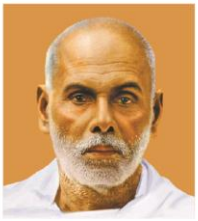
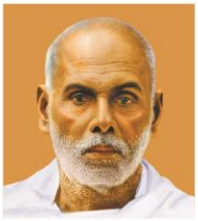
Sree Narayana Guru College
of Engineering & Technology
CHALAKKODE P.O., KOROM, PAYYANUR, KANNUR-670 307



DETAILS OF FIELD WORKS

Sree Narayana Guru College
of Engineering & Technology
CHALAKKODE P.O., KOROM, PAYYANUR, KANNUR-670 307



LIFE MISSION PROJECT

ചന്ദ്രശേഖർ, എസ്., ഐ. എ. എസ്.
ജില്ലാ കളക്ടർ & ജില്ലാ മജിസ്ട്രേറ്റ്
കണ്ണൂർ

'രണോത്സ-മാതൃോത്സ'

തീയതി: 17/03/2023

കത്ത് നം. KNRLF/162/2023

തീയതി .....

ഡോ. ലീന.എ.വി.
പ്രിൻസിപ്പാൾ
ശ്രീ നാരായണ ഗുരു കോളെജ് ഓഫ് എഞ്ചിനീയറിംഗ് & ടെക്നോളജി
കോറോം. പയ്യന്നൂർ - 670307

മാഡം.

വിഷയം: ലൈഫ് മിഷൻ പദ്ധതി – മിച്ചഭൂമി – ലൈഫ് മിഷൻ പദ്ധതിക്ക് കൈമാറി ഉത്തരവായത് – മാസ്റ്റർ പ്ലാൻ തയ്യാറാക്കുന്നത് സംബന്ധിച്ച്

സൂചന: (1) 16/09/2021-ലെ എൽ.ബി.ബി3-1562/00 നമ്പർ സ്റ്റേറ്റ് ലാൻഡ് ബോർഡിന്റെ നടപടിക്രമം
(2) 17/03/2023 തീയിതിയിൽ താങ്കളുമായി ജില്ലാ ലൈഫ് മിഷൻ കോ-ഓർഡിനേറ്ററുടെ കൂടിക്കാഴ്ച

മേൽ സൂചന (1) പ്രകാരം പയ്യന്നൂർ താലൂക്കിലെ പെരിങ്ങോം വില്ലേജിൽ ബ്ലോക്ക് നം.39-ൽ സർവ്വെ 317/1-ൽപ്പെട്ട (റീസർവ്വെ 129/2, റീസർവ്വെ 130/2) 2.84 ഹെക്ടർ മിച്ചഭൂമി ലൈഫ് മിഷൻ പദ്ധതിക്ക് കൈമാറുന്നതിനായി കേരള ഭൂപരിഷ്കരണ നിയമം സെക്ഷൻ 90(1-എ), 1790-ലെ കെ.എൽ.ആർ (സീലിംഗ്) റൂൾസ്- റൂൾ-32 പ്രകാരം പൊതു ആവശ്യത്തിന് നീക്കിവെച്ച് ഉത്തരവായിട്ടുള്ളതാണ്. പ്രസ്തുത സ്ഥലം ലൈഫ് മിഷൻ പദ്ധതി പ്രകാരം അർഹതപ്പെട്ട ഗുണഭോക്താക്കൾക്ക് കൈമാറുന്നതിനുള്ള നടപടികൾ സ്വീകരിച്ചുവരുന്നു.

ഈ സാഹചര്യത്തിൽ, പ്രസ്തുത 2.84 ഹെക്ടർ ഭൂമിയുടെ ഭൌമ ഘടന പരിശോധിച്ച് ആവശ്യമായ പൊതു സൌകര്യങ്ങൾക്കുള്ള (കളിസ്ഥലം, അംഗനവാടി, കമ്മ്യൂണിറ്റി ഹാൾ, വാട്ടർ ടാങ്ക്, വേസ്റ്റ് മാനേജ്മെന്റ്, ഓരോ വീടിനും റോഡ് സമീപ്യം, കുടിവെള്ളം, വൈദ്യുതി മുതലായവ) പ്രൊവിഷൻ ഉൾപ്പെടുത്തി താങ്കളുടെ കോളെജിലെ അദ്ധ്യാപകരുടെ/വിദ്യാർത്ഥികളുടെ/പൂർവ്വ-വിദ്യാർത്ഥികളുടെ പങ്കാളിത്തത്തോടെ അവർക്ക് പ്രവൃത്തി പരിചയം ലഭിക്കുവാനുതകുംവിധം ഒരു മാസ്റ്റർ പ്ലാൻ തയ്യാറാക്കി നൽകുന്നതിന് താത്പര്യപ്പെടുന്നു. ഇക്കാര്യത്തിലുള്ള തുടർ നടപടിയ്ക്ക് ജില്ലാ ലൈഫ് മിഷൻ കോ-ഓർഡിനേറ്റർ, ശ്രീ. ജസീർ.പി.വി. (ഫോൺ- 9562242370) യുമായി ബന്ധപ്പെടേണ്ടതാണ്.

വിശ്വസ്തതയോടെ,

DISTRICT COLLECTOR
KANNUR.

HOD CE,
Kindly take necessary action to prepare the DPR as per the order. This will be a remarkable work for the dept of CE & also will be a great experience for our students. Pls submit a unified report in this regard & finalise a date for completion.
18/03/23

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

1. Angan Vadi

2. Gym / Yoga - Play area.

3. Mini Shopping Complex.
(2 or 3 Shops + Women empowerment space on first floor)

4. Community Service Centre
— Library and meeting hall

Mr. Shibin. B

Group 1 (4)

1) Rajath
2) Abhijitha
3) Anupriya
4) Fiza
5) Keerthana

Community Centre.

Ms. Revathi

Group 2 (2)

1) Apaena
2) Sreenushna
3) Arjun K.M
4) Vyshna K
5) Amaya

Gym / Yoga Centre, Play area

Ms. Sharanya

Group 3 (3)

1) Zuhra
2) Sajjad
3) Alen
4) Shahana
5) Sreelakshmi

Mini Shopping Complex

Ms. Rinsha

Group 4 (1)

1) Anunindha
2) Muhammed
3) Vyshnavi
4) Maejaana
5) Akshaya

Angan Vadi

Dr. LEENA A. V.
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SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

ABSTRACT ESTIMATE - WATER SUPPLY SYSTEM -LIFE MISSION

SL.NO.	ITEM	QUANTITY	RATE	AMOUNT
1	Submerised pump (10HP Power. Kirloskar Brand)	1	60,000	60,000
2	4 Sq. mm cable	200 m	140	28000
3	80mm GI pipe for supply to tank	1750m	800	1400000
4	Sluice valve	5Nos.	6,000	30000
5	Main switch with panel board	1	10,000	10000
6	ELCB	1	50,000	50,000
6	PVC piping for supply	Lumpsum		4,00,000
7	Labour	Lumpsum		3,00,000
	Lumpsum			22,000
	Total			**23,00,000**
	Rupees Twenly three Lakhs only			

HOD

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

ABSTRACT ESTIMATE - ELECTRIFICATION -LIFE MISSION

SL.NO.	ITEM	QUANTITY	RATE	AMOUNT
1	11KV line	480 m	670/m	3,21,600
2	LT 3Phase line	590 m	310/m	182900
	street light provision	75 x 520		39000
3	LT Single Phase line	838 m	400/m	335200
	street light provision	85 x 200		17000
4	Transformer	2 No.	390000/ No	7,80,000
	Installation	2310 X 2		4620
5	Electric Post	36 No.	9000/ No.	324000
	Labour charge	36 No.	1200/ No.	43200
	TOTAL			**20,47,520**
	GST	18 percentage		368553.6
	Lumpsum			83,926
	Total			**25,00,000**

Rupees Twenly Five Lakhs only

HOD

Dr. LEENA A. V.
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SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

ABSTRACT ESTIMATE - DSOR YEAR : 2018, COST INDEX APPLIED FOR THIS ESTIMATE IS 1.339

SL NO	DESCRIPTION	NO	L	B	D	QUANTITY	REMARKS	
1	**3.13.2.B**							
	Earth work in excavation of foundation of structures as per drawing and technical specification, including setting out, construction of shoring and bracing, removal of stumps and other deleterious matter, dressing of sides and bottom, backfilling the excavation earth to the extent required and utilising the remaining earth locally for road work.							
	Ordinary Rock (not requiring blasting) - Mechanical Means							
	drain	1	1129	1.2	1	1354.8		
	Culvert	1	7.2	2.7	1	19.44		
	wing wall	4	2	2	1	16		
						total quantity	1390.24	
					say 1390.24 cum @ Rs 70.47			**97970.2128**
2	**12.4**							
	12.4 Plain cement concrete 1:3:6 nominal mix in foundation with crushed stone aggregate 40 mm nominal size mechanically mixed, placed in foundation and compacted by vibration including curing for 14 days							
	Drain	1	1129	1.2	0.15	203.22		
	culvert	1	7.2	2.6	0.2	3.744		
	wing wall	4	2	2	0.2	3.2		
						total quantity	210.164	
					say 210.164 @ Rs.6198.96			**1302798.229**
3	**12.8.A.1**							
	Plain/Reinforced Cement Concrete in Open Foundation complete as per Drawing and Technical Specifications.							
	PCC Grade M15							
	drain	2	1129	0.2	0.8	451.6		
	culvert abutment	2	7	(0.7+0.5)/2	1.2	10.08		
	wing wall	4	1.5	(0.7+0.5)/2	1.2	4.32		
						Total quantity	466	
					Say 466 cum @ Rs.7107.58			**3312132.28**
4	**12.8.1.C.1**							
	Plain/Reinforced Cement Concrete in Open Foundation complete as per Drawing and Technical Specifications							
	RCC Grade M20 - Using Concrete Mixer'<br							
	culvert bed block	2	7	0.5	0.2	1.4		1091426.4
	wing wall bed block	4	1.5	0.5	0.2	0.6		121269.6
	culvert slab	1	7	2	0.2	2.8		
	drain slab	1	1129	1	0.15	169.35		
						total quantity in cum	174.15	
					say 174.15 cum @ Rs.7857.67			**1368413.231**
5	**12.4**							
	Supply,,Fitting and Placing un- coated HYSD bar Reinforcement in Foundation complete as per Drawing and Technical Specifications							
	Qty as above x 75kg/m3	1	174.15	0.075		13.06125		
						total quantity in sqm	13.06125	
					Say 13.06125 MT @ Rs.70446.39			**920117.9114**

NET TOTAL Rs . **7001431.864**

HOD

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KANNUR

ABSTRACT ESTIMATE - DSOR YEAR : 2018, COST INDEX APPLIED FOR THIS ESTIMATE IS 1.339

SL NO	DESCRIPTION	NO	L	B	D	CF	QUANTITY		REMARKS
1	**2.3.2.A**								
	Clearing and grubbing road land including uprooting rank vegetation, grass, bushes, shrubs, saplings and trees girth up to 300 mm, removal of stumps of trees cut earlier and disposal of unserviceable materials and stacking of serviceable material to be used or auctioned, up to a lead of 1000 metres including removal and disposal of top organic soil not exceeding 150 mm in thickness In area of light jungle - By Mechanical Means 								
	In area of light jungle - By Mechanical Means							Rs 53795.28908 / Hectare	
							total quantity	0.9692 hectare	
					say 0.9692 hectare @ Rs 53795.28908				**Rs 52,138.40**
	2.1.1								
	Cutting of trees, including cutting of trunks, branches and removal of stumps, roots, stacking of serviceable material with all lifts and up to a lead of 1000 metres and earth filling in the depression/pit. Girth from 300 mm to 600 mm								
								Rs 383.64 each	
					say 50 no of tress @ Rs513.69				**25684.5**
2	**3.4**								
	Excavation for roadway in ordinary rock by deploying a dozer, 80 HP including cutting and pushing the cut earth to site of embankment upto a distance of 100 metres (average lead 50 metres), trimming bottom and side slopes in accordance with the requirements of lines, grades and cross sections								
	7`m road	1	1129	6	0.5	3387	3951.5		1187385.84
	5m road	1	540	5	0.5	1350	1350		405661.365
	3m road	1	100	3	0.5	150	150		45073.485
							Total quantity	5451.5	cum
					say 5451.5 cum @ Rs300.4899				**1638120.69**
3	**4.12**								
	Providing, laying, spreading and compacting graded stone aggregate to Wet Mix Macadam specification including premixing the Material with water at OMC in mechanical mix plant carriage of mixed Material by tipper to site, laying in uniform layers with paver in sub- base / base course on well prepared surface and compacting with vibratory roller to achieve the desired density.								
	7m road	1	1129	6	0.15	1016.1	1185.45		3194645.496
	5m road	1	540	5	0.15	405	405		1091426.4
	3m road	1	100	3	0.15	45	45		121269.6
							total quantity in cum	1635.45	
					say 1635.45 cum @ Rs2694.88				**4407341.496**
4	**5.1.a**								
	Providing and applying primer coat with bitumen emulsion (SS) on prepared surface of granular Base including clearing of road surface and spraying primer at the rate of 0.70 - 1.0 kg/sqm using mechanical means.								
	7m road	1	1129	7			7903		536376.61
	5m road	1	540	5			2700		183249
	3m road	1	100	3			300		20361
							total quantity in sqm	10903	
					say 10903 sqm @ Rs 67.87				**739986.61**

HOD

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KANNUR

	5.2.a								
	Providing and applying tack coat with bitumen emulsion(RS) using emulsion pressure distributor at the rate of 0.20 - 0.30 kg per sqm on the prepared bituminous surface cleaned with mechanical broom								
	TACK COAT								
	7m road	1	1129	7			7903		99893.92
	5m road	1	540	5			2700		34128
	3m road	1	100	3			300		3792
							total quantity in sqm	10903	
					say 10903 sqm @ Rs 12.64				**137813.92**
	OD								
	Mix seal surfacing								
	Mix seal surfacing Providing, laying and rolling of close graded premixed surfacing material of 20mm thickness composed of 11.2mm to 0.9mm (Type A) or 13.2 mm to 0.9mm (Type B) aggregates using Bitumen VG-30 to required line, grade and level to serve as wearing course on a previously prepared base, including mixing in a suitable plant, laying and rolling with a static roller 8-10 Kn and finishing to required level and grades as per Technical specification. By manual means Type A(Bitumen VG-30)								
	MSS								
	7m road	1	1129	7			7903		2008389.39
	5m road	1	540	5			2700		686151
	3m road	1	100	3			300		76239
							total quantity in sqm	10903	
					say 10903 sqm @ Rs 254.13				**2770779.39**
5	**12.4**								
	Plain cement concrete 1:3:6 nominal mix in foundation with crushed stone aggregate 40 mm nominal size mechanically mixed, placed in foundation and compacted by vibration including curing for 14 days.								
	BERM CONCRETE - PCC								
	7m road	1	1129	0.5	0.15	169.35	169.35		909029.4786
							total quantity in cum	169.35	
					say 169.35 cum @ Rs5367.756				**909029.4786**
	12.8.1.C								
	Plain/Reinforced Cement Concrete in Open Foundation complete as per Drawing and Technical Specifications RCC Grade M20 - Using Concrete Mixer - (Without formwork) 								
	7m road	1	1129	0.5	0.05	56.45	56.45		363331.393
							total quantity in cum	56.45	
					say 56.45 cum @ Rs6,436.34				**363331.393**

NET TOTAL **Rs. 10966402.98**

HOD

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KANNUR

District CANNANORE

Taluk TALIPARAMBA

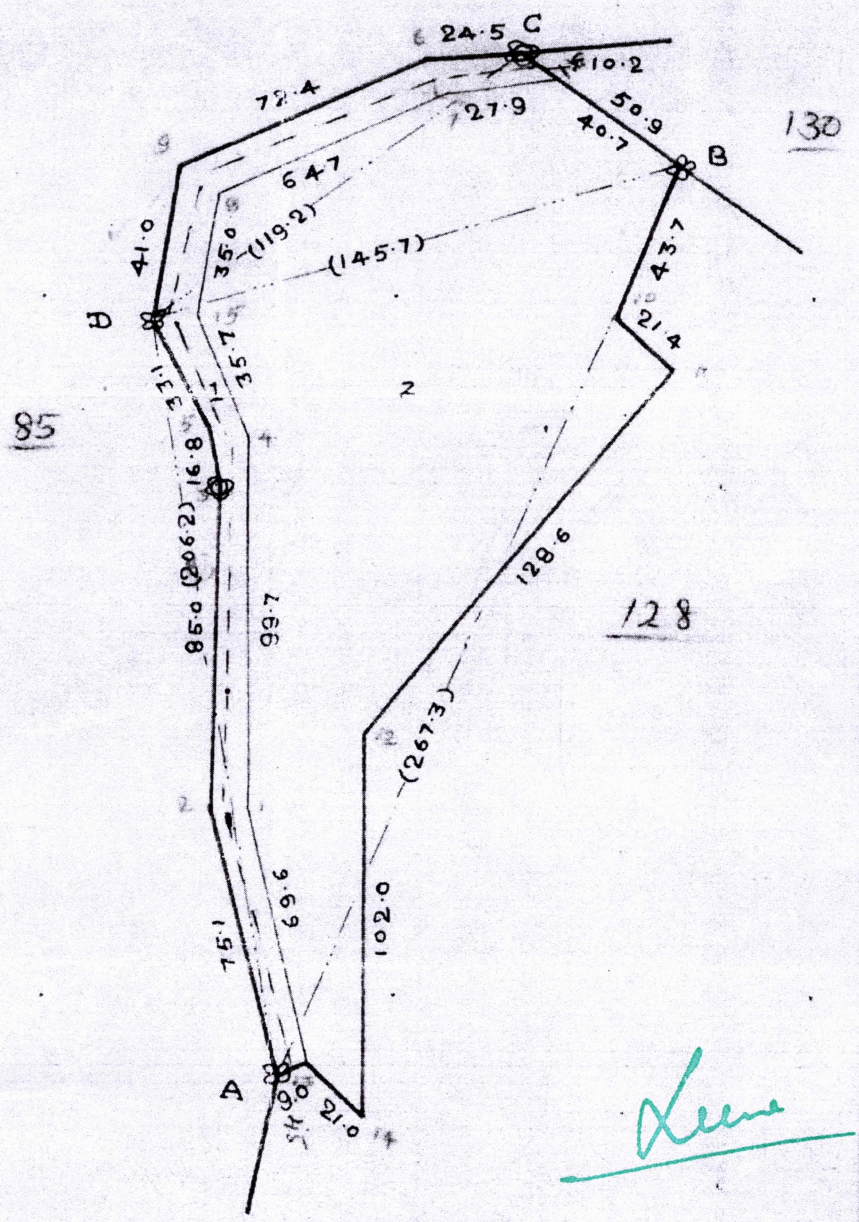
Field No. 129

Block **Village**

No. 39

Name Peri

Area 2·C



Dr. LEENA A. V.
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ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

District CANNANORE

Taluk TALIPARAMBA

Field No. 130

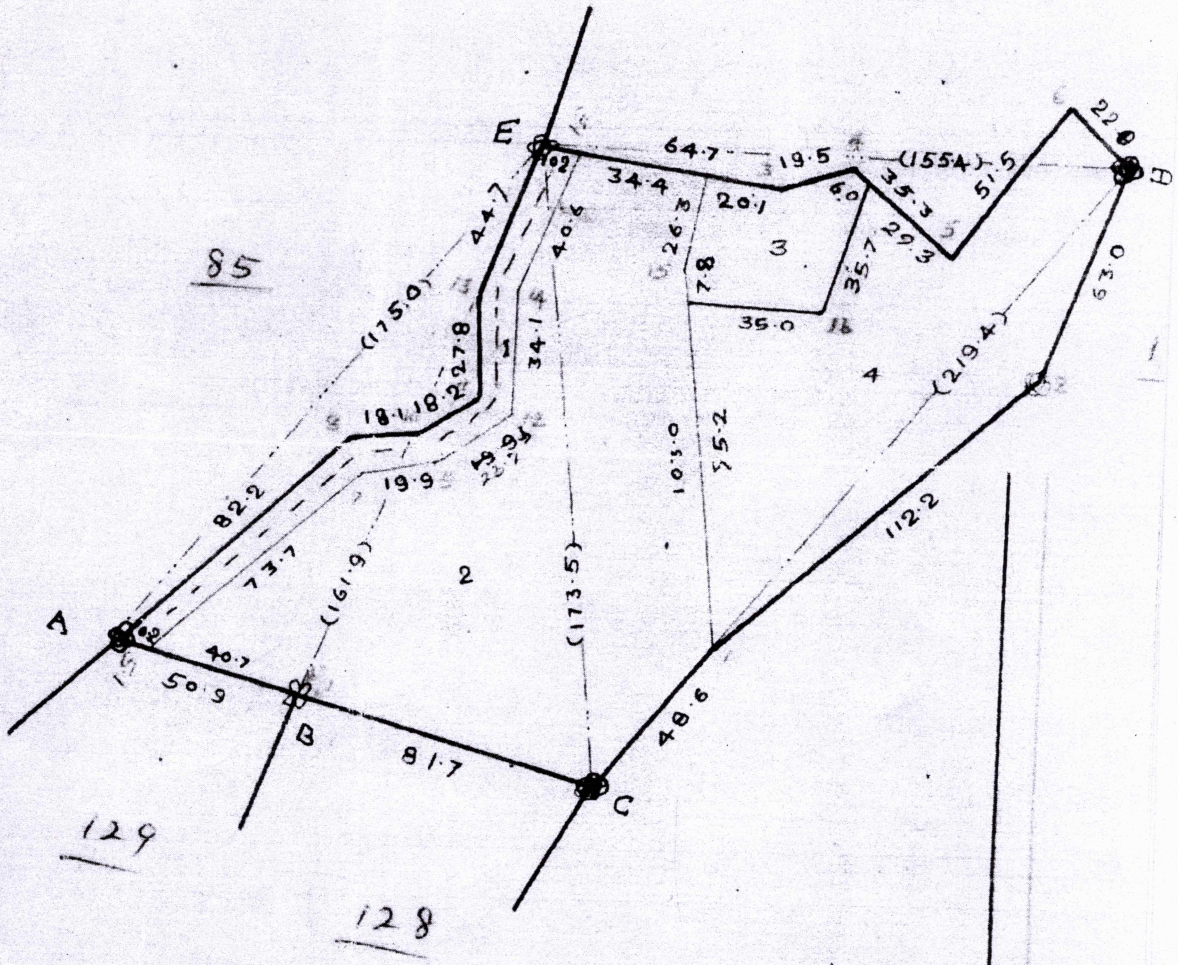
Block

Village

No. 39

Name PERI

Area 2.



S.D. 3 and 4 plotted as per ALC

FG 21/10/94

Dr. LEENA A. V.
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ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

15·4

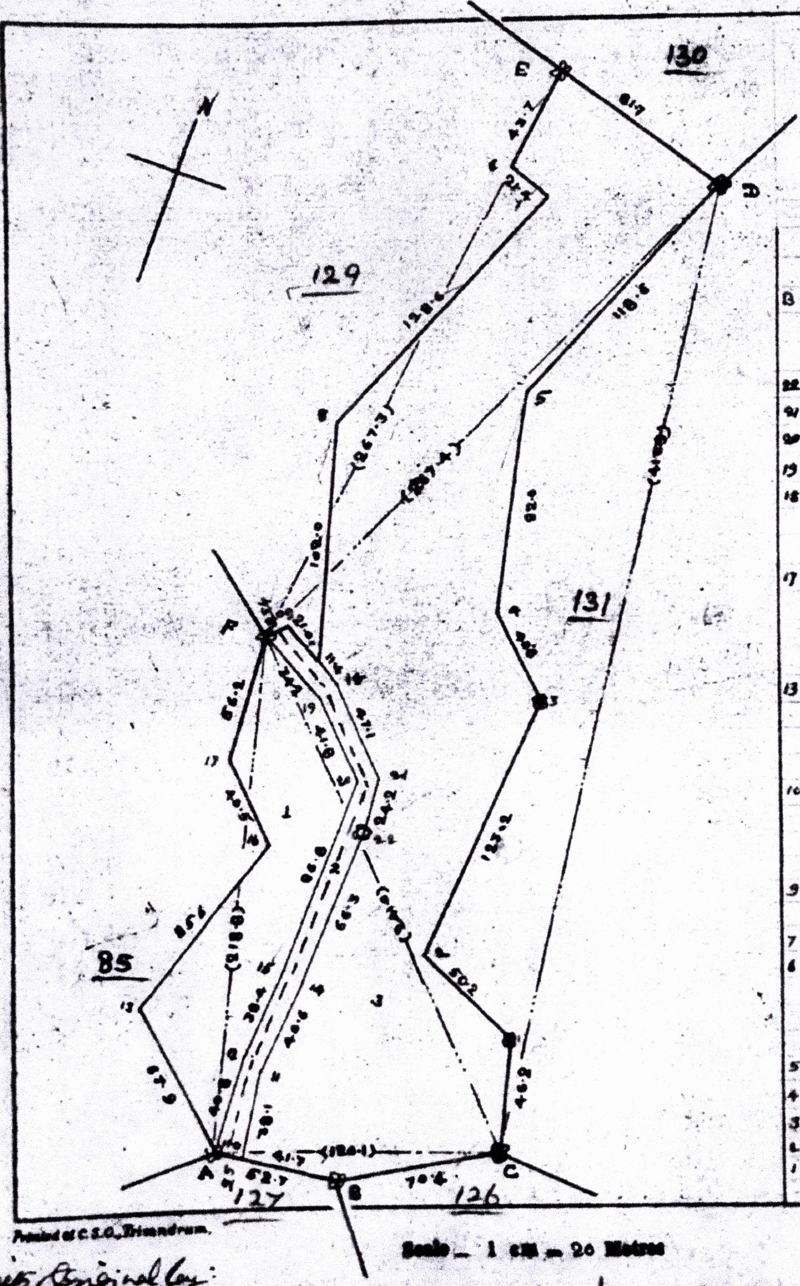
28·2

District CANNANORE

Taluk TALIPARAMBA

Field No. 128

Block **Village** { **No.** 39 / **Name** Pevingome / **Area** 4.1120 **Hectares** }



		A		
		(120.1)		
B	13.4	69.1		
		C		
		(241.0)		
22	1.7	95.4		
21	17.4	77.2		
20	9.8	74.5		
19	9.9	38.7		
18	17.8	30.2		
		F		
		(218.8)		
17	11.2	163.7		
		128.6	8.9	16
		76.1	21.2	15
		73.8	28.6	14
13	37.2	56.5		
		40.8	7.2	12
		38.7 ~~37.59~~	14.8	11
		A		
10	24.1	1.6		
		+		
		F		
		(267.3)		
9	50	~~227.9~~		
		174.6	15.1	8
7	20.9	50.9		
6	9.8	43.7		
		E		
		D		
		(416.9)		
5	60.1	314.9		
4	50.8	283.2		
3	24.9	191.1		
2		70.6		
1	6.3	45.8		
		C		

Printed at C.S.O., Trivandrum.

Scale _ 1 cm. = 20 **Metres**

Raveendran. A.S
C.G.S- 18-8-79

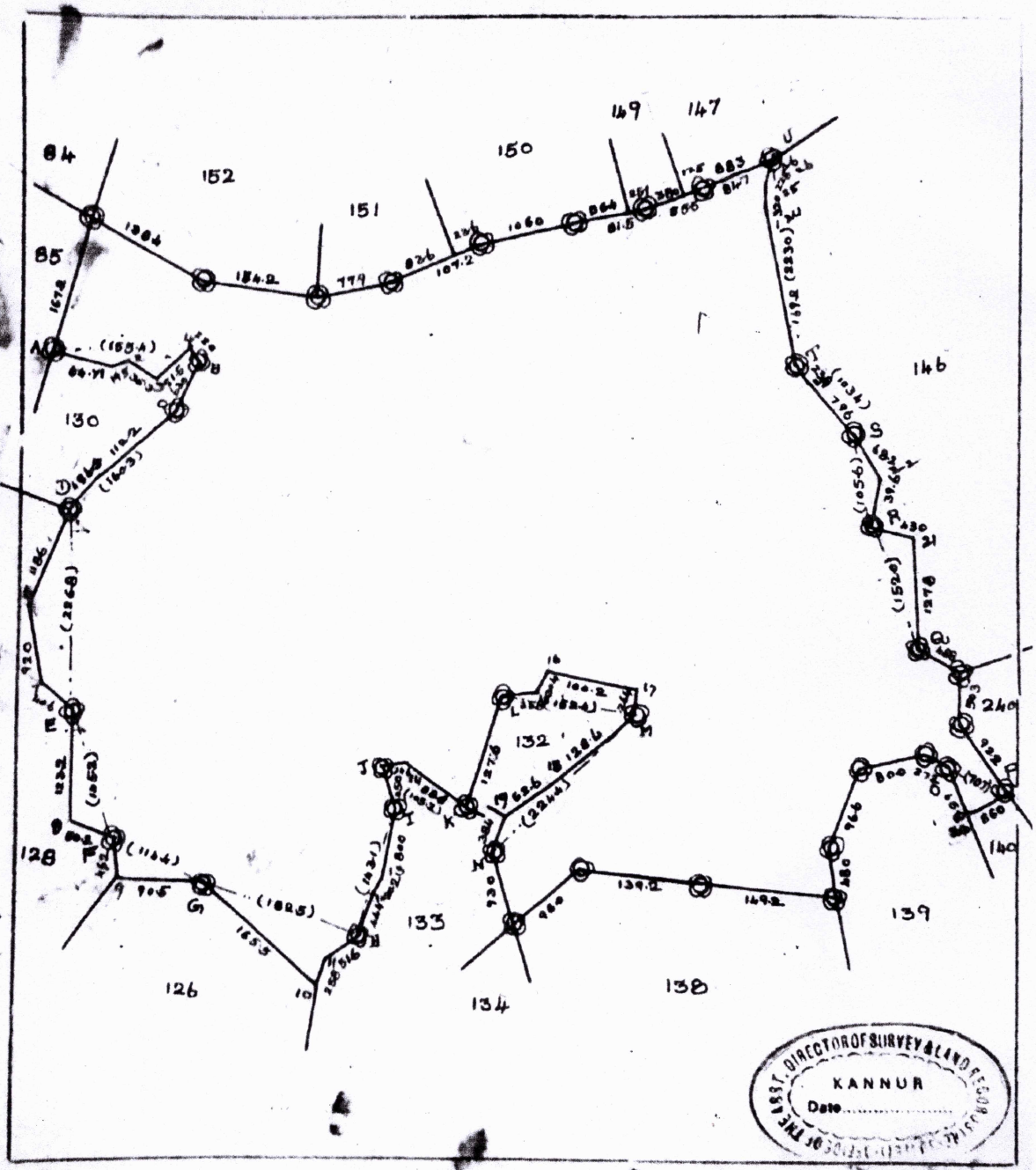
Signature in full of Surveyor with date

(C. Raveendran. A.S)

Prepared from original by: ... (Town drawing) 8/28

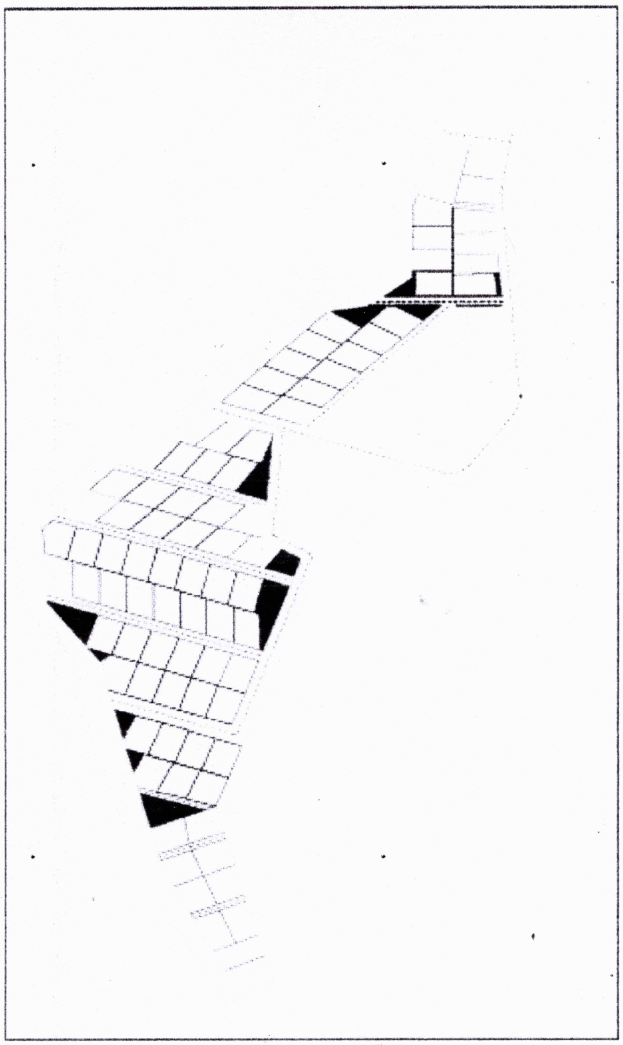
.../10/79
H

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR



ASSISTANT DIRECTOR
of Survey & Land Records
(Mapping), THRISSUR

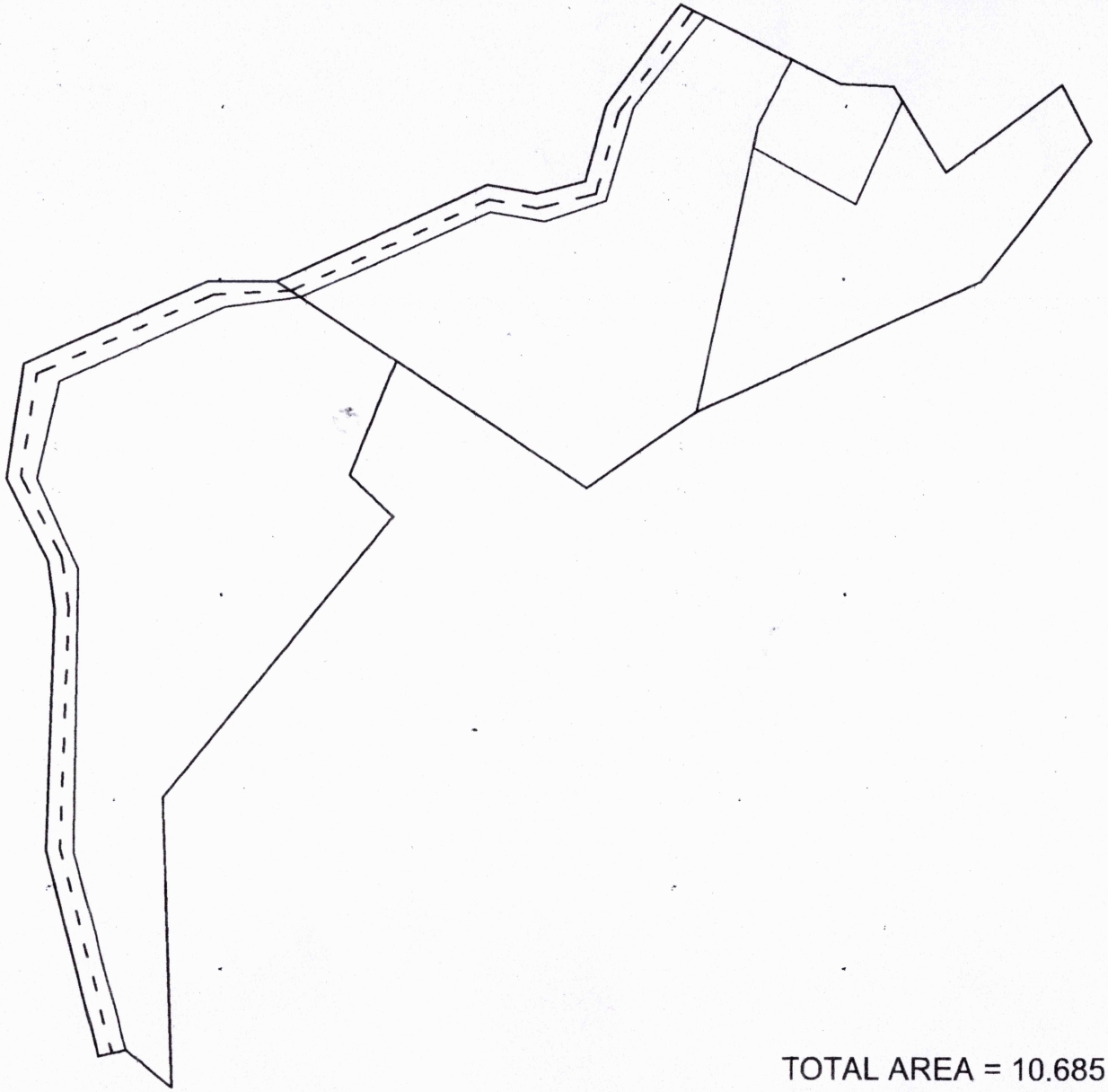
Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR.



SUBDIVIDED PLOT WITH ROAD NETWORK

Dr. LEENA A. V.
PRINCIPAL
SREE NARAYANA GURU COLLEGE OF
ENGINEERING & TECHNOLOGY, PAYYANUR
KANNUR

LI E MISSION PROJECT - SITE LAN



TOTAL AREA = 10.685 Acre

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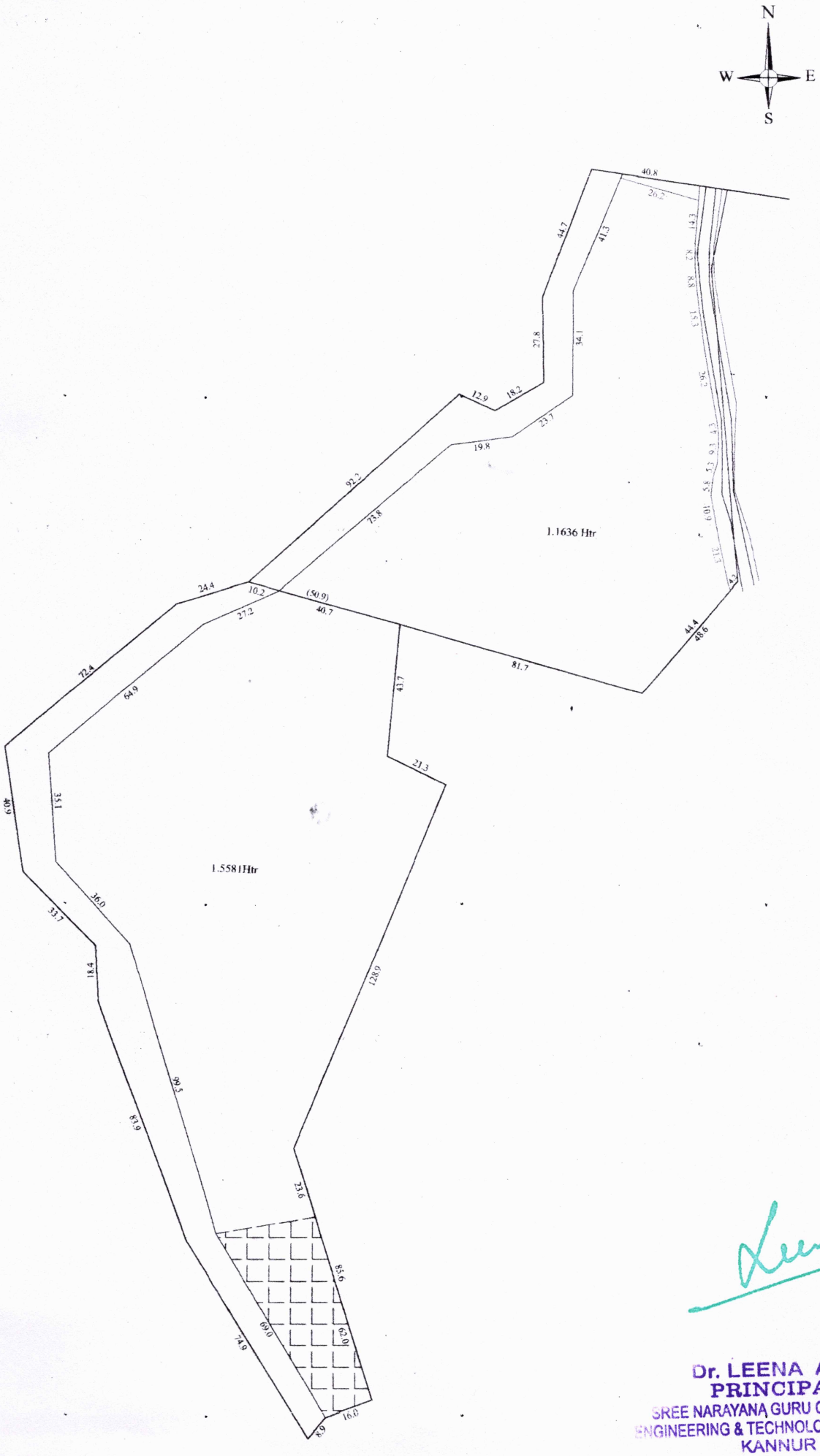
District: Kannur
Taluk :Payyannur
Village :Peringome

Field no :

Block no :



all dimensions are in mtr

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REPORT ON LIFE MISSION PROJECT AT PERINGOME

The inauguration of the proposed Life Mission project at Erattakkulam in Peringome Panchayat was made on 28th March ,2023. The proposed project is to plan residential plots with common facilities like Anganvadi, community centre, shops, recreation centre etc.with road access to every plot.

Principal Dr. Leena A V, Head of the Department of Civil Engineering Ms.Mary Sonia George ,other staff members- Ms.Saritha Sasindran, Mr. Shibin B, Ms. Shamya Sukumaran M, Ms. Pooja K P and Ms. Reeba Maria along with the students from S6 CE attended the function.

Familiarisation of the proposed site was done on that day and it was decided to conduct a total station contour survey of the site. The revenue sketches of the plots were collected from the village office on the same day.

The students of S6 CE were assigned the work of preparing the drawings of the common facilities like Anganvadi, community centre, shops, recreation center etc,under the guidance of faculty from the department. They have completed this task.

The total station survey of the site was done on April 14th. All the students of S6 CE and the staff members Ms.Saritha Sasindran, Mr. Shibin B, Ms. Shamya Sukumaran M, Ms. Pooja K P and Ms. Reeba Maria participated in the survey. The survey was carried out from 9am to 5.30pm.

After obtaining the contour sketch from the total station survey the preparation of master plan has been started. In Autocad, the subdivision of the plot and planning of road network is being carried out.

In order to fix and identify some boundary points a site visit was made on May 5th by the faculty and a few students along with an official from the village office Peringome. The boundary marks on several points could be identified during this visit.But a few boundary points couldn't be located .These points are to be fixed by surveying, before finalising the master plan.

The planning of road network and sub division of plot has been done in Autocad. After seeking expert opinion from a town planner we are reworking on the plot sub-division in order to make it more suitable for the layout of buildings. This will be completed by 7th June.

We are planning a site visit this week to confirm the measurements in the drawings and that in the field.

Report prepared by

Saritha Sasindran, 5/6/23

APCE

DATE: 05/06/2023

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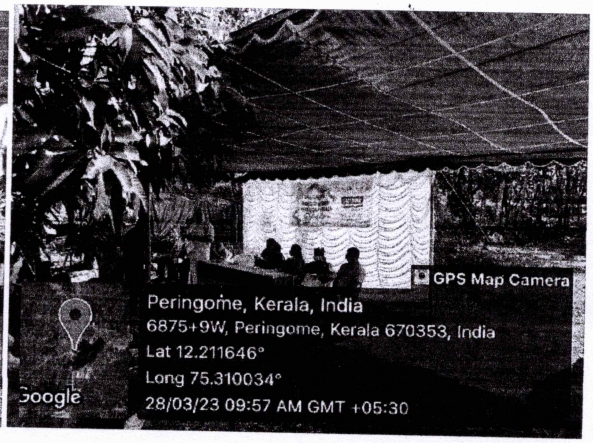
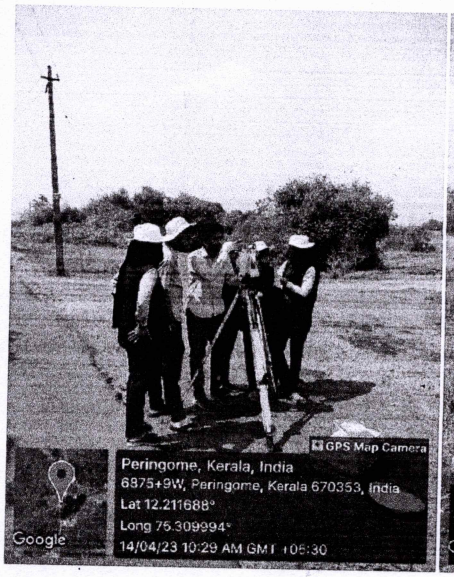
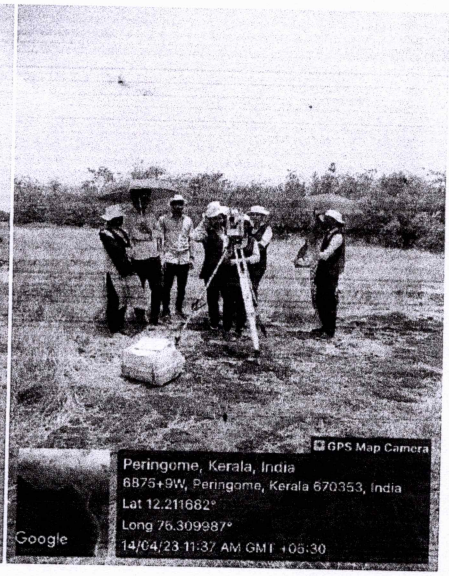


INAUGURAL FUNCTION





TOTAL STATION SURVEYING

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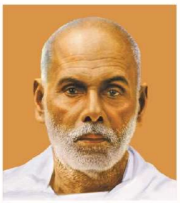

പയ്യന്നൂർ എസ്.എൻ.ജി. എൻജിനീയറിംഗ് കോളേജിന് കളക്ടറുടെ പ്രശംസ പത്രം

പയ്യന്നൂർ: ലൈഫ് മിഷൻ വി ല്ലേജിന്റെ മാസ്റ്റർ പ്ലാൻ ത യ്യാറാക്കിയതിന് പയ്യന്നൂർ ശ്രീനാരായണ ഗുരു കോളേജ് ഓഫ് എൻജിനീയറിംഗ് ആൻ ഡ് ടെക്നോളജിക്ക്, ജില്ലാ ക ളക്ടറുടെ പ്രശംസ പത്രം. പയ്യ ന്നൂർ താലൂക്ക് പെരിങ്ങോം വി ല്ലേജിൽ നിർമ്മിക്കുന്ന ലൈ ഫ് മിഷൻ വില്ലേജിന്റെ മാസ്റ്റ ർ പ്ലാൻ തയ്യാറാക്കി നല്കിയ തിനാണ് കോളേജിന് ജില്ലാ കളക്ടർ പ്രശംസ പത്രം നൽ കിയത്. കളക്ടറേറ്റിൽ നടന്ന ചടങ്ങിൽ ജില്ലാ കളക്ടർ എ സ്. ചന്ദ്രശേഖർ, കോളേജ് പ്രി ൻസിപ്പൽ ഡോ: എ.വി. ലീന യ്ക്ക് പ്രശംസ പത്രം സമർപ്പിച്ച. പെരിങ്ങോം വില്ലേജിൽ റവ ന്യൂ വകുപ്പ് അനുവദിച്ച ഏഴ് ഏ

പയ്യന്നൂർ എസ്.എൻ.ജി. എൻജിനീയറിംഗ് കോളേജ് പ്രിൻസിപ്പൽ ഡോ. എ.വി. ലീന, ജില്ല കളക്ടർ എസ്. ചന്ദ്രശേഖറിൽ നിന്ന് പ്രശംസ പത്രം ഏറ്റുവാങ്ങുന്നു

വും, റിക്രിയേഷൻ സെന്ററും, അ ങ്കണവാടിയും ഉൾപ്പെടുന്ന ലൈ ഫ് മിഷൻ വില്ലേജ് നിർമ്മിക്കുന്ന

ട്ടത്തി സിവിൽ എൻജിനീയറിം ഗ് വിഭാഗം വിദ്യാർത്ഥികളും, അ ദ്ധ്യാപകരും ചേർന്നാണ് സമയ

HOD

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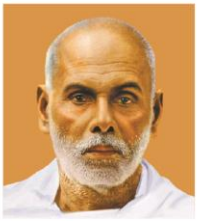

POLLUTION ABATEMENT PROJECT -PERUVAMBA RIVER

Water Resources Department, Kerala invites your virtual presence for Workshop on "Tie up between Engineering Colleges and Water Resources Department of Kerala".

Agenda of the meeting on 19.01.2020 (Tuesday)

Time: 3 pm to 5 pm

Welcome: Dr. P. Sojan Lal, Principal, Mar Baselios Institute of Technology and Science (MBITS), Kothamangalam.

Introductory Remarks: Shri.Pranabjyothi Nath IAS, Secretary, WRD

Session 1 : "Sampling Protocols for Water Quality Monitoring " – by Sri.Johar T.S, Water Quality Specialist, Field Studies Circle, Thrissur (25 Minutes)

Session 2 : "Standard Methods for the analysis of faecal coliforms and total coliforms in water samples" – By Dr. M. G. Grasious, Department of Civil Engineering, Viswajyothi College of Engineering, Vazhakkulam. (25 Minutes)

Section 3 –"Standard Operating Procedure – a walkthrough" – by Dr.Deeepesh Valsan , Scientist C , Central Pollution Control Board, Bangalore. (30 Minutes)

Question and answer session: 25 minutes.

Vote of Thanks: Smt. Priji S.S., Deputy Director, IDRB

Zoom Meeting ID: 976 1995 4170

Pass Code: 232323

Zoom Meeting Link:

https://zoom.us/j/97619954170?pwd=ckxQTTFtWVIvZVA1SURnWXZnTTRiQT09

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GOVERNMENT OF KERALA

Water Resources Department invites your virtual presence for 1 st meeting on the 2nd Phase of talks

on

"Tie up between Engineering Colleges and Water Resources Department of Kerala"

Date: 08.04.2021 **Time: 4.00 PM IST**

Chief Guest:- Dr. V Venu IAS, Additional Chief Secretary (Planning & Economic Affairs, Higher Education & Environment Departments)

Special Invitees: Dr. Rajasree M.S, Vice Chancellor, APJ Abdul Kalam Technological University.

Er. Sreekala .S , Member Secretary, KPCB.

Shri. Arun Alex, Co-ordinator, Industry Attachment Cell,APJ Abdul Kalam Technological University.

Meeting ID: 93150049534 **Pass Code: 5678**

AGENDA	TIME
Welcome Speech by Shri . Sunil Raj, Superintending Engineer, Irrigation, South Circle	04.00 PM - 04.05 PM
Introductory Remarks by Shri. Pranabjyothi Nath IAS, Secretary, WRD	04.05 PM - 04.10 PM
Guest of the Day Dr. V Venu IAS, Additional Chief Secretary (Planning & Economic Affairs, Higher Education & Environment Departments)	04.10 PM - 04.20 PM
The Catchlight by	04.20 PM - 04.30 PM

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Dr. Rajasree M.S, Vice Chancellor, APJ Abdul Kalam Technological University.	
River Rejuvenation- DPR – Evaluation Results by Smt. Priya K.L, Assistant Professor, Department of Civil Engineering, TKM College of Engineering, Kollam	04.30 PM - 04.40 PM
21 DPRs – An Assessment by Shri. Priyesh. R Director, IDRB	04.40 PM - 04.55PM
Way Forward by Shri. Biju.D Chief Engineer, IDRB	04.55 PM - 05.05 PM
Path Breaking by Er. Sreekala .S , Member Secretary, KPCB.	05.05 PM - 05.15 PM
The Mission by Shri. Arun Alex, Co-ordinator, Industry Attachment Cell,APJ Abdul Kalam Technological University.	05.15 PM - 05.25 PM
Specific remarks by Shri. T.K. Jose IAS, ACS (WRD)	05.25 PM - 05.45 PM
Open Forum	05.45 PM - 5.55 PM
Vote of Thanks	05.55 PM - 06.00 PM

by Smt. Sandhya S.G, Joint Director (Hydrology), IDRB	

Meeting Facilitator: Dr. P. Sojan Lal, Principal, MBITS .

Technical Support: Shri. Eldose Varghese & Shri. Mahesh K.M , MBITS

END OF PROGRAMME

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RECORD OF DISCUSSIONS

Date: 21.01.2021 Time: 4PM

Venue :- Video Conferencing on tie up between Engineering Colleges and Water Resources Department of Kerala.

Agenda : - Abatement of Pollution in Rivers in Kerala in view of the Order of the National Green Tribunal (NGT), Pipe Testing for Jal Jeevan Mission (JJM) & Water Quality testing of Wells & Micro Irrigation System.

List of participants is enclosed as Annexure - 1.

1. The meeting started at 04:00PM with Smt. L.Sreedevi, Dy.C.E (I&A) welcoming all the participants.

2. Shri. Pranabjyoti Nath IAS, Secretary, WRD expressed the happiness in seeing how the mastermind of the ACS(WRD) is moving forward and is in its 9th week. In his ppt he spoke about the journey of this project till day including the various workshops on water sampling. The ppt is made available in the IDRB

website (www.idrb.kerala.gov.in).

3. Shri. Prashanth Nair IAS, MD, KIIDC & KSINC spoke on how in spite of the pandemic blockade, response from the students of the participating Engineering Colleges is overwhelming as they have taken up the field visits and collection of water for sampling tests. This progress shows how we are nearing the target date set for the DPR preparation. He winded up his speech by stating that the sane saying "Best is the enemy of the good" should always be borne in mind.

4. Shri. Jauhar T.S, Water Quality Expert, Field Study Circle, Thrissur, IDRB presented a ppt on the "Need for WQ Monitoring & Infrastructure Requirement". He explained on the need for water quality monitoring as, one in six people lack access to pure water. He explained the anthropogenic causes of pollution. He highlighted the prerequisites for water quality monitoring which mainly included instrumentation, laboratory space and human resources. The ppt is made available in the IDRB website (www.idrb.kerala.gov.in).

5. Shri. Pranabjyoti Nath IAS, introduced Kumari. Mrinmayi Shashank Joshi IAS, District Collector, Palakkad & Smt. Navjyot Kosa IAS, District Collector, Thiruvananthapuram to the talks.

6. Kumari. Mrinmayi Shashank Joshi IAS, District Collector, Palakkad expressed her happiness in the fact that the very first meeting that she is attending in her new position as District Collector, Palakkad is that of her parent department itself. She offered the full cooperation and support from her district in this venture.

7. Smt. Navjyot Kosa IAS, District Collector, Thiruvananthapuram in her talks supported the initiative and the whole hearted cooperation that the Engineering Colleges and Water Resources department are providing as this being a social issue. She stated that she will ensure that the full support will be provided on all actionable points pertaining from the O/o the District Collector, Thiruvananthapuram.

8. Shri. S Venkateshapathy IAS, MD, KWA at the start stated that he will be speaking on the various projects of KWA & GW which are in its different stages of inception.

9. As regards Pipe Testing is concerned he detailed the list of colleges that have approached KWA and the tests that need to be conducted. He once again called upon the participating engineering colleges to forward their willingness for pipe testing in the email id managingdirectorkwa@gmail.com after which they can be empaneled. He reiterated the contractor's license eligibility criteria, limiting the Non Revenue Water (NRW) etc .

10. The ppt gave an insight into the NRW and Well Census .The ppt is made available in the IDRB website (www.idrb.kerala.gov.in).

11. His ppt mainly showcased the comprehensive plan for the Management of Sewerage/Faecal Sludge Management for the State. The ppt is made available in the IDRB website (www.idrb.kerala.gov.in).

12. Shri.Biju Balakrishnan, PCB, Alleppey brought out the main aspects under pollution abatement as well as that for sewerage management. He narrated the different aspects of sewerage

treatment and how the bake houses and slaughter houses are the main enemies in choking the sewerage lines.The ppt is made available in the IDRB website (www.idrb.kerala.gov.in).

13. Smt.Sanju Sreedharan, Associate Professor, SCMS School of Engineering & Technology, Karukutty, Ernakulam spoke on the "Odyssey through the rivers- Kecheri & Kadambrayar". She presented a ppt in which she put forth the methodology to be adopted by the colleges, by the selection of appropriate sample collection points , the parameters that are tested at the field, the investigations that are to be done in the laboratory etc.

14. The ppt gave a complete insight into the journey undertaken by SCMS School of Engineering & Technology, Karukutty, Ernakulam in the rivers of Kecheri & Kadambrayar & a comparison of these 2 rivers with entirely different pollution characteristics The ppt is made available in the IDRB website (www.idrb.kerala.gov.in).

Points Discussed in the Open Forum:-

1. Is NABL accredited labs compulsory for evaluating the quality ?

Its not mandatory, but the process involved for the same should be as per IS standards.

2. Does the Government of Kerala or the IDRB assist the institutions with aid for improving the facilities ?

IDRB will facilitate the participating engineering colleges with data sharing, but no capital investments will be supported by Government or by IDRB.

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3. What are the other options available for testing of BOD, COD, total coli forms etc which are not available in certain college labs and wherein the PCB is not willing to take up the water quality testing in their labs and CWRD is asking for 50% of the cost ?

All the labs under KWA, Irrigation Department and Ground Water Department may start accepting water samples immediately from Engineering Colleges. Procedures for this can be decided subsequently.

4. Is it possible to get the details of sewerage system existing in the river basins as secondary data ?

The data that is available will be shared. Once the GIS data is done with the same will be uploaded in the website of KWA.

5. What all has to be considered while taking samples in locations where there are tidal effects ?

Samples can be taken from different profiles at different depths in order to get a clear picture. If possible integrated samples can be collected to get a better picture of the saline intrusion.

The meeting ended with a vote of thanks by Smt.B.Sindhu, Director, KERI.

The meeting ended at 5.45 PM.

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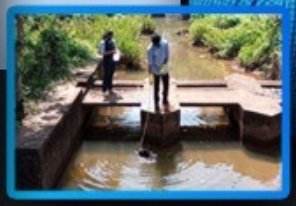


ENGINEERING FOR ECOLOGY/ENVIRONMENT

Water Resources Department
Government of Kerala

Preparation of actionable DPRs for abatement of pollution in the two critically polluted rivers in the State

A collaborative project with Water Resources Department, Kerala State for the River Peruvamba from Dec 2020 till March 2021

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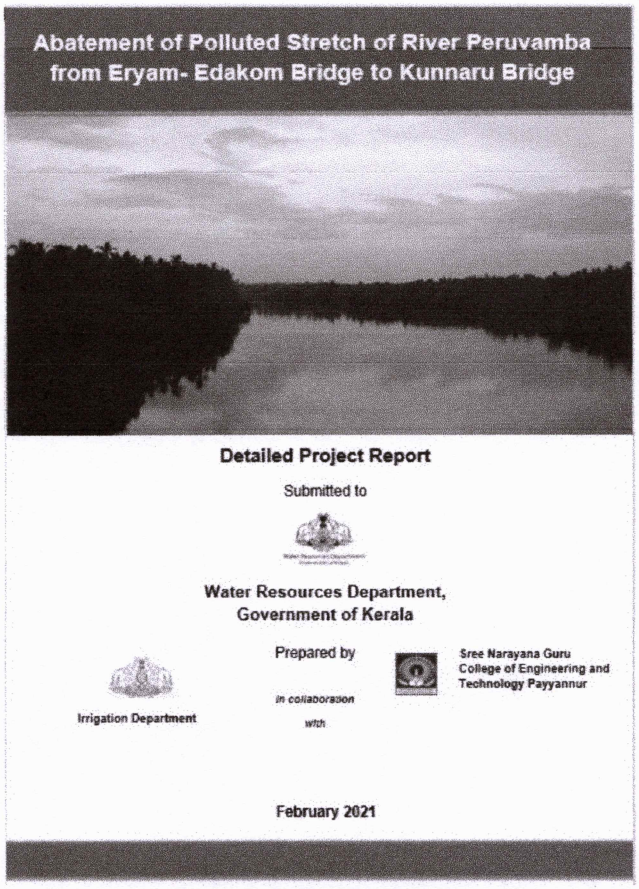
Pollution Abatement Project - Peruvamba River

SNGCET Payyannur is committed to serve the needs of society and encourage the students to apply their knowledge and skills in real life socio-technical environmental issues.

As per the order of the Hon'ble National Green Tribunal (NGT) in O.A No. 673/2018, pertaining to the rejuvenation of 21 critically polluted river stretches in Kerala, it has been decided to propose short-term, long-term solutions to prevent the pollution in rivers and to restore its pristine quality through holistic approach.

Our faculty and students, in association with Water Resources Department, Govt of Kerala was involved in the**Field studies**, **Water quality testing** and preparation of **Detailed Project Report (DPR)** of **River Peruvamba**(Perumba)., Payyannur Kannur District during the period of January – February 2021.



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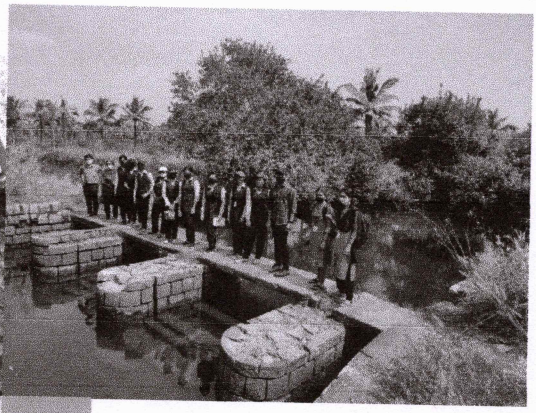

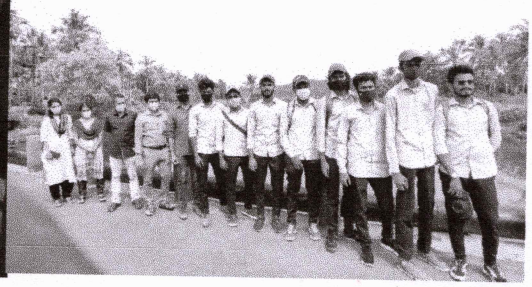

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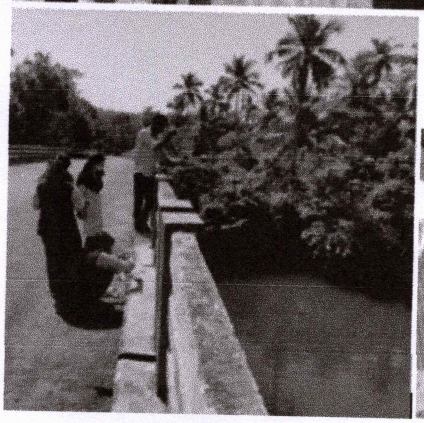

Co-ordinator
(Saritha Sasindran)

(HoD, CE)

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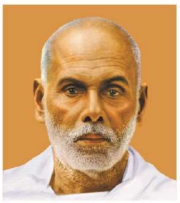

Photos of Pollution Abatement Project -Peruvamba River

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Abatement of Polluted Stretch of River Peruvamba from Eryam- Edakom Bridge to Kunnaru Bridge

Detailed Project Report

Submitted to

Water Resources Department
Government of Kerala

Water Resources Department,
Government of Kerala

Prepared by

Irrigation Department

HOD

In collaboration

with

Sree Narayana Guru College of Engineering and Technology Payyannur

St. Thomas College of Engineering and Technology Sivapuram

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February 2021

Contents

List of Tables

List of Figures

Acknowledgement

We would like to express our sincere gratitude to Water Resources Department, Government of Kerala and the concerned officials for extending their support and the valuable inputs during the preparation of this Detailed Project Report.

We extend our heartiest gratitude to Sri.T.K. Jose IAS, Additional Chief Secretary, Water resource, Home and Vigilance Government of Kerala for his guidance and motivation.

Our sincere thanks to Sri. Pranobjyoti Nath IAS, Special Secretary Water Resources Department for his relentless support in pursuing this task.

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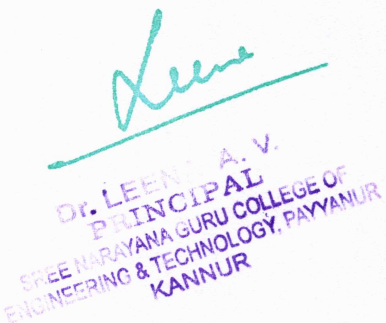
We are truly thankful to faculty of various engineering colleges for their immense support which were instrumental in completion of the same.

Last but not the least, we take this humble opportunity to thank all those who have inspired and motivated us to prepare this Detailed Project Report.



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Executive Summary

As per the order from the Hon'ble National Green Tribunal (NGT) O.A No. 673/2018 by pertaining to action plan for the 21 critically polluted river stretches in Kerala, a detailed study of polluted stretch of the river Peruvamba was conducted during the month of January 2021. The study was conducted by St. Thomas College of Engineering and Technology (STM) and Sree Narayana Guru College of Engineering and Technology (SNGCET) Payyanur in association with Water Resources Department. The study includes Reconnaissance survey, Detailed field visits, Data collection related to the river, River water sampling, Testing, Analysis of test results as well as further interaction with the experts, officials and public.

The study revealed that the river is in a healthy condition along most of its stretches. However, the unscientific and irrational practices in the agricultural fields at the upstream and the rapidly progressing industrialization at the downstream may become a threat to the river in future. The study puts forward action plans including proposal of Sewage Treatment Plant at Payyanur Municipality. Conglomerative actions of public organizations, student groups, experts and other stakeholders have also been put forward.

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1. Introduction

1.1 Background

Rivers have always been an important source for humans. All the ancient civilizations emerged and flourished on the banks of rivers. However, over the course of time, as the population increases, the rivers were polluted. A polluted river stretch not only contaminates the river water ecosystems, but it affects the nearby human settlements also.

River water pollution is defined as the presence of toxic chemicals and biological agents that exceed certain permissible limits and may cause a threat to human health and/or the environment. Legal measures are being enforced globally, over the raising concerns on river water pollution. In India, as part of these, water pollution prevention acts are being enforced statewide and national wide. The River Boards Act 1956, The Water Prevention and Control of pollution Act 1974, The Water Pollution (Prevention) Cess Act 2003 etc. are few among those. The Honorable Supreme court held that right to clean water and environment is a fundamental right under article 21 of Indian constitution. The Central Pollution Control Board (CPCB), in association with State Pollution Control Boards (KSPCB), is monitoring the quality of water bodies at 2500 locations across the country under the Water Quality Monitoring Programme.

As part of National Water Quality Monitoring Programme, CPCB came up with a brief report presenting the analysis of the monitoring of the water quality in India. Report classifies Indian rivers based on priority of action demanded for the protection. The classification is given in Table 1.1.

Table 1.1 Classification of Indian rivers based on priority of action

Priority	Definition of criteria	Number of Stretches
Priority 1	Locations with BOD > 30 mg/l in on any occasion; All monitoring locations with BOD > 6 mg/l on all occasions.	35
Priority 2	Monitoring locations having BOD between 20-30 mg/l on any occasion; All monitoring locations with BOD > 6 mg/l on all occasions.	15
Priority 3	Monitoring locations having BOD between 10-20 mg/l; All monitoring locations exceeding BOD concentration 6 mg/l on all occasions.	26
Priority 4	Monitoring locations having BOD between 6-10 mg/l.	38
Priority 5	Monitoring locations having BOD between 3-6 mg/l. The locations exceeding desired water quality of 3mg/l BOD.	36
	Total	150

A four-member River Rejuvenation Committee (RRC) has been constituted in compliance with the direction of the Hon'ble National Green Tribunal (NGT) Principal Bench, New Delhi, to work towards ensuring a healthy river ecosystem in the state. The tribunal directed the authorities to ascertain the causes of pollution and take immediate preventive measures. The government and its departments concerned have been told to submit its suggestions as to how each one can play its role effectively for preventing the pollution of the river.

Based on the orders of the Hon'ble National Green Tribunal (NGT) in O.A No. 673/2018, pertaining to action plan for the 21 critically polluted river stretches in Kerala, it has been decided to prepare a plan to prevent the pollution in rivers and to restore its pristine quality through a holistic approach where the Irrigation Department and the Engineering Colleges could work together for developing new and innovative solutions for the abatement of pollution in the 21 critically polluted rivers in the State. River Peruvamba is one of the critically polluted rivers selected for rejuvenation under this scheme from the district Kannur.

Kannur is one of the 14 districts along the west coast in the state of Kerala, India. The city of Kannur is the district headquarters and gives the district its name. The old name, Cannanore, is the anglicized form of the Malayalam name "Kannur". Kannur district is bounded by Kasaragod District to the north, Kozhikode district to the south, Mahé (UT) to the southwest and Wayanad District to the southeast. To the east, the district is bounded by the Western Ghats, which forms the border with the state of Karnataka (Kodagu district). The Arabian Sea lies to the west. The district was established in 1957. Kannur is the sixth-most urbanized district in Kerala, with more than 50% of its residents living in urban areas. Kannur has an urban population of 1,640,986, which is the second largest in Kerala after Ernakulam district. Out of 44 major rivers in Kerala, 7 are in Kannur district. They are Ramapuram River, Kuppam River, Peruvamba River, Valapattanam River, Ancharakandy River, Ponniyam River and Mahe River which is mentioned in Table 1.2.

Table 1.2 Major river of Kannur District

Sl.No.	Name of River	Place of origin	Length in km		Basin area in sq.km
			Total	Navigable	
1	Valapatanam river	Brahmagiri Ghats	113	45	1191
2	Kuppam river	Padinalkad forest	71	24	536
3	Ancharakkandy river	Kannoth forests	64	27	113
4	Mahe river	Wayanad Ghats	55	24	223
5	Peruvamba river	Eramam Kuttor Ghat	51	17	287
6	Ponniyam river	Kannoth forests	29	22	108
7	Ramapuram river	Pariyaram village	19	6	92

Peruvamba river popularly known as Perumba river is one of the major fresh water rivers in Malabar. It originates at the Western Ghats near Wayakkara village in Kannur district, runs through a stretch of 51 km. A tributary of Peruvamba which is called as **Vannathi River** flows through the town Mathamangalam. Peruvamba is called as **Panappuzha** in the Mathamangalam area.

The other main tributaries are Macharuthode, Challachal, Nitaringapuzha and Mukkuttenkarachal. The head stream of the river is known as Panappuzha. Another head stream Kallankulam thodu rises from Ezhilamvayal. Both the head streams join at Korom and form the main stream of Peruvamba. The river flows into the Arabian Sea near the Payyannur town. It has a total basin area of 287 km^2. A tributary of Peruvamba which is called as Vannathippuzha flows through Mathamangalam. Location of the river is given in Fig 1.1 to Fig 1.2.

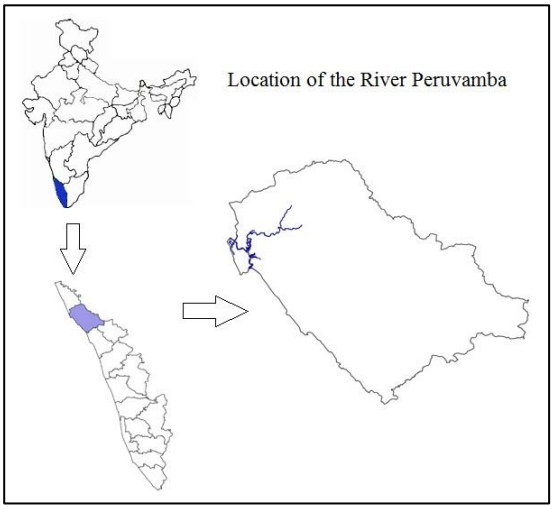

Fig 1.1 Location of the river Peruvamba

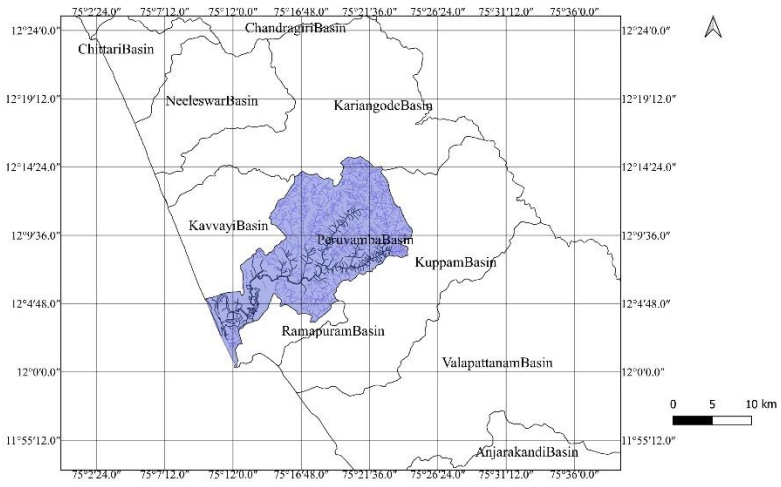

Fig 1.2 Peruvamba river basin

1.2 Polluted Stretch of the River

A stretch of 34 km starting from Eryam Edakkom bridge to Kunnaru Bridge is identified to be polluted out of the 51km of Peruvamba river. KSPCB conducts periodic water quality sampling from 4 sampling stations along the river. The stretch extends from upper hilly region of Kadannappalli Panappuzha Panchayat; where agricultural activities are predominant, upto the the coastal regions of Ramanthalli Panchayat. Along the course, it passes through Payyanur Municipality where significant municipal wastes are added into the river.

Along with the river Peruvamba, Kannur district is blessed with a hand full of estuaries/ backwaters. Out of the major 32 estuaries across Kerala, 5 are situated in Kannur district. The estuaries in Kannur district are, Dharmadam backwater, Mannayed estuary, Kavvayi backwater, Mahe estuary and Kattampally estuary.

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The major agricultural products on the Peruvamba river basin are rice, cashew, coconut, rubber and vegetables. The downstream portion of the river basin is associated with cash crops such as cashew, coconut etc., while the upstream portion consists of cultivation of rubber, vegetable and spices. In hilly stretch of Kadannappally Panappuzha Panchayat, rice was cultivated on a large scale during the last decade, but it further gave way for tapioca and rubber, but hopefully the recent trends shows an improvement in rejuvenation of paddy fields. Organic vegetable cultivation by families for domestic purpose is an emerging trend all over the basin. Usage of chemical fertilizers was at its peak for five years back, but hopefully, the river quality test results shows that loads of fertilizers and pesticides has decreased, may be due to scientific irrigation methods or the decreased usage of chemical fertilizers. Appendix A-1 and A-2 gives the details of Cities, Towns, Panchayats and Villages near the polluted stretch.

2. Objectives and Outcomes of the Action Plan

Main objectives of the study include

1. Identification of sources of pollutants
2. To propose short- and long-term action plans for the abatement of pollution and rejuvenating the river water to class B standard (IS 2296- 1992).
3. Identifying third party in monitoring river stretches.
4. Contributing to the public awareness regarding waste disposals.

Outcomes:

The outcomes envisaged after the implementation of Action Plan include:

- Enhancement in river water quality to Class B
- Maintenance of minimum environmental flow
- Improvement of bio diversity.

3. Pollution Inventory

The river pollution is mainly due to the drains flowing into it. Municipal Solid Waste, Bio- medical waste, Hazardous waste, E waste etc. contributes to the pollution from various waste dumping sites.

3.1 Details of Drains Contributing Pollution

River Peruvamba is associated with a vast network of drains, which is spread over an area of 287 $km^{2.}$ The drains and the locations at which the drains meet the river are listed in Table 3.1

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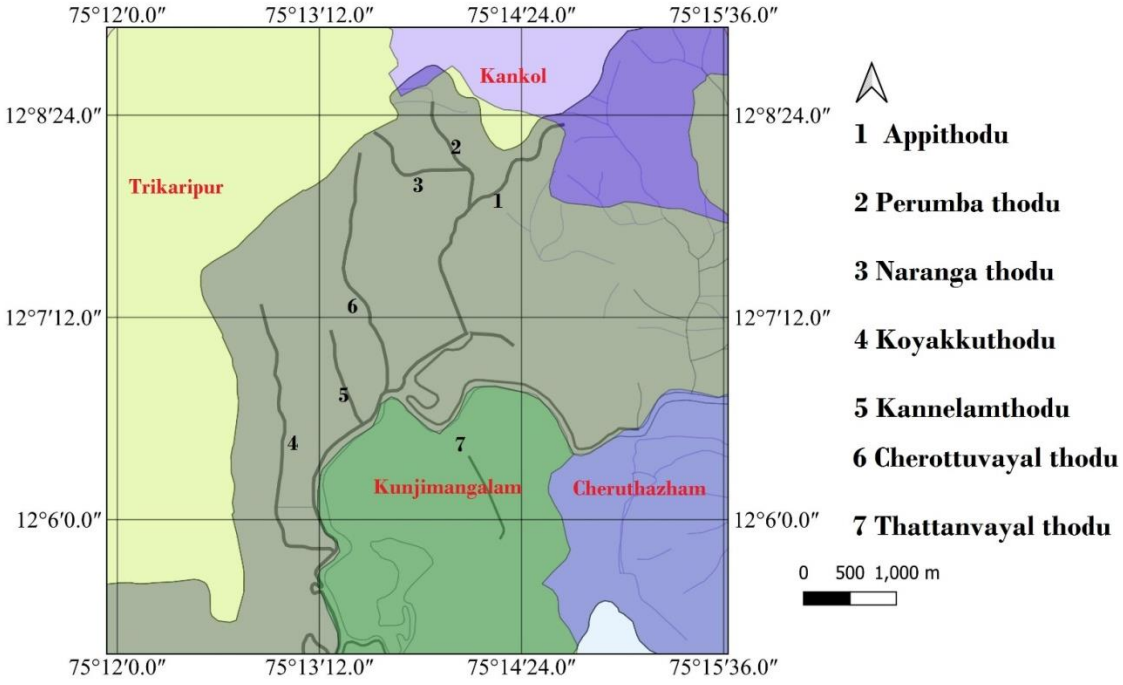

Fig 3.1 Location of drains associated with the river Peruvamba

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Table 3.1 Pollution Load of Drains joining the river.

SL.NO.	DRAIN NAME	LOCATION		Pollution load BOD										
		LAT	LONG	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Oct-20	Nov-20	Dec-20
1	Naranga thodu	75°13'17.19"	12°5'9.69"	12	A	A	A	2.8	2.8	3.9	3.8	2.23	10.8	3.14
2	Perumba thodu	75°13'27.47"	12°6'33.92"	10	12.3	10.6	14.7	1.4	2.6	4.82	4.92	6.72	8.4	8.6
3	Valliohmthodu	75°18'13.80"	12°7'31.98"	1.3	1	0.8	4	6.8	2.6	5.76	5.84	3.94	2.2	5.5
4	Panapuzha thodu	75 0 22''7.68''	12 0 8''7.82''	1	0.9	0.9	3.8	1.32	1.4	2	0.2	0.79	0.6	1.2
5	Poomkottu Chal			0.44	0.7	0.9	0.44	0.2	1.6	1.3	0.96	1.18	0.36	1.1
6	Manjangottu Thode			0.2	A	A	A	1.34	1.2	1.86	0.84	0.86	0.2	B
7	Kannelamthodu	75°16'57.44"	12°6'36.36"	1.4	A	A	A	1.32	2.6	2	0.78	0.78	1.6	0.82
8	Appithodu	75°18'48.76''	12°9'7.54"	1	A	A	A	0.53	1.3	1.3	1.24	1.76	0.3	2.2
9	Mavullapoyil thodu			0.6	0.6	0.8	4.5	0.66	0.2	1.62	1.2	1.06	0.1	0.86
10	Kollali thodu	75°13'27.49"	12°3'22.90"	1.7	A	A	A	3.26	2.2	A	1.2	B	0.3	B
11	Kannada thodu	75°13'17.12"	12°5'9.67"	5.2	1.2	0.9	5.1	0.8	0.8	C	C	1.68	11.4	1.2
12	Koyakkotu thodu Thokadu	75°11'35.46"	12°4'28.61"	2.6	A	A	1.8	0.4	0.6	C	1.2	0.4	1	B
13	Cherottuvayal thodu	75°13'18.34"	12°3'44.92"	1.8	A	0.5	1	0.54	0.68	0.84	0.96	0.8	1.2	1.1
14	Kayyil arakulam thodu Kunjimangalam puzha			1.7	2	1.9	4.4	1.8	2.2	C	2.26	2.04	0.6	B
15	Tattanvayal thodu	75°13'32.49"	12°3'4.05"	5.6	A	A	A	0.4	0.4	C	0.72	0.4	11.2	B

COLOUR CODE	BOD RANGE
	0 TO 1.0
	1.0 TO 2.0
	2.0 TO 3.0
	BOD above 3 mg/L

COLOUR CODE	REMARKS
A	No water
B	Could not fetch water as there was only less amount of water
C	Could not fetch water as the sites were in Containment zone

Table 3.1 shows the test results from KSPCB. Monthly BODs for the year 2020 sampled from 15 selected drains joining the river. BOD values from Naranga thodu, Peruvamba thodu, Valliohmthodu drains within Payyannur municipality area (downstream) are found to be significantly high compared to the remaining drains.

Naranga thodu: Located at the Payyanur town near Lulu Cycle Mart, and Deepak nursing home. The presence of BKM Hospital makes the location crowded on weekdays. Fish selling shops and chicken centres having no proper sewage treatment facilities are located nearby the drain. Naranga thodu is found to be having the most critical pollution load as per KSPCB. The river gets almost dried during the summer, which contributes to the increased pollution load at that period.

Perumba thodu: Located nearby the Children Park- Payyanur town. Location of Municipality Canteen makes the area popular. Construction of a mall was observed nearby the location, and it was informed that the water table is high which adds troubles during monsoon season. In the month of May, the water level drops considerably and the pollution load gets increased.

Valliomthodu: The Perumba thodu drain gets connected to Valliyomthodu, which in turn connects to the Peruvamba river. The proposed site of an STP was found nearby the drain, and the location was found for anti-social activities. However, the opening of new shops makes the location more livable and it was

informed that the pollution load got decreased considerably over the past few months. An abnormal increase in pollution load was observed during June 2020, which may be due to local specific site conditions, particularly at the time of sample collection, which demanded further sampling and testing.

Panappuzha thodu: Situated at the upstream of the river nearby the Mathamangalam. The pollution load is considerably less due to the absence of major industrial and commercial activities.

Mavullapoil thodu: The drain joins the river at the junction where the roads from Alakkad, Perumbadavu and Payyanur meet. Location is less populated and the pollution load is also less. Pollution load was found to be high during the summer season, which may be due to the decrease in water level.

Kambipalam thodu: A site which shows comparitively lesser pollution load. One of the rivergauge stations of the Peruvamba river is located at this site.

Thattumvayal thodu: Located nearby comparitively less populated areas such as Padiyottuchal. The river water is found to be clean, and the flow velocity in the region is higher, which contributes an increased level of erotion, and a lesser pollution load.

Kunjimangalam thodu: Located nearby the Kunjimangalam railway bridge. The site is comparitively abandoned, high load was observed during May only. It may be due to a decrease in water level during summer.

In general, drains in the upstream are observed to be fully or partly dried during the non monsoon seasons and as a result tend to give relatively higher values of BOD due to the stagnation.

3.2 Details of Sewage Pollution Sources and Treatment Systems

The contaminated water from most of the drains gets directly mixed with river water. The upland of Panappuzha, Peringome, Vayakkara Panchayats and the midlands of Payyannur municipality and Pariyaram, contribute differently to the river water pollution. Major sources of sewage are from the drainages of Payyannur Municipality which is spread over an area of 54.63 km^2. The main waste generating sources are households, agricultural fields, institutions, hospitals, marketplaces and industries. The daily waste generated in Payyannur municipality is about 22.34 TPD. In Payyannur Municipality area, approximately 21.8% of households have been covered with various bio degradable waste management devices, which mean 78.2% households haven't been supplied with any bio-degradable waste management devices.

Estimated sewage generation for various Panchayats and municipality served by Peruvamba river is listed below.

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Table 3.2: Details of estimated population and MSW from Panchayats

SI. NO.	PANCHAYAT	NAME OF VILLAGE	POPULATION (2011)	DECADAL GROWTH (%)	ESTIMATED POPULATION (2021)	ESTIMATED MSW (KG/DAY)
1	Peringome Vayakkara	Peringome	16,721	3.17	17,163	8,810
2		Vayakkara	18,687		18,868	
3	Eramam Kuttor	Kuttoor	8,143	3	8,204	8,350
4		Eramam	9,448		9,426	
5	Kadannapilly Panapuzha	Kadannappally	10,430	2.3	10,478	6,535
6		Panappuzha	11,355		11,370	
7	Payyannur	Payyannur		7.7	72,111	21,700
8	Ceruthazham	Cheruthazham	29,348	NA	29,698	NA
9	Kunhimangalam	Kunchimangalam	18,965	NA	19,065	NA
10	Ramanthali	Ramanthali	25,711	NA	26,157	NA

3.2.1 Sewage treatment Plant at Pariyaram

Sewage treatment is the process of removing contaminants from wastewater, primarily from household sewage. It includes physical, chemical, and biological processes to remove these contaminants and produce environmentally safe treated wastewater (or treated effluent). A by-product of sewage treatment is usually a semi-solid waste or slurry, called sewage sludge that has to undergo further treatment before being suitable for disposal or land application.is the process of removing contaminants from wastewater, primarily from household sewage.

It works on the principle of Aerobic Treatment with the help of aerobic bacteria, which is most conventional and proven method throughout the world. As per the medical centres rules all main hospitals are to have dedicated STPs.

Pariyaram Govt. Medical College, being on the river basin of Peruvamba, a detailed field visit to STP inside the campus was made to observe the adopted sewage treatment process. The current centralized STP came into operation since 2005 and is of 1 Million litre capacity per day. Hospital block, dental block and academic block are connected to the STP.

Raw sewage water from the above blocks is passed through bar screen and initially collected in an equalization tank. The floating large materials get screened in this stage and are removed frequently to ensure the smooth flow of water to equalization tank. From equalization tank, the water is passed to aeration tank where aerobic sludge digestion takes place.

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Moving Bed Bioform Reactor (MBBR) accelerates the aerobic decomposition and the waste is passed to secondary clarifier. The sedimentation takes place in this chamber and the relatively clear water is made to flow into a collection chamber from where it is further taken through Sand filtration and followed by Carbon filtration. Water from the carbon filtration is moved to clear water tank where further chemical treatment and are utilized for field irrigation and gardening purpose.

The sludge from the sedimentation/secondary clarifier is passed to Sludge drying bed tanks which on drying is used as manure.

While considering the cost, apart from the initial cost, operation and maintenance costs are also to be considered. It is noted that about 10 units electricity is consumed on daily basis for its operation and a dedicated staff is essential to ensure the function for 24hours.

Sewage is the waste generated from residential, institutional, commercial and industrial establishments. STP plant treats the sewage to make it fit for safe disposal, agricultural use or domestic use in toilets etc. Sewage usually contains a high quantity of organic and inorganic wastes. It is essential to treat sewage before it enters into any water body. If sewage, is allowed to enter the water sources without treatment, it will contaminate them; which is why it is essential to treat sewage properly before letting it into rivers or any other sources of water.

As per the rules, it has become mandatory for all hospitals to have their own STPs for treating water from lavatories, laundry etc. Proper monitoring of sewage disposal in such critical locations has to be taken up.

Fig. 3.2 a: Process Diagram

Fig. 3.3 b: Aeration tank

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Fig. 3.2 c: Aeration tank

Fig. 3.2 d: Secondary Clarifier

As there is a significant contribution of pollution from the Municipality drains, it is a necessity to provide Sewage Treatment Plant for the same. Type and specification of the STP (centralized system or de centralized system) depends upon multiple aspects such as volume of sewage to be treated, distribution or geographical positions of the drains and other sewage outlets, operational and maintenance aspects and economy, energy consumption etc.

Table 3.3: Types of STPs and comparisons

Particulars	Normal STP	Bio STP
Design	Design is complex	Simple. Works on DRDO's Bio Digester Technology
Installation Cost	Very high	Less
Maintenance cost	Maintenance cost required. Operational cost for Electricity and Staff required.	Maintenance cost not required. Recovers its cost within 10 years.
Space required.	Large space required above the ground level.	Small space required as it can be constructed underground also
Hygiene	Hygienic	Hygienic
Power / Electricity	Required	Not electricity required.
By product generation	Lesser Bio gas in comparison to Bio STP	Large amount of Bio gas and potable water.

3.3 Details of Waste Management

The details of waste management include, Municipal solid waste, their disposal (Fig 3.4), collection points (Table 3.4) Bio medical waste, Hazardous waste and E waste; transport and management of these wastes.

3.3.1 Municipal Solid Waste

Municipal Solid Waste consists of household waste, construction and demolition debris, horticulture, and waste from streets. Municipal Solid Waste is to be segregated into groups of bio-degrables, recyclables and hazardous waste.

Payyannur Municipality has an existing Material Recovery Facility (MRF) to handle dry waste. There is a centralized Vermi Composting Facility (VCF) for the Municipality in the trenching ground, where wet waste is being composted by the method of Vermi Composting in 5 pits. One such pit can process up to 200 kg/day.

Although there is no collection of wet waste from households and institutions, wet waste obtained from open dumping is processed through Vermi Composting. Municipality is selling manure obtained from composting and a major share of money obtained out of sale goes to the workers involved in composting.

Biodegradables like organic waste from the kitchen, market and slaughter houses can be converted into rich organic manure or energy. Plastics, papers, glass, metals etc. can be recycled.

The construction and demolition waste can used as landfill cover.

3.3.1 a) Existing methods for Non-biodegradable waste

The municipality has been collecting dry waste from households and commercial institutions. A user fee of Rs.40 is being collected from the users for the service. The Municipality/Panchayat has appointed one Haritha Karma Sena member for each ward (apart from other sanitation workers) for collecting non-biodegradable waste from households and commercial institutions. The members collect cleaned plastic waste from households and institutions on a fortnightly basis. Other dry wastes like E-waste as well as other combustible and non-combustible waste is collected once in 6 months.

The collected non-biodegradable waste is being sent to the existing Material Recovery Facility (MRF) in Ward No.17 of Panchayat, where the collected non-biodegradable waste is segregated and sent for further processing. Plastic carry bags or Poly Ethylene bags are sent to Shredding unit for shredding. Plastic bottles and other recyclable plastic are sent to the baling unit for compressing the waste and then be sent for recycling. E-wastes may be handed over to agencies dealing with e-waste, with whom an agreement shall be executed by the Municipality for interruption free handing over. Rejects will be sent to the Regional Landfill site. A schematic representation of solid waste collection and disposal of existing systems is given in Fig 3.3.

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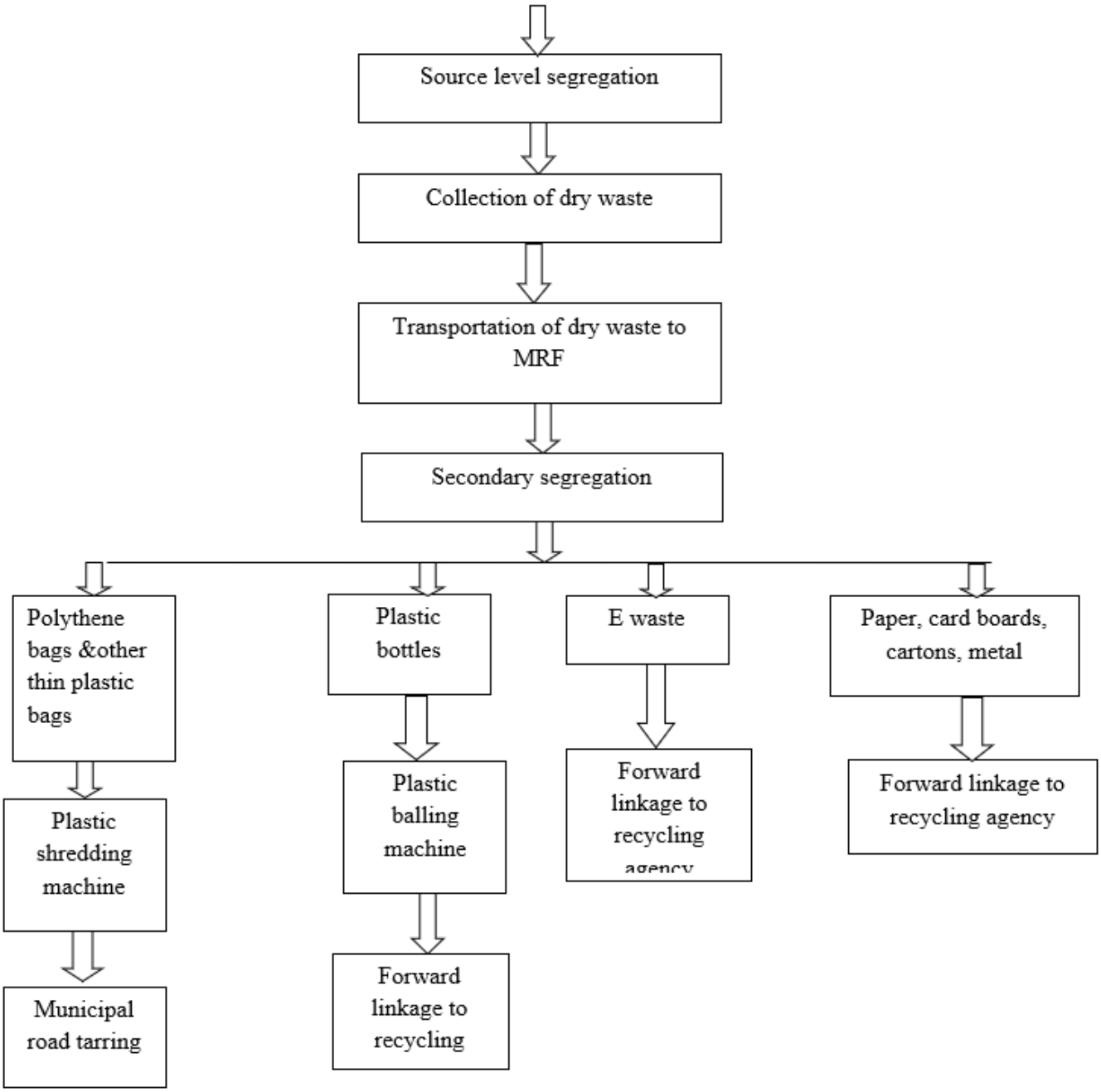

Fig 3.3 Solid waste collection and disposal of existing system.

The municipality has the following vehicles for waste collection

1. Tractor-1in Number.

2. Lorry- 1 in Number.

3. Goods carrier auto rickshaw- 2 in Numbers.

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The identified gaps in this regard are the lack of proper treatment for E Waste. Since the exsisting system concentrates more on plastic waste, E waste is also treated under the category of plastic waste, which may fetch far reaching consequences in the coming days. A tremendous increase in the quantity of E waste, demands scientific methods of treatment. E waste usually demands sufficient fragmentation before disposal since it may contain toxic heavy metals like lead, mercury, cadmium and beryllium, polluting PVC plastic, and hazardous chemicals, such as brominated flame retardants, which can harm human health and the environment.

3.3.1 b) Treatment technologies adopted for Biodegradable waste

Following methods are adopted for treating Biodegradable waste

- **Composting**

Composting is an effective means of converting non-infectious and non-toxic biodegradable kitchen and other wastes into manure for useful purposes. Composting can be performed in a number of ways as follows.

- **Rotary drum composting**

A combination of vegetable waste, cattle manure and sawdust was utilized for high rate composting in a household rotary drum composter. The rotary drum composting process of mixed organic waste yields suitable compost with moisture content reduction of 61% to 43% and the BOD/COD ratio reduced from 0.94 to 0.23, within a composting period of 20 days.

- **Centralized Treatment- Vermi Composting System**

The vermi composting of domestic waste could be an effective technology to convert the negligible resource into some value-added products. It utilizes various species of worms, to create a mixture of decomposing vegetable or food waste.

There is a centralized Vermi Composting facility for the municipality in the trenching ground, where wet waste is being composted by the method of Vermi Composting in 5 pits. One such pit can process up to 200kg/day. Although there is no collection of wet waste from households and institutions, wet waste obtained from open dumping is processed through vermi composting.

- **Pipe compost and Ring compost**

Pipe compost and Ring compost installed in most of the households and household-biogas plants contribute to composting degradable solid wastes from houses.

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Fig 3.4 a Ring compost

Fig 3.4 b Pipe compost

(Source: https://swachhbharat.mygov.in/activities/ring-compost-mattanur-municipality)

- **Anaerobic Digestion**

The anaerobic digestion of organic fraction of municipal solid waste had been conducted in pilot-scale reactor based on high-solid combined anaerobic digestion process yielded efficient bio-gas production.

- **Mechanical Biological Treatment**

The mechanical biological treatment (MBT) includes the mechanical stage of shredding of waste followed by removal of some recyclable material and the biological stage of composting or digesting the waste. it reduces the volume of residual waste and the biodegradability, thus reducing the methane and leachate production from the landfill.

- **Incineration**

The incineration is the process of treating the waste by the combustion of organic materials. Incinerators may reduce the volume of solid waste, but they do not dispose the toxic substances contained in the waste. They create the largest source of dioxins and emit a wide range of pollutants in their stack gases, ashes and other residues. The special benefit of incineration is destruction and detoxification of particular wastes

- **Land Filling**

Landfill is a land that is built up from deposits of solid refuse in layers covered by soil. The organic waste dumped in a landfill site will decompose with time, but the inorganic constituents will be remaining for long time. Since each landfill has its own constituents and the leachate quality of a particular landfill also changes over time.

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Table 3.4: Details of sewage collecting points

Si. No.	Panchayat	Name of village	Collection points
1	Peringome Vayakkara	Peringome	Peringome
2		Vayakkara	Vayakkara
3	Eramam Kuttor	Kuttoor	Kuttoor
4		Eramam	Eramam
5	Kadannapilly Panapuzha	Kadannappally	Kadannappally
6		Panappuzha	Panappuzha
7	Payyannur	Payyannur	Payyannur
8	Ceruthazham	Cheruthazham	Cheruthazham
9	Kunhimangalam	Kunjiimangalam	Kunjimangalam
10	Ramanthali	Ramanthali	Ramanthali

In the case of Payyannur Municipality, the MSW from for all the wards are moved Kunjimangalam where the segregations and incinerations are done in a centralized manner.

3.3.2 Bio-medical Waste

Bio medical waste or hospital waste refers to the kind of waste, containing infectious (or potentially infectious) materials which are restricted from environmental release. It mainly includes surgical bio waste, plastics, cotton and metals etc.

In view of the need for scientific management of the above types of waste from hospitals and health centres, a dedicated agency named IMAGE (Indian Medical Association Goes Eco-friendly) has been set up by Indian Medical Association in the year 2014 It has a single centralized Biomedical Waste Treatment and Disposal Facility at Palakkad.

IMAGE collects, transports, segregates and disposes waste from Panchayats and Municipalities as per the Biomedical Waste (Management and Handling) Rules 1998 and with the approval of Kerala State Pollution Control Board (KSPCB).

Hospitals and health centres (both Government as well as Private) are to register under IMAGE inorder to avail the services from the agency. Service charges are estimated based on the number of beds in the hospitals and are as per the following terms.

Major health centres of Panchayats and Municipalities are given in Table 3.5

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Table 3.5: Health care centers and location

Hospital/PHC	Latiutude	Longitude
PHC Ramanthali	12^0 3' 51.66''	75^0 11' 54.17''
PHC Ettikkulam	12^0 0' 55.76''	75^0 12' 28.51''
PHC Kunjimangalam	12^0 5' 0.50''	75^0 13' 57.63''
PHC Eramam	12^0 8' 23''	75^0 17' 22.24''
PHC Kankol	12^0 10' 46''	75^0 14' 44.60''
PHC Kadannappalli	12^0 5' 44.56''	75^0 17'17.16''
Payyanur Cooperative Hospital	12^0 6' 21.67''	75^0 12' 36.07''
Taluk Hospital Payyanur	12^0 6' 51.3''	75^0 12' 39.13''

3.3.3 Hazardous Waste

Hazardous waste by definition, are those with substantial or potential threats to public health or the environment, mostly from industrial sectors than domestic sectors.

Management of such waste (safe handling, generation, processing, treatment, package, storage, transportation, use reprocessing, collection, conversion, and offering for sale, destruction and disposal of Hazardous Waste) are to be done in a safe manner. These Rules came into effect in the year 1989 with final notification of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008.

3.3.4 E-Waste

Carelessly discarded electrical or electronic devices would be of a potential challenge to environment in terms of its disposal or reuse. As per the standard on E Waste management, 2016 rules, all the local bodies are to have collection points for the E Wastes. As of now the Panchayaths and Municipalities across Kerala are yet to open E-Waste collection centres.

Clean Kerala Company collects all types of wastes and sends them outside the state for dismantling and disposal. Details of e-waste disposal facilities specifying collection centers, dismantling and recycling facilities, any gaps in the recycling as per e-waste rules, 2016. (Appendix A-6)

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3.4 Details of Industrial Pollution Sources

Along the full stretch, no major industries except a Municipal fish market and a Wood industry are identified to be functioning near the banks Peruvamba.

It is observed that both the industries have donot have any effluent treatment plants.

3.5 Sources from agricultural areas

Along the upstream, Peringome, Vayakkara, Kadannappally, Panappuzha, Eramam, and Kuttur are more associated with agricultural activities.

People from the uplands of Peringome, Vayakkara and Panappuzha cultivate cash crops such as rubber and cashew. Earlier these were the main centres of paddy fields. The unavailability of better-quality seeds, lack of modern irrigation and agricultural practices, increased cost of cultivation, challenging weather conditions and shortage of labours are the main reasons behind the decline of paddy cultivation. Few years back a peak in usage of chemical fertilizers was observed, but cultivation of rubber, cashew etc. contributed a decrease in the trend. Fertilizers rich with Nitrates, Phosphates and Potassium were used predominantly; most of them were used without proper consultation with the agricultural officers.

Low lands of Kadannappally, Mathamangalam and Kuttur shows a taste towards vegetable, coconut and paddy cultivation. There are eight Group farmings units of paddy fields at Kadannappally-Panappuzha village. Awareness on ecological aspects among the youth made a drastic decline in the usage of chemical fertilizers. Vegetable cultivation for household purpose shows an increasing trend, which prefers little chemical fertilizers.

Salt water intrusion at the downstream raises huge concerns over the paddy cultivation. An increased demand for check dams at downstream was observed from farmers. The salt water intrusion is beneficial for fisheries, but usage saline water is not recommended for most of the crops. Decline in the water level during summer is also a concern for farmers, which can be overcome by constructing more check dams.

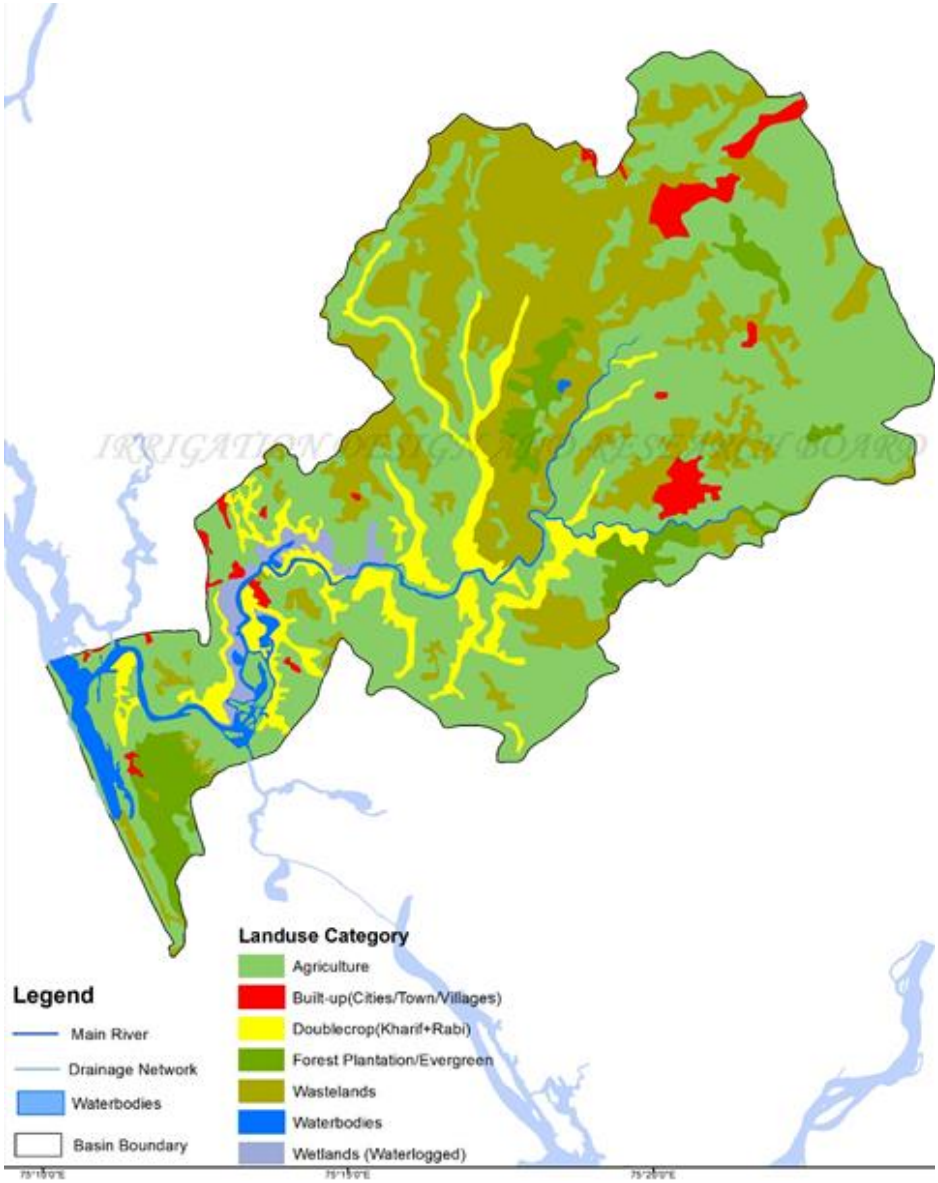

Fig 3.5 Map showing agricultural area

(Courtesy: irrigation-idrb.org)

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4 Flow Inventory

In the river Peruvamba, natural flow is maintained throughout its upstream. The existing hydraulic structures include Meenkuzhi check dam, and Poorakkadavu regulator, at which construction work is in progress. Flow parameters such as velocity, discharge etc. and geometrical properties such as area of cross section, wetted perimeter, top width etc. at various sections of the river can be studied for fixing appropriate locations for proposal of hydraulic structures in future. The river gauge station situated at Kambipalam near Kaithapram, gives daily data on flow properties (Table 4.1 and 4.2). Flow profile at the site can be predicted using the data. From these observations, the flow can be classified into Super critical, Critical or Subcritical region. Various hydraulic structures demand particular types of flow conditions, the detailed analysis over a period of time gives the exact locations for setting out these structures.

Table 4.1: Monthly variation of flow parameters in 2018

Date	Discharge	Top Width	Wetted Perimeter	Velocity	Area	Max Velocity
June	66.32	28.00	30.44	0.77	86.00	1.24
July	52.36	27.00	29.39	0.67	78.00	0.66
August	22.42	22.20	23.98	0.53	43.00	0.88
September	6.00	22.20	22.82	0.25	24.00	0.44
October	5.39	24.20	25.09	0.17	31.00	0.31
November	5.39	24.20	25.09	0.17	31.00	0.31
December	5.39	24.20	25.09	0.17	31.00	0.31

Table 4.2: Monthly variation of flow parameters in 2019

Date	Discharge	Top Width	Wetted Perimeter	Velocity	Area	Max Velocity
June	3.43	25.72	25.05	0.42	8.24	0.47
July	119.29	25.00	26.77	1.13	105.45	1.65
August	23.12	25.00	25.33	0.57	40.30	0.93
September	12.22	25.00	25.23	0.38	32.50	0.66
October	3.86	25.00	25.24	0.12	32.95	0.25
November	5.90	25.00	25.15	-	24.40	0.81

The flow parameters such as Discharge (m^3/s), Top width (m), Wetted perimeter (m), Velocity (m/s), Area (m^2) and Maximum velocity (m/s) are obtained from Kaithapram river gauge station over a period of 2 years. At the location, readings are taken day by day. The values taken are the average values for each month, by considering the readings of each day.

The parameters shows that as most of the other nearby rivers, Peruvamba also gets dried in summer, especially during January to May. On moving from June to December over each water year, the water gets reduced considerably. A declining trend was observed while moving from 2018 to 2019, which may be due to specific rainfall variations.

The values at a single point will not give proper findings which can be treated as a gap identified in the study. Still, values can be approximated if the site conditions are known. A thorough study of the above data gives most economical channel section for the condition, which can be used to design canals or river training works from the point of observation. Flow profiles can be drawn, and the flow can be categorized into mild sloped or steep sloped. Flow at a site can be identified as super critical, critical or subcritical from the above observations. The flow condition can be used to decide the best location for various hydraulic structures proposed.

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5. Status of Groundwater

State Groundwater Department (GWD) being the nodal agency for groundwater investigation and construction of groundwater abstraction structures in the State, conduct routine water sampling and level observations at various test wells spread across the various places in the district. From the available data (levels, quality of water of test wells) as well as interaction with GWD scientists certain observations are made.

Loss in water table is very minimal though there is a general trend of decline in ground water levels.

From the field observations as well as enquiry with local residents, it is understood that the Salinity due to salt water intrusion is predominant during most of the months, impairing well water and causing major issues leading local residents to resort to pipe water supply from prevailing drinking water schemes.

Observed gentle decline in the water levels in the test wells can be attributed to various general reasons and not indicative of over exploitation.

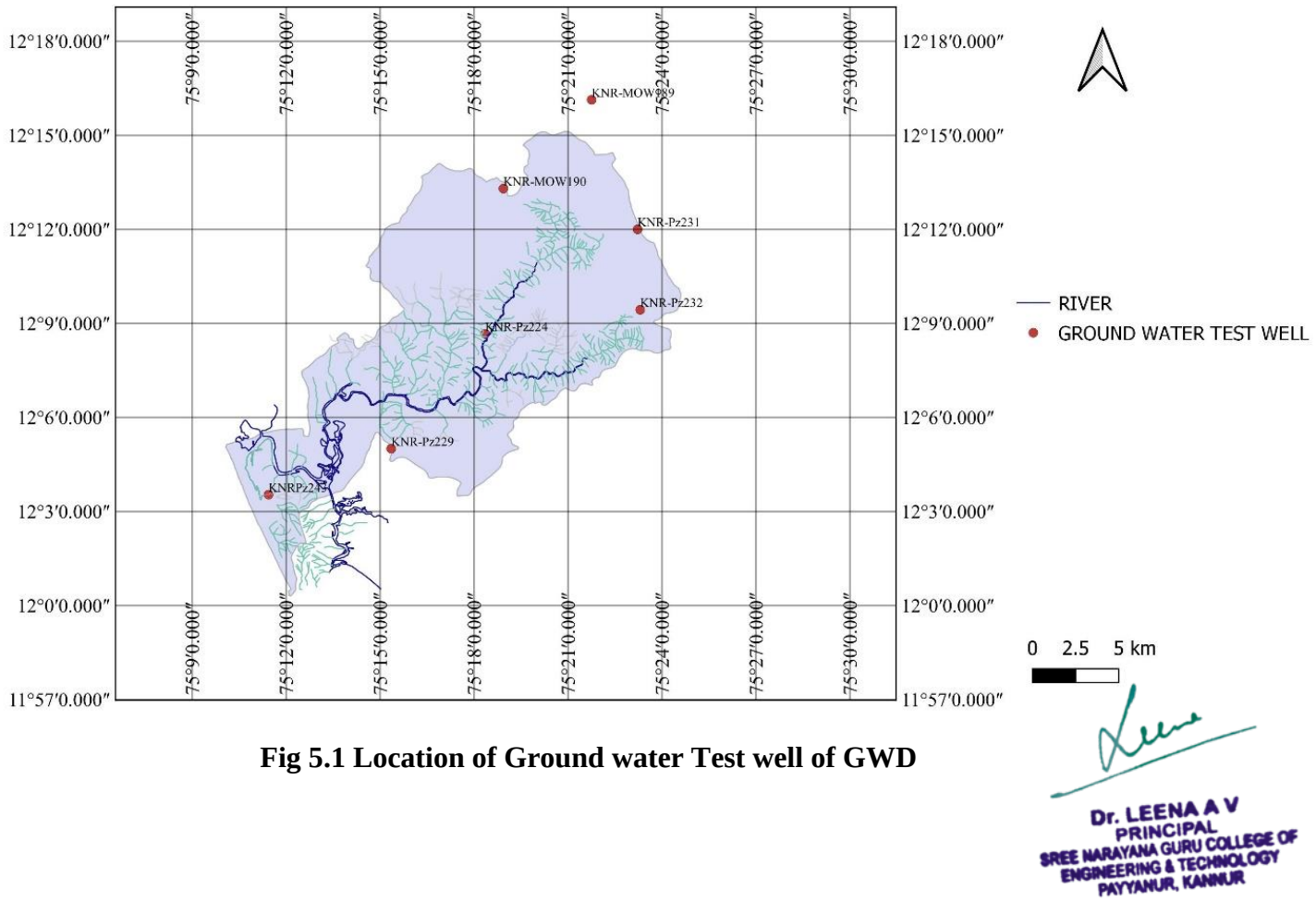

Fig 5.1 Location of Ground water Test well of GWD

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Table 5.1: Water quality results from GWD Test wells

Sl.No	Well Code	Sub_Basin	Minor_Basin	Station	PERIOD	Latitude	Longitude	Altitude	pH	EC	TDS	Turbidty	TH	Ca	Mg	Na	K	TA	CO3	HCO3	SO4	Cl	NO3N	Fe	F
1	KNR-MOW187	Perumba	Perumba	Kuttoor	May-16	12°08'09"	75°18'05"	30.58	7.30	263.00	173.58	0.50	103.00	18.54	13.77	19.80	3.40	116.39	142.00	-	3.07	9.52	0.14	0.10	0.01
2	KNR-MOW189			Vayakkara	May-16	12°16'08"	75°21'45"																		
3	KNR-MOW190	Perumba	Nitiringa puzha	Peringome	May-16	12°13'18"	75°18'56"	164.35	6.20	96.80	63.89	0.50	28.33	6.18	3.13	5.20	6.70	18.54	22.62	-	1.01	15.42	3.35	1.39	0.01
4	KNR-Pz224	Perumba	Perumba	Perumba	May-16	12.14444	75.30583	17.80	6.90	207.60	137.02	0.60	96.94	16.32	13.64	9.20	1.90	70.04	76.65	4.76	5.60	12.70	1.06	0.16	0.016
5	KNR-Pz229	Perumba	Vannathi puzha	Vannathi puzha	May-16	12.08333	75.25584	21.24	7.30	110.00	72.60	0.60	43.37	7.75	5.83	9.30	2.70	39.14	47.75	-	4.40	8.62	0.93	0.61	0.01
6	KNR-Pz231	Perumba	Vannathi puzha	Vannathi puzha	May-16	12.20000	75.38695	177.72	7.40	230.30	152.00	0.40	102.04	16.32	14.88	9.00	2.30	93.73	114.35	-	1.44	11.79	1.26	0.32	0.014
7	KNR-Pz232	Perumba	Vannathi puzha	Vannathi puzha	May-16	12.15722	75.38834	92.47	7.40	163.00	107.58	0.40	86.73	18.77	9.67	9.50	2.70	100.94	123.15	-	1.90	3.17	1.45	0.31	0.01
8	KNRPz243	Perumba	Perumba	Perumba	May-16	12.05889	75.19055	11.68	7.40	146.10	96.43	0.20	64.30	23.40	1.35	8.70	2.20	62.30	76.60	-	0.01	8.60	0.62	0.79	0.02
1	KNR-MOW187	Perumba	Perumba	Kuttoor	Feb-17	12°08'09"	75°18'05"	30.58							No sample										
2	KNR-MOW189			Vayakkara	Feb-17	12°16'08"	75°21'45"		7.40	77.00	46.20	-	18.23	2.50	3.00	7.80	1.52	23.10	-	28.14	1.21	11.69	0.62	0.15	0.04
3	KNR-MOW190	Perumba	Nitiringa puzha	Peringome	Feb-17	12°13'18"	75°18'56"	164.35	7.50	191.00	114.60	-	67.70	15.42	7.10	10.00	4.06	42.80	-	523.00	2.77	21.58	5.00	0.20	0.03
4	KNR-Pz224	Perumba	Perumba	Perumba	Feb-17	12.14444	75.30583	17.80	7.90	137.00	82.20	-	62.50	2.50	7.60	6.20	1.83	37.89	-	46.23	0.54	15.73	0.54	0.13	0.08
5	KNR-Pz229	Perumba	Vannathi puzha	Vannathi puzha	Feb-17	12.08333	75.25584	21.24	7.80	113.00	67.80	-	46.87	6.66	7.34	4.00	1.58	43.20	-	52.63	3.10	7.64	0.04	3.65	0.14
6	KNR-Pz231	Perumba	Vannathi puzha	Vannathi puzha	Feb-17	12.20000	75.38695	177.72	8.30	237.00	142.20	0.10	122.40	21.66	24.50	5.10	2.20	101.05	3.79	115.56	0.91	8.10	1.40	0.04	0.09
7	KNR-Pz232	Perumba	Vannathi puzha	Vannathi puzha	Feb-17	12.15722	75.38834	92.47	7.30	169.00	101.40	-	83.33	19.60	15.50	4.11	2.30	74.73	-	91.17	0.68	9.00	0.02	0.75	0.09
8	KNRPz243	Perumba	Perumba	Perumba	Feb-17	12.05889	75.19055	11.68	7.60	123.00	73.80	-	62.50	15.41	5.82	4.50	1.53	46.14	-	56.30	0.08	11.60	1.30	0.93	0.04
1	KNR-MOW187	Perumba	Perumba	Kuttoor	Apr-18	12°08'09"	75°18'05"	30.58	6.90			-	27.00	4.00	4.00			21.00	-	25.00	2.00	12.00		0.60	
2	KNR-MOW189			Vayakkara	Apr-18	12°16'08"	75°21'45"		6.80			0.20	27.00	4.25	3.80			20.50	-	25.00	3.00	13.40		2.30	
3	KNR-MOW190	Perumba	Nitiringa puzha	Peringome	Apr-18	12°13'18"	75°18'56"	164.35	7.00			0.10	40.00	7.45	5.20			33.00	-	41.00	4.00	20.20		0.44	
4	KNR-Pz224	Perumba	Perumba	Perumba	Apr-18	12.14444	75.30583	17.80	7.90			0.20	28.70	6.90	2.70			20.50	-	25.00	2.00	19.00		0.54	
5	KNR-Pz229	Perumba	Vannathi puzha	Vannathi puzha	Apr-18	12.08333	75.25584	21.24	7.90			0.10	43.10	5.70	9.10			54.00	-	66.00	7.60	16.80		0.62	
6	KNR-Pz231	Perumba	Vannathi puzha	Vannathi puzha	Apr-18	12.20000	75.38695	177.72	8.30			-	132.20	28.70	14.60			118.00	18.40	107.00	6.10	12.30		3.00	
7	KNR-Pz232	Perumba	Vannathi puzha	Vannathi puzha	Apr-18	12.15722	75.38834	92.47	8.30			-	83.40	19.50	8.40			92.00	9.20	93.00	6.10	11.20		0.89	
8	KNRPz243	Perumba	Perumba	Perumba	Apr-18	12.05889	75.19055	11.68	7.90			-	8.60	2.30	0.70			23.00	-	28.00	2.00	11.20		0.35	

Sl.No	Well Code	Sub_Basin	Minor_Basin	Station	PERIOD	Latitude	Longitude	Altitude	pH	EC	TDS	Turbidty	TH	Ca	Mg	Na	K	TA	CO3	HCO3	SO4	Cl	NO3N	Fe	F
1	KNR-MOW187	Perumba	Perumba	Kuttoor	May-18	12°08'09"	75°18'05"	30.58	7.30			-	46.00	17.00	0.70			51.20	-	62.00	2.00	14.00		1.07	
2	KNR-MOW189			Vayakkara	May-18	12°16'08"	75°21'45"		7.30			0.10	49.00	18.00	0.80			43.50	-	53.00	5.00	15.00		2.56	
3	KNR-MOW190	Perumba	Nitiringa puzha	Peringome	May-18	12°13'18"	75°18'56"	164.35	7.40			0.10	66.10	17.20	5.60			48.60	-	59.00	8.00	38.00		2.40	
4	KNR-Pz224	Perumba	Perumba	Perumba	May-18	12.14444	75.30583	17.80	7.90			0.10	98.00	23.00	10.00			102.00	-	125.00	5.00	18.00		0.33	
5	KNR-Pz229	Perumba	Vannathi puzha	Vannathi puzha	May-18	12.08333	75.25584	21.24	7.50			0.10	40.00	14.00	1.30			41.00	-	50.00	8.00	11.00		0.30	
6	KNR-Pz231	Perumba	Vannathi puzha	Vannathi puzha	May-18	12.20000	75.38695	177.72	8.30			-	127.00	39.00	7.00			109.00	5.40	122.00	6.00	10.00		0.70	
7	KNR-Pz232	Perumba	Vannathi puzha	Vannathi puzha	May-18	12.15722	75.38834	92.47	8.30			-	167.00	48.00	11.00			134.00	14.00	136.00	5.00	14.00		1.58	
8	KNRPz243	Perumba	Perumba	Perumba	May-18	12.05889	75.19055	11.68	7.10			-	23.00	9.00	-			18.00	-	22.20	2.00	11.00		0.33	
1	KNR-MOW187	Perumba	Perumba	Kuttoor	Nov-18	12°08'09"	75°18'05"	30.58	7.00	62.18	37.31	-	17.16	3.53	2.02	5.29	1.24	8.84	-	10.77	8.90	9.82			0.027
2	KNR-MOW189			Vayakkara	Nov-18	12°16'08"	75°21'45"		7.50	76.63	45.98	0.30	19.61	3.92	2.38	6.78	1.33	13.25	-	16.16	11.70	10.75			0.054
3	KNR-MOW190	Perumba	Nitiringa puzha	Peringome	Nov-18	12°13'18"	75°18'56"	164.35	7.00	93.86	56.31	0.20	24.51	6.66	1.91	6.53	3.38	13.25	-	16.16	17.10	14.03			0.016
4	KNR-Pz224	Perumba	Perumba	Perumba	Nov-18	12.14444	75.30583	17.80	7.90	143.08	85.85	-	49.02	16.08	2.14	12.01	-	44.20	-	53.89	2.60	14.96			0.05
5	KNR-Pz229	Perumba	Vannathi puzha	Vannathi puzha	Nov-18	12.08333	75.25584	21.24	6.90	85.75	51.45	0.10	24.51	3.53	3.81	8.20	0.69	15.46	-	18.86	6.40	14.49			0.05
6	KNR-Pz231	Perumba	Vannathi puzha	Vannathi puzha	Nov-18	12.20000	75.38695	177.72	8.40	260.75	156.45	0.30	95.58	18.82	11.79	13.08	-	111.56	7.28	121.27	8.40	11.68			0.05
7	KNR-Pz232	Perumba	Vannathi puzha	Vannathi puzha	Nov-18	12.15722	75.38834	92.47	7.90	208.14	124.89	-	73.53	17.25	7.38	11.49	-	81.73	1.98	95.67	9.10	13.09			0.04
8	KNRPz243	Perumba	Perumba	Perumba	Nov-18	12.05889	75.19055	11.68	6.50	90.20	54.12	-	12.25	3.14	1.07	13.30	0.75	24.30	-	29.64	6.90	11.78			0.07

Sl.No	Well Code	Sub_Basin	Minor_Basin	Station	PERIOD	Latitude	Longitude	Altitude	pH	EC	TDS	Turbidty	TH	Ca	Mg	Na	K	TA	CO3	HCO3	SO4	Cl	NO3N	Fe	F
1	KNR-MOW187	Perumba	Perumba	Kuttoor	Dec-18	12°08'09"	75°18'05"	30.58	7.60	95.00	57.00	-	24.00	6.80	1.60	12.10	-	30.70	-	37.50	1.00	9.00			
2	KNR-MOW189			Vayakkara	Dec-18	12°16'08"	75°21'45"		7.40	90.00	54.00	0.10	16.00	6.00	0.30	12.30	-	24.30	-	29.70	4.00	13.40			
3	KNR-MOW190	Perumba	Nitiringa puzha	Peringome	Dec-18	12°13'18"	75°18'56"	164.35	7.40	125.00	75.00	-	32.00	9.30	2.10	13.40	3.02	22.00	-	26.50	8.00	21.30			
4	KNR-Pz224	Perumba	Perumba	Perumba	Dec-18	12.14444	75.30583	17.80	7.60			0.20	40.00	9.20	4.00			23.00	-	28.00	3.00	23.00		0.30	
5	KNR-Pz229	Perumba	Vannathi puzha	Vannathi puzha	Dec-18	12.08333	75.25584	21.24	6.90			0.10	26.00	3.50	4.20			14.00	-	17.00	3.00	13.00		0.20	
6	KNR-Pz231	Perumba	Vannathi puzha	Vannathi puzha	Dec-18	12.20000	75.38695	177.72	8.00			0.10	127.00	21.00	18.20			107.00	-	130.00	4.00	15.00		0.30	
7	KNR-Pz232	Perumba	Vannathi puzha	Vannathi puzha	Dec-18	12.15722	75.38834	92.47	7.90			-	98.00	21.00	11.20			89.00	-	108.00	6.00	14.00		-	
8	KNRPz243	Perumba	Perumba	Perumba	Dec-18	12.05889	75.19055	11.68	7.20			-	14.40	3.50	1.40			23.00	-	28.00	3.00	13.00		0.30	
1	KNR-MOW187	Perumba	Perumba	Kuttoor	Apr-19	12°08'09"	75°18'05"	30.58	7.70	91.00	54.60	-	32.00	8.50	2.60			32.00	-	38.70	2.40	12.40	0.10	0.70	
2	KNR-MOW189			Vayakkara	Apr-19	12°16'08"	75°21'45"		7.30	427.00	256.20	0.10	192.00	74.50	1.50			172.50	-	211.00	3.00	17.10	0.20	7.21	
3	KNR-MOW190	Perumba	Nitiringa puzha	Peringome	Apr-19	12°13'18"	75°18'56"	164.35	7.90	199.00	119.40	0.30	53.20	13.00	5.20			25.00	-	30.50	5.00	30.00	3.30	0.32	
4	KNR-Pz224	Perumba	Perumba	Perumba	Apr-19	12.14444	75.30583	17.80	7.50	326.00	195.60	0.30	154.00	43.00	12.00			143.00	-	175.00	2.00	14.30	0.90	0.57	
5	KNR-Pz229	Perumba	Vannathi puzha	Vannathi puzha	Apr-19	12.08333	75.25584	21.24	6.40	69.00	41.40	-	37.27	6.40	5.20			11.35	-	13.85	4.20	7.60	0.10	0.10	
6	KNR-Pz231	Perumba	Vannathi puzha	Vannathi puzha	Apr-19	12.20000	75.38695	177.72	7.50	237.00	142.20	0.10	117.04	23.41	14.22			102.20	-	124.62	5.50	10.40	1.00	0.40	
7	KNR-Pz232	Perumba	Vannathi puzha	Vannathi puzha	Apr-19	12.15722	75.38834	92.47	8.00	356.00	213.60	0.10	175.56	66.00	2.58			129.40	-	157.85	7.80	6.65	2.00	0.28	
8	KNRPz243	Perumba	Perumba	Perumba	Apr-19	12.05889	75.19055	11.68	6.80	67.00	40.20	-	15.96	4.30	1.30			22.70	-	27.69	2.50	8.50	0.30	0.69	

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6. Monitoring of Pollution Sources

The pollution sources are monitored as follows.

6.1 Monitoring of Drains

Table 6.1: Details of Drains

Sl.no	Drain
1	Naranga thodu
2	Perumba thodu
3	Valliohmthodu
4	Panapuzha thodu
5	Poomkottu Chal
6	Manjangottu Thode
7	Kannelamthodu
8	Appithodu
9	Mavullapoyil thodu
10	Kollali thodu
11	Kannada thodu
12	Koyakkotu thodu
	Thokadu
13	Cherottuvayal thodu
14	Kayyil arakulam thodu
	Kunjimangalam puzha
15	Tattanvayal thodu

The river is nurtured by a number of drains. The drains collect water from the corresponding micro watersheds and contribute to the flow of river. Out of a total number of more than 82 drains following is the list of important drains associated with the river. KSPCB is conducting regular sample collection and testing on these drains. The conclusion obtained from the test results of SPCB clearly emphasize that the drains are also under a threat of pollution.

Increased population at the watersheds lead to an increase of in BOD level within years in these drains. According to test results from KSPCB, Narangattodu, Perumba thodu, Villainhood are the drains that faces most critical conditions.

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6.2 Monitoring of River

Based on reconnaissance surveys as well as interactions with the local bodies, 22 specific locations on the river were identified as sampling stations.

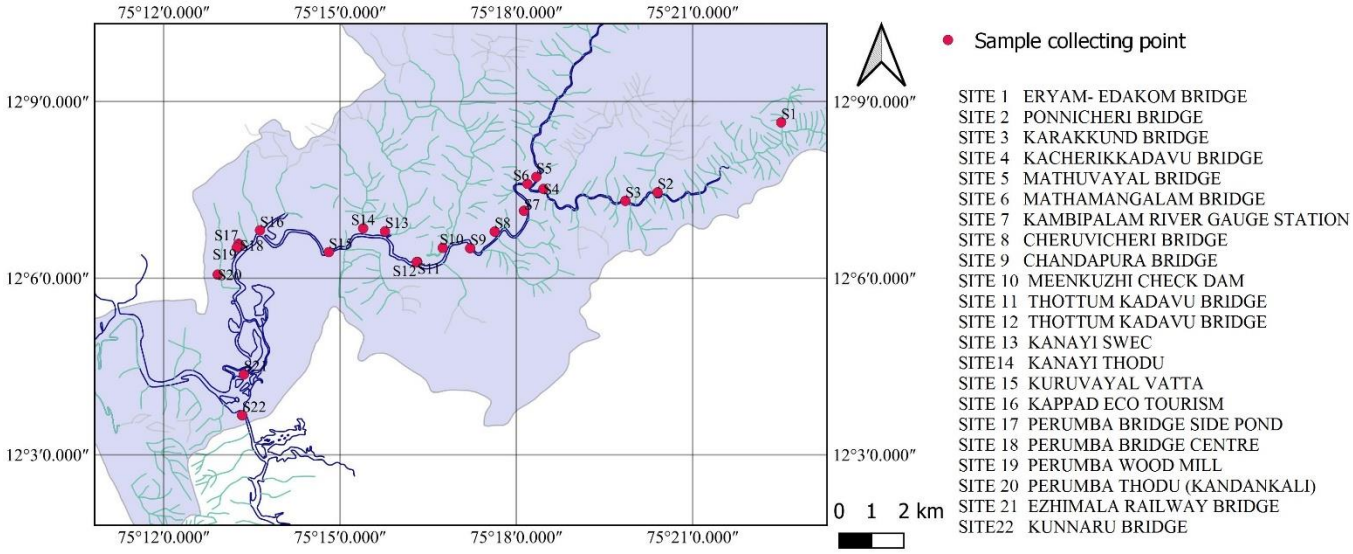

Fig 6.1: Locations of Water Sampling stations

The locations are selected nearby important bridges, construction sites or locations were major industrial or agricultural activities going on. The sites were observed well before the sample collection by conducting reconnaissance survey and a further detailed site visit, by the students, faculties and engineers.

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Fig 6.2.a Water Sampling from various stations

Fig 6.2.b Water Sampling from various stations

Fig 6.2.c. Water Sampling from various stations

Adhering the Standard Sampling procedure, water samples were collected from the above stations and sent to Kerala water authority Kannur for analyses on 8-Feb-2021.

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6.3 Monitoring of Polluting Industries

It is observed that no major industries except a Municipality Fish market and a Wood Industry are located along the stretches.

Fig 6.3.a: Behind Fish market

Fig 6.3.b: Wood industry

7. Analysis of Environmental Flow

According to text K Subrahmania on his book Engineering Hydrology, Environmental flow assessment is the science of determining the quantity and quality of water required in a stream for its ecosystem conservation and resources protection. The book says that, EFA tries to identify an environmental flow requirement (EFR) of a river at a given location that can assure a reasonably healthy ecological condition of the river. In a stream, high flows of different frequency are needed for breeding of birds and animals. Different levels of flows are needed for different purposes in a river or stream, which is provided in the Figure 7.1.

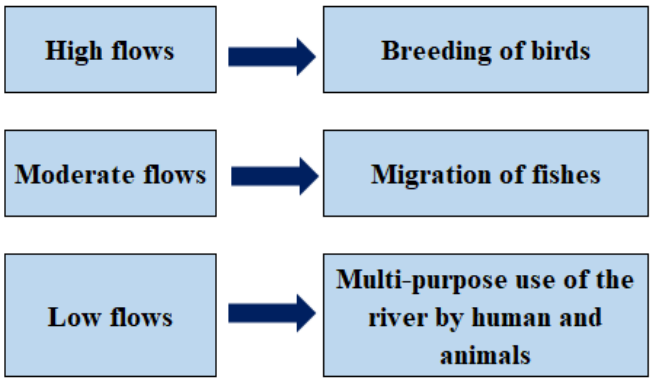

Fig 7.1 Different levels of flows and their purposes

Tennant's method or Montana method gives the guidelines for flow management based on percentage of Mean Annual Flow. In this method, the water year is considered in two parts, high flow season (HFS) and low flow season (LFS). For each season, a certain flow expressed as a percentage of

mean annual flow (MAF) rate is prescribed to attain a desired level of eco- status. The method is based on hydrological data and on subjective assessment.

In this concept, the flow description of good habitat means that to achieve this level of eco status, the basin managers must provide 40% of MAF rate during half year of high flow (April to September) and 20% of MAF rate during the other half year of relatively lower flow (October to March). In addition to this, an additional flushing flow of 200% MAF rate for duration of 48 to 96 hours must be provided during high flow season.

Table 7.1: - Environmental Flow Requirement by Tennant's Method

Description of Flow	Flow to be released during	
	(HFS)	(LFS)
	April to September	October to March
Flushing flow (from 48 to 96 hours)	200% MAF rate	Not applicable
Optimum range of flow	60% - 100% MAF rate	60% - 100% MAF rate
Outstanding habitat	60% MAF rate	40% MAF rate
Excellent habitat	50% MAF rate	30% MAF rate
Good habitat	40% MAF rate	20% MAF rate
Fair and degrading habitat	30% MAF rate	10% MAF rate
Poor or minimum habitat	10% MAF rate	10% MAF rate
Severe degradation	<10% MAF rate	<10% MAF rate
MAF rate = Mean Annual Flow rate.		HFS = High flow Season of 6 months
LFS = Low Flow Season of 6 months		

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Table 7.2: Calculation of EFR by Tennants Method

Month	No. of days in the month	Mean monthly flow volume (Cumec days) @ Kaithapram	Mean monthly flow volume (Cumec days) @ river basin	EFR (Cumec days) in the month		Flushing flows in the month (Cumec day)	Total EFR volume in the month (Cumec day)	Mean monthly flow rate (Cumecs)	Average EFR rate in the monthy (Cumecs)
				In HFS @ 40% of MAF rate	In LFS @ 20% of MAF rate				
June	30.00	171.43	380.06	265.21			265.21	5.71	8.84
July	31.00	1,113.24	2,468.05	274.05		44.20	318.25	35.91	10.27
August	31.00	1,063.65	2,358.11	274.05			274.05	34.31	8.84
September	30.00	796.18	1,765.13	265.21			265.21	26.54	8.84
October	31.00	320.82	711.26		137.03		137.03	10.35	4.42
November	30.00	170.00	376.89		132.61		132.61	5.67	4.42
December	31.00	3.35	7.43		137.03		137.03	0.11	4.42
January	31.00	-	-		137.03		137.03	-	4.42
February	28.00	-	-		123.77		123.77	-	4.42
March	31.00	-	-		137.03		137.03	-	4.42
April	30.00	-	-	265.21			265.21	-	8.84
May	31.00	-	-	274.05			274.05	-	8.84
Total	365.00	3,638.67	8,066.93						

River gauge data obtained from the IRDB is used to calculate the Mean Annual Flow rate.

Conversion factor = (Area of Peruvamba River basin)/(Area of Kaithapram river gauge station)

= 2.217

Mean monthly flow volume = 2.217 X 3638.67

= 8066.93 Cumec days

Mean Annual daily flow = ∑(Mean monthly flow volume)/365

= 8066.93/365

= 22.10 Cumec

Mean annual flow rate= MAF rate= 22.10 Cumec

Flushing flow volume= 200% of the MAF volume for 2 days= 2X 22.10

= 44.20 Cumec

For the good habitat condition desired,

EFR volume in a month in HFS = No of days of the month X 22.10 X 0.4

EFR volume in a month in LFS = No of days of the month X 22.10 X 0.2

Flushing flow volume is provided in July

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PAYYANUR, KANNUR

For July, flushing flow contributes an average rate of 44.20/31= 1.43 Cumec.

The Discharges in m^3/s obtained as mean monthly flow rate and Average EFR rate in the month are plotted against time, for a duration of an entire water year. The graphs represent normal stream flow and EFR.

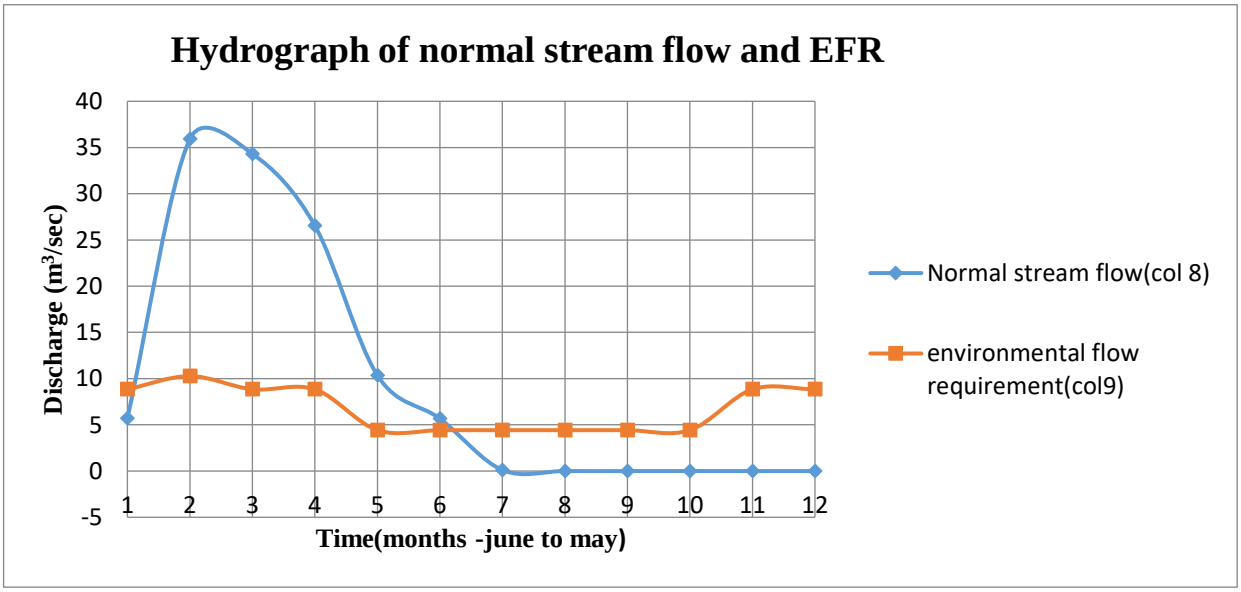

Fig 7.2: Hydrograph of Normal stream flow and EFR

According the National Water Policy, in the planning, implementation and operation of a project, the preservation of the quality of environment and the ecological balance should be a primary consideration. The adverse impact on the environment if any, should be minimized and should be offset by adequate compensatory measures. The project should nevertheless be sustainable. NGT recommends that 15 to 20 % of the average flow must be equal to the the minimum environmental flow, which is not observable in most of the months. It indicated that the river flow is far away from its environmental flow, during most of the months.

8. Detailed Gap Analysis

Even though the rules are being implemented it is a fact that our water bodies are polluted by man made activities. Plastic waste from households to hazardous industrial wastes are constantly being dumped into our rivers from time immemorial. It shows that rules are not enough and the authorities should find an alternative solution for this crucial issue.

The river is said to be flowing under environmental flow condition during June and November. From the Fig 3.10 It can be inferred that during the months of July, August and September, the river shows a discharge almost three times its environmental flow value during the corresponding months. The water

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PAYYANUR, KANNUR

gets discharged to the sea, without undergoing percolation, which contributes nothing to the ground water level. The condition gets upside down during December to February. The discharge gets reduced and almost a fully dried situation is arrived in this season.

Construction of hydraulic structures like check dams may ensure water during these months, still the river is not observed to be under environmental condition. The River is found to be having very. A detailed gap analysis should be conducted by considering different sites, under a period of observation time. The gaps identified in this aspect are that, certain test results were missing. If there are maximum number of river gauge stations along the river, the test result will show some trends, which makes the analysis part more accurate.

9. Management Planning Framework

Major Management objectives to be achieved are

Objective:

1. Reduction in pollution load from drains

Targets:

(i) Control of pollution from industry discharging effluent into drains

(ii) Control of solid waste dumping near the drains

(iii) Control of pollution from households

Performance Indicators:

(i) BOD < 3 mg/L; TC < 500 MPN/100 mL

Strategies:

(i) Status of industries w.r.t consent, ETP installation and adequacy, final discharge point

(ii) Strict enforcement of discharge limit of effluent into drains

(ii) Collection and segregation of solid waste

(iii) Untapped drains to be provided with in-situ bioremediation or Phyto-remediation

2. Ensuring sufficient environmental flow in the river.

Gradual decline in the ground water table is indicative of the reduction in environmental flow. Hence the preferred quantity in the immediate future.

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Targets:

- There should be sufficient base flow.
- Free flow of stream should be ensured without obstacles.

Performance Indicators:

Natural flow of river should be atleast **15 to 20%** of the environmental flow [As per NGT]

Strategies:

- Thorough hydrographic studies to be conducted to understand the trends in the surface runoff and baseflow over the catchment area.
- Sufficient aquifer recharge should take place at the upstream side.Scientific methods to be adopted for replenishment of Aquifers in the upstream side.

3. **Monitoring of river stretches**

Targets:

Monitoring of disposal of pollutants directly into the river.

Performance Indicators:

Field observations and feedback from the local residents.

Strategies:

Regular site visits
Observation using CCTV
Continuous and real time monitoring of river stretches using advanced systems such as GIS.

4. **Reduction in salt water intrusion**

Targets:

Wells water to be consumable for drinking and domestic purpose.

Performance Indicators:

Well water quality parameters to be within the drinking water standards.

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Strategies:

- Ensuring sufficient environmental flow.
- Ensuring enhanced ground water replenishment.
- Construction of temporary check dams may curtail the salt water intrusion to upstream side.

10. Action Plan for Restoration of Polluted River Stretch

Following are the short- and long-term action plans for the selected river stretch.

10.1 Short Term Action Plan

A list of short-term action plans is given in Table 10.1

Table 10.1 Short term action plans

SI. No.	Action	Timeline	Implementing Department / Agency	Estimated Expenditure, Rs.
	Component I: Sewage Management			
1	Identification and enlisting of all the major sources contributing sewage to the drains as well as rivers directly	NA	Local bodies	Nil
2	Immediate cleaning up of debris	NA	Local bodies and NGO, voluntary agencies	10,00,000.00
3	Ensuring proper septic tanks in every household/ offices/ business	NA	Engineering wing of the local bodies	Nil
	Component II: Industrial Waste Management			
1	Immediate cleaning up of the accumulated waste from the industry.	1 month	Concerned Industry /authority	10,00,000.00
2	Strict implementation of waste management rules and imposing heavy fine for violation.	1 month	By KSPCB	Nil
	Component III: Solid Waste Management			
1	Immediate cleaning up of the accumulated waste	1 month	Payyannur Municipality and Panchayaths	Nil
2	Providing dumping yard away from populated areas	NA	Payyannur Municipality and Panchayaths	Nil

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3	Strict measures are to be taken by the local government bodies to prevent dumping of waste in water bodies	NA	Payyannur Municipality	22,00,000.00
	Component IV: Environmental Flow			
1	Ensuring free flow throughout the stream.	NA	Haritha Keralam mission Local bodies	20,00,000.00
2	Removal of debris	NA	Local bodies and NGO, voluntary agencies	10,00,000.00

10.2 Long Term Action Plan

A list of short-term action plans is given in Table 10.2

Table 10.2 Long term action plans

SI. No.	Action	Timeline	Implementing Department / Agency	Estimated Expenditure, Rs.
	Component I: Sewage Management			
1	Provision of decentralized Sewage Treatment Plant in the municipality	1 year	Payyannur Municipality and Panchayaths	14,00,00,000.00
2	Provision for using the treated waste water for irrigation	NA	Payyannur Municipality and Panchayaths	5,00,000.00
3	Providing net or mesh like grit to prevent the entry of waste in the River through the underground drains	NA	Payyannur Municipality and Panchayaths	60,00,000.00
4	Proper implementation of building bylaws regarding the size and number of occupants	NA	Payyannur Municipality and Panchayaths	Nil
	Component II: Industrial Waste Management			
1	Keeping all the industries away from the town center and planning an industrial area in each municipality	NA		Nil
2	Provision of mini sewage treatment plant or mobile/portable plants	NA	Concerned industries, Payyannur municipality	2,00,00,000.00

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3	Permission for industries should be granted only after ensuring proper waste management methods	NA	Payyannur Municipality and Panchayaths	Nil
	Component III: Solid Waste Management			
1	Enhancing effectiveness of collection and segregation disposal.	NA	Payyannur Municipality and Panchayaths	Nil
2	Use of solid waste in construction industry	NA	PWD, Irrigation department, Engineering Colleges,	Nil
3	Use of solid waste as land fill	NA	Payyannur Municipality and Panchayaths	Nil
4	Providing fencing on both sides of Perumba bridge at Perumba (N.H) in Payyannur Municipality	NA		20,00,000.00
	Component IV: Environmental Flow			
1	Periodic removal of debris	NA	Payyannur Municipality and Panchayaths	3,00,000.00
2	Sand, Silt removal	NA	Revenue Department. Incase of necessity, to be done in collaboration with River Research Centres, Ecological and Geological experts.	3,00,00,000.00
3	Study of watershed and flow inventories and ensuring free flow throughout the stream.	NA	Kerala forest research institute. National centre for earth science studies society for environmental education seekerala. Engineering colleges	Nil

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	General			
1	Monitoring using CCTV at critical points	NA	Payyannur Municipality and Panchayaths	5,00,000.00
2	Imposing fines for improper disposals	NA	Payyannur Municipality and Panchayaths	
3	Recruiting and Training of youths in the waste management process	NA	Haritha sena Local bodies	10,00,000.00
4	District wise biomedical waste processing units	NA		Nil
5	Regular health monitoring of river stretches	NA	Schools, Local bodies	Nil
6	Periodic Water sampling and analysis from identified stations	NA	Engineering colleges	Nil
7	Periodic Water sampling and analysis	NA	KSPCB	Nil
8	Conservation of hills, mountains and vegetations	NA	Payyannur Municipality and Panchayaths, local bodies	Nil

11. Third Party Monitoring and Evaluation

Table 11.1 give the details of third-party monitoring and evaluation.

Table 11.1 give the details of third-party monitoring and evaluation.

Activity/Component	Performance Indicators	Means of Verification	Frequency of Monitoring
KSPCB	Water quality parameter (Applicable tests)	Water Sample collection and testing	Monthly
Involving schools in monitoring selected stretches of river.	Disposal of solid and liquid pollutants in the river stretch	Detailed visual monitoring	Monthly

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Engineering Colleges	Water quality parameter (Applicable tests)	Water Sample collection and testing	Monthly
Haritha karma sena NSS, Rotary clubs	Conducting awareness camps	Classes, field visits	Monthly
Rewards and recognitions by Panchayath and Municipality	Attaining water quality as well as overall activities	Based on the regular monitoring	Half yearly

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Integrated Watershed Development Master plan- Kadannappally- Panappuzha Panchayath

Statistics on local Self Government Development 2015-2018- Kadannappally- Panappuzha Panchayath

Haritha Kerala Mission District Action Report- Kannur 2019

Panchayat Development Action Plan 2017-2022- Cheruthazham Panchayath

Haritha Kerala Mission- Watershed Development Report Kannur

Development Master Plan 2019- Eramam Kutur Grama Panchayath

Integrated Watershed Development Masterplan 2018- Eramam Kutur Grama Panchayath

Integrated Watershed Development Masterplan2018- Peringom Vayakkara Grama Panchayath

Haritha Kerala Mission Watershed Development Report 2018- Payyanur Municipality

Watershed Development Report 2018- Kunjimangalam GramaPanchayath

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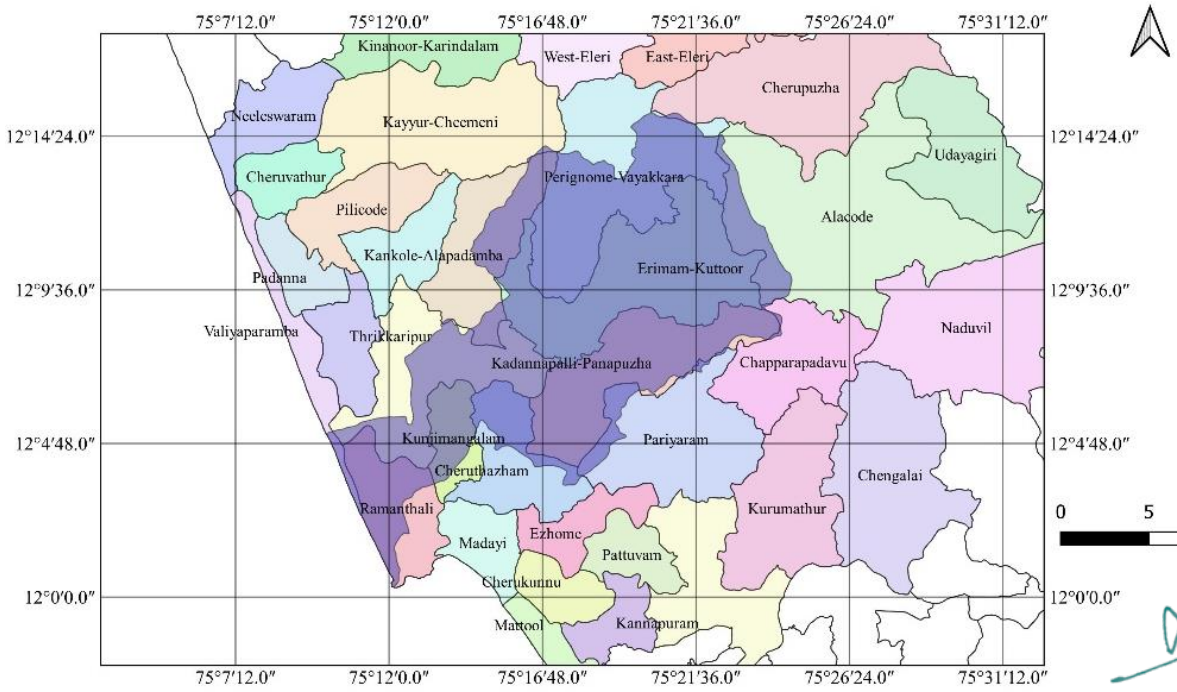
Appendices

A-1 Details of Cities and Towns

Si. No.	Panchayat	Name Of Village
1	Peringome Vayakkara	Peringome
2		Vayakkara
3	Eramam Kuttor	Kuttoor
4		Eramam
5	Kadannapilly Panapuzha	Kadannappally
6		Panappuzha
7	Payyannur	Payyannur
8	Ceruthazham	Cheruthazham
9	Kunhimangalam	Kunchimangalam
10	Ramanthali	Ramanthali



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A-2 Details of Grama Panchayath and Revenue Villages

Si. No.	Panchayath	Name of village	Population (2011)	Decadal growth (%)	Estimated population (2021)	Estimated MSW (kg/day)
1	Peringome Vayakkara	Peringome	16,721	3.17	17,163	8,810
2		Vayakkara	18,687		18,868	
3	Eramam Kuttor	Kuttoor	8,143	3	8,204	8,350
4		Eramam	9,448		9,426	
5	Kadannapilly Panapuzha	Kadannappally	10,430	2.3	10,478	6,535
6		Panappuzha	11,355		11,370	
7	Payyannur	Payyannur		7.7	72,111	21,700
8	Ceruthazham	Cheruthazham	29,348	NA	29,698	NA
9	Kunhimangalam	Kunchimangalam	18,965	NA	19,065	NA
10	Ramanthali	Ramanthali	25,711	NA	26,157	NA

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A-3 Pollution Source Mapping of River from Eryam Edakkom bridge to Kunnaru Bridge

Sl.No	Name of drain	Latitude	Longitude	Domestic / Industrial / mixed	Tapped / Untapped/ Partially Tapped	Bar screen status
1	Naranga thodu	$75^0$13’17.19’’	$12^0$5’9.69’’	Mixed	Partially trapped	No screen
2	Perumba thodu	$75^0$13’27.47’’	$12^0$6’33.92’’	Mixed	Trapped	No screen
3	Valliohmthodu	$75^0$18’13.80’’	$12^0$7’31.38’’	Mixed	Partially trapped	No screen
4	Panapuzha thodu	75 0 22’7.68’’	12 0 8’7.52’’	Mixed	Trapped	No screen
5	Poomkottu Chal	NA	NA	NA	NA	NA
6	Manjangottu Thode	NA	NA	NA	NA	NA
7	Kannelamthodu	$75^0$16’57.44’’	$12^0$6’36.36’’	Domestic	Trapped	No screen
8	Appithodu	$75^0$18’48.76’’	$12^0$9’7.54’’	Domestic	Trapped	No screen
9	Mavullapoyil thodu	NA	NA	NA	NA	NA
10	Kollali thodu	$75^0$13’27.49’’	$12^0$3’22.90’’	Mixed	Untrapped	No screen
11	Kannada thodu	$75^0$13’17.12’’	$12^0$5’9.67’’	Mixed	Untrapped	No screen
12	Koyakkotu thodu Thokadu	$75^0$11’35.46’’	$12^0$4’28.61’’	Mixed	Untrapped	No screen
13	Cherottuvayal thodu	$75^0$13’18.34’’	$12^0$3’44.92’’	Domestic	Partially trapped	No screen
14	Kayyil arakulam thodu Kunjimangalam puzha	NA	NA	Domestic	Partially trapped	No screen
15	Tattanvayal thodu	$75^0$13’32.49’’	$12^0$3’4.05’’	Domestic	Untrapped	No screen

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A-4 Details of Municipal Solid Waste Management

SI. No.	District	Name of City / Town / Panchayath / Village	No. of Collection Points	Status of Segregation	Details of Disposal System / Site
1	Kannur	Peringome vayakkara	10	Segregation takes place	Clean Kerala Company
2	Kannur	Kadannappalli - panapuzha	6	Currently no segregation	Clean Kerala Company
3	Kannur	Eramam Kutoor	6	Currently no segregation	PVT agency
4	Kannur	kunjimangalam	2	Segregation takes place	Clean Kerala Company
5	Kannur	Cheruthazham	6	Segregation takes place	Clean Kerala Company
6	Kannur	Ramanthali	5	Segregation takes place	Clean Kerala Company

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A-5 Status of E-Waste Management

SI. No.	Name and Address	Regional Office	Status of Authorization	Status of Registration	Type	Capacity (T/Annum)
1	Only in the planning stage					

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A-6 Details of Industries

SI. No.	Name and Address	Latitude	Longitude	Type of Industry	Treatment Mechanism (ETP/CETP)	Effluent discharge (KLD)	Effluent discharge drain (distance from river)	Remarks
1	NA	NA	NA	Fish Market	No ETP	NA	Directly to the river	Nil
2	NA	NA	NA	Wood Industry	No ETP	NA	Directly to the rive	Nil

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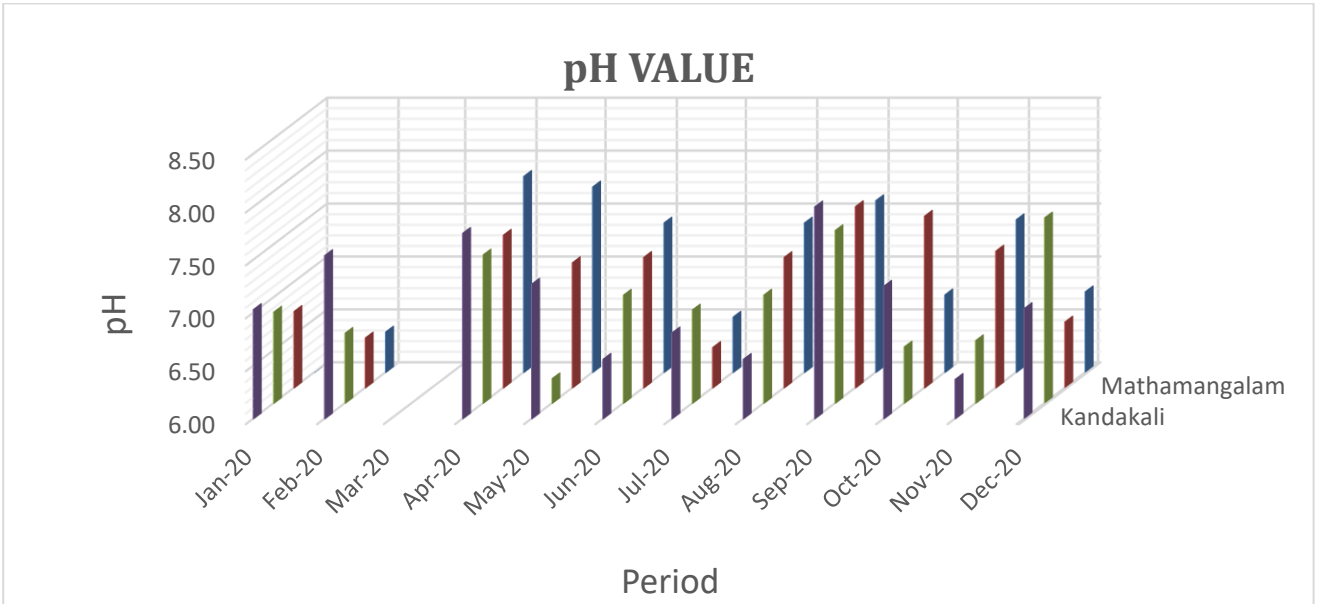
A-7 River Water Quality Data

Being the regulatory authority, Kerala State Pollution Control Board, carries out routine Water quality analyses of Peruvamba river along the polluted stretch (of main river) as well as at various polluted drains joining it.

From the monthly data for the whole year of 2020, trend analyses is performed for selected parameters at the 4 sampling stations (Kacherikadavu, Mathanangalam, Chandapura,Kandankali) along the main river. pH, Turbidity, Total Hardness, Magnesium hardness, Calcium hardness, Ammonia, Chlorides, Sulphates, Phosphates, BOD, facal coliform are the parameters considered for studied. It is to be noted that the sampling for the month of February and March are done together and therefore there is no separate entry for the month of March.



	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	7.04	7.55		7.76	7.28	6.57	6.82	6.57	8.01	7.54	7.26	6.38	7.05
Chandapura	6.87	6.67		7.41	6.24	7.03	6.89	7.03	6.27	7.64	6.54	6.60	7.76
Mathamangalam	6.73	6.48		7.45	7.19	7.24	6.39	7.24	7.72	6.82	7.63	7.30	6.63
Kacherikadavu	5.33	6.39		7.86	7.76	7.42	6.53	7.42	7.63	6.58	6.74	7.45	6.77

pH value at the upstream side of the river is found to be slightly low (more towards acidic) during the off-monsoon season and is close to 7.5 during the monsoon. From the experts, it is understood the acidic nature is commonly observed with the soils observed in Kannur region.

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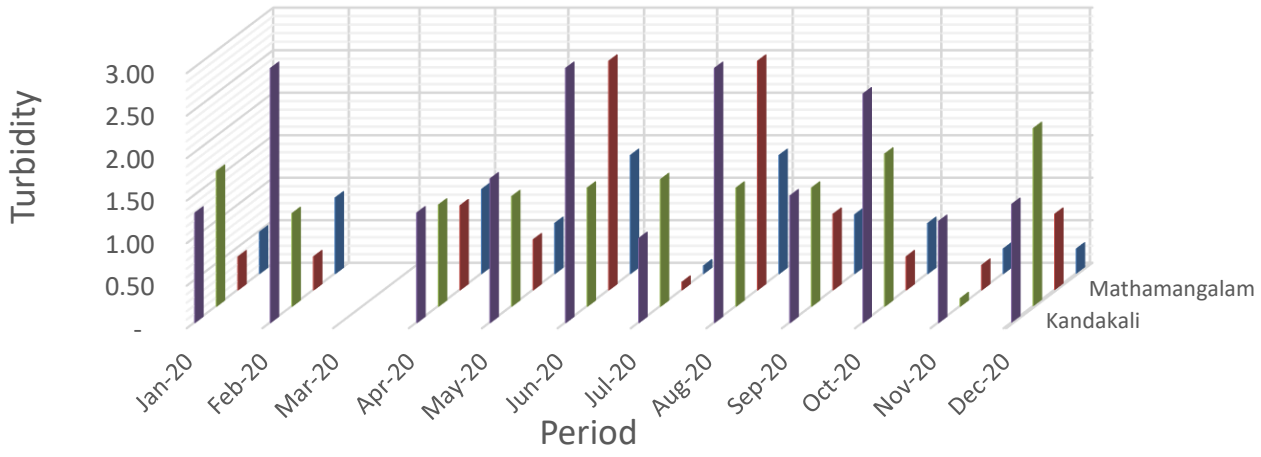

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	1.30	3.30		1.30	1.70	3.1	1.00	3.10	1.50	1.20	2.70	1.20	1.40
Chandapura	1.60	1.10		1.20	1.30	1.4	1.50	1.40	1.40	1.40	1.80	0.10	2.10
Mathamangalam	0.40	0.40		1.00	0.60	2.7	0.10	2.70	0.90	0.10	0.40	0.30	0.90
Kacherikadavu	0.50	0.90		1.00	0.60	1.4	0.10	1.40	0.70	0.10	0.60	0.30	0.30

Turbidity at the downstream side is found to be relatively high compared to the upstream side. Same can be confirmed with visible observation during the sampling. Turbidity in water is mainly due to various dissolved salts in it.

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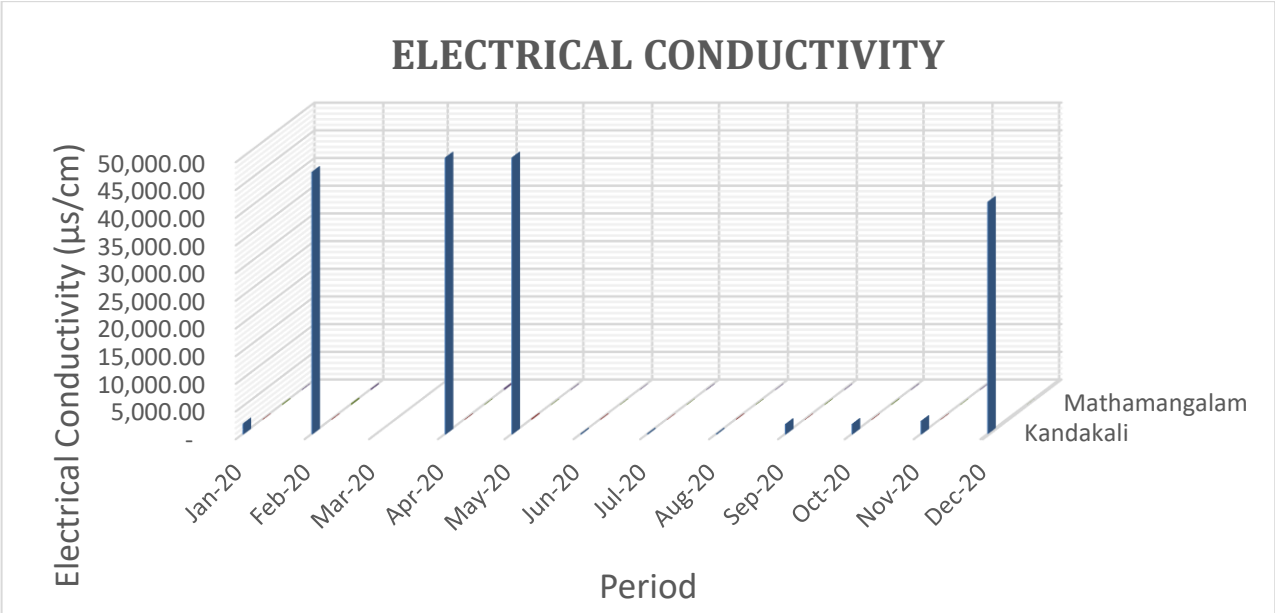

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	2,008.	47,400		54,400	55,300	171.1	177.40	171.10	1,191.	1,880.	1,906.	2,436.	42,000
Chandapura	65.00	78.20		76.80	152.00	82.6	44.50	82.60	38.40	36.90	42.50	40.70	59.70
Mathamangalam	123.00	203.00		71.80	48.90	36.7	40.40	36.70	69.10	36.70	90.50	40.20	86.50
Kacherikadavu	58.00	150.70		264.00	69.20	37.3	39.70	37.30	40.10	36.00	77.30	40.00	47.40

Electrical conductivity depends on the chlorides and other dissolved salts present in the water.

It can be observed that electrical conductivity values along the upstream sides are considerably low compared to the coastal areas. During monsoon period, water flows from upstream to downstream and the river water will free from salt. During the off monsoon season, sea water intrusion takes place back inside the river and thereby the increasing the electrical conductivity of the water.

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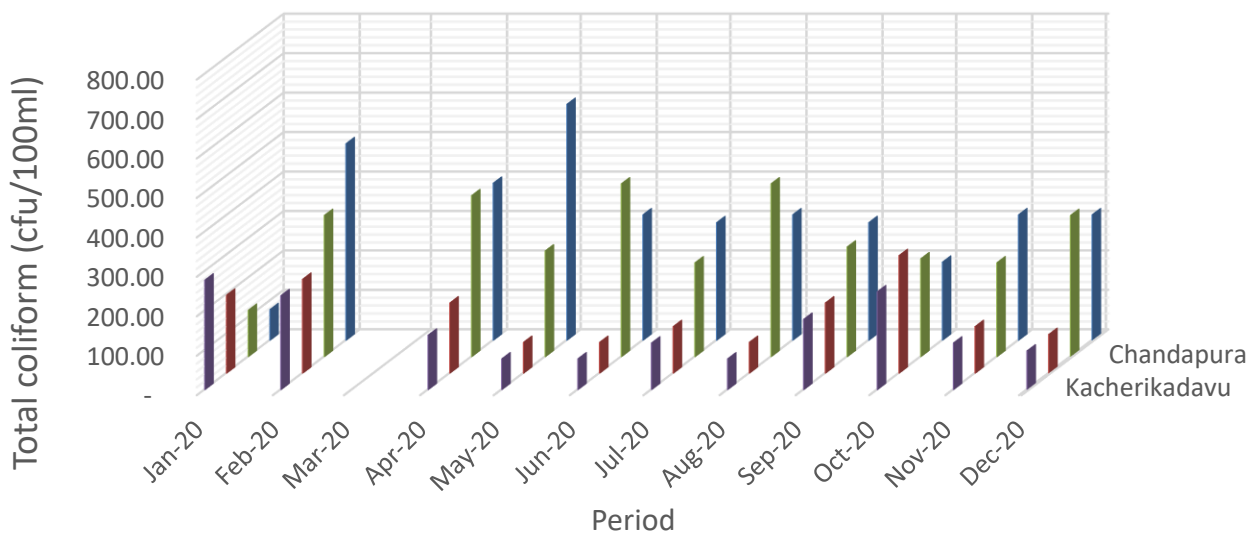

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kacherikadavu	280.00	240.00		140.00	80.00	80	120.00	80.00	120.00	180.00	250.00	120.00	100.00
Mathamangalam	200.00	240.00		180.00	80.00	80	120.00	80.00	140.00	180.00	300.00	120.00	100.00
Chandapura	120.00	360.00		410.00	270.00	440	240.00	440.00	180.00	280.00	250.00	240.00	360.00
Kandakali	80.00	500.00		400.00	600.00	320	300.00	320.00	300.00	280.00	200.00	320.00	320.00

Total coliform in the upper part of the stream shows a higher value of coliform. It shows maximum value at Kandankali during the summer season of April. It may be due to the absence of sufficient discharge during summer. Total coliform indicates the presence of harmful microorganisms in the water.

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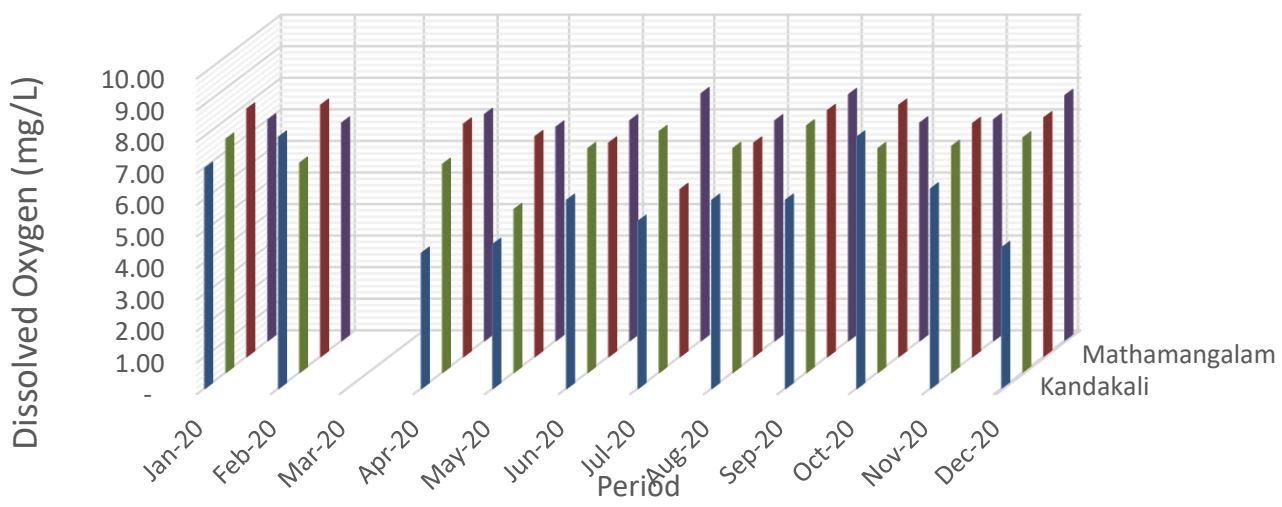

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	7.02	8.00		4.32	4.60	6	5.33	6.00	6.00	6.00	8.00	6.36	4.50
Chandapura	7.43	6.67		6.63	5.20	7.13	7.67	7.13	6.93	7.85	7.13	7.20	7.47
Mathamangalam	7.88	8.00		7.40	7.00	6.8	5.33	6.80	7.50	7.83	8.00	7.42	7.60
Kacherikadavu	7.03	6.93		7.20	6.80	7	7.86	7.00	6.00	7.83	6.93	7.03	7.80

Dissolved Oxygen is the amount of gaseous oxygen (O_2) dissolved in the water. Oxygen enters the water by direct absorption from the atmosphere, by rapid movement, or as a waste product of photosynthesis.

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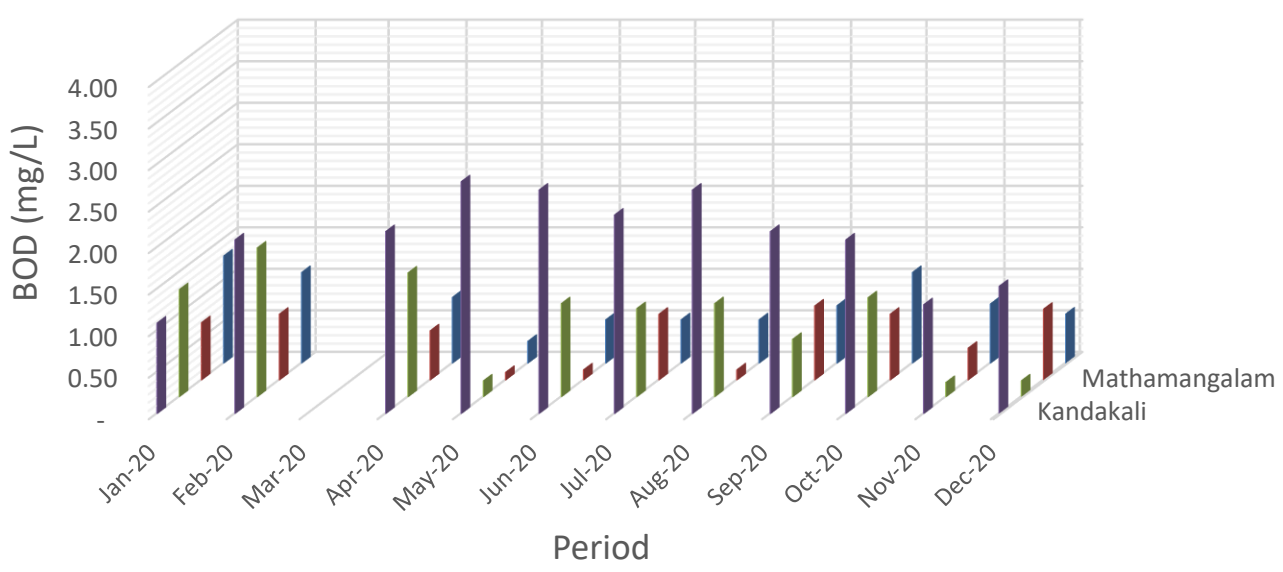

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	1.10	2.10		2.20	2.80	2.7	2.40	2.70	2.20	1.80	2.10	1.32	1.54
Chandapura	1.30	1.80		1.50	0.20	1.13	1.07	1.13	0.40	0.70	1.20	0.18	0.20
Mathamangalam	0.70	0.80		0.60	0.10	0.13	0.80	0.13	0.90	0.90	0.80	0.39	0.86
Kacherikadavu	1.30	1.10		0.80	0.27	0.53	0.53	0.53	0.70	0.17	1.10	0.72	0.60

BOD is shown to be maximum at Kandankali, which is the site nearest to the sea water. The trend remains constant throughout the year. The test value indicates that river water is strongly in need of dissolved oxygen at some of the sample collecting points.

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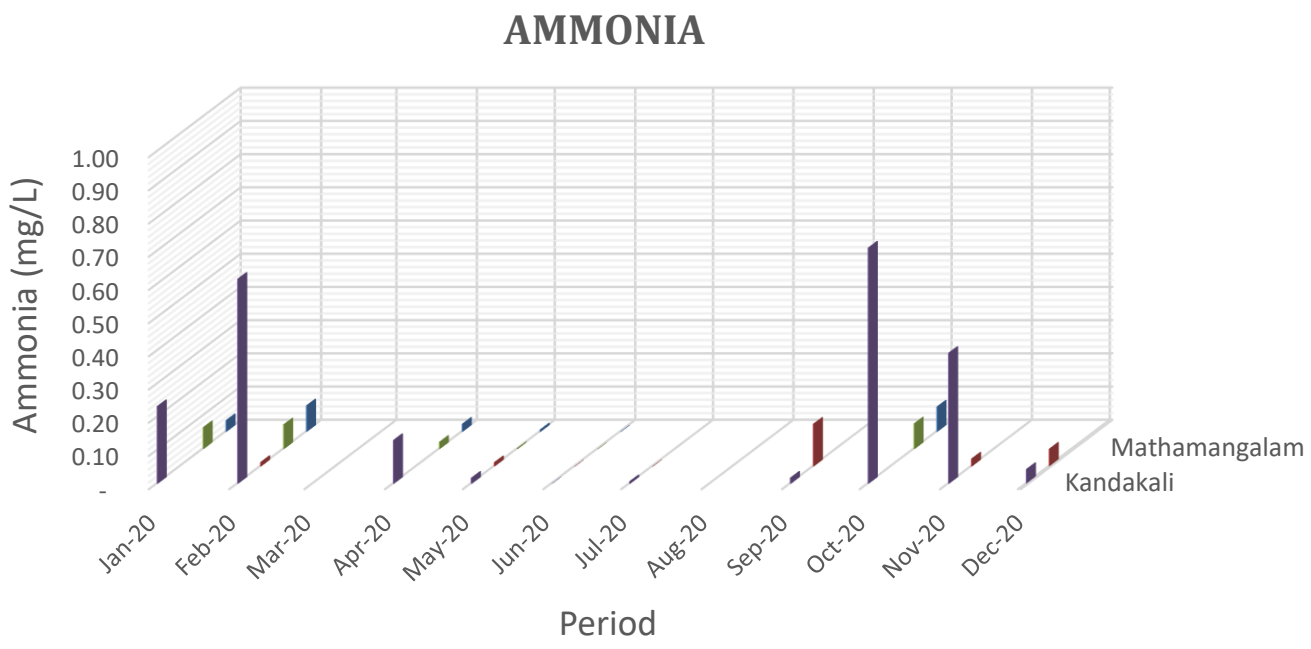

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	0.23	0.62		0.13	0.02	-	0.01		0.02	0.01	0.71	0.39	0.04
Chandapura		0.01			0.01	-	-			0.13		0.02	0.05
Mathamangalam	0.07	0.07		0.02	0.00	-					0.08		
Kacherikadavu	0.03	0.08		0.02	0.01	-					0.08		

Ammonia in water is non-toxic to humans, but it is toxic to aquatic life. Unlike other forms of nitrogen, which can indirectly harm aquatic ecosystems by increasing nutrient levels and promoting algae growth in the process known as eutrophication, ammonia has direct toxic effects on aquatic ecosystems.

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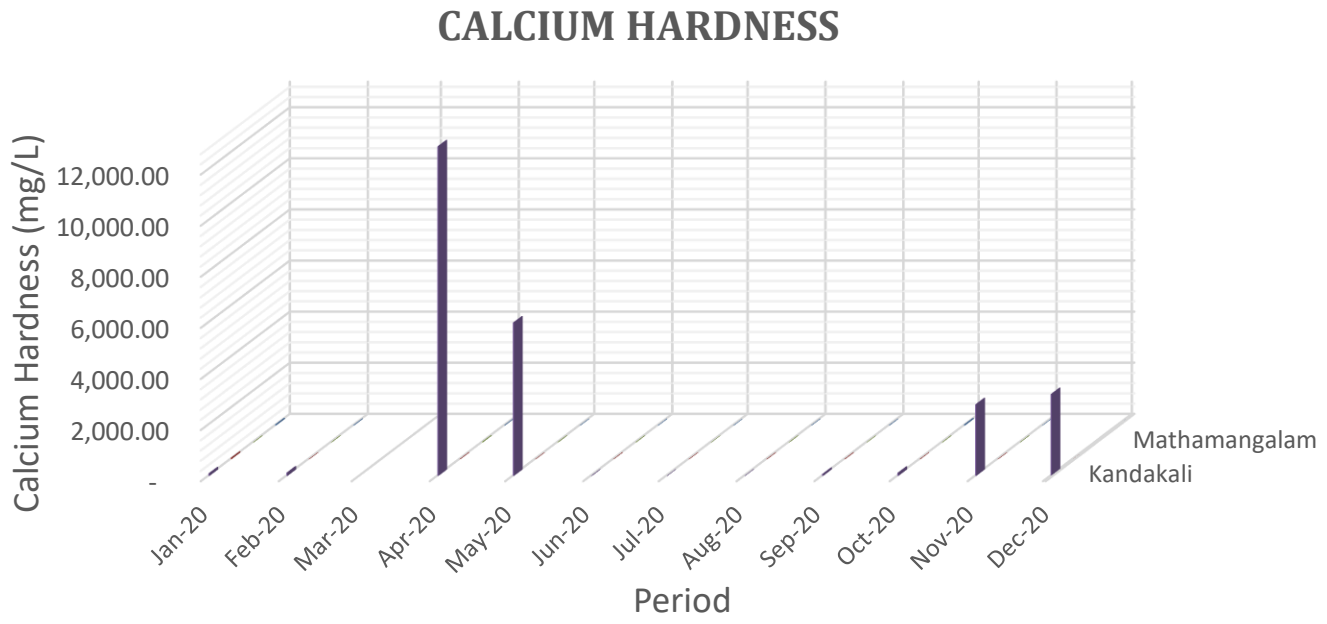

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	100.00	130.00		12,900	6,000.	9	6.00	9.00	13.00	74.00	120.00	2,800.	3,200.
Chandapura	48.00	9.00		13.00	10.00	10	4.00	10.00	6.00	10.00	8.00	4.00	9.00
Mathamangalam	7.00	7.00		19.00	13.00	8	2.00	8.00	3.00	5.00	7.00	8.00	3.00
Kacherikadavu	40.00	16.00		15.00	6.00	7	1.00	7.00	9.00	7.00	34.00	2.00	6.00

It indicates the hardness in river water due to the presence of Calcium salts. The trend strongly supports the presence of salt water intrusion.

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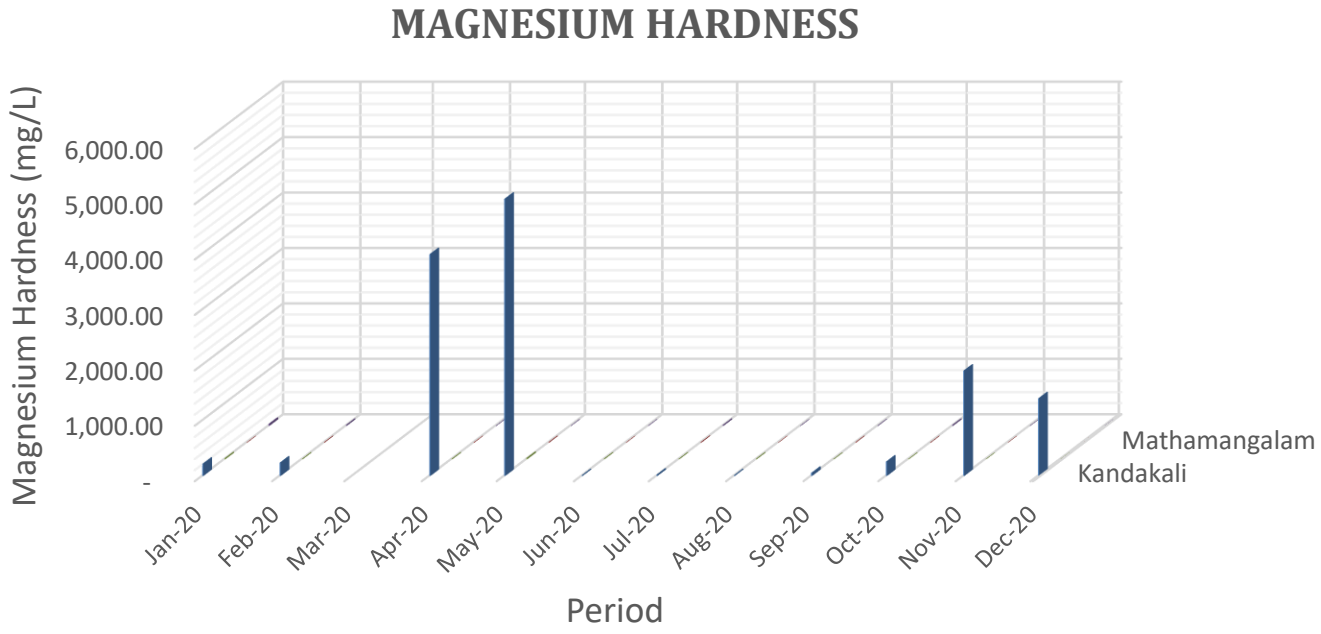

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	220.00	242.00		4,000.	5,000.	13	23.00	13.00	35.00	56.00	260.00	1,900.	1,400.
Chandapura	16.00	9.00		11.00	22.00	11	10.00	11.00	8.00	7.00	6.00	4.00	7.00
Mathamangalam	3.00	8.00		4.00	8.00	2	9.00	2.00	7.00	2.00	5.00	1.00	2.00
Kacherikadavu	35.00	16.00		3.00	3.00	3	14.00	3.00	6.00	2.00	16.00	2.00	4.00

It indicates the hardness in river water due to the presence of magnesium salts. The trend strongly supports the presence of salt water intrusion.

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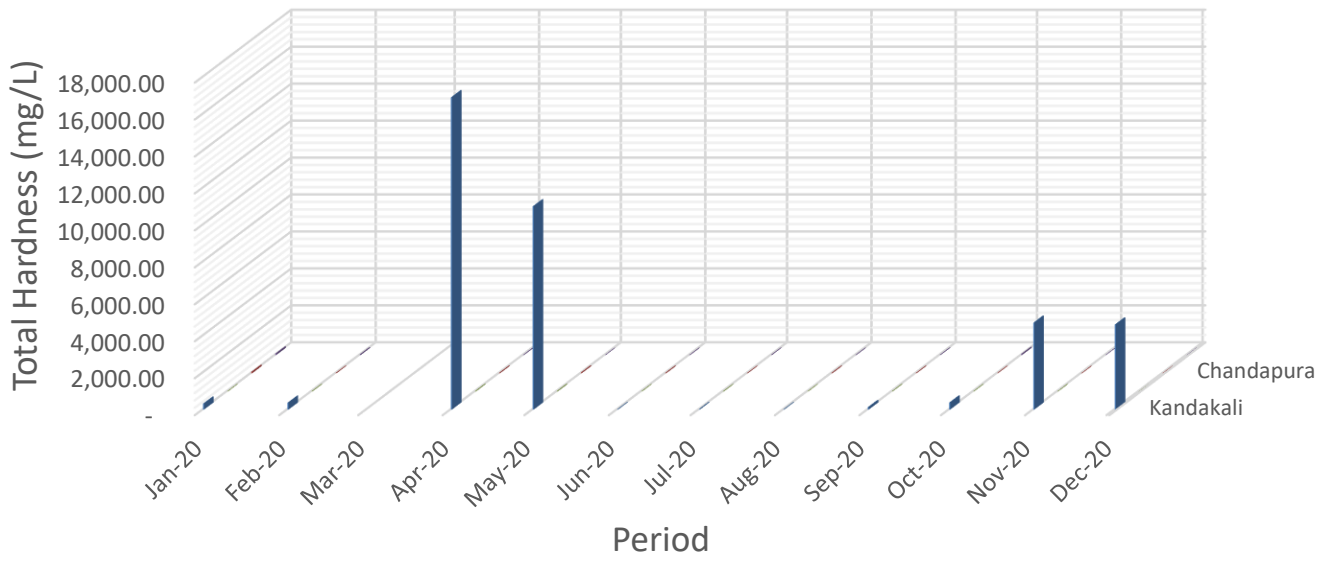

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	320.00	372.00		16,900.	11,000.	22	29.00	22.00	48.00	130.00	380.00	4,700.0	4,600.0
Mathamangalam	10.00	15.00		23.00	21.00	10	11.00	10.00	10.00	7.00	12.00	9.00	5.00
Chandapura	64.00	18.00		24.00	32.00	21	14.00	21.00	14.00	17.00	14.00	8.00	16.00
Kacherikadavu	75.00	32.00		18.00	9.00	10	15.00	10.00	15.00	9.00	50.00	4.00	10.00

Hardness is observed maximum at Kandankali, which clearly indicates salt water intrusion from the nearby sea. Presence of sea water minerals such as bicarbonates and sulphates of Calcium and Magnesium are responsible for hardness in river water.

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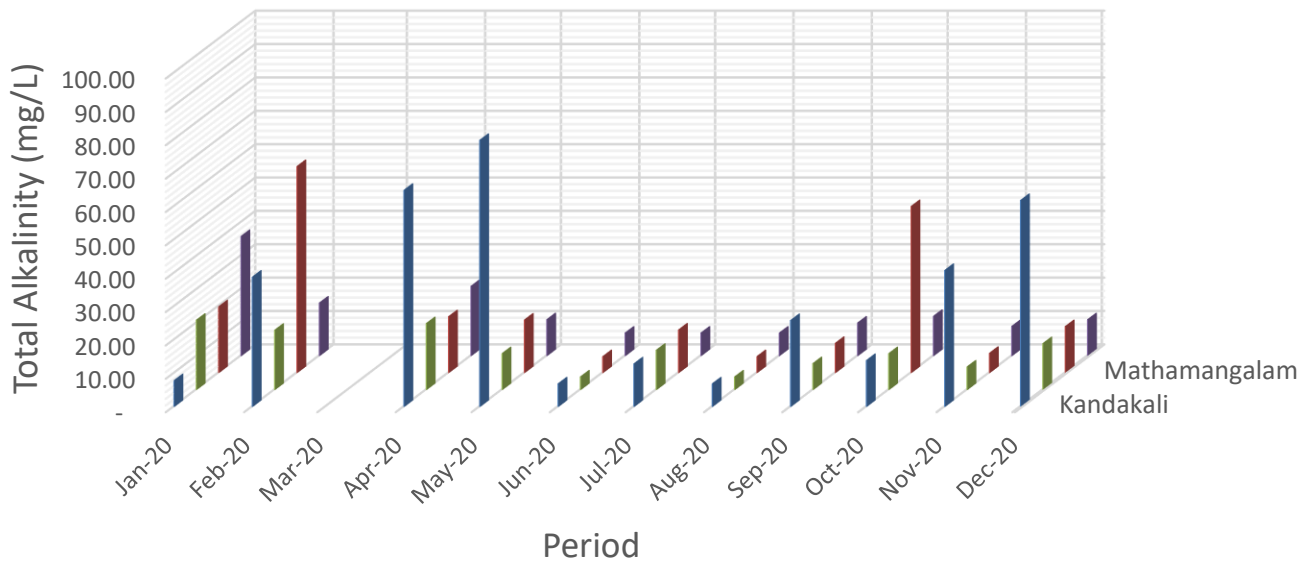

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	8.00	39.00		65.00	80.00	7	13.00	7.00	26.00	10.00	14.00	41.00	62.00
Chandapura	21.00	18.00		20.00	11.00	4	12.00	4.00	6.00	8.00	11.00	7.00	14.00
Mathamangalam	20.00	62.00		17.00	16.00	5	13.00	5.00	9.00	6.00	50.00	6.00	14.00
Kacherikadavu	36.00	16.00		21.00	11.00	7	7.00	7.00	10.00	4.00	12.00	9.00	11.00

Alkalinity is a measure of a river's buffering capacity, or its ability to neutralize acids. High alkalinity is good indication in river water because it keeps the water safe for organisms. The amount of Alkalinity that should be in our water is 20-200 mg/L for typical river water. Alkalinity is basically dissolved minerals in the water.

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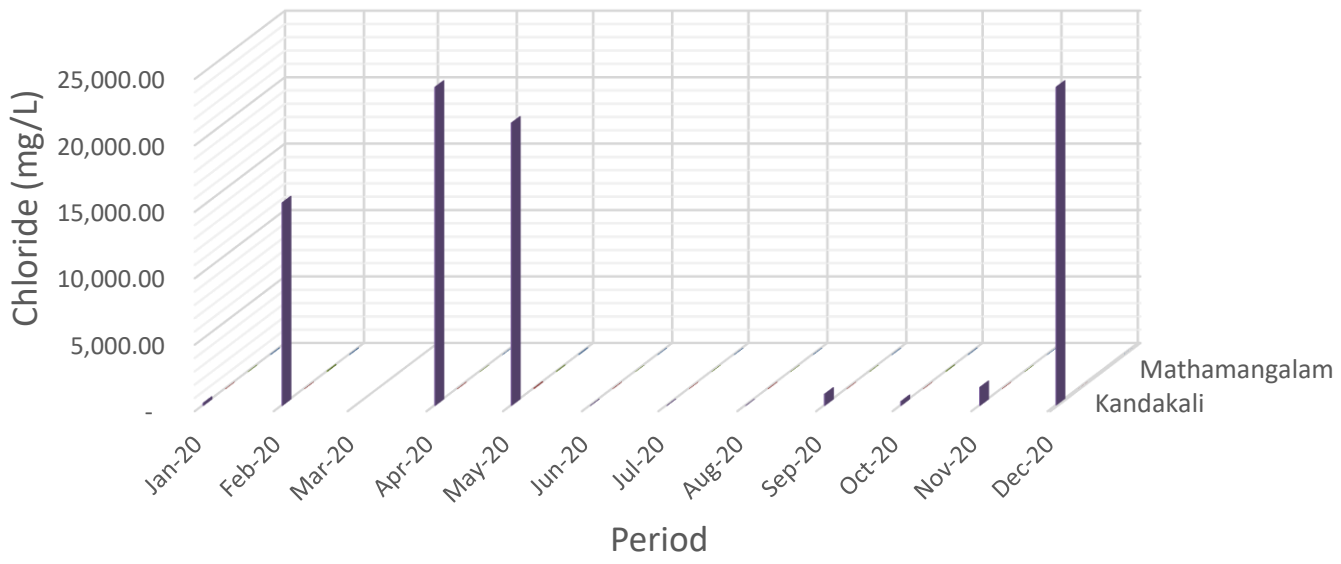

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	220.00	15,300.		24,000.	21,300.	37	37.00	37.00	56.00	900.00	340.00	1,400.0	24,000.
Chandapura	15.00	16.00		15.00	57.00	21	8.00	21.00	11.00	7.00	7.00	8.00	14.00
Mathamangalam	26.00	82.00		14.00	48.00	10	10.00	10.00	12.00	11.00	50.00	8.00	12.00
Kacherikadavu	42.00	36.00		9.00	49.00	20	14.00	20.00	16.00	10.00	35.00	2.00	9.00

Chlorides are harmless at low levels, river water high in sodium chloride can damage plants if used for gardening or irrigation, and give drinking water an unpleasant taste. The presence of chloride is maximum at Kandankali, a downstream, which clearly indicates salt water intrusion from the sea.

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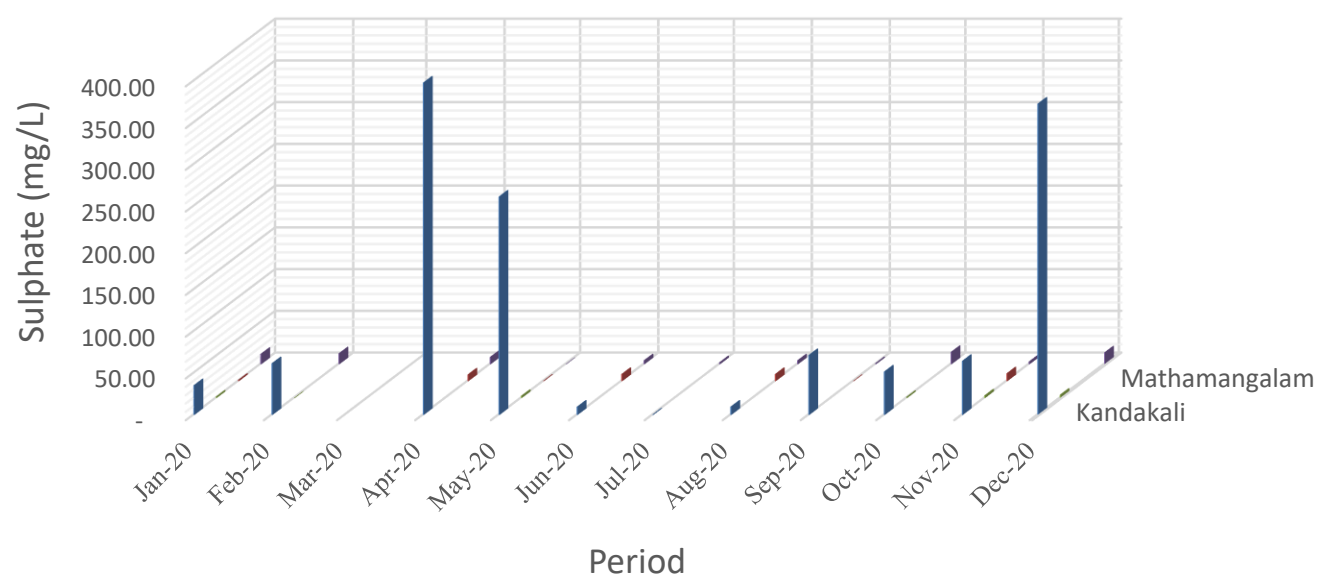

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	35.44	61.83		398.08	261.55	9.84414	0.70	9.84	0.13	71.64	51.95	64.66	372.86
Chandapura	1.61	0.28			2.49						1.23	3.06	3.77
Mathamangalam	1.43			7.89	0.64	8.4415		8.44		0.26		9.26	
Kacherikadavu	12.32	13.02		8.59	0.12	4.5454	2.21	4.55	1.20	0.78	14.68	3.22	14.12

When sulphate is less than 0.5 mg/L, algal growth will not occur but, sulfate salts can be major contaminants in natural waters. It shows an increase in concentration during April and December which may be due to a decrease of proper discharge.

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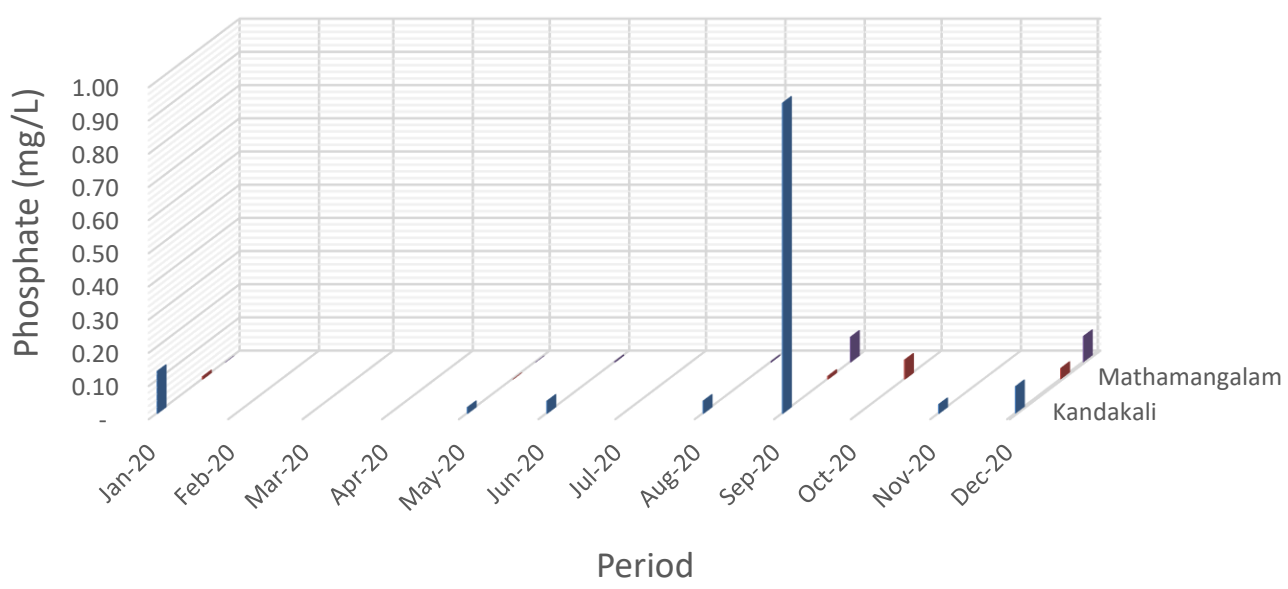

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	0.13				0.02	0.03927		0.04		0.94		0.03	0.08
Chandapura													
Mathamangalam	0.01				0.00					0.01	0.06		0.03
Kacherikadavu	0.00				0.00	0.00374		0.00		0.08			0.08

Phosphorus gets into water in both urban and agricultural settings. Phosphorus is an essential element for plant life, but when there is too much of it in water, it can speed up eutrophication (a reduction in dissolved oxygen in water bodies caused by an increase of mineral and organic nutrients) of rivers and lakes. Phosphate are found to be in very less quantity along the river stretch. It shows an increased phosphate concentration at upostream station such as Kacherikkadavu, where the source can be fertilizers from agricultural fields.

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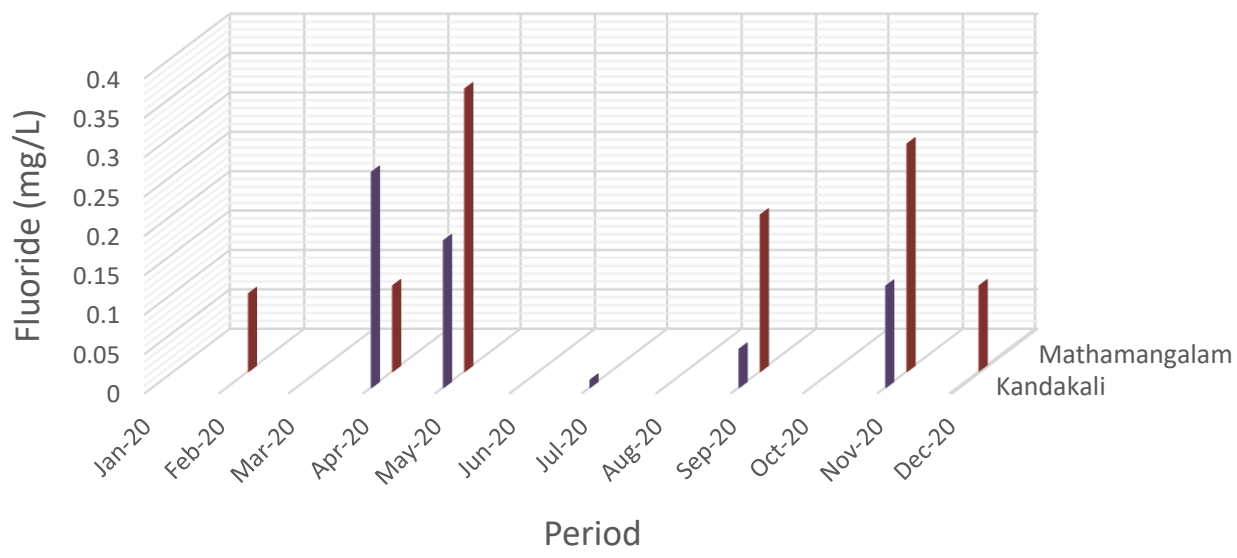

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali				0.27	0.19		0.01		0.01	0.05		0.13	
Chandapura		0.10		0.11	0.36				0.20			0.29	0.11
Mathamangalam													
Kacherikadavu													

Presence of Flurides is sparingly observed along the downstream side and is not observed in the upstream. Presence of Flurides in the downstream rivers is very much dependent on the flow through the river/ monsoon.

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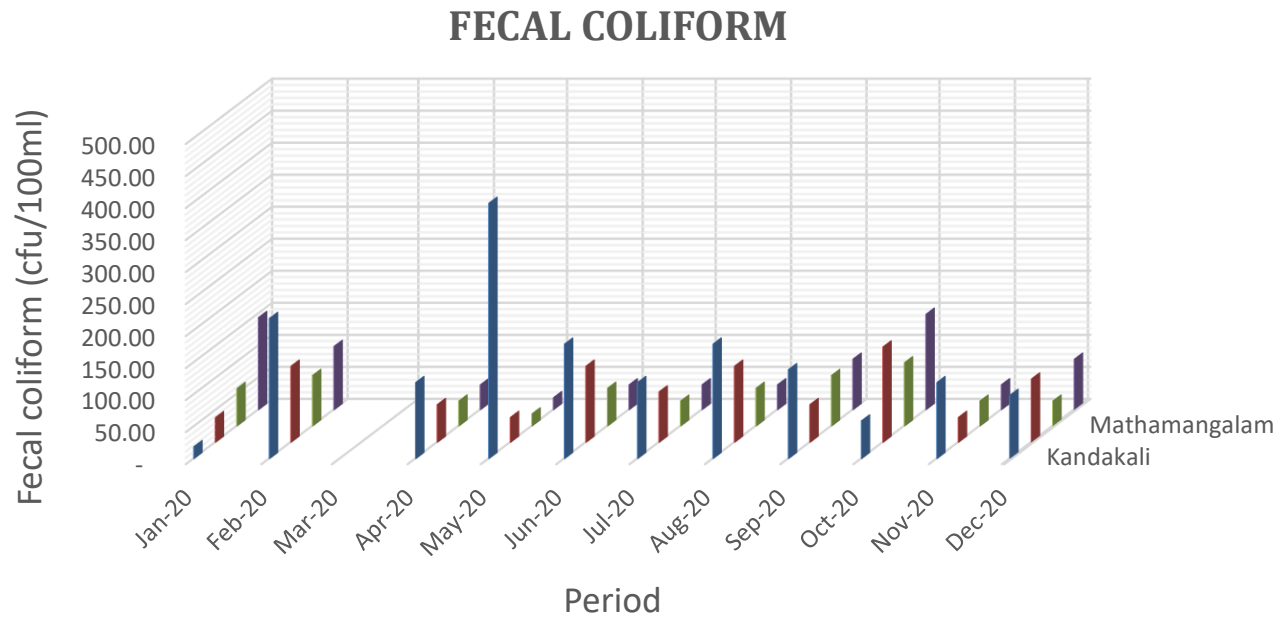

	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20	Jul-20	Aug-20	Sep-20	Sep-20	Oct-20	Nov-20	Dec-20
Kandakali	20.00	220.00		120.00	400.00	180	120.00	180.00	140.00	80.00	60.00	120.00	100.00
Chandapura	40.00	120.00		60.00	40.00	120	80.00	120.00	40.00	60.00	150.00	40.00	100.00
Mathamangalam	60.00	80.00		40.00	20.00	60	40.00	60.00	80.00	40.00	100.00	40.00	40.00
Kacherikadavu	145.00	100.00		40.00	20.00	40	40.00	40.00	80.00	40.00	150.00	40.00	80.00

A fecal coliform is a facultatively anaerobic, rod-shaped, gram-negative, non-sporulating bacterium. The assay is intended to be an indicator of fecal contamination; more specifically of E. coli which is an indicator microorganism for other pathogens that may be present in feces.

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Analysis of Water Quality Parameters as part of River Survey (January-February 2021)

Details of Sampling Stations

SAMPLE ID	LANDMARK	LATITUDE	LONGITUDE	REMARKS
S1	Eryam- Edakom Bridge (S1)	12^0 8' 38.79''	75^0 22' 30.21''	Nil
S2	Ponnicheri Bridge (S2)	12^0 7' 27.56''	75^0 20' 24.06''	Nil
S3	Karakkund Bridge (S3)	12^0 7' 18.86''	75^0 19' 51.23''	Nil
S4	Kacherikkadavu Bridge (S4)	12^0 7' 31.09''	75^0 18' 27.55''	Nil
S5	Mathuvayal Bridge (S5)	12^0 7' 43.32''	75^0 18' 20.29''	Nil
S6	Mathamangalam (S6)	12^0 7' 36.27''	75^0 18' 11.21''	Nil
S7	Kambipalam Rivergauge Station (S7)	12^0 7' 8.77''	75^0 18' 7.69''	Nil
S8	Cheruvicheri Bridge (S8)	12^0 6' 47.54''	75^0 17' 37.78''	Nil
S9	Chandappura Bridge (S9)	12^0 6' 30.58''	75^0 17' 12.77''	Nil
S10	Meenkuzhi Checkdam (S10)	12^0 6' 31.04''	75^0 16' 44.78''	Nil
S11	Thottum Kadavu Bridge (S11)	12^0 6' 16.83''	75^0 16' 18.79''	Nil
S12	Thottum Kadavu Bridge (S12)	12^0 6' 16.62''	75^0 16' 18.29''	Nil
S13	Kanayi Swec (S13)	12^0 6' 47.92''	75^0 15' 45.85''	Nil
S14	Kanayi Thodu (S14)	12^0 6' 50.87''	75^0 15' 23.56''	Nil
S15	Kuruvayal Vatta (S15)	12^0 6' 26.65''	75^0 14' 48.55''	Nil
S16	Kappad Eco Tourism (S16)	12^0 6' 48.87''	75^0 13' 38.25''	Nil
S17	Perumba Bridge Side Pond (S17)	12^0 6' 35.1''	75^0 13' 16.39''	Nil
S18	Perumba Bridge Centre (S18)	12^0 6' 33.61''	75^0 13' 17.64''	Nil
S19	Perumba Wood Mill (S19)	12^0 6'31.36''	75^0 13' 14.63''	Nil
S20	Perumba Thodu (Kandankali) (S20)	12^0 6' 3.79''	75^0 13' 55.07''	Nil
S21	Ezhimala Railway Bridge (S21)	12^0 4'21.99''	75^0 13' 21.80''	Nil
S22	Kunnaru Bridge (S22)	12^0 3' 22.03''	75^0 12' 20.03''	Nil

Date of Sample Collection: 8-Feb-2021
Date of analysis: 8-Feb-2021 to 14-Feb-2021

Below table shows the comparison of all the sampling station results against the designated use value of water bodies. Designated use **Type B** which is **Outdoor bathing** the target quality to be achieved.

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Table : Comparison of Water qualities at Sampling station against Quality Standards for Designated use

Sl.No	Characteristics	Designated best use A	B	C	D	E	SAMPLING LOCATIONS S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
1	Electrical conductivity, micromhos/cm, max	-	-	-	-	2,250	39	38	55	43	57	42	44	95	50	10,510	14,070
2	pH value	6.5-8.5	6.5-8.5	6.0-9.0	6.5-8.5	6.0-8.5	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.20	6.20	7.20	7.00
3	Colour, Hazen units, max.	10	300	300	-	-											
4	Odour	Un-objectionable			-	-											
5	Taste	Tasteless	-	-	-	-											
6	Total dissolved solids, mg/l, max.	500	-	1,500	-	2,100											
7	Total hardness (as CaCO3), mg/l, max.	200	-	-	-	-											
8	Calcium hardness (as CaCO3), mg/l, max.	200	-	-	-	-											
9	Magnesium hardness (as CaCO3), mg/l, max.	200	-	-	-	-											
11	Iron (as Fe), mg/l, max.	0.3	-	0.5	-	-	1.02	BDL	1.02	0.80	1.03	1.05	0.80	0.60	1.03	1.20	0.80
12	Manganese (as Mn), mg/l, max																
13	Cholorides (as Cu), mg/l, max	250	-	600	-	600	9.94	9.94	13.92	9.94	13.92	11.93	11.93	21.87	11.93	3,580	4,972
14	Sulphates (as SO4), mg/l, max	400	-	400	-	1000	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	80.00	80.00
15	Nitrates (as NO3), mg/l, max.	20	-	50	-	-	BDL	BDL	5.00	BDL	5.00	BDL	BDL	5.00	BDL	BDL	5.00
16	Fluorides (as F), mg/l, max	1.5	1.5	1.5	-	-											
17	Dissolved Oxygen (DO)mg/l min	6	5	4	4	-	6.80	7.00	6.80	5.50	5.50	6.30	5.70	3.20	7.40	6.00	5.80
18	Biochemical Oxygen demand (BOD)mg/l, max	2	3	3	-	-	6.50	4.90	3.10	2.80	5.00	2.50	2.30	1.00	1.50	5.90	2.90
19	Total coliform organisms MPN/100ml, max	50	500	5000	-	-	75.00	30.00	145.00	175.00	70.00	210.00	1100+	115.00	135.00	100.00	375.00

Sl.No	Characteristics	Designated best use A	B	C	D	E	SAMPLING LOCATIONS S12	S13	S14	S15	S16	S17	S18	S19	S20	S21	S22
1	Electrical conductivity, micromhos/cm, max	-	-	-	-	2,250	18,650	16,490	18,450	36,800	39,600	34,300	37,000	36,200	38,800	43,100	47,200
2	pH value	6.5-8.5	6.5-8.5	6.0-9.0	6.5-8.5	6.0-8.5	7.00	7.00	7.00	7.50	8.20	7.50	7.60	7.50	7.50	8.10	8.10
3	Colour, Hazen units, max.	10	300	300	-	-											
4	Odour	Un-objectionable			-	-											
5	Taste	Tasteless	-	-	-	-											
6	Total dissolved solids, mg/l, max.	500	-	1,500	-	2,100											
7	Total hardness (as CaCO3), mg/l, max.	200	-	-	-	-											
8	Calcium hardness (as CaCO3), mg/l, max.	200	-	-	-	-											
9	Magnesium hardness (as CaCO3), mg/l, max.	200	-	-	-	-											
11	Iron (as Fe), mg/l, max.	0.3	-	0.5	-	-	1.02	1.30	0.60	0.30	0.30	1.30	0.40	0.30	0.40	0.60	0.40
12	Manganese (as Mn), mg/l, max																
13	Cholorides (as Cu), mg/l, max	250	-	600	-	600	7258.91	6165.09	7159.46	13722.34	15014.98	11932.40	12926.80	12429.00	13622.86	15313.29	17600.34
14	Sulphates (as SO4), mg/l, max	400	-	400	-	1000	90.00	90.00	80.00	70.00	70.00	50.00	80.00	70.00	70.00	60.00	60.00
15	Nitrates (as NO3), mg/l, max.	20	-	50	-	-	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
16	Fluorides (as F), mg/l, max	1.5	1.5	1.5	-	-											
17	Dissolved Oxygen (DO)mg/l min	6	5	4	4	-	7.40	8.00	8.90	9.00	6.00	5.90	6.00	6.70	2.60	9.00	6.40
18	Biochemical Oxygen demand (BOD)mg/l, max	2	3	3	-	-	2.60	2.30	0.30	2.20	2.40	4.00	2.50	3.20	1.20	4.20	0.20
19	Total coliform organisms MPN/100ml, max	50	500	5000	-	-	105.00	115.00	100.00	20.00	20.00	20.00	45.00	210.00	215.00	75.00	20.00

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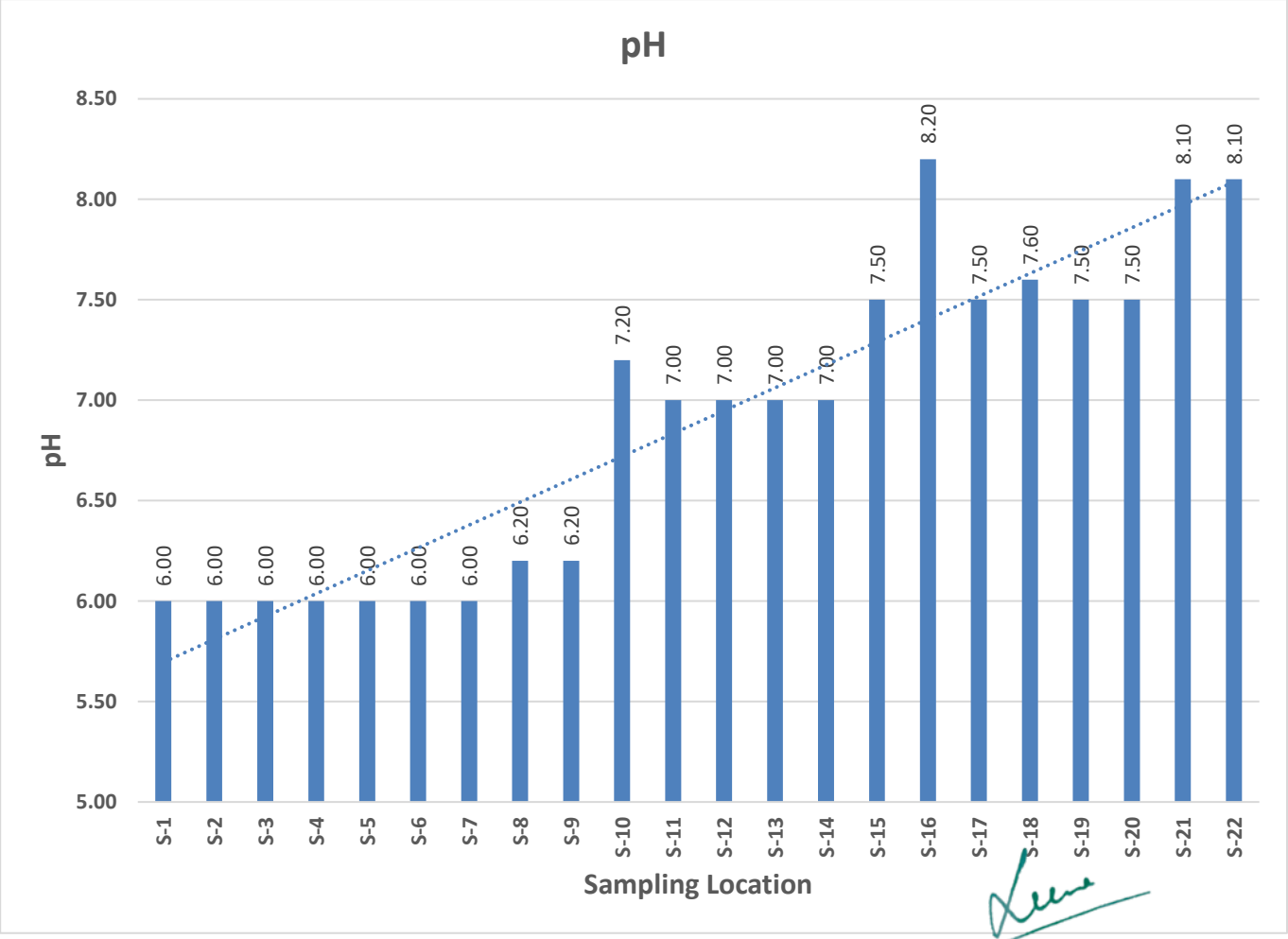
pH value

pH value is indicative of salinity of the water. pH value as per Surface water quality standards (IS 2296 -1992), following are the river water pH ranges.

Observed trend in pH is as shown in Figure. The upstream sites show pH values slightly acidic. This may be due to the application of pesticides and fertilizers from the nearby agricultural fields.

While moving downstream, the increases in the pH could be because of the salinity from sea water as well as the alkalinity from industrial or municipal wastes.



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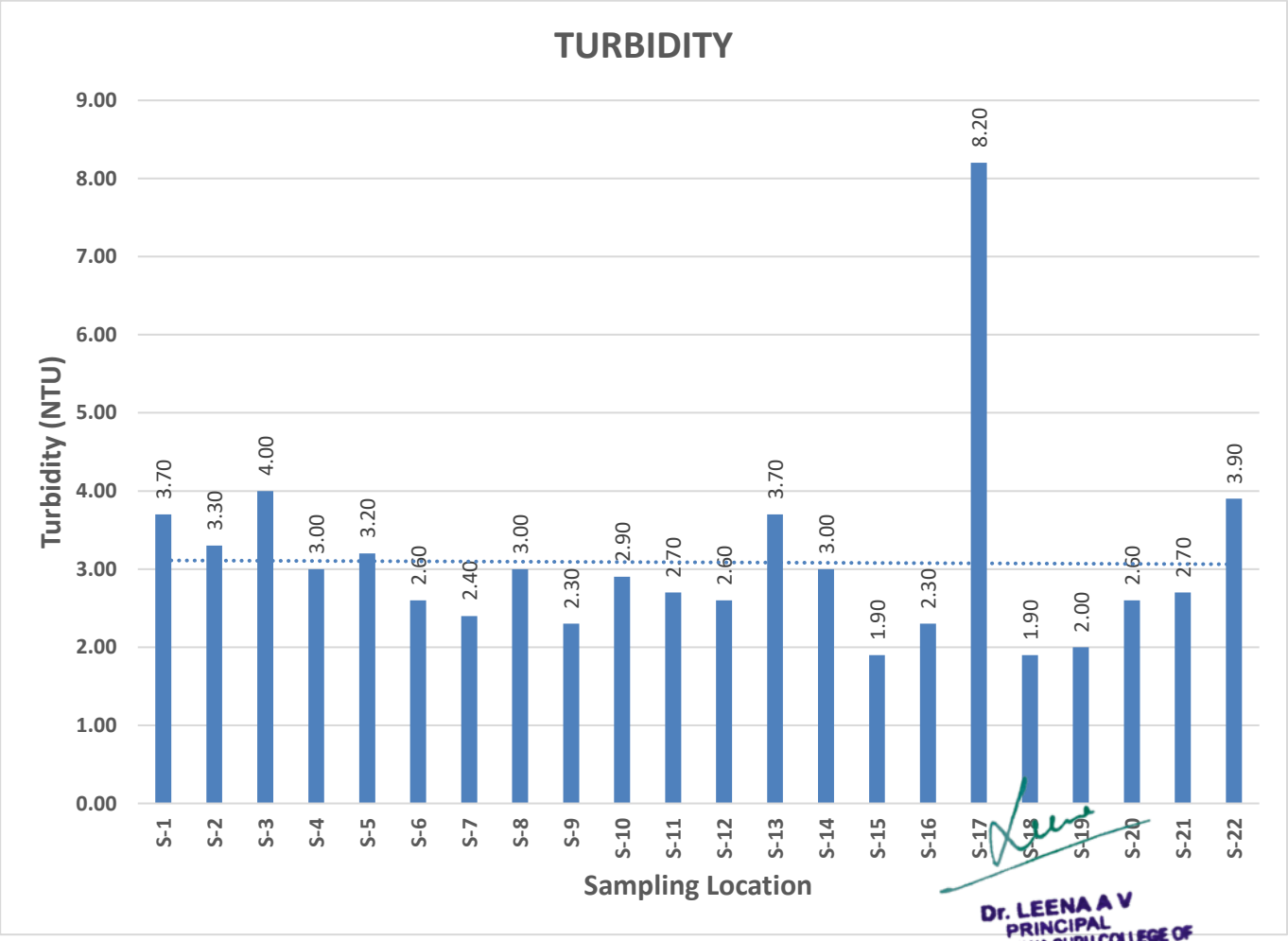
Turbidity

Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality.

Turbidity value shows a gradual increasing trend from upstream to downstream. Though the highest recorded value is at S-17, Stagnant pond near Perumba bridge which is visibly polluted. The siltation and flooding results in water accumulation in such swampy areas.

As water level in the river goes down, the stagnant water in the depressions gets polluted.

This is aggravated by the inflow from the sides of the bridge where wastes are identified to be thrown. This polluted swamp could add to river water pollution during rain.



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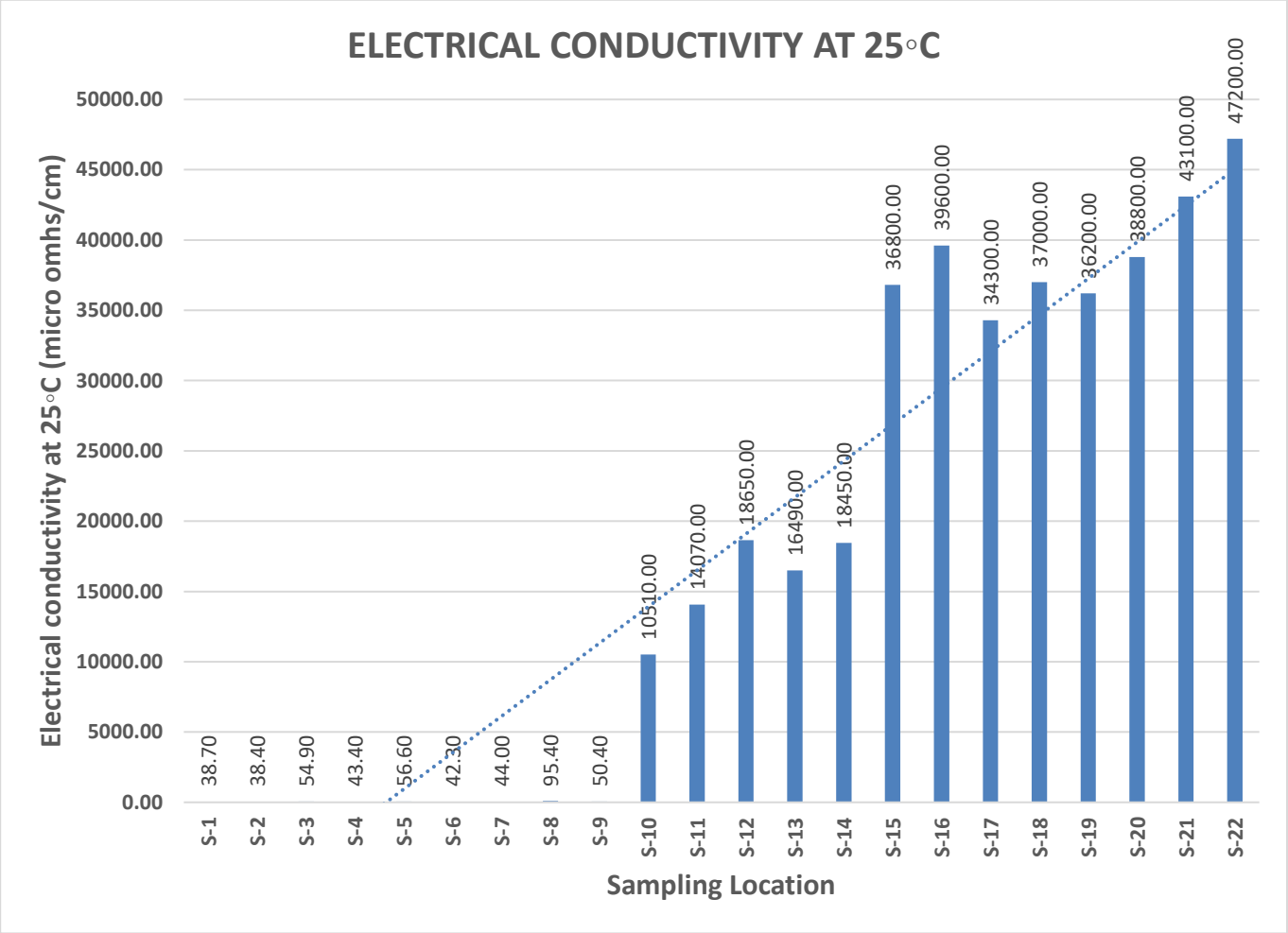
Electrical Conductivity

As per the figure, Electrical conductivity varies significantly along the stretch and is very high at the lower reaches. This is prominently due to the sea salt water entering from the coastal areas.

Salt water entry inward the river is influenced by Tidal variations variation and which intern affects the conductivity value. Electrical Conductivity value significantly reduces during the rain.



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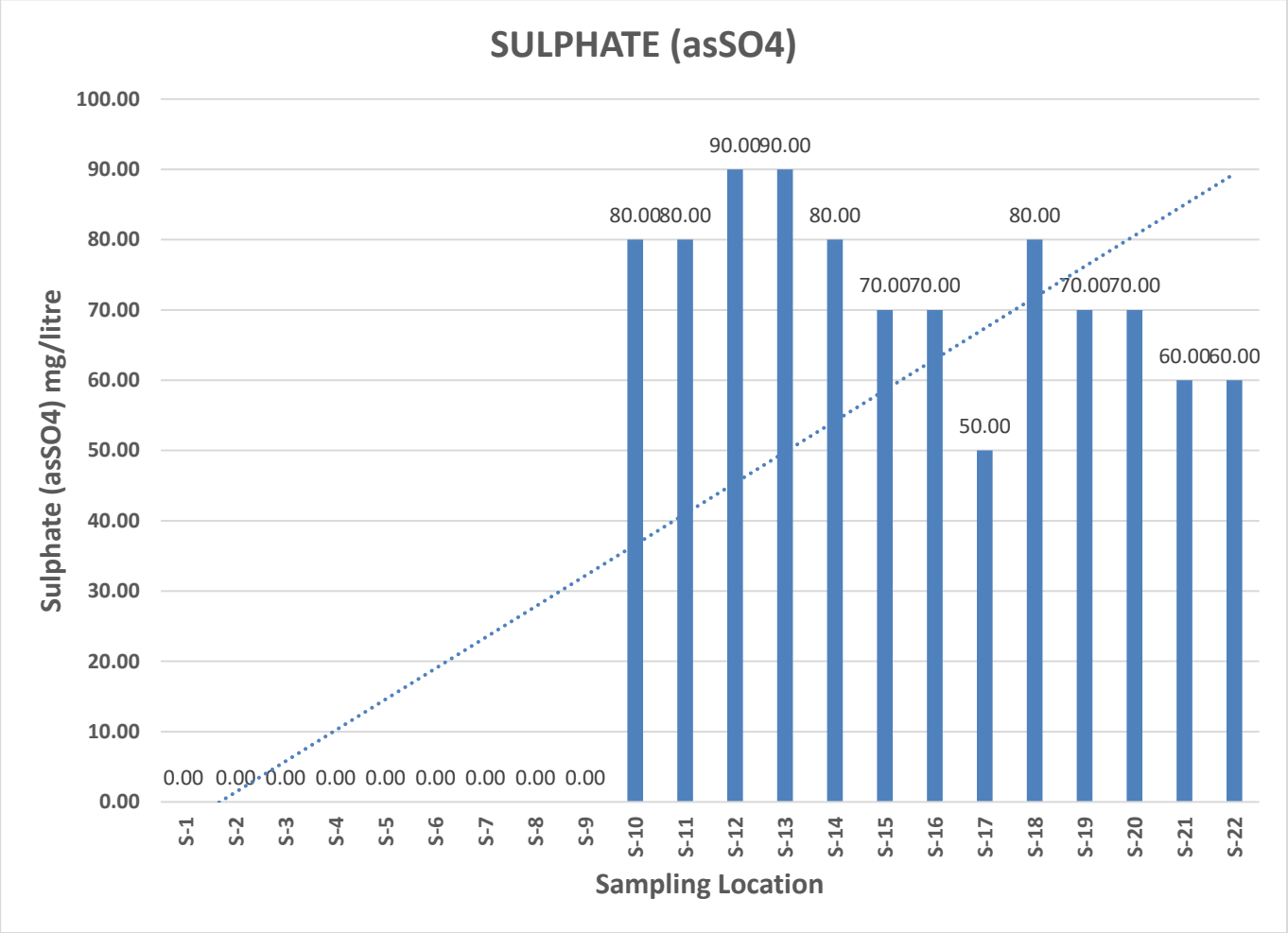
Sulphates

Water quality analysis indicates that the presence of sulphates in the upstream side is below detectable level (BDL) and is found from station Meenkuzhi checkdam (S-10) to downstream side. Sulphates in Perumba bridge side pond (S-17) is at a detectable level but low compared to that of river.



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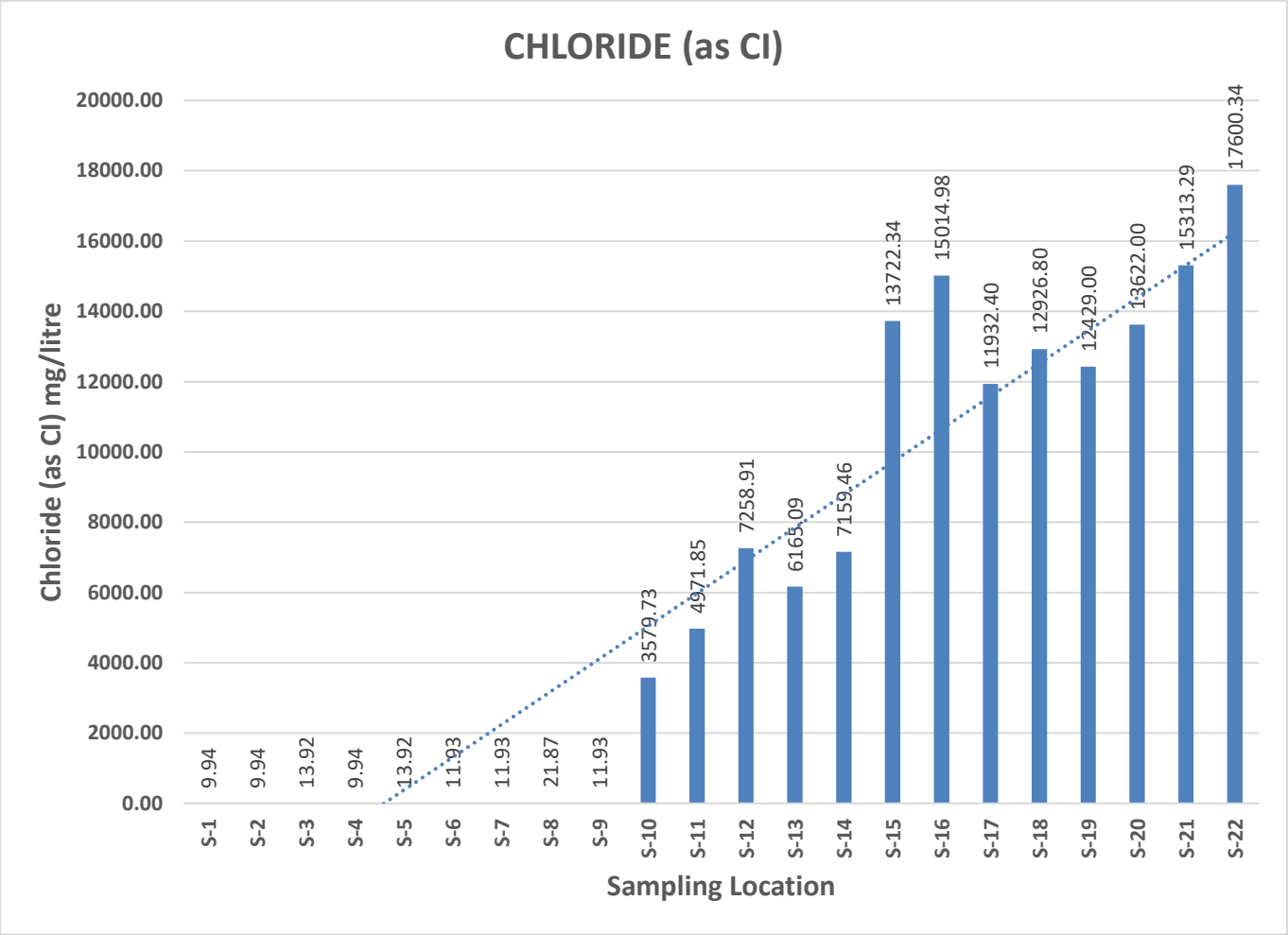
Chlorides

Chlorides are very common water pollutants. The trend shows Chloride free water upstream of Meenkuzhi Check dam (S-10), where the salt water intrusion from Sea is checked. Chloride value increases along the downstream indicating the general salinity.



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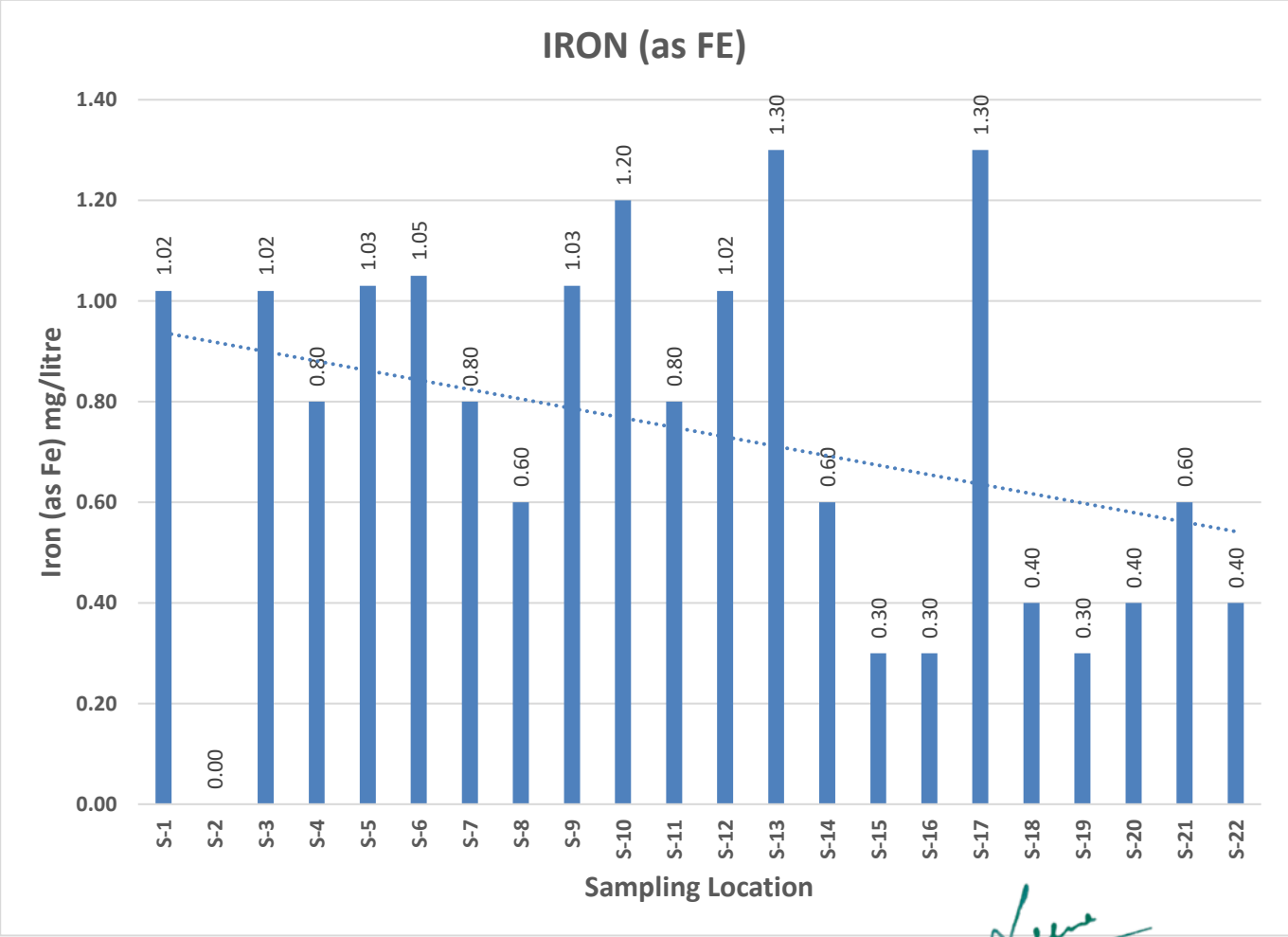
Iron

Iron exists naturally in rivers, lakes, and underground water. It may also be released to water from natural deposits, industrial wastes, refining of iron ores, and corrosion of iron containing metals.

Analysis does not give any specific trend in the iron though the values are slightly low towards the downstream side.



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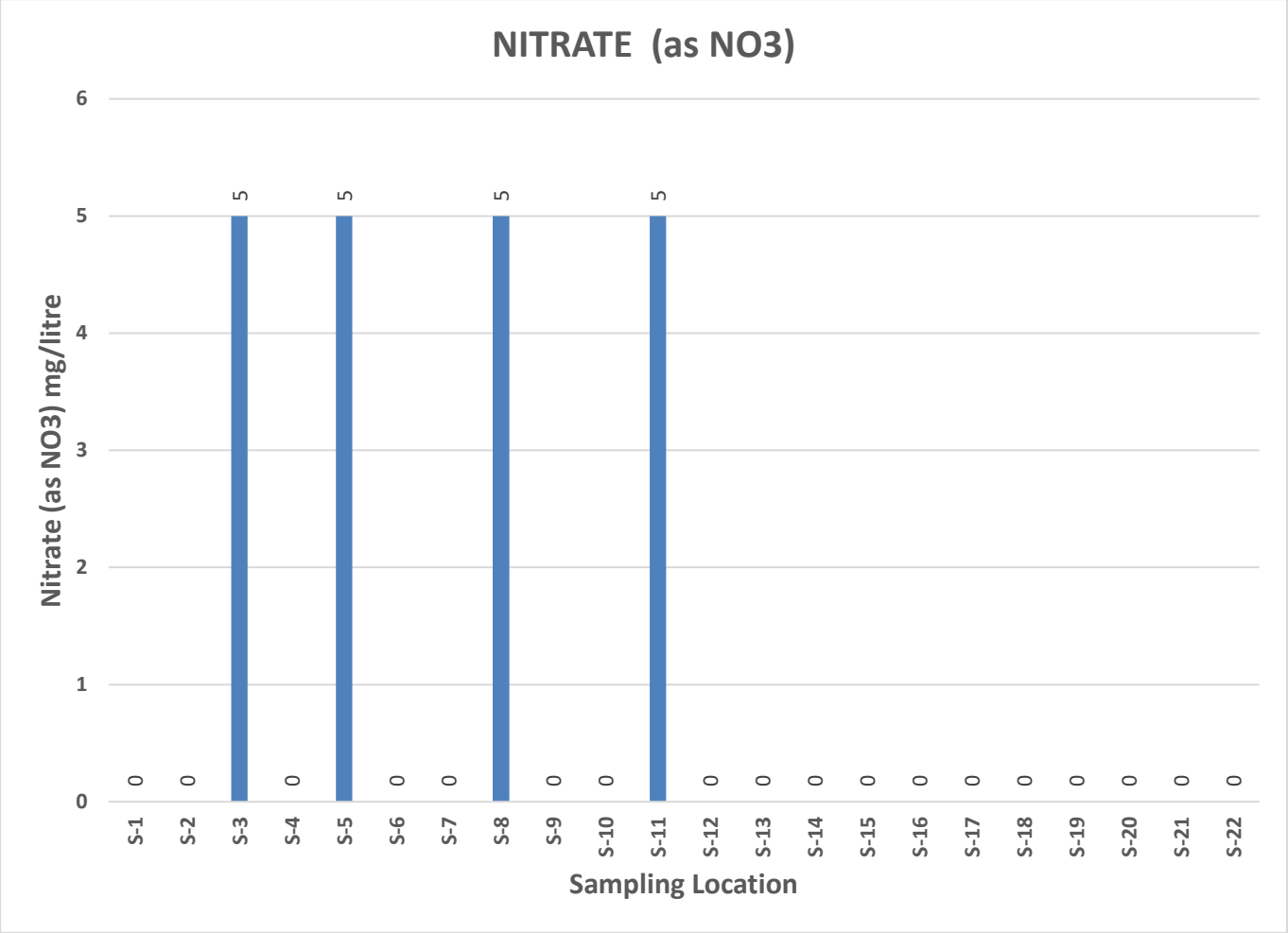
Nitrates



Presence of Nitrates is maximum at the upstream sites, which clearly shows the presence of fertilizers from agricultural fields at the paddy fields of Kadannappally Panappuzha Panchayats. While moving downs, it disappears, may be due to dilution effect from the water from tributaries.

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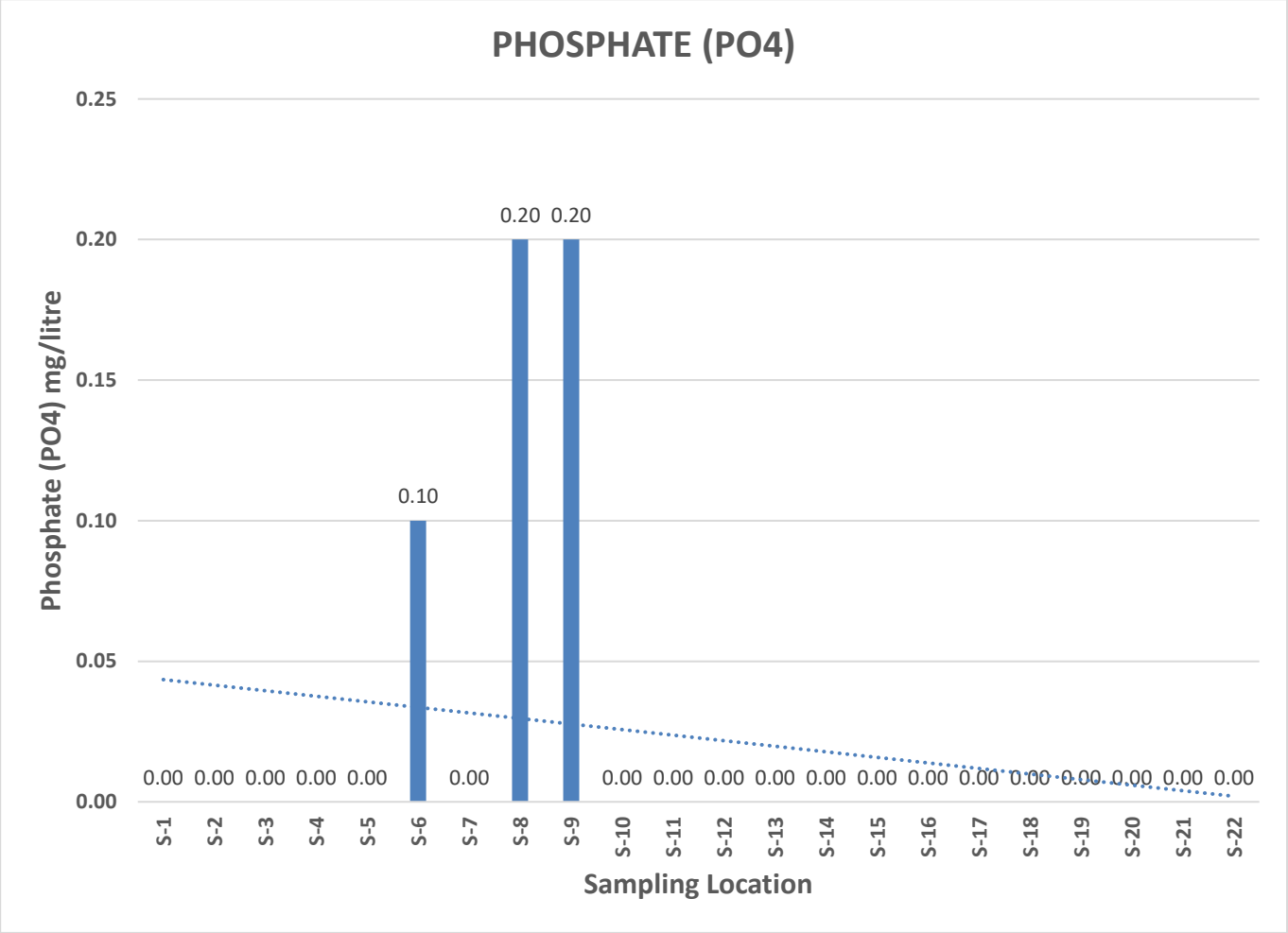
Phosphates



Phosphate also follows the trend shown by Nitrates. The fertilizers and pesticides from the agricultural filed can be assumed as the reason behind the increased phosphate concentration at the upstream.

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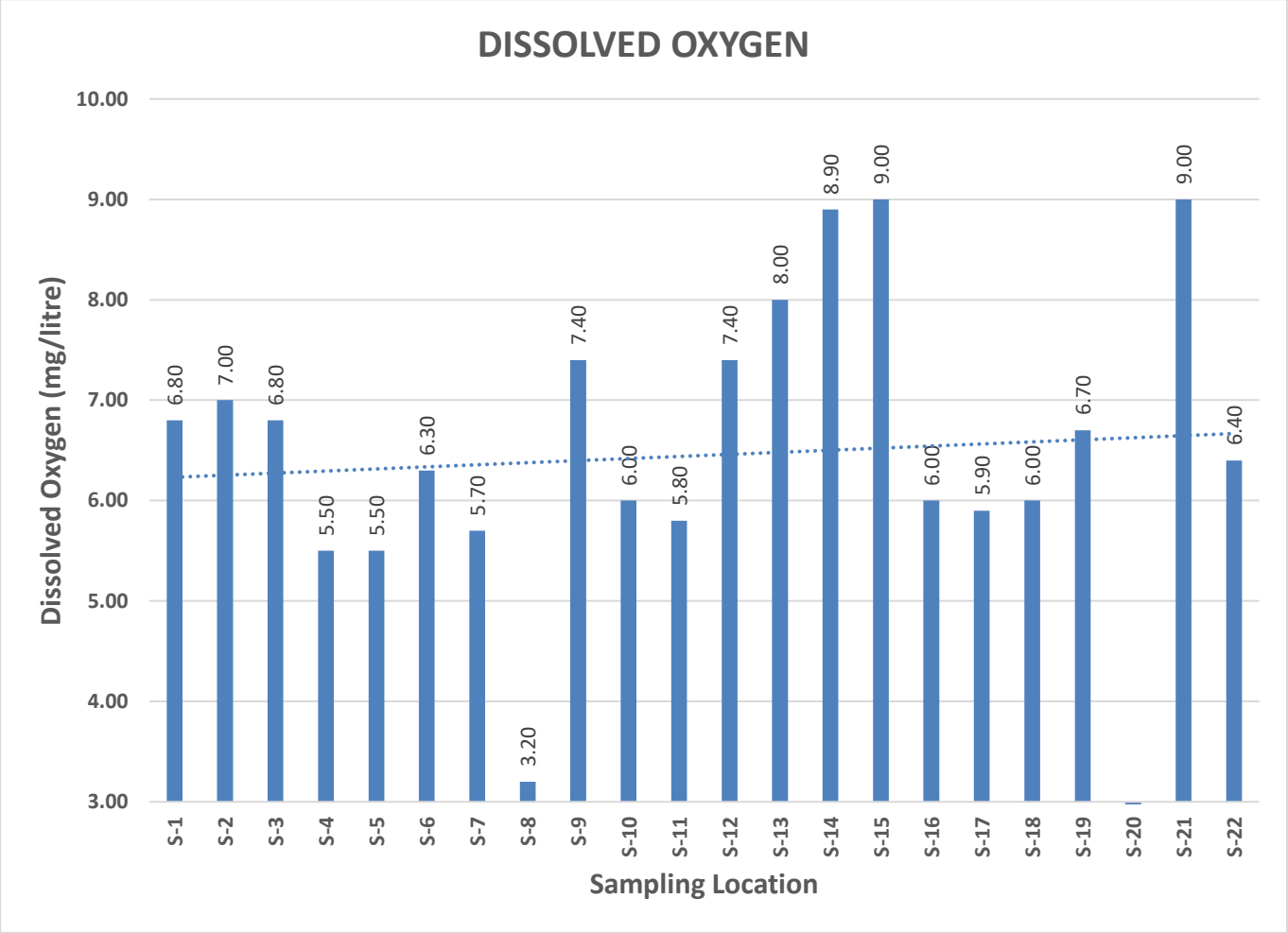
Dissolved Oxygen



DO shows more or less the same pattern throughout the stretch. Compared to the river water standard, the river stretch shows a decreased DO, which may be harmful for the river water ecosystem.

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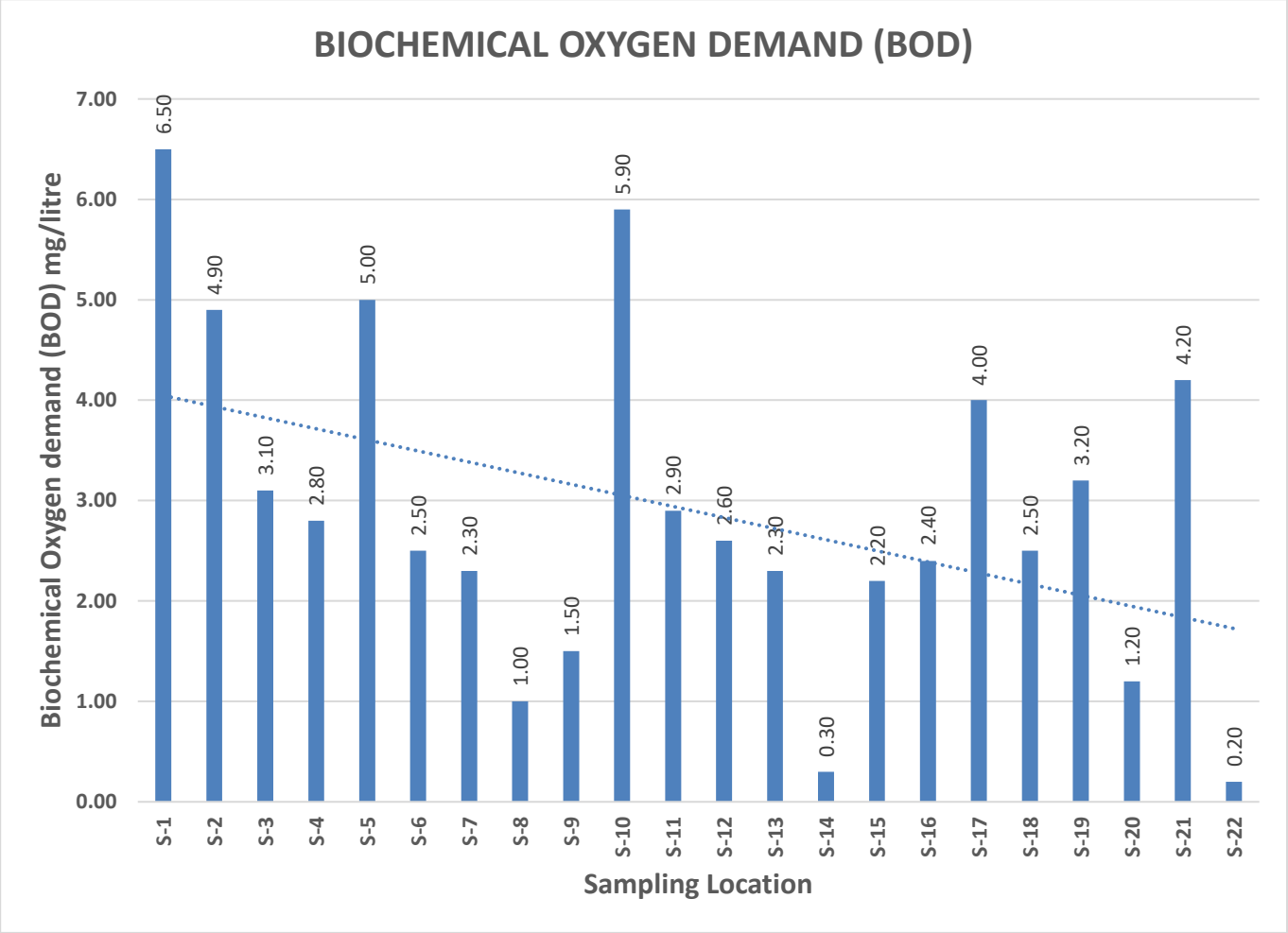
BOD



BOD shows a declining trend while moving downstream. The decreased velocity leads to less aeration and the water gets stagnated at various parts at the downstream. It may be the reason behind the decreased BOD at downstream. Contaminants from downstream municipality waste may also be a reason behind the same.

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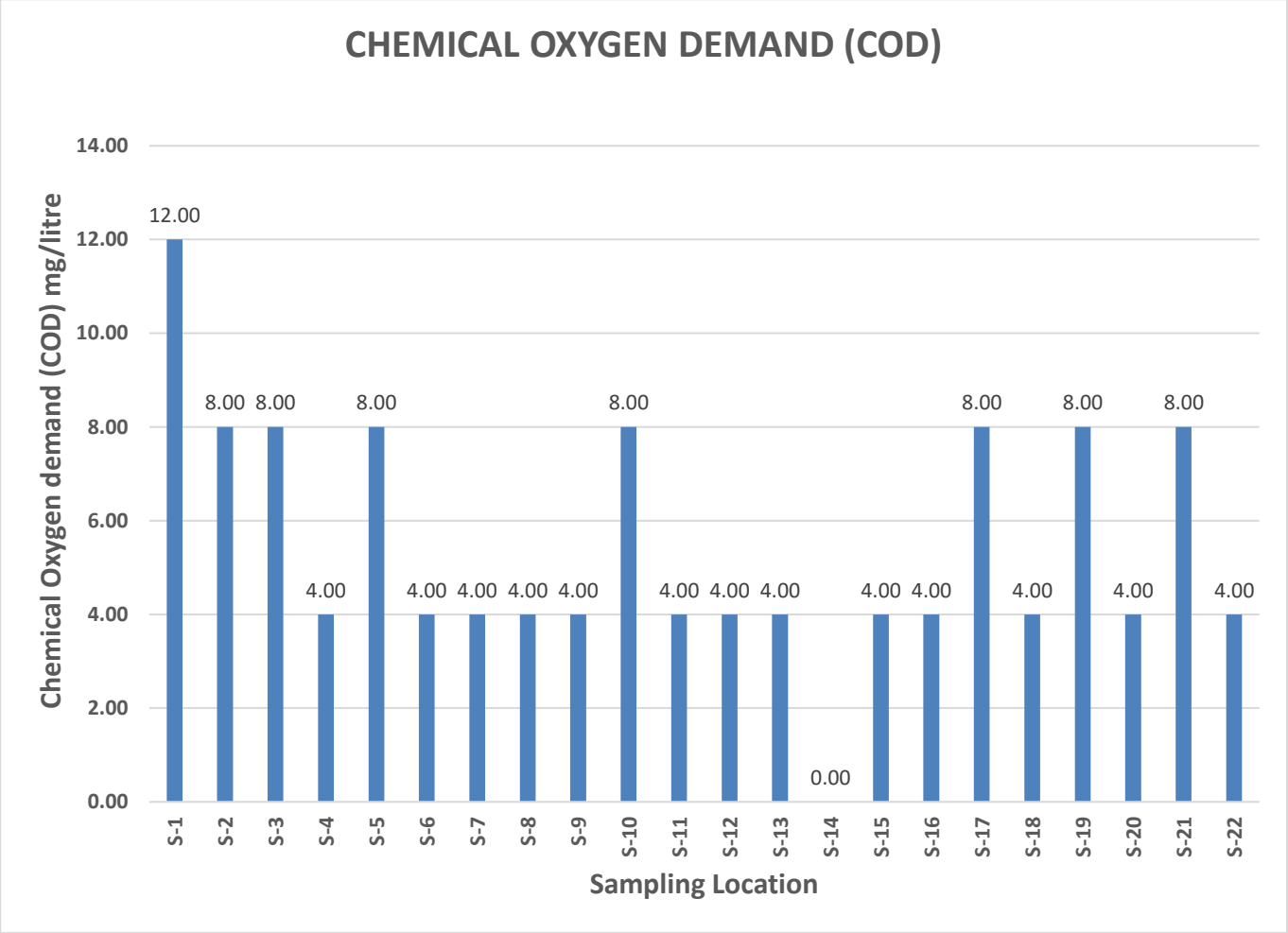
COD



Chemical Oxygen Demand shows a constant trend throughout. However a drastic increase in COD at the site 1 is a matter of suspicion. The increased value may be due to some local variation in flow properties or presence of any temporary waste disposal at the site, which requires further tests to ensure the exact test results.

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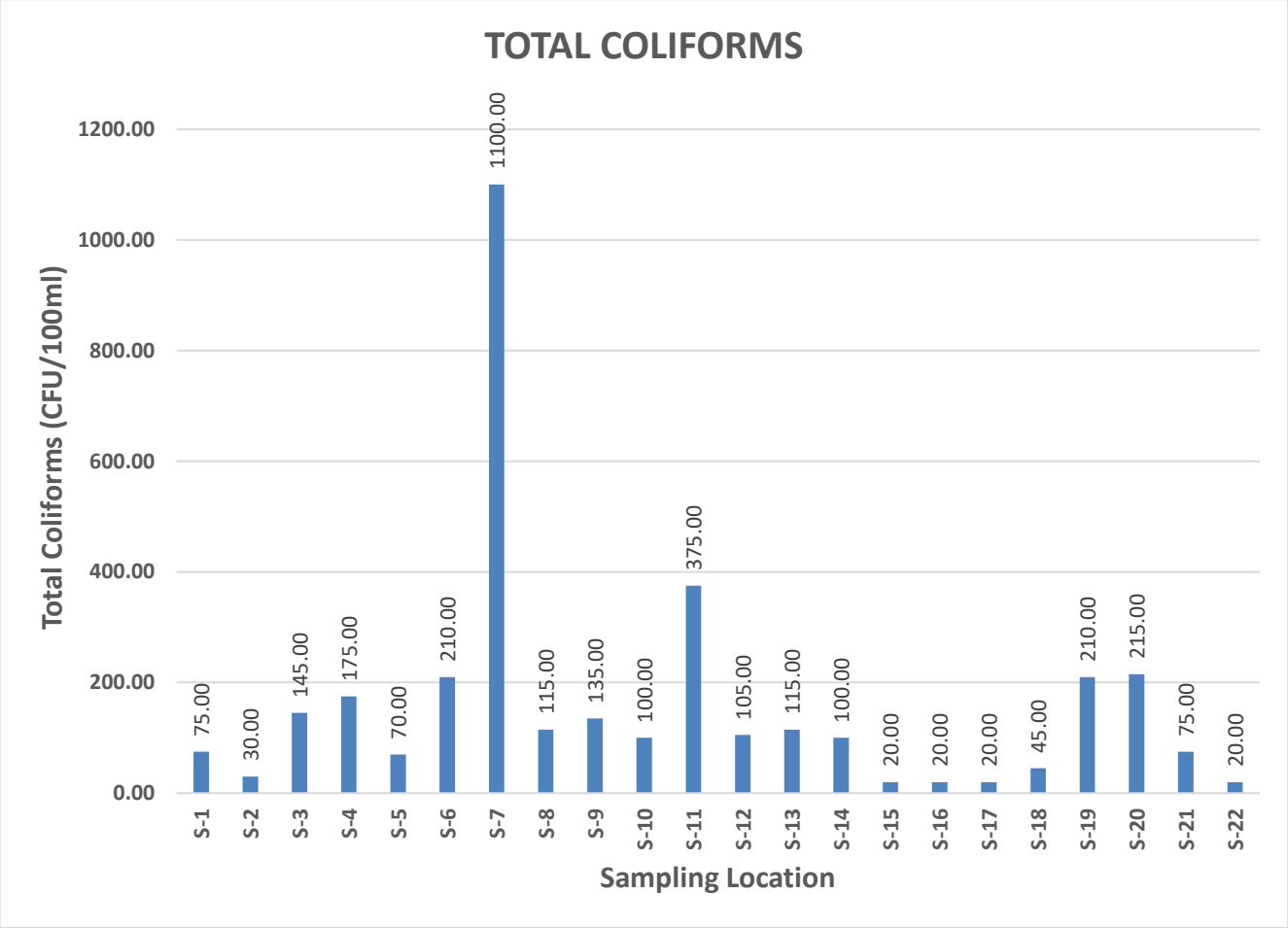
Total Coliform



Site 7 shows a drastic increase in total coliform which may be due to the presence of an unexpected foreign material on the sampling site. Remaining values shows a satisfactory trend.

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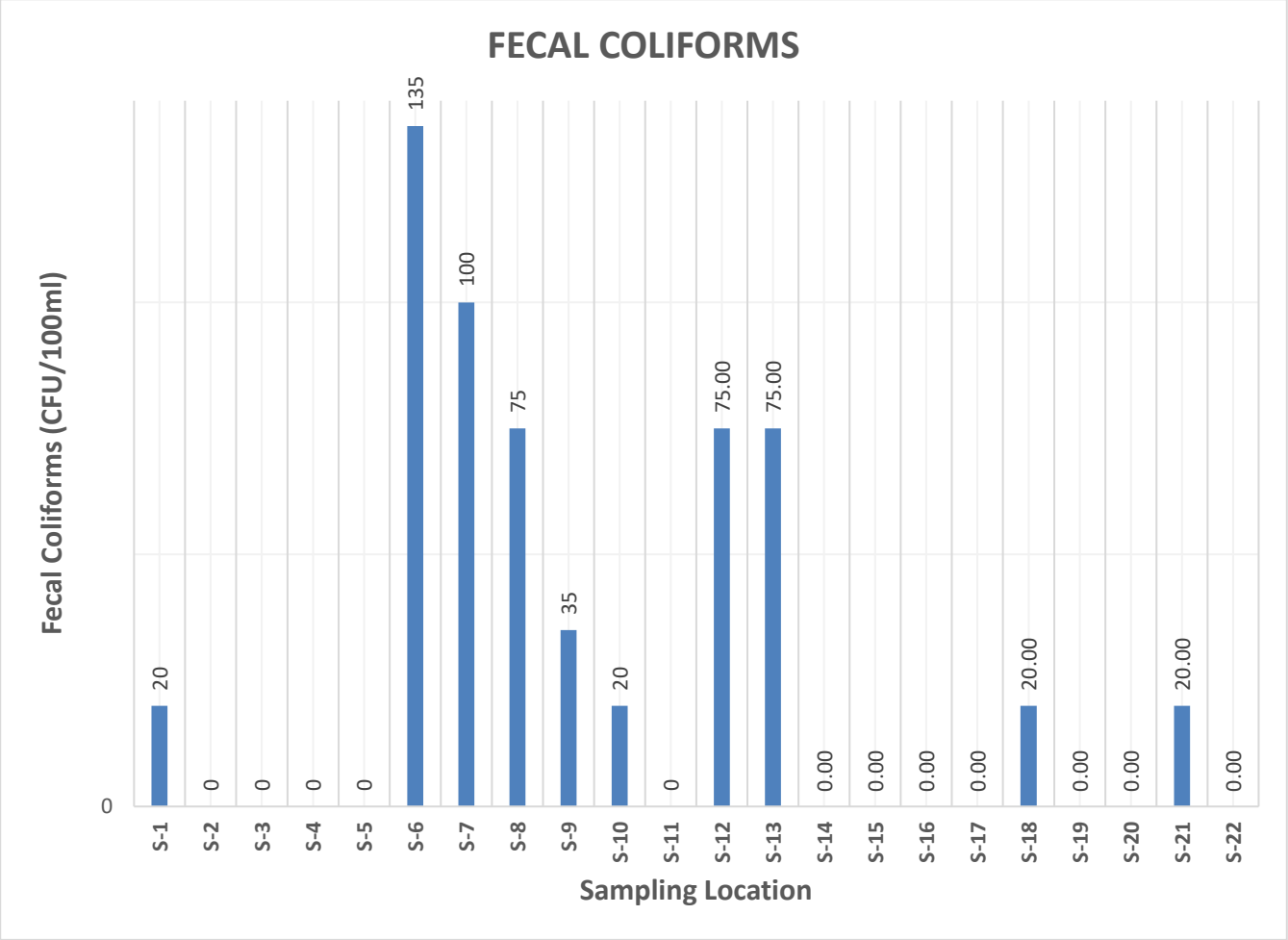
Fecal coliform



Site 7 and site 6 shows increased value may be due to unknown reasons, as obtained for some of the other tests.

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Classification of water for best designated uses

CLASSIFICATION	TYPE OF USE
Class A	Drinking water source without conventional treatment but after disinfection
Class B	**Outdoor bathing**
Class C	Drinking water source with conventional treatment followed by disinfection.
Class D	Fish culture and wild life propagation
Class E	Irrigation industrial cooling or controlled waste disposal

Water Quality Standards in India (Source IS 2296:1992)

Characteristics	Designated best use				
	A	B	C	D	E
Dissolved Oxygen (DO)mg/l, min	6	5	4	4	-
Biochemical Oxygen demand (BOD)mg/l, max	2	3	3	-	-
Total coliform organisms MPN/100ml, max	50	500	5,000	-	-
pH value	6.5-8.5	6.5-8.5	6.0-9.0	6.5-8.5	6.0-8.5
Colour, Hazen units, max.	10	300	300	-	-
Odour	Un-objectionable			-	-
Taste	Tasteless	-	-	-	-
Total dissolved solids, mg/l, max.	500	-	1,500	-	2,100
Total hardness (as $CaCO_3$), mg/l, max.	200	-	-	-	-
Calcium hardness (as $CaCO_3$), mg/l, max.	200	-	-	-	-
Magnesium hardness (as $CaCO_3$), mg/l, max.	200	-	-	-	-
Copper (as Cu), mg/l, max.	1.5	-	1.5	-	-
Iron (as Fe), mg/l, max.	0.3	-	0.5	-	-
Manganese (as Mn), mg/l, max.	0.5	-	-	-	-
Cholorides (as Cu), mg/l, max.	250	-	600	-	600
Sulphates (as SO_4), mg/l, max.	400	-	400	-	1,000
Nitrates (as NO_3), mg/l, max.	20	-	50	-	-
Fluorides (as F), mg/l, max.	1.5	1.5	1.5	-	-
Phenolic compounds (as C_2H_5OH), mg/l, max.	0.002	0.005	0.005	-	-
Mercury (as Hg), mg/l, max.	0.001	-	-	-	-
Cadmium (as Cd), mg/l, max.	0.01	-	0.01	-	-
Salenium (as Se), mg/l, max.	0.01	-	0.05	-	-
Arsenic (as As), mg/l, max.	0.05	0.2	0.2	-	-
Cyanide (as Pb), mg/l, max.	0.05	0.05	0.05	-	-
Lead (as Pb), mg/l, max.	0.1	-	0.1	-	-
Zinc (as Zn), mg/l, max.	15	-	15	-	-
Chromium (as Cr^{6+}), mg/l, max.	0.05	-	0.05	-	-
Anionic detergents (as MBAS), mg/l, max.	0.2	1	1	-	-
Barium (as Ba), mg/l, max.	1	-	-	-	-
Free Ammonia (as N), mg/l, max	-	-	-	1.2	-
Electrical conductivity, micromhos/cm, max	-	-	-	-	2,250
Sodium absorption ratio, max	-	-	-	-	26
Boron, mg/l, max	-	-	-	-	2

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Plate-1 River Basin Map

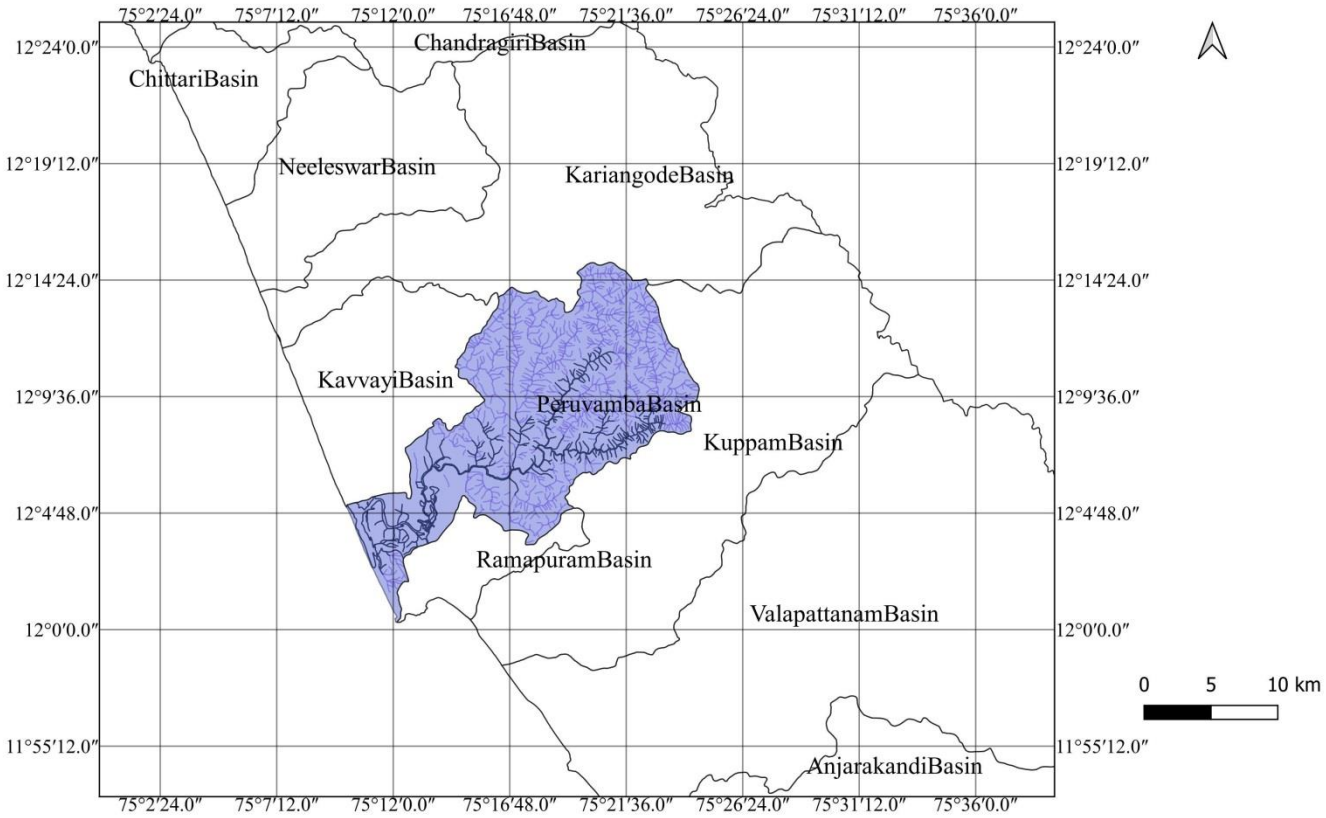

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Plate-2 Watershed Map

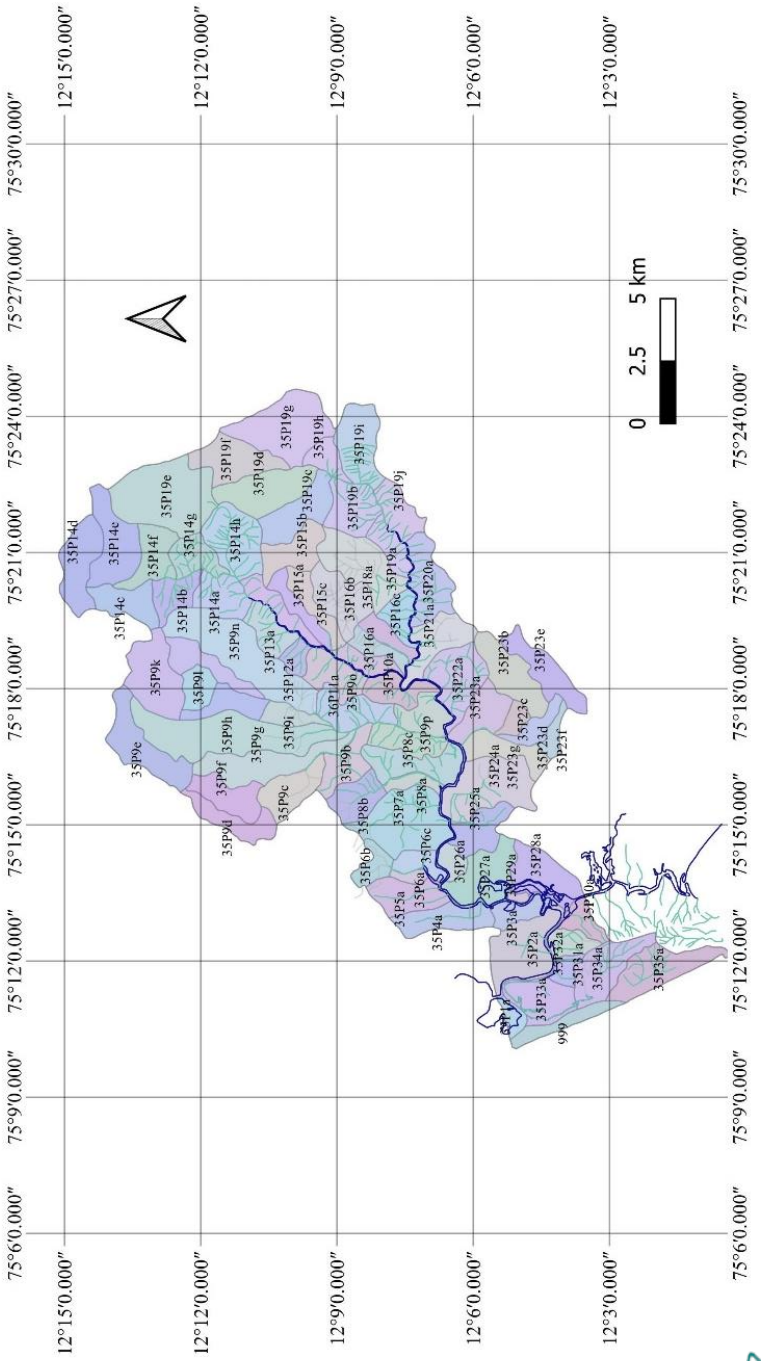

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Plate-3 Land Use Map

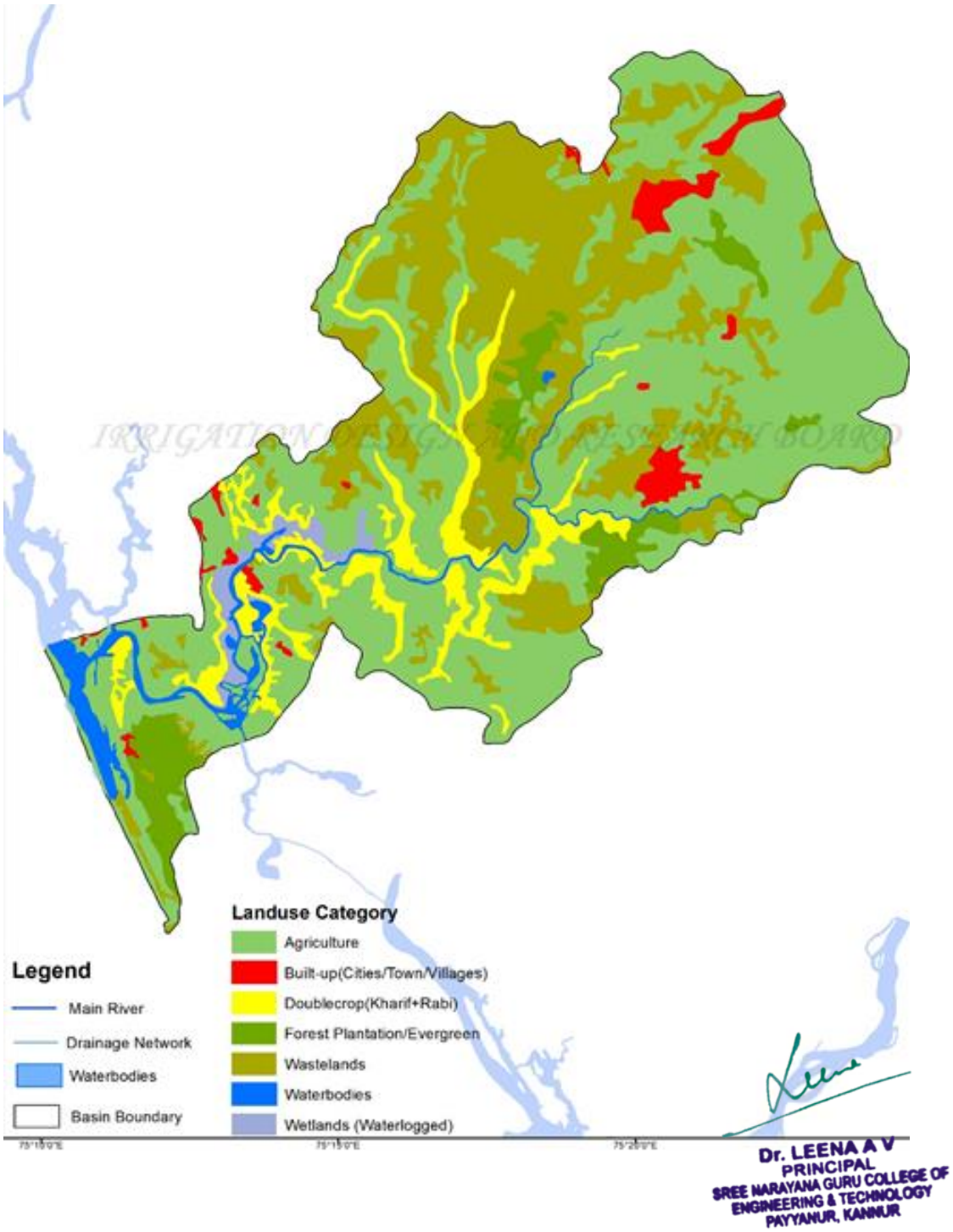

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Plate-4 Location of Rain Gauge and River Gauge Stations

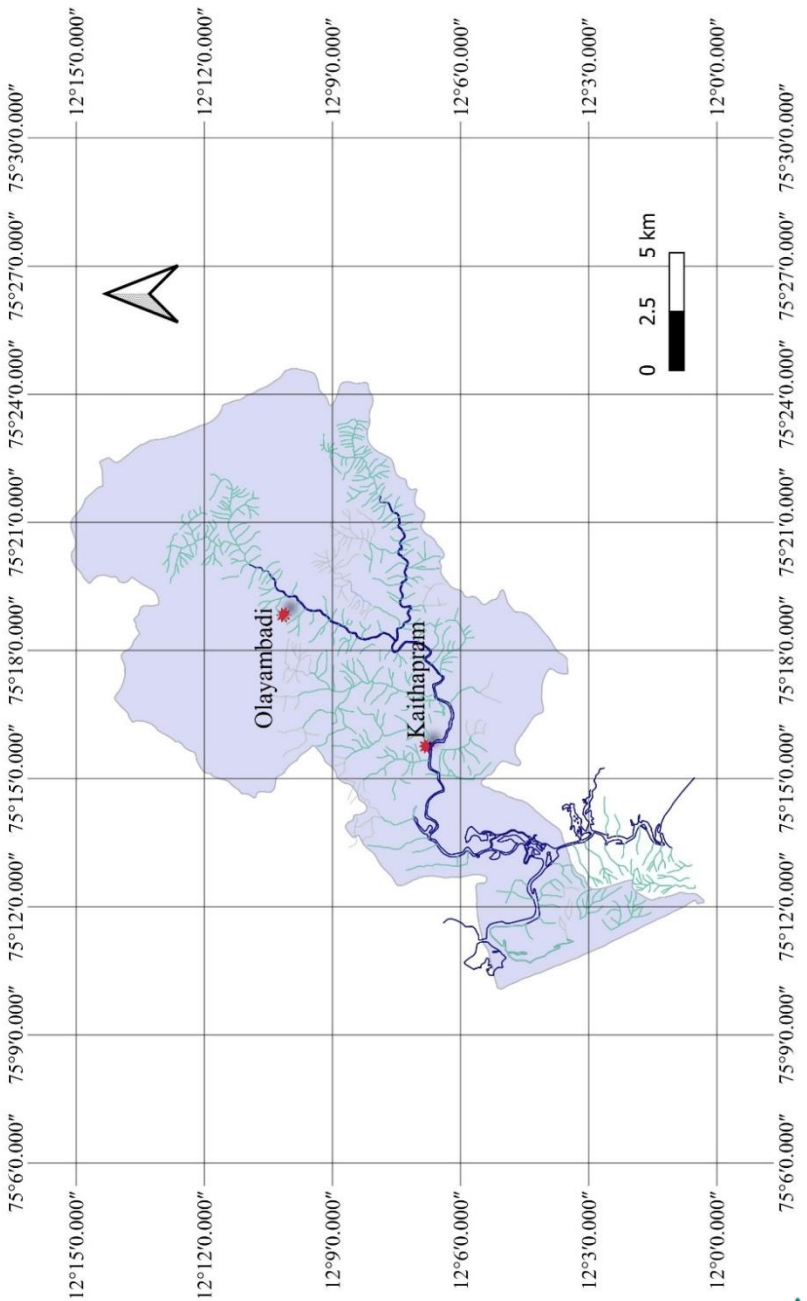

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Plate-5 Map showing Irrigation Assets

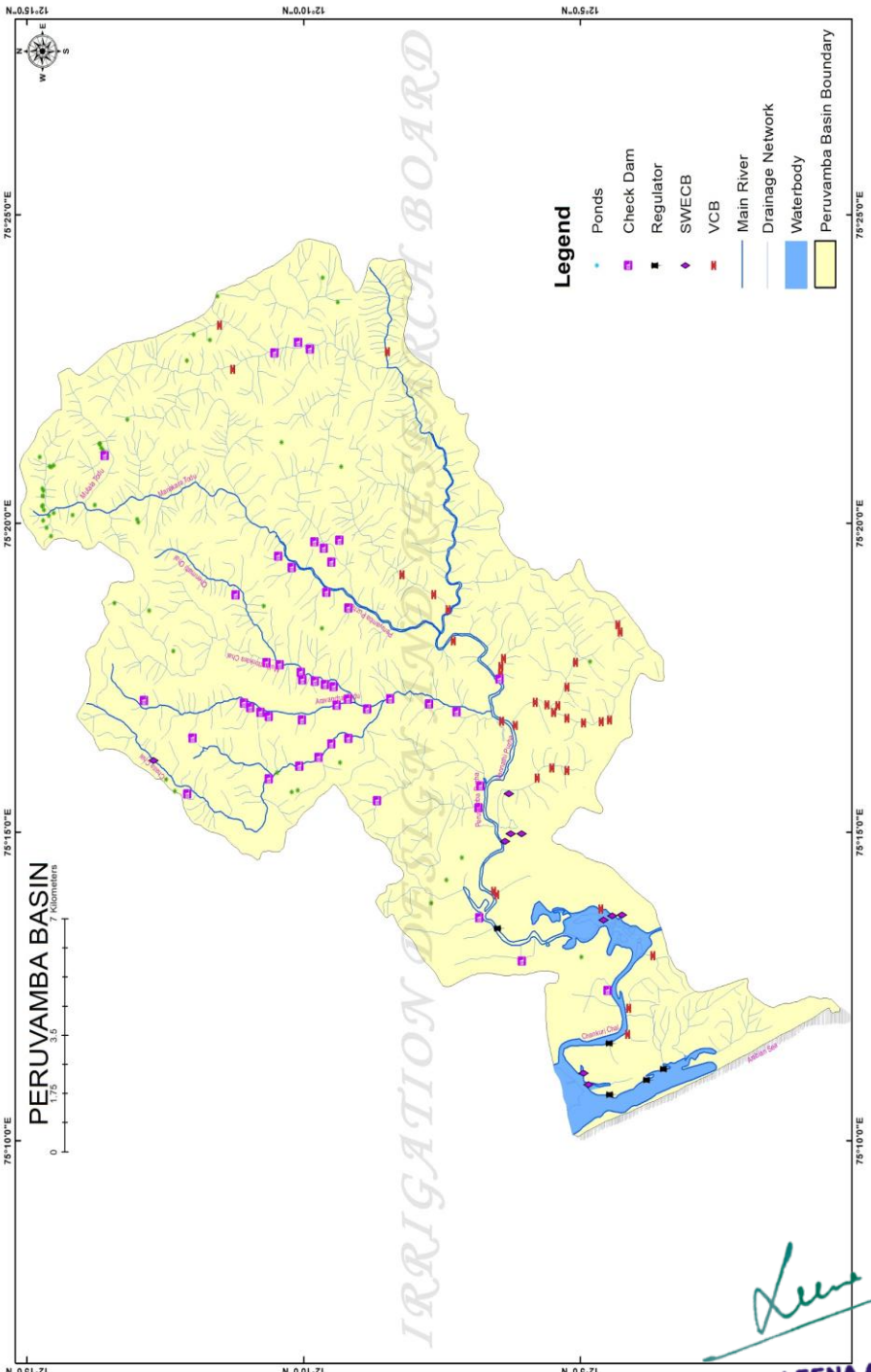

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Plate-6 Map showing Road Networks

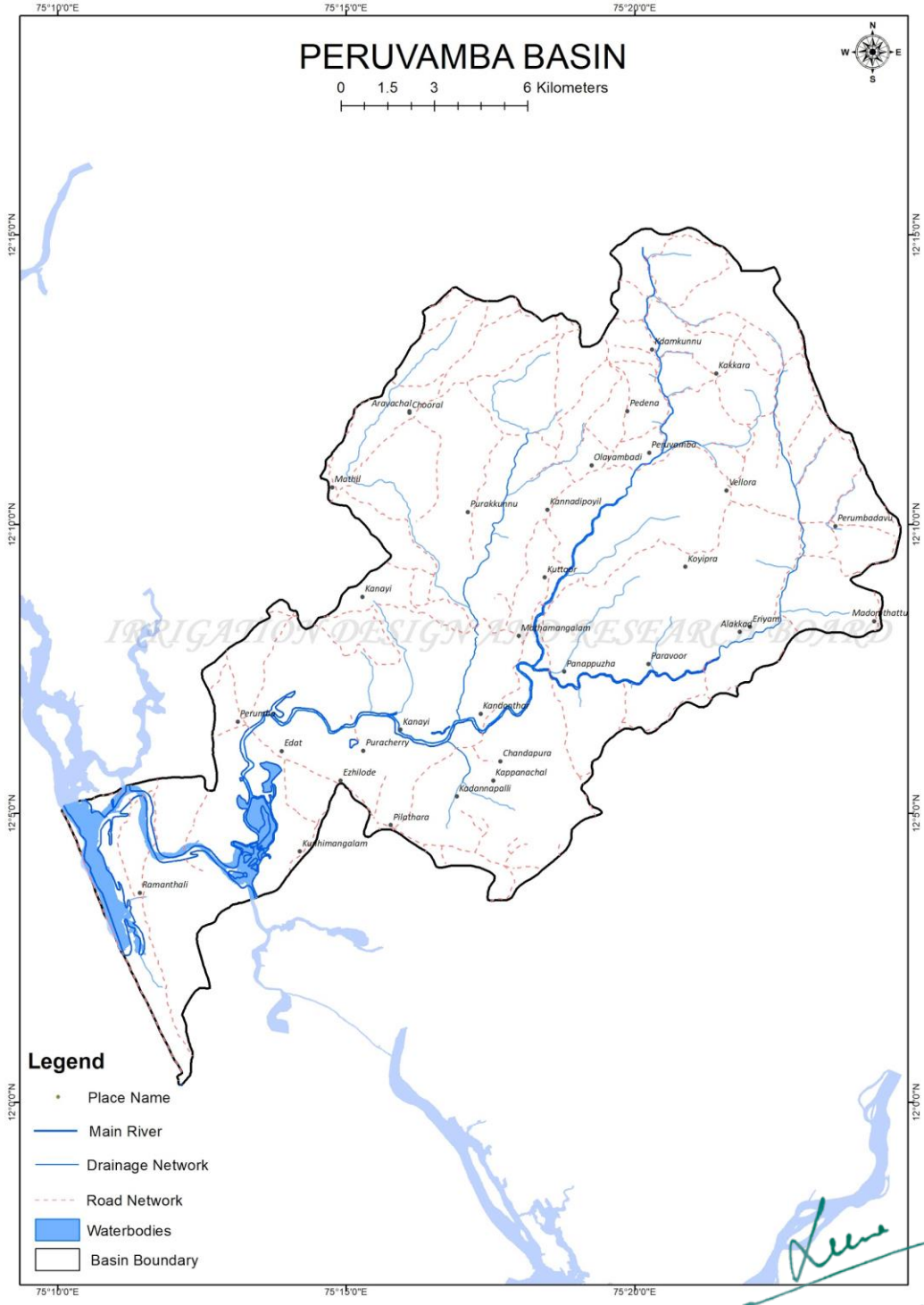

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Plate-7 Map showing Drains joining the River

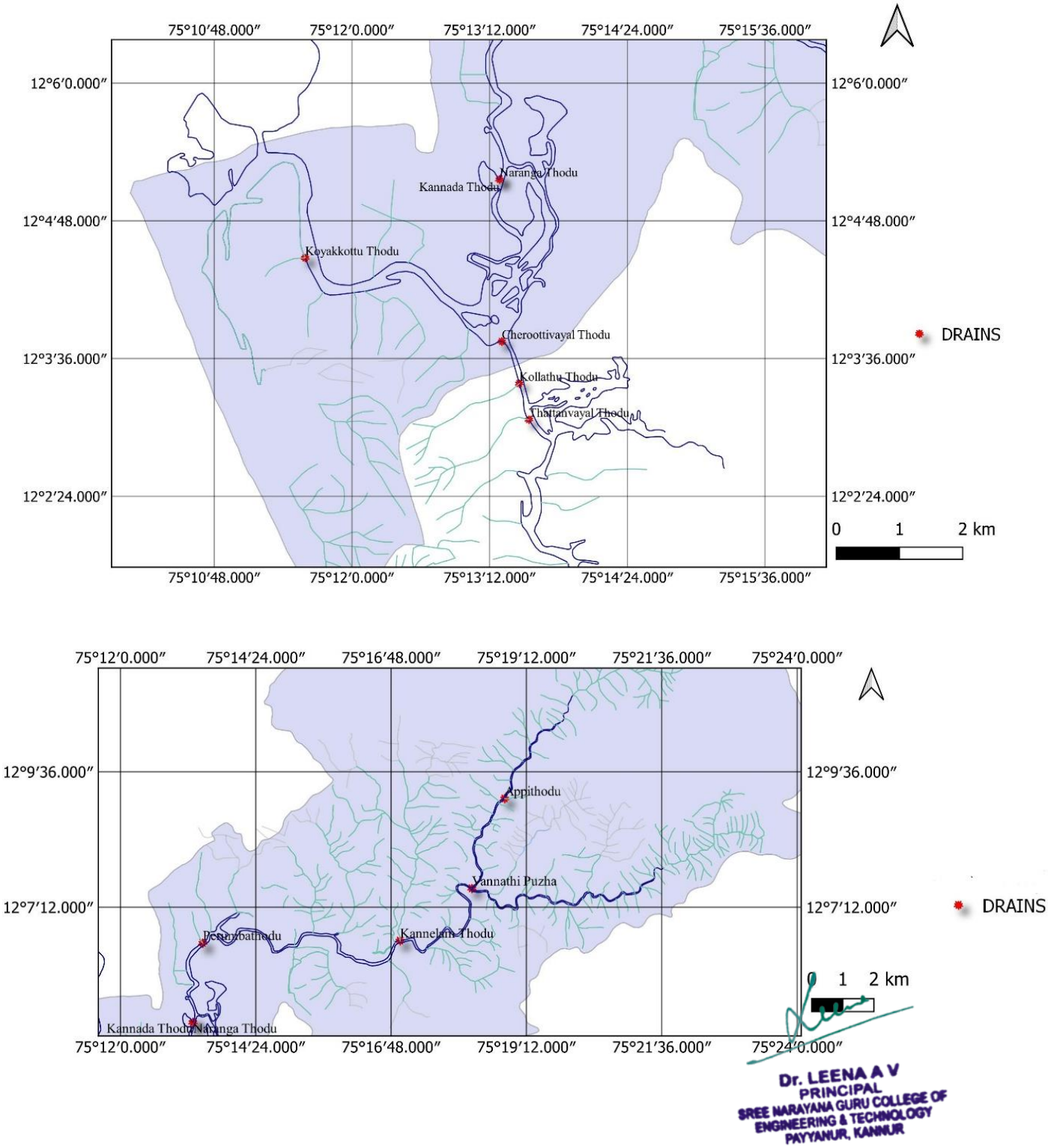

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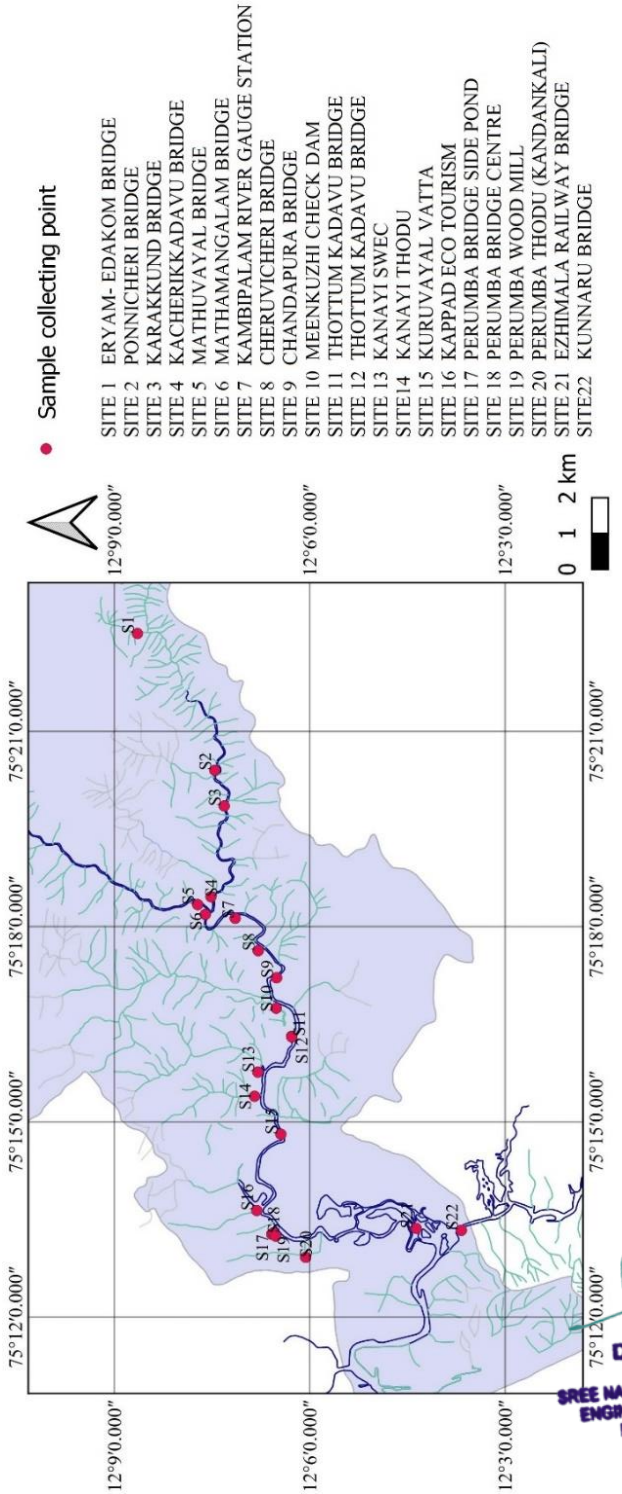
Plate-8 Map showing Water Quality Sampling Stations



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