.4	1.2	1.0	0.0
23	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0	0.3	4.2	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	22.0	1.2	0.0
25	0.0	0.0	0.0	53.5	0.0	0.0	2.4	0.0	0.0	0.1	0.0	0.0
26	0.0	0.0	3.5	0.0	0.0	0.0	35.8	2.4	0.0	4.6	0.0	0.0
27	0.0	0.0	0.0	3.7	0.0	0.0	4.2	0.9	0.0	2.2	0.0	0.0
28	0.0	0.0	0.0	0.4	0.0	7.4	1.0	14.6	0.3	17.9	0.0	0.0
29	0.0		0.0	0.0	0.0	4.2	1.0	15.8	0.0	4.5	1.7	0.0
30	0.0		0.0	0.5	0.7	17.6	5.7	9.8	0.0	4.9	0.0	0.0
31	0.0		0.0		10.0		18.4	6.8		0.2		0.0
TOTAL	1.2	0.3	9.8	188.7	377.1	237.9	160.5	76.1	102.2	186.6	233.4	0.0

DAILY RAINFALL (in mm)

STATION : THIRUVANANTHAPURAM CITY YEAR : 1996

DATE	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.0	0.0	0.0	0.7	0.4	27.7	0.0	1.1	0.0	2.7	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	3.5	0.0	0.0	0.0	12.8	10.7	0.0
3	0.0	0.0	0.0	19.0	0.0	5.6	0.0	5.4	0.0	2.8	0.4	0.0
4	0.0	0.0	0.0	5.8	0.0	96.1	0.0	0.0	4.0	0.0	0.0	0.0
5	0.0	0.0	0.0	9.6	0.0	3.5	0.0	14.4	0.0	0.0	5.9	0.0
6	0.0	0.0	0.0	0.0	0.0	0.3	0.0	1.2	0.0	0.0	0.4	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	24.6	0.8	5.3	0.0	0.0	0.0
8	0.0	0.0	0.0	1.8	0.0	0.0	1.4	0.0	1.8	2.3	0.0	2.5
9	0.0	0.0	0.0	55.8	0.0	4.4	3.9	0.0	0.2	15.6	0.0	11.7
10	0.0	0.0	0.0	0.3	0.0	6.6	15.6	4.4	0.0	25.7	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	15.7	12.5	0.3	1.0	0.0	2.6	2.6
12	0.0	0.0	0.0	0.0	0.0	0.0	0.2	2.5	24.8	1.4	5.2	2.0
13	0.0	0.0	0.0	19.4	0.0	40.2	1.2	6.6	2.8	83.9	0.0	0.2
14	0.0	0.0	0.0	0.0	0.0	11.5	6.4	12.0	1.8	20.1	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	1.8	4.3	1.9	0.2	61.2	6.8	9.5
16	37.5	0.0	0.0	11.3	0.0	5.4	25.2	5.9	21.1	8.6	0.1	29.2
17	0.0	0.0	0.0	0.0	0.0	21.0	3.8	0.6	2.2	0.2	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	2.8	89.7	2.4	0.0
19	0.0	0.0	0.0	0.2	0.0	0.2	28.2	0.0	1.0	42.0	0.5	0.3
20	0.0	0.0	0.0	18.2	0.0	20.4	10.8	0.0	2.6	7.4	3.8	0.0
21	0.0	0.0	0.0	15.6	0.0	39.1	9.2	0.0	1.4	0.0	4.2	0.0
22	0.0	0.0	0.0	0.0	0.0	23.8	1.5	0.0	0.0	0.0	3.4	0.0
23	0.0	9.4	0.0	0.0	0.0	0.4	34.4	0.4	0.0	0.4	2.2	0.0
24	0.0	0.0	0.0	22.5	0.0	0.6	28.9	42.1	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	7.8	2.6	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	13.2	2.3	25.2	0.0	0.9	0.0
27	0.0	0.0	0.0	0.0	5.6	0.0	2.5	21.9	13.8	0.0	17.0	0.0
28	0.0	10.8	0.3	0.0	7.9	0.0	0.4	0.0	29.3	0.0	7.1	0.0
29	0.0	0.0	0.0	0.0	8.9	0.0	0.3	1.5	6.8	0.0	3.4	0.0
30	0.0		0.0	0.0	0.0	0.0	0.0	11.4	0.6	0.0	0.0	0.0
31	0.0		0.0		2.5		0.0	0.4		0.0		0.0
TOTAL	37.5	20.2	0.3	180.2	25.3	328.8	236.3	139.7	148.7	376.8	77.0	58.0

DAILY RAINFALL (in mm)

STATION : THIRUVANANTHAPURAM CITY YEAR : 1997

DATE	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.0	0.0	0.0	0.0	0.0	0.0	4.6	34.7	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	8.9	7.2	0.0	0.0	3.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	28.7	2.8	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	15.2	0.0	0.5	0.2	0.0	0.0	2.3	2.2
5	0.0	0.0	0.5	2.0	0.0	0.0	2.9	0.0	0.0	34.6	30.7	0.0
6	0.0	0.0	0.0	24.8	0.0	0.0	5.2	0.0	0.5	14.6	0.1	0.7
7	0.0	0.0	0.0	0.0	34.0	0.0	0.9	6.7	0.0	0.0	0.7	10.0
8	0.0	0.0	0.0	0.0	27.1	10.8	0.9	23.2	6.3	0.2	3.7	0.7
9	0.0	0.0	0.0	0.0	32.4	0.0	17.4	0.4	42.0	0.0	62.6	0.2
10	0.0	0.0	0.0	3.2	0.0	0.0	8.4	0.0	49.6	21.9	24.0	0.0
11	0.0	5.0	0.0	0.0	0.0	1.6	13.8	0.4	0.0	0.0	1.6	0.2
12	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.0	30.8	27.6	3.8	0.0
13	0.0	0.0	0.0	0.0	0.3	37.8	0.0	0.0	0.0	0.5	7.2	0.0
14	0.0	0.0	0.0	0.0	4.3	23.4	0.5	0.0	12.2	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	5.8	1.9	0.1	0.0	0.0	10.6	0.0	0.1
16	0.0	0.0	0.0	0.0	0.2	0.0	2.5	0.0	46.5	1.6	78.0	6.8
17	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	12.9	25.6	0.2	0.0
18	0.0	0.0	0.0	0.0	0.0	1.4	0.6	0.0	11.0	0.2	0.0	2.6
19	0.0	0.0	0.0	0.0	2.2	0.0	4.4	0.0	20.2	0.0	0.0	49.4
20	0.0	0.0	0.0	0.0	0.0	4.0	0.7	3.4	26.2	7.4	0.0	11.1
21	0.0	0.0	0.0	0.0	0.0	0.0	18.2	12.5	58.8	0.8	21.4	4.1
22	0.0	0.0	0.0	0.0	0.0	0.0	3.1	1.2	34.7	28.0	0.0	0.4
23	0.0	0.0	0.0	1.3	0.0	36.3	20.0	12.2	10.6	5.1	20.6	1.7
24	0.0	0.0	23.5	0.0	0.0	6.6	3.3	1.7	33.8	0.0	37.0	0.0
25	0.0	0.0	0.0	0.0	0.0	40.2	35.1	0.4	48.1	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	1.7	20.2	0.1	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	21.9	5.0	0.7	0.4	4.8	0.0	0.0
28	0.0	0.0	0.0	12.4	0.0	31.3	0.2	7.5	0.2	6.4	1.6	0.0
29	0.0		0.0	3.2	0.0	12.9	0.6	20.8	0.0	28.3	11.0	0.0
30	0.0		0.0	0.3	0.0	57.2	2.6	0.5	0.0	0.7	30.4	0.0
31	0.0		1.8		0.0		0.0	0.0		8.9		0.0
TOTAL	0.0	5.0	25.8	47.2	121.5	289.0	210.3	137.6	444.8	227.8	339.9	90.2

DAILY RAINFALL (in mm)

STATION : THIRUVANANTHAPURAM CITY YEAR : 1998

DATE	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.4	4.0	1.8	1.6
2	0.0	0.0	0.0	0.0	23.4	0.2	0.0	0.2	0.0	0.1	0.0	25.6
3	0.0	0.0	0.0	21.6	23.2	4.1	29.3	0.0	1.4	3.8	0.0	0.5
4	0.0	0.0	0.0	0.0	4.2	24.0	13.9	0.0	0.0	0.0	10.0	0.0
5	0.0	0.0	0.0	0.0	30.2	1.8	0.4	0.0	79.5	0.0	189.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.6	0.0	2.2	18.0	2.2	14.5	11.4
7	0.0	0.0	0.0	0.0	8.2	28.5	0.0	0.0	1.8	2.1	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.4	0.0	4.8	10.4	68.4	0.0	28.7
9	0.0	0.0	0.0	0.1	2.8	0.4	0.0	7.6	87.3	29.3	32.0	8.5
10	0.0	0.0	0.0	0.0	1.2	1.4	3.2	1.5	2.8	41.8	2.2	14.0
11	0.0	0.0	0.0	0.0	51.2	37.8	2.4	2.4	5.6	57.5	10.6	1.8
12	0.0	0.0	0.0	0.0	18.4	7.2	3.2	4.2	1.0	73.0	0.0	5.9
13	0.0	0.0	0.0	0.0	22.0	0.5	10.8	0.1	0.7	28.2	0.0	9.0
14	0.0	0.0	0.0	18.4	4.1	5.7	0.0	0.2	1.2	32.4	46.6	2.8
15	0.0	0.4	0.0	0.0	38.5	0.6	2.5	0.0	13.1	17.1	4.3	0.0
16	0.0	0.0	0.0	0.0	74.6	7.4	0.0	0.9	38.8	0.0	0.0	0.0
17	0.0	0.0	0.0	13.2	29.9	33.5	4.9	0.0	1.6	0.0	0.0	10.2
18	0.0	0.0	0.0	0.0	0.0	3.8	1.4	0.0	1.3	1.4	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.4	6.4	2.5	0.0	2.8	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	2.2	34.9	9.8	0.0	0.0	0.0	2.6
21	0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.0	1.6	0.0	0.0	54.0
22	0.0	0.0	0.0	0.0	0.4	2.1	0.2	65.6	13.8	0.0	0.0	0.0
23	2.6	0.0	0.0	0.5	0.0	3.7	0.2	38.0	31.2	0.0	0.0	4.6
24	0.0	0.0	0.0	22.7	0.0	8.7	0.0	49.8	30.2	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	18.1	4.1	2.9	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	6.6	0.0	12.5	0.6	0.0	0.9	0.0	0.2	0.0
27	0.0	0.0	0.0	0.8	0.0	21.6	0.0	0.0	0.8	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	1.8	30.0	4.4	0.0	10.0	19.4	1.5	2.4
29	0.0		0.0	0.0	0.0	10.6	0.3	4.4	21.0	2.3	0.2	0.1
30	0.0		0.0	0.0	0.0	6.0	0.8	0.0	0.8	10.0	0.0	0.0
31	0.0		0.0		0.0		2.4	0.0		0.3		1.0
TOTAL	2.6	0.4	0.0	83.9	334.1	273.8	128.0	199.1	375.2	396.1	312.9	184.7

DAILY RAINFALL (in mm)

STATION : THIRUVANANTHAPURAM CITY YEAR : 1999

DATE	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.1	0.0	0.0	0.0	0.4	1.4	0.0	6.2	0.0	6.8	0.0	1.3
2	2.3	0.0	0.0	0.0	0.0	9.6	0.0	1.8	1.0	29.8	0.0	3.9
3	0.4	0.0	0.0	0.0	0.0	5.0	1.6	8.3	0.2	0.0	0.0	2.5
4	0.0	0.4	0.0	0.0	0.0	0.4	0.6	7.6	3.0	0.4	0.0	0.0
5	0.0	0.1	0.0	1.6	0.0	0.0	3.9	2.4	0.0	9.0	0.0	0.0
6	0.0	13.9	0.6	0.0	4.1	78.2	10.8	0.0	6.6	8.6	0.0	0.0
7	0.0	0.4	0.0	2.5	0.2	71.2	6.3	0.0	0.0	2.4	0.0	0.0
8	0.0	19.4	0.0	16.2	38.3	69.2	0.2	0.0	0.0	9.7	0.0	0.0
9	0.0	13.6	0.0	0.0	1.4	21.1	14.2	0.0	0.1	58.6	0.0	0.0
10	0.0	0.0	0.0	0.0	6.2	32.5	0.0	2.8	0.3	0.0	0.0	0.0
11	0.0	0.8	0.0	0.0	0.8	19.6	2.4	0.0	0.2	3.2	0.0	0.0
12	0.0	0.0	20.5	0.0	2.4	18.7	0.0	0.2	0.0	0.7	0.0	0.0
13	0.0	0.0	0.0	2.1	2.4	7.6	0.1	0.8	0.0	0.2	0.0	0.0
14	0.0	0.0	0.0	0.0	5.6	17.4	0.0	0.0	0.0	45.7	0.0	0.0
15	0.0	0.0	0.0	0.1	39.8	1.9	0.0	0.0	0.0	42.2	0.0	0.0
16	0.0	0.0	14.8	0.0	33.5	8.8	2.9	0.0	0.8	71.7	0.0	0.0
17	0.0	0.0	0.0	0.0	9.0	2.6	12.2	0.0	0.0	19.6	0.0	0.0
18	0.0	0.0	12.0	3.2	0.8	0.4	34.4	30.1	0.0	33.5	1.2	0.0
19	0.0	8.2	0.0	0.2	25.5	0.4	11.8	0.0	0.0	25.9	0.0	4.6
20	0.0	0.0	0.0	0.0	4.9	0.0	5.3	3.2	0.0	4.9	10.0	0.0
21	0.0	0.0	0.0	0.0	14.6	3.1	1.3	2.2	0.0	14.0	30.7	0.0
22	0.0	0.0	0.0	5.4	1.9	0.0	0.7	0.0	0.0	0.0	23.0	0.0
23	0.0	0.0	0.0	6.3	3.0	0.0	2.8	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	74.0	2.5	0.0	6.0	1.8	0.0	33.0	0.3	0.0
25	0.0	0.0	0.0	3.0	63.3	0.0	0.0	6.9	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	2.6	31.5	0.0	20.2	3.3	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	5.7	0.0	6.5	2.6	0.0	0.0	0.8	0.0
28	0.0	0.0	0.0	1.6	15.7	0.0	0.4	0.3	0.0	9.5	19.2	0.0
29	0.0		0.0	11.9	16.5	0.0	9.8	0.0	16.4	17.8	1.3	0.0
30	8.0		1.8	0.7	26.5	0.0	0.0	0.3	6.6	3.8	30.2	0.0
31	0.0		0.0		26.8		3.8	0.0		0.4		0.0
TOTAL	10.8	56.8	49.7	131.4	383.3	369.1	158.2	81.3	35.2	451.4	116.7	12.3

DAILY RAINFALL (in mm)

STATION : THIRUVANANTHAPURAM CITY YEAR : 2000

DATE	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.0	0.0	0.0	4.6	0.0	6.6	8.8	0.0	0.0	9.1	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	2.3	4.4	0.0	0.0	44.7	0.2	0.0
3	0.0	0.0	0.0	0.6	0.0	0.8	0.2	0.0	0.0	31.9	0.0	0.0
4	0.0	7.7	0.0	0.0	0.0	2.8	2.9	0.9	0.0	8.3	0.1	0.0
5	0.0	18.5	0.0	0.4	0.0	1.6	4.4	0.0	0.1	1.2	0.6	0.0
6	0.6	0.0	0.0	23.4	0.0	26.2	3.5	1.0	0.0	0.1	0.0	18.2
7	0.0	52.2	0.4	46.3	0.0	34.8	4.6	27.4	0.0	6.4	19.8	0.0
8	0.0	0.0	0.0	30.2	0.0	37.0	4.8	38.9	0.0	5.8	0.0	0.0
9	0.6	0.0	0.0	0.0	0.0	43.2	0.8	24.1	0.0	2.4	0.0	0.0
10	0.0	0.0	0.1	0.0	0.0	5.3	0.5	13.8	0.0	0.1	0.0	0.0
11	0.7	0.0	0.1	0.0	0.0	9.0	0.0	22.0	0.0	9.2	8.8	0.0
12	0.3	6.7	0.0	0.0	0.0	23.1	0.4	0.0	0.0	0.0	0.0	0.0
13	0.0	1.4	0.0	0.0	0.0	0.4	0.0	0.0	0.0	6.3	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	2.0	0.0	2.6	0.0	0.4	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	1.4	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	25.8	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	1.3	0.8	0.0	0.0	0.0	37.6	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	3.1	1.6	8.2	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	0.0	5.6	1.6	0.0
20	0.0	0.0	0.0	38.4	1.0	2.6	0.0	47.2	0.0	0.2	14.8	0.0
21	0.0	0.0	0.0	0.0	0.6	27.0	0.0	9.7	8.4	0.0	36.9	0.0
22	0.0	0.0	0.0	0.4	0.0	5.6	0.0	12.4	21.1	0.0	7.0	0.0
23	0.0	0.0	0.0	0.0	0.0	1.0	0.0	42.1	0.4	0.0	9.1	0.0
24	0.0	8.3	0.0	0.0	0.0	0.8	0.0	61.8	0.4	0.0	1.2	0.0
25	0.0	0.0	17.2	0.0	0.0	7.5	0.0	50.2	1.0	0.5	2.8	0.0
26	0.0	0.0	0.0	0.0	1.9	0.0	0.0	10.8	19.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	1.4	0.4	0.0	18.8	14.7	0.0	0.0	0.2
28	0.0	0.0	0.0	0.0	0.5	11.0	28.4	4.1	19.3	0.0	0.0	52.4
29	0.0	1.0	0.0	0.0	0.0	1.6	0.1	4.5	0.0	0.0	0.0	1.1
30	0.0		15.1	0.0	0.0	1.0	0.0	0.0	19.6	0.0	1.7	0.0
31	0.0		0.0		0.0		0.0	0.0		0.0		0.0
TOTAL	2.2	95.8	32.9	144.3	6.7	255.0	66.9	399.2	138.0	171.2	104.6	71.9

DAILY RAINFALL (in mm)

STATION : THIRUVANANTHAPURAM CITY YEAR : 2001

DATE	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.0	0.0	0.0	0.0	6.2	0.0	1.2	39.4	0.4	3.1	0.0	0.0
2	7.8	4.8	0.0	0.0	69.9	0.0	6.6	3.3	0.0	2.2	0.0	0.0
3	0.6	0.1	0.0	0.0	0.2	0.1	6.4	1.2	0.0	0.0	0.0	0.0
4	0.0	2.4	0.0	0.0	0.0	5.0	36.4	7.5	0.0	0.0	0.0	13.4
5	0.0	0.0	0.0	2.8	0.5	0.8	7.9	3.6	0.0	0.0	0.0	0.0
6	0.0	0.6	0.0	8.7	0.0	5.3	14.8	0.0	0.0	1.0	2.7	0.0
7	0.0	1.3	0.0	6.0	24.6	10.1	27.4	0.0	0.0	0.0	21.7	7.8
8	0.0	0.0	0.0	2.6	25.8	1.4	12.4	2.5	0.0	0.0	4.5	0.0
9	0.0	0.0	0.0	0.1	0.0	24.5	112.3	0.8	0.0	0.0	5.3	0.0
10	0.0	0.0	0.0	0.4	0.2	5.1	31.6	0.0	0.0	0.0	21.0	0.0
11	0.4	0.0	0.0	43.8	0.0	22.6	12.9	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	15.9	0.0	27.3	0.8	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	6.5	0.0	20.3	0.0	2.0	0.0	56.8	0.0	0.0
14	0.0	0.0	0.0	32.9	0.0	8.2	0.0	0.2	0.0	38.6	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0	0.0	20.4	29.4	0.0
16	0.0	0.0	0.0	0.6	0.0	0.6	0.0	5.1	0.0	29.4	8.0	0.0
17	0.0	0.0	0.0	20.4	0.0	0.4	0.6	1.6	0.0	0.2	11.3	0.0
18	0.0	11.6	0.0	0.7	0.0	25.7	0.0	0.2	0.0	5.3	0.0	0.0
19	0.0	0.6	0.0	7.0	0.0	9.0	0.0	1.4	47.3	13.8	0.2	16.4
20	0.0	0.0	0.0	0.2	0.0	12.0	0.6	12.2	115.4	0.4	0.0	0.0
21	0.0	6.8	0.5	2.4	0.3	3.0	0.0	1.9	9.5	0.4	0.0	0.0
22	0.0	0.0	0.0	1.3	0.5	1.9	0.0	15.8	50.0	20.6	0.0	0.0
23	0.0	0.0	0.0	0.0	1.4	15.1	0.0	5.7	45.3	0.0	35.5	0.0
24	9.4	0.0	0.0	1.8	32.4	4.1	0.1	2.2	117.4	0.6	0.0	0.0
25	1.6	0.0	0.0	0.0	0.2	3.8	2.6	3.1	25.7	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	2.2	17.8	9.2	95.4	15.7	0.0	0.0	0.3
27	0.0	0.0	0.0	0.0	6.5	0.6	4.4	0.3	0.3	20.4	0.0	0.0
28	0.0	0.8	0.0	16.9	0.1	4.7	3.7	0.0	9.4	0.1	0.0	0.0
29	0.0		0.0	0.8	20.8	5.6	7.0	0.0	16.9	0.0	0.0	0.0
30	0.0		3.9	63.0	0.0	20.2	0.0	0.4	27.5	3.6	0.4	0.0
31	0.5		0.0		19.1		0.0	0.3		0.0		0.0
TOTAL	20.3	29.0	4.4	234.8	210.9	257.4	298.9	206.1	480.8	216.9	140.0	37.9

DAILY RAINFALL (in mm)

STATION : THIRUVANANTHAPURAM CITY

YEAR : 2002

DATE	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.0	0.0	0.0	0.0	3.8	0.0	0.0	18.4	0.0	0.0	0.1	0.0
2	0.0	18.0	0.0	0.0	0.0	22.2	3.8	14.4	0.0	3.6	0.0	0.0
3	0.0	0.0	0.0	0.0	24.4	0.0	0.1	0.7	0.0	0.2	24.8	0.0
4	0.0	0.0	0.0	0.0	13.7	0.0	7.8	0.5	0.0	1.1	0.0	0.3
5	0.0	0.1	0.0	0.0	5.3	0.0	0.0	3.4	0.0	7.4	8.7	0.0
6	0.0	0.0	0.0	2.8	7.1	0.0	2.0	0.5	0.8	21.8	5.8	0.0
7	0.0	0.0	0.0	0.0	10.2	5.3	1.6	1.0	0.0	27.0	35.4	1.4
8	0.0	0.0	0.0	0.0	3.7	23.6	0.0	3.2	1.1	7.0	1.0	3.2
9	0.0	0.0	0.0	0.0	0.0	3.0	0.0	0.8	0.7	98.4	7.5	0.0
10	0.0	0.0	0.0	0.0	0.0	17.8	0.0	2.5	16.1	13.2	15.4	0.0
11	0.0	0.0	0.0	0.0	0.0	3.3	0.0	6.3	0.0	2.7	23.4	0.0
12	0.0	0.0	0.0	11.4	0.0	1.5	3.2	0.0	0.0	10.4	0.3	0.0
13	0.0	0.0	0.0	19.2	8.4	70.7	2.0	0.0	0.0	1.6	0.0	0.0
14	0.0	0.0	0.0	4.0	8.0	11.8	1.1	0.2	0.0	11.9	83.2	0.0
15	0.0	0.0	0.0	0.0	0.0	4.6	0.7	0.0	0.0	93.7	2.9	0.3
16	0.0	0.0	3.0	0.0	3.8	0.7	3.8	6.7	0.0	8.6	0.0	0.0
17	0.0	0.0	27.9	12.8	2.3	0.0	0.0	36.5	3.5	55.3	0.0	0.0
18	0.0	0.0	0.0	0.0	19.0	0.0	1.1	0.8	0.0	0.4	1.3	0.0
19	0.0	0.0	0.0	5.5	74.3	0.0	1.5	0.2	0.0	49.0	15.8	0.0
20	0.0	0.0	0.0	5.8	0.0	0.0	2.6	0.0	0.0	6.4	3.3	0.0
21	0.0	0.0	0.0	0.8	1.8	0.0	0.0	0.0	0.0	0.0	0.4	0.0
22	1.0	0.0	0.0	3.0	22.2	0.6	0.0	0.0	0.0	0.0	1.4	0.0
23	0.4	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	10.4	3.1	0.0
24	0.0	0.0	0.0	1.2	0.0	8.4	0.0	0.0	0.0	0.0	0.6	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.9	0.0
26	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	12.2	0.4	0.0
27	0.0	0.0	3.7	0.8	0.8	0.0	0.0	0.0	0.0	5.8	0.0	0.0
28	0.0	0.0	0.0	2.6	0.1	0.0	0.3	0.0	0.0	0.5	0.4	0.0
29	0.0		0.0	0.0	56.0	0.0	1.7	0.0	0.0	0.8	0.0	0.0
30	0.0		0.0	0.1	0.9	0.0	5.2	0.0	1.2	0.3	0.0	0.0
31	0.0		7.0		0.0		6.7	0.0		31.5		0.0
TOTAL	1.4	18.1	41.6	70.0	268.2	173.5	45.2	96.1	23.4	481.2	245.1	5.2

DAILY RAINFALL (in mm)

STATION : THIRUVANANTHAPURAM CITY YEAR : 2003

DATE	JAN	FEB	MAR	APL	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.0	0.0	0.0	12.0	1.2	0.0	0.4	11.8	5.6	0.0	7.2	0.0
2	0.0	2.6	0.0	0.0	1.4	0.0	12.3	5.2	0.0	43.4	6.6	0.0
3	0.0	0.0	0.0	2.0	0.0	0.0	0.3	0.0	0.0	88.9	31.8	0.2
4	0.0	0.0	0.0	0.3	0.0	0.0	3.4	0.0	0.0	19.4	6.3	0.0
5	0.0	0.0	0.0	0.0	2.3	0.0	7.5	0.0	0.0	35.4	6.7	0.0
6	0.0	0.0	0.0	0.0	46.1	0.0	5.3	4.0	0.0	83.4	16.8	0.0
7	0.1	0.0	0.0	0.0	0.1	0.0	6.6	5.3	0.0	28.4	15.1	0.0
8	0.2	47.3	0.0	0.0	0.0	0.6	0.0	0.8	0.0	20.0	2.4	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0	0.4	5.3	0.0
10	10.7	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.2	0.0	0.0	0.0
11	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	2.2	0.0	0.5	1.2	0.0	0.0	0.0	0.0	0.0
13	0.0	7.4	0.0	2.0	0.0	0.4	0.0	2.2	0.0	0.1	4.5	0.0
14	0.0	0.0	0.8	0.1	9.7	2.4	11.6	0.0	2.1	0.0	0.0	0.0
15	0.0	0.0	0.2	0.4	1.2	32.7	8.1	0.0	7.6	0.0	7.3	0.0
16	0.0	17.2	6.8	10.5	2.3	5.2	36.8	0.3	0.0	0.4	2.1	0.0
17	0.0	0.0	0.8	2.6	0.6	22.2	0.3	0.0	0.0	0.0	0.2	0.0
18	0.0	0.0	21.4	0.0	1.1	14.5	0.5	0.0	0.1	10.2	0.0	0.0
19	0.0	0.0	4.9	0.0	0.4	20.4	0.0	0.0	0.0	1.9	0.0	0.0
20	0.2	0.0	0.0	0.0	0.0	28.7	0.0	0.0	0.0	8.8	0.0	0.0
21	0.0	0.0	8.8	3.2	0.0	19.2	0.0	4.8	0.0	19.4	0.0	0.0
22	0.0	0.0	0.0	1.6	0.0	15.9	0.0	24.5	0.0	18.8	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	30.5	4.0	13.7	0.0	10.3	0.4	0.0
24	0.0	0.0	0.0	0.0	0.0	17.6	3.8	5.4	0.0	115.6	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.1	0.0	11.3	0.0	0.0
26	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0
27	0.0	42.8	0.0	0.0	0.5	0.0	1.0	0.0	0.0	0.0	12.5	0.0
28	0.0	0.6	0.0	1.2	0.3	0.0	8.2	0.0	0.0	0.0	0.0	0.0
29	0.0		0.0	0.0	0.0	0.0	0.8	0.0	0.0	0.3	2.0	0.4
30	0.0		14.8	7.6	1.1	6.6	0.0	7.0	0.0	0.0	2.2	0.0
31	0.0		0.0		0.0		0.0	9.6		0.2		0.0
TOTAL	11.2	118.0	58.5	55.7	68.3	219.6	112.1	100.6	15.6	516.6	129.4	0.6

Draft for approval

MINUTES OF THE MEETING HELD BY THE HON'BLE CHIEF MINISTER ON 18-04-05 TO DISCUSS THE FLOODING IN THIRUVANANTHAPURAM CITY

Sub: Providing drainage facilities to Thampanoor and pazhavangadi area to control flooding

The meeting started at 10.15 AM in the Chief Ministers Conference hall with the Hon'ble Minister in the chair. The Hon'ble Minister for water resources, Sri. B. Vijayakumar MLA and Sri. K. Mohankumar MLA, Advisor to Government, Secretaries and Head of the Departments of various departments along with Railway officials attended the meeting. (Attendance enclosed).

At the outset the Chair enquired the main causes of the frequent flooding at Thampanoor and Pazhavangadi areas which is causing much hardships and inconveniences to the commuters arriving at the capital city by train and buses and the devotees of Pazhavangadi Ganapathy Temple. The Chair also added that this is being severely criticized by the mass media frequently.

The advisor to the government, Sri. Babu Jacob explained the situation and suggested the following measures to avoid flooding in the city.

1. Desilting and maintaining the slope of Pazhavangadi thodu from Chengalchoola to Kannanmoola for a length of 4.30Km and its periodic maintenance.
2. Reconstructing the Pazhavangadi culvert.
3. Cutting open the Thakaraparambu culvert.
4. Removing the silt and obstruction inside the Railway culvert
5. Constructing silt chamber for the flushing system of KWA treatment

He has suggested carrying out item no.1 by the Water Resources department.

The Chief Engineer (I&A) explained that an amount of **Rs.40 Lakhs** is required for the desilting the Pazhavangadi thodu and a new Head of Account has to be opened for this as there is no earmarked funds for drainage in this years budget.

For item no 2 and 3, the Advisor to Government suggested to carry out the work through PWD for which provision is available in the arranged work of Kerala Road Fund Board for Capital City Development Programme. Also regarding Thakaraparambu culvert some encroachments have to be evicted and the culvert is to be cut open for the smooth flow of water.

The Chief Minister accepted this and instructed to start the work on or before 30-04-05 positively and complete both the works within 3 months and Chief Engineer, PWD has agreed the time frame stipulated. Meanwhile, the Hon'ble Minister for Water Resources suggested to ensure adequate measures for draining out the storm water during rainy season while executing the above works.

All the above issues were decided to be executed in utmost care and supervision.

The Railway Divisional Manager explained that they have verified the estimation of storm water proposed by M/s Kirloskar consultants and the Irrigation Department and found that the existing culvert is adequate for discharging the flow if the obstructions are removed. According to him if the reverse slope in the thodu d/s of Railway culvert is corrected, the intensity of flow can be increased and if one more gratings is provided u/s of NH culvert, blocking of culvert due to garbage can be avoided. He has extended full cooperation for executing the desilting work inside the Railway culvert by them or by the Irrigation Department at Railways' cost.

At this juncture, the MLA, Sri. B. Vijayakumar stated that there is obstruction in the form of masonry structure inside the Railway culvert which is the real problem obstructing the free flow and suggested a parallel ventway or reconstructing the existing railway culvert for a permanent solution. The Divisional Railway Manager agreed to demolish the obstructions inside the culvert before the onset of monsoon.

The Chief Minister again stressed that if the present situation of flooding exists even after executing the above works, Railway has to sort out other methods to reconstruct the culvert with adequate size for the flood discharge and the Railway Divisional Manager accepted this in principle and suggested that the cost of construction should be met by the State Government.

Sri. Mohankumar MLA suggested to deepen the Amayizhanchanthodu d/s of Kannamoola bridge to Akkulam so as to obtain free flow of water. He also suggested to evict the encroachments along the side of the thodu and widen if necessary.

Sri. B. Vijayakumar MLA suggested that the vent way of Anamughom bridge near KIMS hospital is smaller than the width of the thodu and hence another span is to be constructed so that flooding in the surrounding low lying areas can be avoided.

The Chief Engineer (I&A) suggested that a running maintenance contract for cleaning the thodu at frequent intervals is to be arranged every year for which an amount of Rs.**20 Lakhs** is to be set apart in the succeeding years.

The Divisional Railway Manager stressed the need for a Committee to monitor the progress of work which is to be convened by the Chief Engineer (I&A) once in a week.

The Secretary, Public Works Department pointed out that once the quantum of silt flushed out by KWA is minimized the quantity of silt deposits in the thodu can be reduced and the Managing Director, Kerala Water Authority stated that the flushing water contain about $4m^3$ of silt daily which can be avoided by constructing a sedimentation tank for which an amount of **Rs.40 lakhs** is required.

The Chief Minister requested the Minister for Water Resources to put up proposals incorporating all the suggestions above before the cabinet for approval and directed all the concerned to carry out the works in a time bound manner.

NOTE SUBMITTED TO THE SECRETARY, WATER RESOURCES DEPARTMENT, THIRUVANANTHAPURAM

Sub: **Providing drainage facilities to Thampanoor and Pazhavangadi area to control flooding-urgent measures to be taken**

Ref: Decision taken in the meeting convened by the Hon'ble Chief Minister on 18-04-05 with the Hon'ble Minister for Water Resources, MLAs, Head of Departments and the Railway authorities.

The causes for frequent flood in Thampanoor and Pazhavangadi areas have been analysed and the measures to overcome the situation before the onset of Monsoon were finalised. The immediate works to be carried out are:

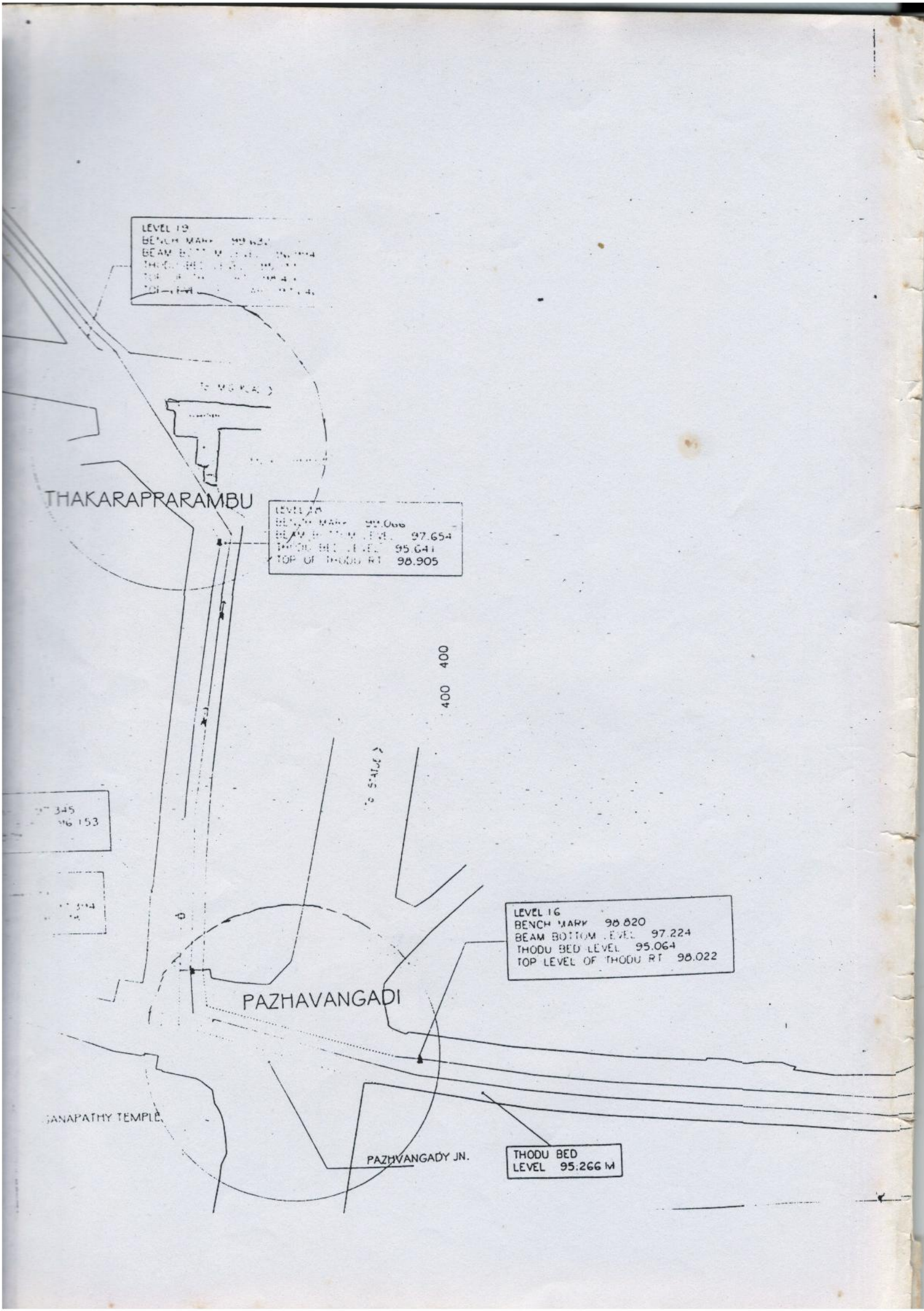
1. Desilting and maintaining the slope of Pazhavangadi thodu from Chengal choola to Kannanmoola for a length of 4.30Km and its periodic maintenance.
2. Providing gratings at the u/s of N.H Bridge
3. Reconstructing the Pazhavangadi culvert.
4. Cutting open the Thakaraparambu culvert.
5. Removing the silt and obstruction inside the Railway culvert
6. Constructing silt chamber for the flushing system of KWA treatment plant.

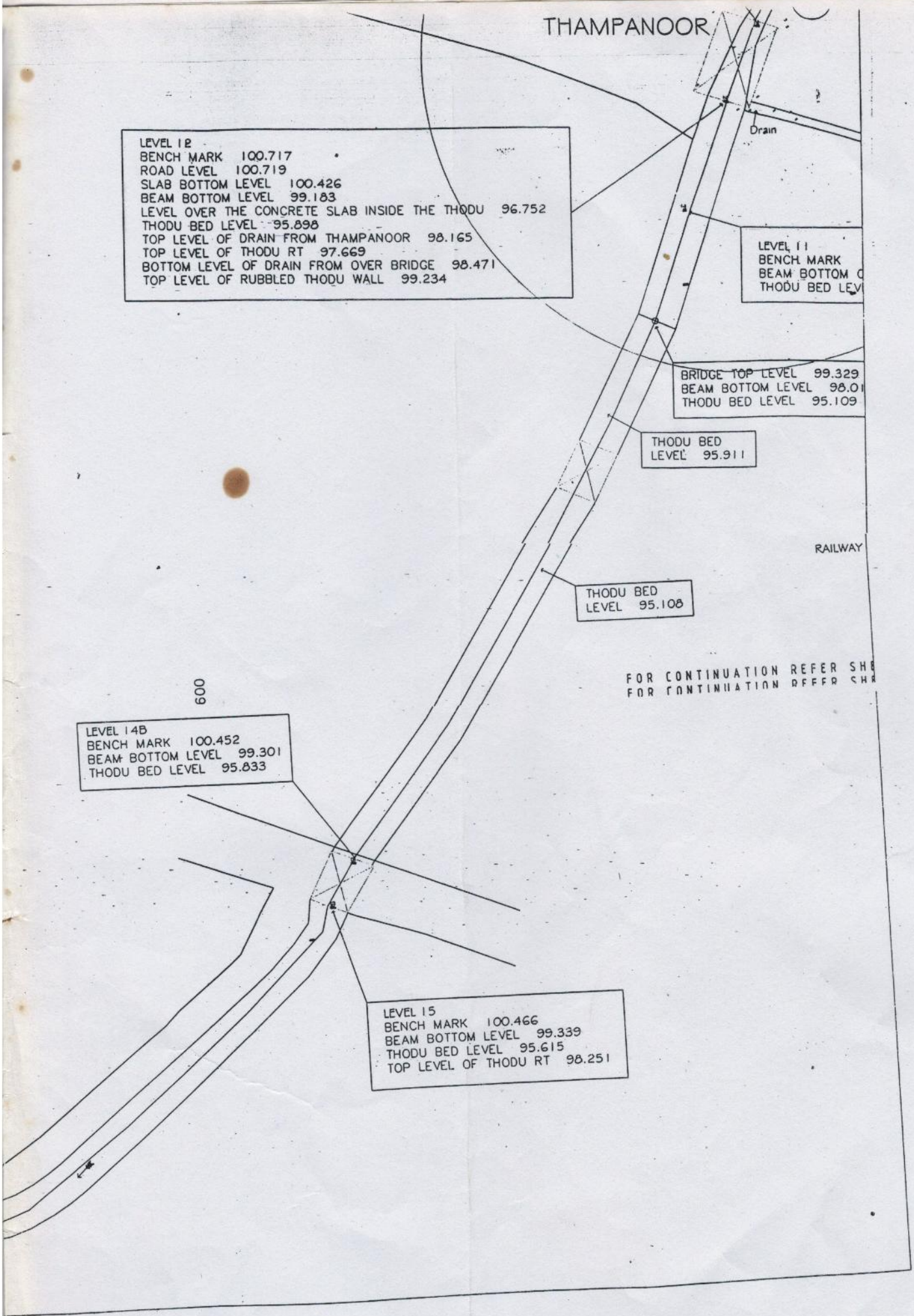
Item no. 3 and 4 is to be done by PWD which is to be started before 30-04-05 and should be completed within 3 months with their funds.

Item no.5 is to be done by the Railway or to be done through the Water Resources department at the cost of the Railways.

Item no.6 is to be done by Kerala Water Authority to reduce the silting in the thodu for which Rs.40 lakhs is to be provided for the KWA (Estimate to be provided by KWA)

Item nos 1 and 2 are to be done by the Water Resources department for which an amount of Rs.60.00 lakhs is to be provided under a new head of account for drainage of surface water in Thiruvananthapuram city for this year as provision is not available in


LEVEL 19
THAKARAPPARAMBU
LEVEL 18
BENCH MARK 99.066
BEAM BOTTOM LEVEL 97.654
THODU BED LEVEL 95.641
TOP OF THODU RT 98.905
400
400
LEVEL 16
BENCH MARK 98.820
BEAM BOTTOM LEVEL 97.224
THODU BED LEVEL 95.064
TOP LEVEL OF THODU RT 98.022
PAZHAVANGADI
GANAPATHY TEMPLE
PAZHVANGADY JN.
THODU BED
LEVEL 95.266 M


THAMPANOOR
Drain
LEVEL 12
BENCH MARK 100.717
ROAD LEVEL 100.719
SLAB BOTTOM LEVEL 100.426
BEAM BOTTOM LEVEL 99.183
LEVEL OVER THE CONCRETE SLAB INSIDE THE THODU 96.752
THODU BED LEVEL 95.898
TOP LEVEL OF DRAIN FROM THAMPANOOR 98.165
TOP LEVEL OF THODU RT 97.669
BOTTOM LEVEL OF DRAIN FROM OVER BRIDGE 98.471
TOP LEVEL OF RUBBLED THODU WALL 99.234
LEVEL 11
BENCH MARK
BEAM BOTTOM
THODU BED LEV
BRIDGE TOP LEVEL 99.329
BEAM BOTTOM LEVEL 98.01
THODU BED LEVEL 95.109
THODU BED
LEVEL 95.911
RAILWAY
THODU BED
LEVEL 95.108
FOR CONTINUATION REFER SH
600
LEVEL 14B
BENCH MARK 100.452
BEAM BOTTOM LEVEL 99.301
THODU BED LEVEL 95.833
LEVEL 15
BENCH MARK 100.466
BEAM BOTTOM LEVEL 99.339
THODU BED LEVEL 95.615
TOP LEVEL OF THODU RT 98.251