STUDY OF OUTFALL WASTEWATER PROFILING & ITS OPTIMAL MANAGEMENT
[TREATMENT FOLLOWED BY DISPOSAL]

IN COMPLIANCE TO GOVERNING NORMS [TNPCB] IN THE IDENTIFIED WATER BODIES FALLING WITHIN COONOOR MUNICIPALITY

PREPARED BY

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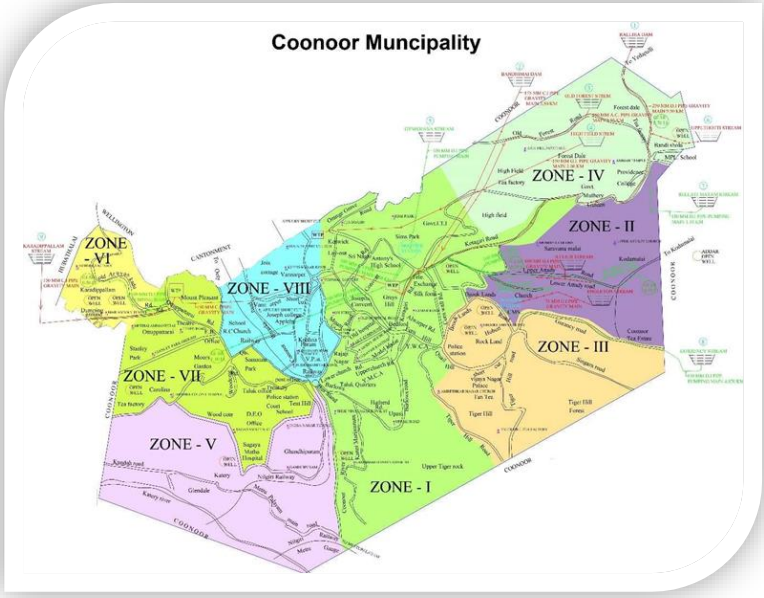
1. PREAMBLE

Coonoor Municipality was constituted in the year 1866 during British Rule which indicates that this is one of the oldest Municipalities in Tamilnadu State. Coonoor is located at 11.35°N 76.82°E.[8] It has an average elevation of 1,850 metres (6,070 feet) above sea level. The town is the second largest in the Nilgiri hills after Ooty, the district headquarters. Coonoor is a Municipality city in district of The Nilgiris, Tamil Nadu.It is located at a distance of 27.6 KM from Udhagamandalam, Head Quarters of Nilgiris District and 28 Km from Mettupalayam. Coonoor is also known as the "Jewel of the Nilgiris". It is famous for its verdant environs and variety of wild flowers and birds.



The Coonoor city is divided into 30 wards and has population of 45,494 of which 22,107 are males while 23,387 are females as per report released by Census India 2011. The town of Coonoor is broadly divided into two geographies - Lower Coonoor and Upper Coonoor.

Lower Coonoor hosts the main Bus Depot, the Railway Station as also the bustling market complex. Upper Coonoor hosts locations like UPASI, Bedford, and Sim's Park.

1.1 Geology

Predominantly, the municipal area is covered by hard rock formations of Gneiss andCharnockites.

1.2 Climate

Coonoor is having a very smooth and enjoyable climatical conditions which attracts tourists from all over the world the climate is hot and dry in many parts of the year and the variation in temperature from day to night is little. Maximum temperature here reaches up to 22.1°C and minimum temperature goes down to 13.1°C.

1.3 Rainfall

The average rain fall for Nilgiris district is 1590.7 mm. (Source: IMD). the bulk of which is collected during the north – west monsoon period (i.e.) from October to December. Thetotal number of rainy days in a year ranges from 75 to 84 days on anaverage. The regionexperiences four main seasons: Cool Months - December to

February; Summer Months -March to May; Windy Months - June to August; and Rainy Months - September toNovember.

1.4 Drainage and water Bodies

Coonoor Municipality situated in the Cauvery river basin and Upper Bhavani sub basin. The Rivers – Coonoor, Shanmugapuram River and the Brookelands River Blue Hills. TheKrishnapuram Stream, MGR Nagar Stream and Model HouseStream are the Major WaterBodies available within the municipal limits. The drainage pattern is the dendritic and sub-dendritic.

1.5 Water Supply

The prime functions of the Municipality as contemplated in Tamilnadu District Municipalities Act 1920 are providing protected Water Supply, Street Light facilities to the Public and ensuring sanitation of the town on an average This Municipality is supplying 90 litres of water per day per head which is adequate at present. The water supply is effected through 9 difference sources in Coonoor Municipality. The sources of water are from the Dams – Ralliah Dam (2.01 Million litres) and Bandhumi Dam (0.29 Million litres) apart from the Emerald Scheme and from the 7 streams namely Bellatimattam, Gurrency, Gymkhana, Old Forest, High field, Attadi and Uppu Thotti

accounting for 1.91 million litres. Apart from the above sources 10 numbers of Open wells in Brook lands are available within the municipality limits accounting for 0.30 million litres. The drinking water demand for Coonoor Municipality is 3.30 mld at the rate of 82 lpcd.

From all the above sources, 4.52 MLD of water is drawn during the rainy season for about 6 months (From October to March) and distributed to the public at the rate of 90 LPCD. During summer and drought seasons, (From April to September) the drawl gets reduced to 3.51 MLD and is distributed to the public at the rate of 70 LPCD. Out of 4.52MLD drawn during raining seasons, 3.15 MLD is from the following sources.

•Raliah Dam.

•Bandumi Dam.

•Gymkhana Stream.

The catchment areas of Raliah Dam and Bandumi Dam is 310 acres and 200 acres respectively. These two dams get filled up with water during north east monsoon and this water is distributed to the public to their full requirements for a period of 6 months. During summer seasons, water level goes down and water drawn from these sources decreases fully and there is scarcity of water prevailing in the town. Water is distributed to the public residing at high level areas once in

five days and in the low-level areas once in two days only. Water is supplied to the public residing at very high-level areas through water lorries, 2 owned by the municipality and by hiring.

1.6 Service reservoirs

5 Numbers of Ground Level Service Reservoirs (GLSRs) with total combined Capacity of16.36 lakh litres is available within the municipality limits at Gray Hills (8.0 Lakh Litres)Vannarpet(4.0 Lakh Litres), Mount Pleasant(4.25 Lakh Litres), Moorse Garden(0.06 LakhLitres) and Uppu Thotti(0.05 Lakh Litres) The length of the Pumping main is 12.10 kmand that of the distribution mains is 63.00 km. Water supply is provided through 282numbers of Public Fountains apart from the 7147 House Service Connections.

1.7 Sewerage systems

There is no underground drainage system in Coonoor. Disposal of Night Soil is normallyby way of individual facilities and liquid waste (Sullage and Kitchen Waste) is through theopen drains. The main mode of individual disposal in the town is through septic tanks, low-Cost Sanitation units and through public conveniences. A phenomenal 38% of thepopulation do not have access to safe

disposal systems. 45 % percent of the population hasresorted to private arrangements, in the form of septic tanks.

Currently, Under Ground Sewerage System (UGSS) and Sewage Treatment Plant (STP)are not implemented in Coonoor municipality. The untreated sewerage is being let out tothe Rivers and streams. Coonoor Municipality has a proposal for establishment of a Decentralized STP is under consideration.

Total area	15.05Sq.Km
Totalpopulationason2011	45494
ProjectedPopulationfor2019	47728
No.of wards	30
Total length of roads	69.255kms
Source o fwater supply	RalliahDam,BandhimaiDam,BellattimattamStream,BrooklandsOpenwell,GurrencyStream,GymkhanaStream,OldForestStream,HighField Emerald Dam(TWADBoard)
Per Capita water supply	82LPCD
No.of openwells	10
Total length of pumping main	10.60km
Total length of distribution line	63.00km
Storm water drains length	28.01km
No.of house service connections	7106
Estimate Water Supplied to Households as per Municipal record	4.52 MLD

Excess extraction from individual households and commercial establishments	1.08 MLD
Presumptive Consumption of Domestic Water	5.6 MLD
Estimate Sewage Generated as studied at various outfalls	4.48 MLD
Extent of compost yard	12.35Acres
Quantity of garbage generation	14.005MT/day

2. OBJECTIVE & NEED OF THE STUDY / ASSESSMENT

Water is a prime source for all the living creatures and its existence in this world. It exists in the form of surface water as rivers, lakes, ponds etc., as well as ground water. Rivers have a special attention in the lives of the Indians. River water is used for irrigation, domestic purpose, industrial and commercial use, which in return gives food to the people, economic growth and basic needs for the people. It is often emphasizing and stressed the need to maintain the ecology of the river and bring prosperity.

Unfortunately, over the years, the river water quality has been deteriorated at a rapid pace. One common problem in the state of Tamil Nadu is that most of the rivers gets polluted by human intervention by way of discharging domestic sewage into the rivers / lakes / ponds and dumping of solid waste in water bodies. In addition, rapid growth of industries has also played a major role in polluting water bodies by the way of disposing the industrial effluents into the water bodies. Growth of industries had also played a major role in polluting water bodies by the way of disposing the industrial effluents into the water bodies. Though enough measures on improved sanitation is being taken by State and Central governments through various schemes. The implementation of such schemes is to be fastened and also importantly such water bodies which are receiving unauthorized outfalls have to be plucked and properly addressed so as to ensure the pristine flow of water from springs and hills to the environment it caters to without being polluted.

In the current context, Coonoor Municipality as is known, is situated in the Cauvery river basin and Upper Bhavani sub basin. Coonoor as stated earlier has got four major water bodies flowing through the town, viz., Coonoor River, Shanmugapuram River, Brookelands Rivers and the Blue Hills River are the major waterbodies flowing through the area.

It may be noted, the joint committee as constituted by the Honable NGT Southern Bench- Chennai; concluded that there is no industrial discharge entering into the water course and the quality of river water falls under the category C & D as per the Bureau of Indian Standards. However, there were multiple sewage outfalls noticed from households.

This is reiterated with additional inputs through an outfall study conducted in February 2021 by this agency, on account of assessing the outfalls, the important aspect revealed are two major things.

1. No Industrial Effluent discharge identified right through the stretch of the water bodies identified under the study [4 numbers of rivers]

2. The outfall wastewater quality at the confluence point of the river, was much better than that of sewage, representing very low BOD and COD levels and in select cases having very high DO levels reported as well.

The study also observed due to the presence of natural springs, the sewage/ domestic effluent gets diluted and sufficient mixing takes place and the river quality is retained. As per NGT order dated 04.A.

108/2020 it was ordered not to discharge any untreated sewage into the bodies.

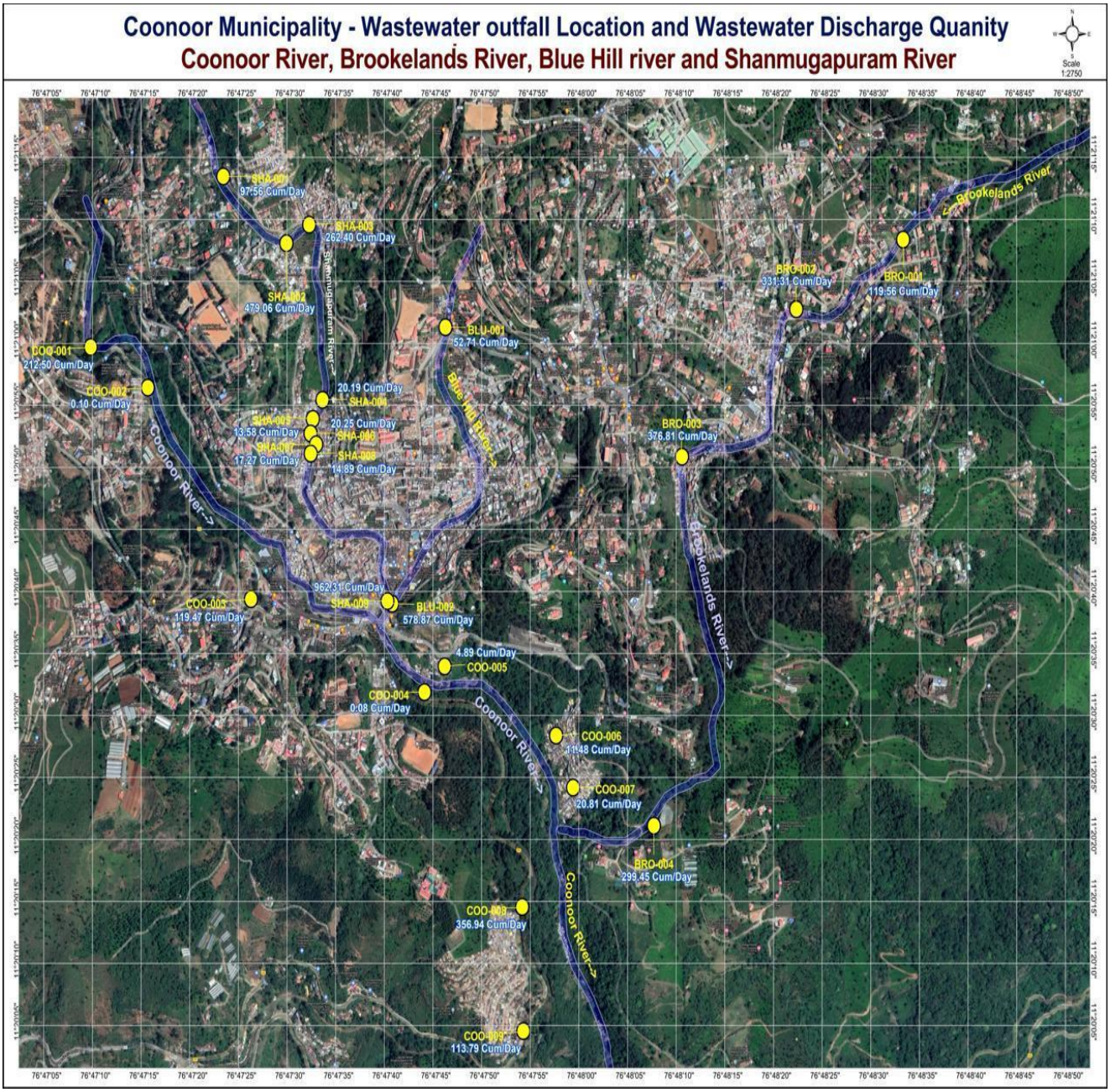
Given the above direction of the Honable NGT, it is imperative to note that objective is to curtail the unauthorised disharges into the water body and ensuring the treatability of such waste waters through appropriate sustainable mechanisms so as to comply with the directions of the NGT and also complying with the governing norms of TNPCB.

In the above lines, the study further assessed the possibilities of various available and prevailing options in practice to first curtail or collect the outfalls prior to being discharged to water bodies and also explored the various decentralised options of treatment available. The key is the scheme should be cost effective and highly sustainable too from the local body's implementation and monitoring and maintenance perspective as well. Under the above terms of reference, the following assessments have been made at all the prospective interceptor [outfall] locations of all the rivers under consideration.

- Location mapping with no of outfalls
- Wastewater Quantities and its Characterization
- Treatment options available
- Evaluation the treatment options
- Stagewise treatment or a decentralized treatment scheme option
- Estimated Area requirement for decentralized and a centralized scheme of management.
- Implementation schedule / span
- Budgetary Economics [Implementation Cost]

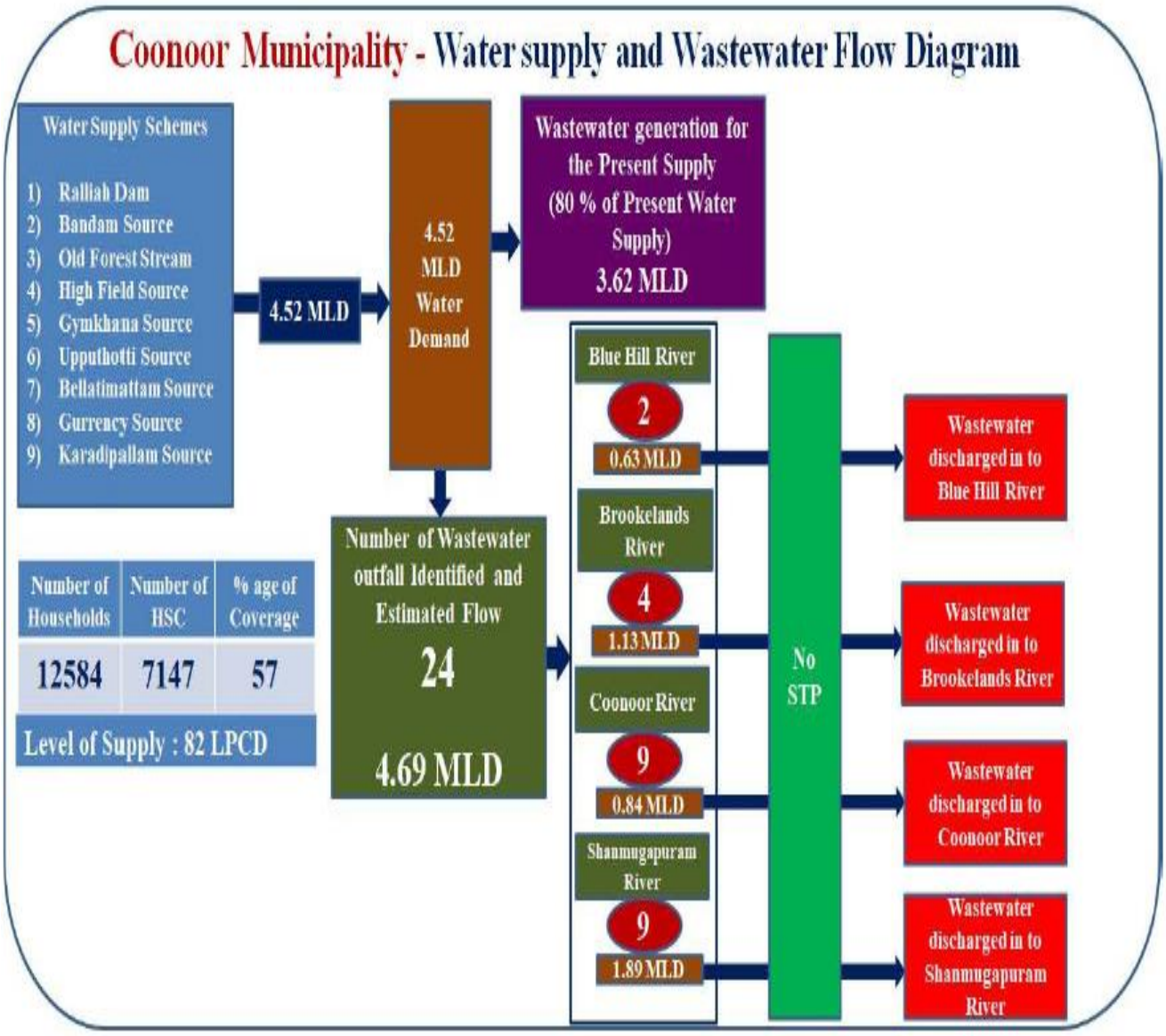
3. LOCATION

Mainly four rivers are flowing through the Coonoor Municipality, namely Coonoor, Blue Hill, Brookelands and Shanmugapuram River. The figure below shows the google earth imagery of the rivers in Coonoor Municipality.



4. SUMMARY OF WASTEWATER OUTFALL STUDY

Wastewater Outfall Study Report for Pollution Abatement in Coonoor River, Blue Hill River, Brookelands River and Shanmugapuram River Stretch within Coonoor Municipality was carried out on Feb 2021. It was identified that untreated sewerageis being let out in the Coonoor River, Brookelands River, Blue Hill River and Shanmugapuram River through 24 outfalls and the total quantity sewage measured in the 24 outfall locations were slightly higher than Municipality water supply (4.52 MLD).



The expected sewage generation is about 3.62 MLD but the calculated sewage quantity from 24 outfall locations is about 4.69.MLD which shows the ground water extraction within the area. During the study Geo-Referenced Scale High Resolution Satellite Imagery on 1:2750 scale for 1 Km Buffer Zone from Rivers falling in Coonoor Municipality in Tamil Nadu was generated.

From the above study it is inferred that the discharge needs to be plugged and diverted to a common collection point in the downstream side for treatment.

Table: Summary of wastewater discharge quantity in Coonoor

Coonoor Municipality

Summary of Wastewater discharge location & estimated discharge quantity into Coonoor River, Tiger Hill River, Brookelands River and Shanmugapuram River

S.No.	Survey Tag No.	Survey Tag No.	Name of River	Location Name	River Bank	Waste water Contributing Wards (Ward Number)	Latitude	Longitude	Peak Quantity in litres/Day	Quantity in Cum / Day	Average Flow Cum / Day	Total Flow Cum / Day	TDS ppm	pH	Do
1	POF 12	BLU-001	Blue Hill river	**River Starting Point** Blue Hill Lodge-Near Road	East		N 11° 21' 1.284"	E 76° 47' 46.265"	39533	39.53	13.18	52.71	100	7.4	13.2
2	POF 10	BLU-002	Blue Hill river	**River Exit Point** Bus Stand Bridge-Near sanitary Complex	East		N 11° 20' 38.988"	E 76° 47' 40.788"	433929	433.93	144.64	578.57	200	7.3	6.6
Blue Hill River									**473462**	**473**	**158**	**631**			
1	POF 22	BRO-001	Brookelands River	**River Starting Point** Brookelands Ward 3 Part-Near Municipal Headworks (Well Field)	East	3 Part	N 11° 21' 8.348"	E 76° 48' 33.305"	89670	89.67	29.89	119.56	100	7.7	15.9
2	POF 21	BRO-002	Brookelands River	**Outfall** Brookelands Ward 3 Part-Near SV Gas Godown	East	3 Part	N 11° 21' 2.73"	E 76° 48' 22.338"	248481	248.48	82.83	331.31	100	7.5	14.5
3	POF 24	BRO-003	Brookelands river	**Outfall** Ambedkar Nagar Ward 4-Near John Bhaskar House	East	4 Part	N 11° 20' 50.842"	E 76° 48' 10.581"	282606	282.61	94.20	376.81	100	7.3	14.8
4	POF 8	BRO-004	Brookelands River	**River Exit Point** Kanninariyamman koil end Ward 3,4,5 Part-Near Bridge	East	3,4,5 Part	N 11° 20' 21.086"	E 76° 48' 7.692"	224587	224.59	74.86	299.45	100	7.8	16.6
Brookelands River									**845345**	**845**	**282**	**1127**			
1	POF 25	COO-001	Coonoor river	**River Starting Point** Muniipal Limit Ooty Road-Near LPG Crematarium	West		N 11° 20' 59.685"	E 76° 47' 9.804"	159375	159.38	53.13	212.50	400	7.3	14.2
2	POF 1	COO-002	Coonoor River	**Outfall** Mount Pleasant Backside Ward no 25Part-Near Petrol Bunk	West	25 Part	N 11° 20' 56.414"	E 76° 47' 15.671"	73169	0.07	0.02	0.10	500	8.3	6.1
3	POF 2	COO-003	Coonoor River	**Outfall** State Bank Line Ward 24 Part-Near Railway Quarters	West	24 Part	N 11° 20' 39.356"	E 76° 47' 26.287"	89601	89.60	29.87	119.47	200	7.8	6.9
4	POF 3	COO-004	Coonoor River	**Outfall** T.Caravan Ward 20 Part-Near Road	West	20 Part	N 11° 20' 31.858"	E 76° 47' 44.117"	63408	0.06	0.02	0.08	400	7.5	9.1
5	POF 9	COO-005	Coonoor River	**Outfall** Siddivinayagar Theru Ward 19 Part-Near River	East	19 Part	N 11° 20' 33.936"	E 76° 47' 46.193"	3664	3.66	1.22	4.89	500	7.6	11.3
6	POF 6	COO-006	Coonoor River	**Outfall** Kanninariyamman Koil Ward 19 Part Near River	East		N 11° 20' 28.356"	E 76° 47' 57.644"	8606	8.61	2.87	11.48	700	7.6	9.4
7	POF 7	COO-007	Coonoor River	**Outfall** Kanninariyamman koil Ward 19 Part-Near River	East	19 Part	N 11° 20' 24.159"	E 76° 47' 59.388"	15608	15.61	5.20	20.81	300	7.8	10.6
8	POF 4	COO-008	Coonoor River	**Outfall** Indira Nagar Ward 29 Part-Near Culvert	West	29 Part	N 11° 20' 14.541"	E 76° 47' 54.153"	267704	267.70	89.23	356.94	500	7.6	3.9
9	POF 5	COO-009	Coonoor River	**Outfall** Gandhipuram Ward 29 Part-Near Culvert	West	29 Part	N 11° 20' 4.528"	E 76° 47' 54.271"	85342	85.34	28.45	113.79	500	7.1	8.7
Coonoor River									**766477**	**630**	**210**	**840**			
1	POF 13	SHA-001	Shanmugapuram River	**River Starting Point** Mount Pleasant Backside Ward no 25Part-Near Bridge	East	25 Part	N 11° 21' 13.441"	E 76° 47' 23.436"	73169	73.17	24.39	97.56	100	7.6	15.9
2	POF 19	SHA-002	Shanmugapuram River	**Outfall** Vinayagar koil Street-Near Throupathiamman Koil	West		N 11° 21' 8.051"	E 76° 47' 29.923"	359295	359.30	119.77	479.06	100	7.7	16.9
3	POF 20	SHA-003	Shanmugapuram River	**Outfall** SM Nagar-Near MSM agency	East		N 11° 21' 9.552"	E 76° 47' 32.272"	196802	196.80	65.60	262.40	200	6.7	9.8
4	POF 14	SHA-004	Shanmugapuram River	**Outfall** Naujegounder Line Ward 14 Part-Near Black Mariyamman temple	West	14 Part	N 11° 20' 55.424"	E 76° 47' 33.627"	15144	15.14	5.05	20.19	500	7.6	11.4
5	POF 15	SHA-005	Shanmugapuram River	**Outfall** Unnari Cottage Ward 14 Part-Near Valli House	West	14 Part	N 11° 20' 53.891"	E 76° 47' 32.648"	10182	10.18	3.39	13.58	900	7.2	7.3
6	POF 16	SHA-006	Shanmugapuram River	**Outfall** Parasuram Street Ward 14 Part-Near Ramasamy House	East	14 Part	N 11° 20' 52.717"	E 76° 47' 32.409"	15188	15.19	5.06	20.25	600	7.4	10.5
7	POF 17	SHA-007	Shanmugapuram River	**Outfall** Parasuram Street Ward 14 Part-Near Lurdhumary House	East	14 Part	N 11° 20' 51.841"	E 76° 47' 32.977"	12950	12.95	4.32	17.27	700	7.2	10.8
8	POF 18	SHA-008	Shanmugapuram River	**Outfall** Krishnapuram Ward 14 Part-Near Pettikadai	West	14 Part	N 11° 20' 51.096"	E 76° 47' 32.42"	11165	11.16	3.72	14.89	900	7.4	8.4
9	POF 11	SHA-009	Shanmugapuram River	**River Exit Point** Market Bridge-Near sanitary Complex	East		N 11° 20' 39.194"	E 76° 47' 40.309"	721730	721.73	240.58	962.31	100	7.2	12.3
Shanmugapuram River									**1415625**	**1416**	**472**	**1888**			
Total wastewater discharge quantity									**3500910**	**3364**	**1121**	**4486**			
Total sewage discharge quantity												**4.49**	**MLD**		

5. Sewage generation

Table: The quantity of sewage generated in Coonoor Municipality

River	No of Outfalls	Quantity of Sewage flow MLD
Coonoor River	9	0.84
Blue Hill	2	0.63
Shanmugapuram River	9	1.89
Brookeland River	9	1.12
Total	20	4.48

As per the data available from the outfall study conducted during the month of Feb 2021, the total sewage generated in Shanmugapuram river is 1.89 MLD. On Scrutiny of the data it was found that there was a build up considered for prospective increase in quantity of the sewage let in to the Shanmugapuram River.

In the above four water bodies, apparently the samples collected at brookeland river showed a very high DO levels, which apparently results in excessive dilution occurring prior to being discharged into the water body from households. Therefore in the current context, it is not considered for the treatability requirements, which is practically not required either in respect to satisfying the governing norms as well. However as a matter of fact, the outfalls have to be plucked at sources or through interceptors, which could be taken up by the Municipality later after addressing the primary concern of the other three river outfalls and its treatment.

With the consideration of factual scenario as represented at site on the outfall locations the realistic quantity is tabulated:

River	No of Outfalls	Modified Untreated sewage flow (MLD)
Coonoor River	9	0.84
Blue Hill	2	0.60
Shanmugapuram River	9	0.96
Total	20	2.40

From the statement the cumulative quantity warranting treatment is estimated to be 2.40 MLD; wherein a prospective treatment design is made for a quantity for 3.00 MLD considering diversities.

6. Raw Sewage Characteristics

From the field sample analysis, it seems quite reasonable to say that the sewage characteristics are of weak in nature. The reason behind low strength of sewage can be attributed to the fact that hence these sewage characteristics represents are remarkably close with the characteristics of grey water.

The waste water characteristics as analysed are tabulated below

S.NO	Parameters	Units / Values
1	pH	6.5-7.5
2	TSS	50 -80mg/L
3	BOD	80 – 100 mg/L
4	COD:	150 – 200mg/L

7. End Disposal and Discharge Standards

The treated wastewater from the any treatment methodology to be adopted shall have to comply with the TNPCB norms and eventually either comply to inland surface water standards in case of water discharge into the rivers or inland irrigation in case of being used for green belt development.

Table : The discharge standards for treated wastewater

S.NO	PARAMETER	UNIT	TREATED EFFLUENT QUALITY (Inland surface water)
1.	pH	-	6.5 – 8.5
2.	BOD5	mg/l	<20
3.	COD	mg/l	<50
4.	TSS	mg/l	<30
5.	Oil & Grease	mg/l	<5
6.	Fecal Coliform	MPN / 100 ml	<100

8. Proposed Treatment Options

The proposed treatment options considered for treatment of sewage ensuring treated effluent quality as per the Prescribed Discharge Norms. However, in order to arrive at techno-economic and environmentally sustainable treatment system, it is necessary to assess various factors which are based on Economical & Technical Criteria and Ease of operation. Following factors have been considered for ranking and recommendation of most suitable techno-economic and environmentally sustainable treatment system:

1) Capital cost
2) Recurring Costs
2) Land area requirement
3) Ease of operation & maintenance
4) Manpower requirement; Skilled / Unskilled
5) Automation requirement
6) Quantity of Sludge generation
7) Aesthetics

Depending upon the size or the volume of wastewater, the technique to be employed for treatment varies. These techniques can be classified as chemical, physical and biological depending upon the method of implementation and the principle of operation and also the nature of the effluent.

Physical Wastewater Treatment Processes

Screens and strainer remove solid contaminants from wastewater. These mechanical processes separate solid pollutants such as diapers, hair, and wet wipes from the wastewater stream. Coarse strainer (> 20 mm) to micro (<0.05 mm) separate solid substances as large to small and tiny sludge particles from the wastewater stream. Filtration separates solid substances from fluids and it removes organic and inorganic suspended solids, sands and dusts from wastewater.

Filtration is a process that removes particles and other media of a certain size and larger from liquids. Removing these particles and debris from a wastewater system allows the water to be reused within that system. Reusing the filtered water allows to reduce their overall waste, lower their water use, and diminish possible chemical consumption. The filters used for wastewater filtration vary from system to system. This is necessary for a number of reasons. First, the condition of the water coming into the system can affect the type of filtration system required. Second, the required purity of the water to be reused after being filtered plays a role in the filter type needed. There are two primary types of filtrations in wastewater treatment systems: particle filtration and membrane filtration.

Particle filtration is a system that separates solids from liquids using either physical or mechanical means. When it comes to wastewater treatment, particle filtration is one of the first steps in the treatment of contaminated wastewater. This is because it is designed to remove solids measuring larger than one micron. Membrane filtration is used when particle filtration alone is not

sufficient for water reuse. The treatment and steps required to process the water can change greatly depending on what the end goal for the water is. When the highest water quality is required, it is common to see membrane filtration systems being used. Recent improvements to membrane filtration processes have worked to increase successful operation, while also lowering the cost of the filtration system. Three common types of membrane filtration are reverse osmosis, ultrafiltration, and microfiltration.

Biological Treatment Systems

Biological treatments rely on bacteria, nematodes, or other small organisms to break down organic wastes using normal cellular processes. Wastewater contains a buffet of organic matter, such as garbage, wastes, and partially digested foods. It also may contain pathogenic organisms, heavy metals, and toxins. The goal of biological wastewater treatment is to create a system in which the results of decomposition are easily collected for proper disposal. Biological wastewater treatment often is used as a secondary treatment process to remove material remaining after primary treatment where sediments and substances such as oil are removed from the wastewater. Different biological wastewater systems available are Activated sludge process (ASP), Moving Bed Biofilm Process (MBBR), Sequential batch reactor (SBR), Natural biological systems (NBS) , etc.

Activated Sludge Process (ASP) utilizes two tanks, an Aeration tank where air (or oxygen) is injected in the mixed liquor and a Settling tank to allow the biological flocs to settle, thus separating the biological sludge from the clear treated water. Sequencing batch

reactors (SBR) use a separate pre-treatment section to mechanically hold back solids and a biological aeration and settling tank. It is a type of activated sludge process for the treatment of wastewater taking place in 4 steps, fill, hold, settle and decant. Moving Bed Biofilm Process (MBBR) is a biological treatment process based on a combination of conventional activated sludge process and biofilm media. The process utilizes floating media within the aeration. The microorganisms consume organic material. The media provides increased surface area for the biological microorganisms to attach and grow and the wastewater is allowed to settle in a clarifying tank.

Combination of Treatment Systems

There are different combination systems adopted in wastewater treatment depending on the type of wastewater:

- Physical and chemical process
- Physical and Biological process

Wastewaters containing water insoluble substances or colloids are effectively treated through processes such as sedimentation, filtration and centrifugal separation. Flotation, where substance particles stick to fine air bubbles due to adhesive forces is another process that, depending on the wastewater's composition. Reliable, mechanical preliminary cleaning is particularly important for the treatment of municipal wastewaters in order to prevent damage in the subsequent treatment stages. Chemical wastewater treatment forces contaminants that are dissolved in wastewater to separate more easily through the targeted addition of specific substances. During precipitation, a previously dissolved substance is turned into

a dissoluble substance that can be filtered from the liquid. Other methods of pollutant removal are ion exchange, flocculation, UV and ozone treatments. Biological treatments are adopted when the biodegradable pollutants are relatively high in wastewater. The small microorganisms break down organic wastes using normal cellular processes.

Chemical Wastewater Treatment Processes

Chemicals are used during wastewater treatment in an array of processes of reducing BOD, COD and TSS to expedite disinfection. These chemical processes, which induce chemical reactions, are called chemical unit processes. Specialized chemicals such as chlorine, hydrogen peroxide, sodium chlorite, and sodium hypochlorite (bleach) act as agents that disinfect, sanitize, and assist in the purification of wastewater at treatment facilities. There are several distinct chemical unit processes, including chemical coagulation, chemical precipitation, chemical oxidation, and advanced oxidation, ion exchange, and chemical neutralization and stabilization, which can be applied to wastewater during cleaning.

Phytoremediation

Phytoremediation is an emerging technology helping to clean the soil and water bodies from noxious pollutants. Phytoremediation can provide a low-cost and sustainable way to improve the economies of developing countries. Phytoremediation can be applied at any site in any geographical area, where plants can grow. Furthermore, this treatment system is considered to be effective in the removal of

nutrients. Moreover, the fact that minimal manual intervention alone needed and lesser energy requirements, comparing to other treatment systems make it more attractive. Importantly though capital intensive and requires lot of ground space compared to other treatment technologies, the higher adaptability and compatibility to treat sewage even at high altitudes without much of skilled involvement in operation and maintenance is making the inclination towards this technology more attractive.

The detailed survey in the river and the streams has been carried out in the Coonoor Municipality to identify the sewage outfall locations and to measure its flow, onsite DO, pH and TDS. Subsequently, from 1st July,2021 to 3rd July, 2021, a detailed survey on the terrain of the water bodies, its geomorphological conditions, availability of lands nearby/ within the streams, etc were assessed. Based on the field study, the following three options have been envisaged for river pollution abatement.

1. Phytoremediation
2. Moving Bed Biofilm Reactor (MBBR)Technology
3. Chemical precipitation, filtration followed by Ozonation.

Phytoremediation

Phytoremediation is wastewater treatment system that mimics and improves the effectiveness of the processes that help to purify water. Phytoremediation technique is a branch of bioremediation that employs the application of plants for the remediation of wastewater. Aquatic plants have the capacity to absorb excess contaminants such as organic and inorganic, heavy metals, and

pharmaceutical pollutants present in agricultural, domestic and industrial wastewater. Among the aquatic plants, Salvinia molesta and Pistia stratiotes have been widely used for the treatment of agricultural, domestic and industrial wastewater. The wide application of these plants is due to their availability, resilience in a toxic environment, bioaccumulation potentials, invasive mechanism and biomass potentials.The treatment consist of a collection tank where the wastewater is collected and then transported to the designed wetland where natural treatment takes place by the plants and aggregates. The effluent is collected and is disinfected and can be reused or disposed.

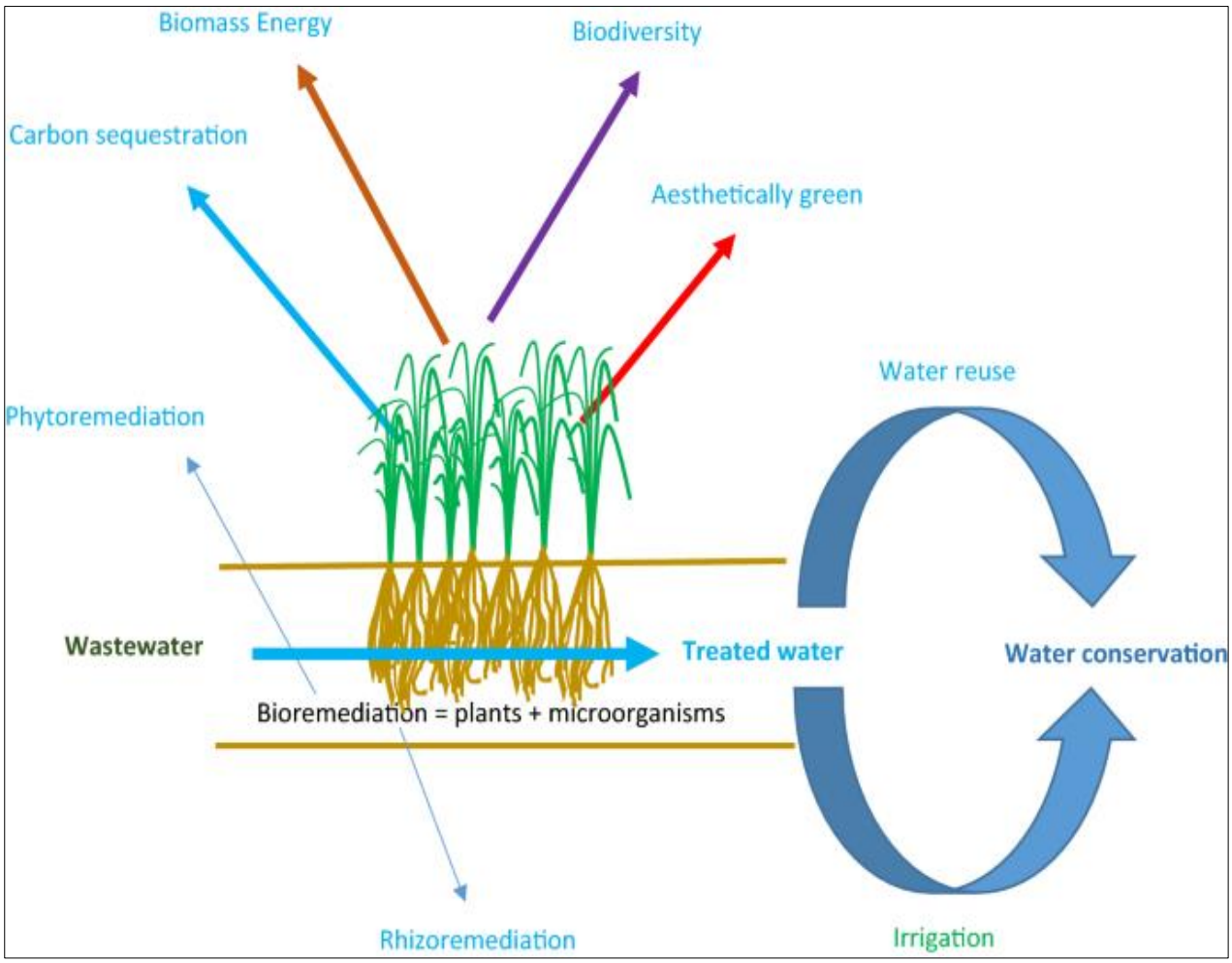


Figure: Components of Phytoremediation

There are many patented technologies on phytoremediation which are described below:

Camus SBT CAMUS-SBT (Continuous Advanced Multistage System – Soil Biotechnology)

Soil Bio-technology or (SBT) process of wastewater treatment and its recycling and reuse has been developed by Indian Institute of Technology Bombay (IITB) indigenously after two decades of research. It is a green engineering approach and is considered as notable technology contribution from IITB to waste management. This technology has been awarded US and Indian patents. SBT is based on a bio-conversion process, maintenance free, claims nonproduction of bio-sludge & foul odour, consumes least energy, claims to give effluent compliant to River water disposal standards and has green aesthetics. Its operation is simple, economical & energy efficient. It claims to have served industries, housing societies, resorts, schools / universities / ashrams, hotels, municipal corporations & airports etc.

The Working principles of SBT/CAMUS-SBT Process:

- Soil Bio-technology is a terrestrial eco-system for wastewater treatment based on the principle of trickling filter. In this system, combination of physical processes like sedimentation, infiltration and bio-chemical processes are carried out to remove the suspended solids, organic and inorganic contents of the wastewater.
- The technology is based on a bio-conversion process where fundamental reactions of nature, namely respiration of micro and macro-organisms, photosynthesis by plants, and mineral weathering take place in a media housing micro & macro organisms which bring about the desired purification.

- SBT is an oxygen supplying biological engine and so the process can treat all types of water - domestic, municipal & industrial. SBT is suitable for treating water with salinity <10,000 mg/L. In conventional STP technologies, the solubility of oxygen in water is low and hence oxygen for biological digestion is to be supplied through mechanical aeration.
- The process requires mesophilic temperatures (20-45o); however, the process can work at high ambient temperatures.
- An advanced version of SBT called "CAMUS-SBT" (Continuous Aerobic Multi-Stage-SBT) has been developed which is capable of even higher levels of purification.
- CAMUS-SBT resolves this problem using a bio-chemical method of oxygenation, which not only uses the atmospheric oxygen, but also uses the nitrogen from the atmosphere in a specially engineered ecology to achieve the desired level of purity.
- In addition, conventional technologies generate large amount of sludge for which additional disposal facilities have to be created. CAMUS-SBT does not face any such problems due to the ecology.

Process Features:

- Very low energy use intensity due to high Natural oxygen transfer in process (0.06 kWh/kL of sewage).
- Very low space intensity of 0.8-1.0 sqm / kLD sewage.
- An engineered evergreen natural process with no moving parts except for pumps.
- No sludge due to ecology at work.
- Very high bacteria, BOD, COD, suspended solids, colour, odour, ammonia removal.
- Practically maintenance free

Table: Specifications of the Bioreactor media (Pattanaik et al., 2003b)

Item	Details
Under drain	Gravel- dp - 25 mm, White Sand dp - 2 mm,
Media	Specific gravity- 2.62 BET specifica surface area-23 m2/g Cation Exchange capacity- 1.5 g/kg
Soil	Sand: 67% Silt- 23%, Clay- 10% Specific gravity- 2.66 BET area- 33.6 rn2/g Cation Exchange capacity- 1.5 g/kg
Earthworm	Phertima elongate

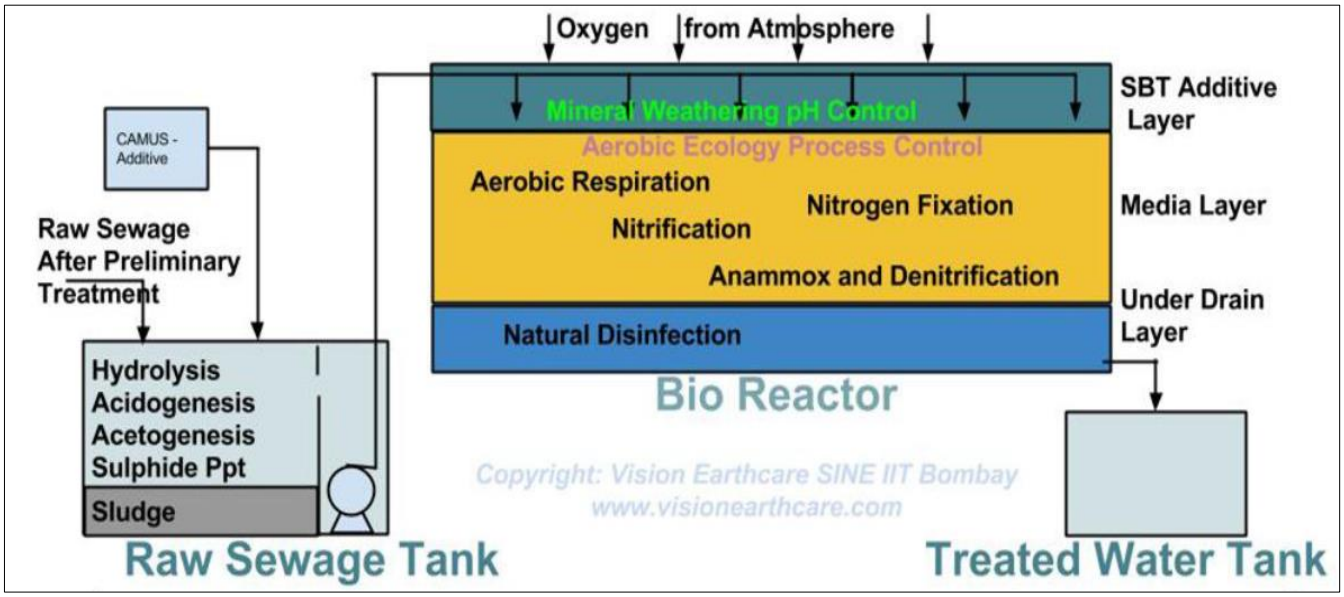


Figure: Schematic representation of Camus SBT

Advantages of CAMUS-SBT Technology

- Colorful, Green Ambiance as a by-product
- Low O&M cost; Low energy consumption; Low mechanization, hence zero down time
- No disposables or process residues (bio-sludge)
- No air or sound pollution. Free from foul odour
- No use of synthetic chemicals. Uses natural ingredients
- Ideal for getting high Green Rating, Carbon Credits
- Water recovery - 90% (Minimum)
- Unskilled people can Operate.
- Long life; one time installation of Media
- The land requirement for STPs constructed using SBT process is comparable to that.
- required for other modern processes like MBBR / SBR, but more than that required for MBR process.

Disadvantages of CAMUS-SBT process

- The Technology is patented and the Operation & Maintenance of this type of treatment plant is very difficult unless the technology providers take up the operation and maintenance.
- Additives are required for effective treatment of sewage. The additives are patented and have purchased from the technology providers only. Hence it is very difficult to assess the actual O&M for the stake holder.
- The plant capacities so far constructed / in operation are small i.e max of 3.0 MLD only.

AAYALA Natural Biological System (NBS)

AAYALA- Natural Biological System (NBS) is a sustainable solution for purification of water, soil, and air. It makes use of a range of natural elements such as plants with remediation abilities, sediments with different physical and chemical properties and various hydrology regimes. Together it degrade,accumulate, extract, and volatilizecontaminants of all kinds in water, soil and the air acting as apowerful physical,chemical, and biological filter.

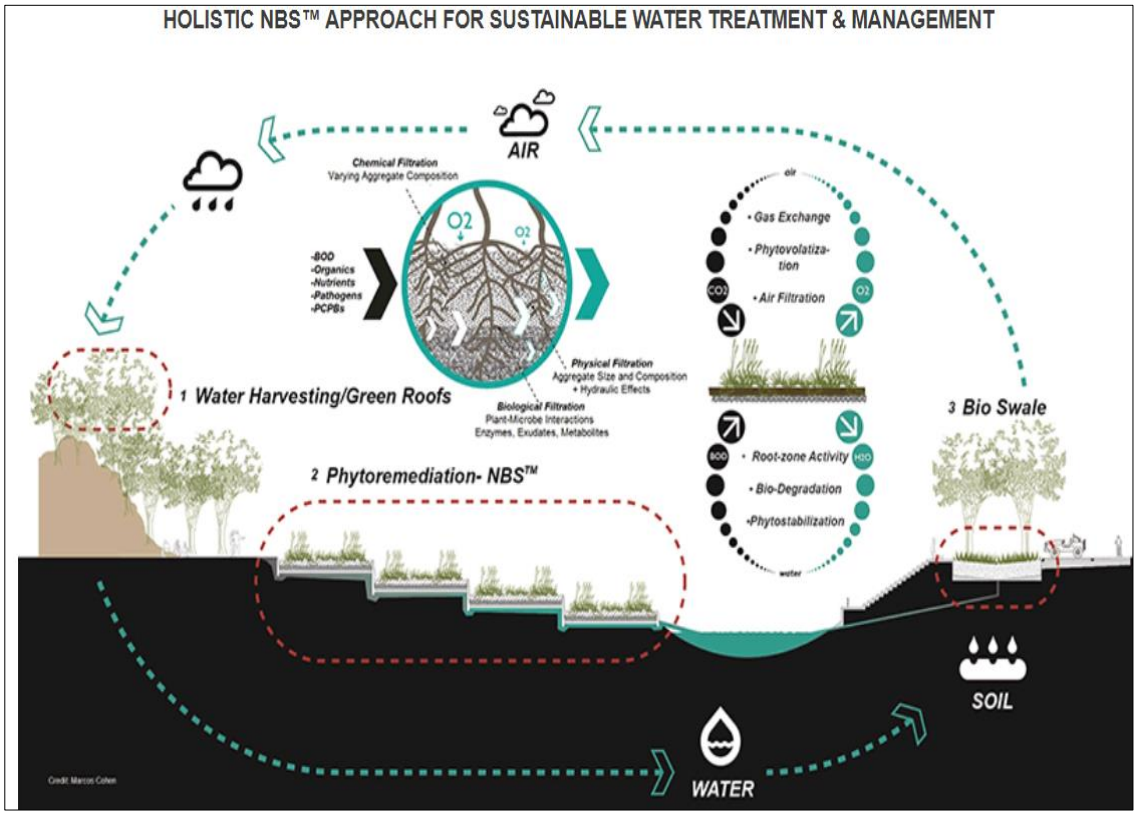


Figure Representation of AAYALA Natural Biological Sysytem

Advantages of Phytoremediation

- Ease of operation and maintenance—it can be applied over a large-scale field and can easily be disposed

- it prevents erosion and metal leaching through stabilizing heavy metals, reducing the risk of spreading of contaminants,
- it can also improve soil fertility by releasing various organic matters to the soil.
- It adds a touch of aesthetics to the environment.
- Does not require highly skilled personnel.
- Removes Nutrients

Moving Bed Biofilm Reactor (MBBR)Technology

In treatment option III, sewage after preliminary treatment is fed to Moving Bed Biofilm Reactor (MBBR) reactor. Wastewater Treatment using Moving Bed Biofilm Reactor (MBBR), a hybrid technology is gaining attention due to its high degree of treatment with the added advantage of low footprint and less operation and maintenance costs. MBBR reactor comprises a column or tower packed with support media for biofilm growth and diffused aerator to supply oxygen. As with traditional sewage treatment, MBBR uses two stages of treatment viz. reactor where BOD is oxidized by attached bacteria and secondary clarification for removing bio sludge if any. It can sustain changes in organic loading due to low F/M ratio and long solid retention time (SRT). MBBR performs smoothly under reasonable variation in influent concentration.

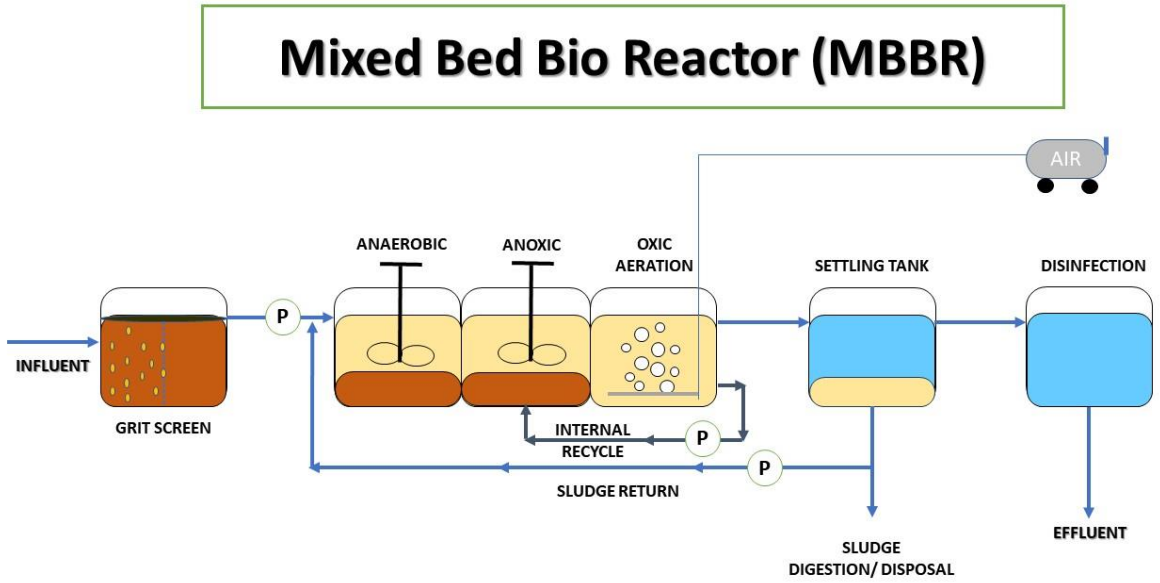
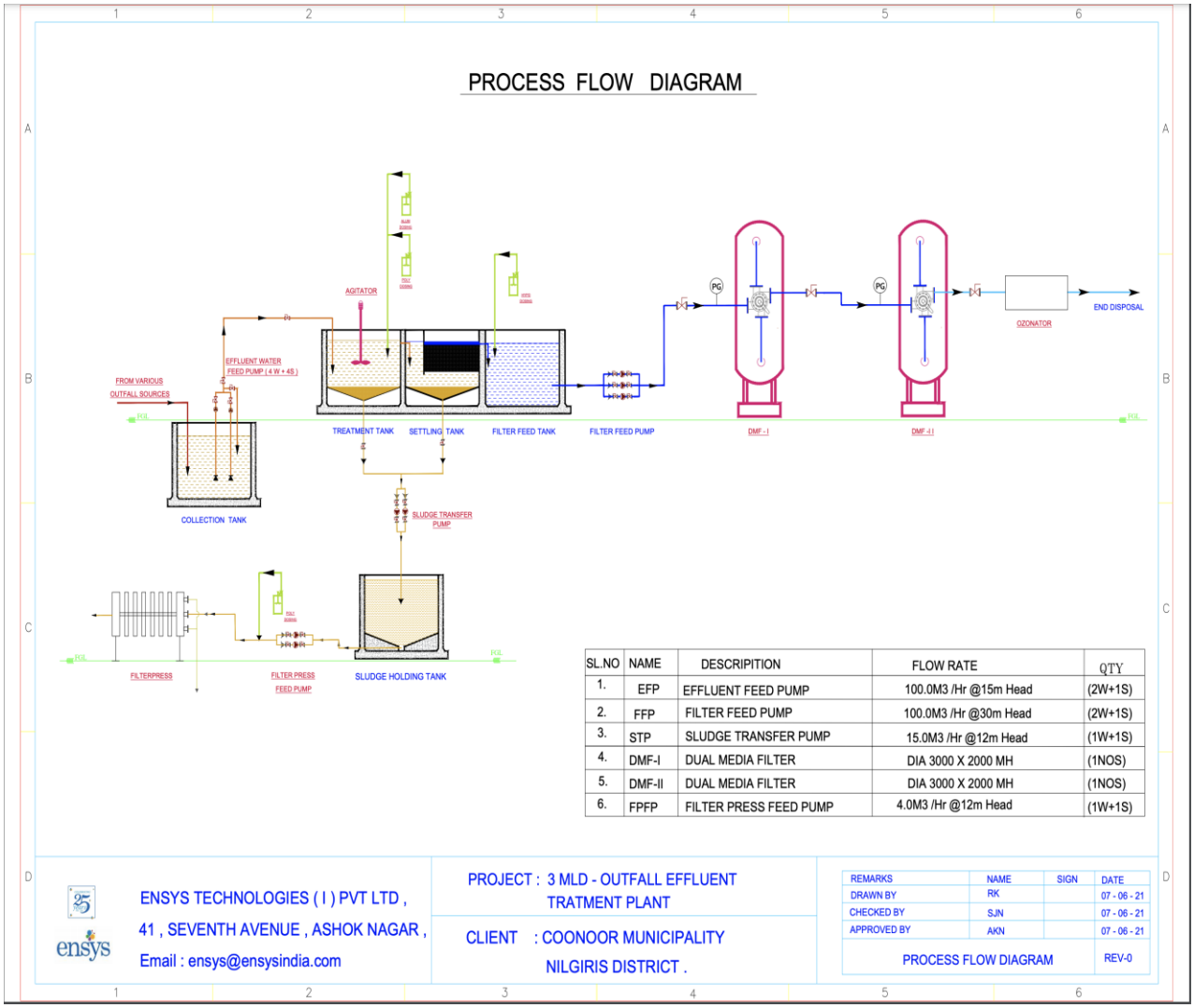


Figure: Representation of a typical MBBR STP for representation purpose

Chemical precipitation followed by Ozonation

Chemical precipitation in wastewater treatment is the change in form of materials dissolved in water into solid particles. Chemical precipitation is used to remove ionic constituents from water by the addition of counter-ions to reduce the solubility. In treatment option 5, the influent is collected in a common tank and then pumped to a treatment tank with agitator where a flocculent addition takes place. The well mixed liquor is then taken into a settling tank where solid liquid separation takes place. The clarified effluent is overflowed to the filter feed tank, from where it is taken to a series of filter units mainly sand filter and carbon filter. The filtered water is then allowed to pass through an ozonator to ensure the dissolved oxygen in the clarified water.



Advantages.

- Self-operating and low maintenance
- ready availability of equipment and many chemicals.
- The process can be well automated.
- Skilled labour not required.
- Both economically advantageous and efficient

9. Recommendation of Most Suitable Treatment Option

A comparative study of the available treatment options are carried out based on the mentioned factors in chap 9.

Factors	Option 1 – Phytoremediation	Option 2- Moving Bed Biofilm Reactor (MBBR)Technology	Option 3 - Chemical precipitation followed by Ozonation
Capital cost	Medium	Medium	Medium
Recurring Costs	Low	Medium	Medium
Land area requirement	High	Low	Low
Indicative area m2/m3	1 – 2	0.3 – 0.5	0.2 – 0.4
Operation & maintenance	Low	Medium	Medium
Manpower requirement; Skilled / Unskilled	Unskilled	Skilled	Semi-skilled
Automation	Low	Medium	Medium
Quantity of Sludge generation	Low	Medium	Medium
Aesthetics	High	Medium	Medium
Ranking	1	3	2

Based on the comparative study of the treatment options available, phytoremediation proves to be the most economical system in terms of capital, recurring and operation and maintenance cost. It also adds to the aesthetics of the system. Since they mimic the natural ecosystem, the carbon footprint will be much less compared to other techniques. But the hydraulic retention time required in such natural systems is of the order of 1 to 2 days and the major constrain with the above system is the requirement of land area.

However, providing such system in the river course, if technically feasible, it would be the most desirable option. Which shall substantially reduce the conveyance to a common place of treatment interms of its investment and operation cost which is a recurring one every month/ year.

The study team observed that all three streams, are having a minimum width of 5.0 meters and much wider in many places, therefore there is a possibility of providing Phytoremediation systems, could be explored, However, the possibility need to be confirmed by the service providers of such system, after making site visit, considering the rainfall pattern, terrain of the area, geomorphologic conditions etc. The same has to be endorsed and facilitated for land acquisition or allotment by the municipal authority as well.

In the event providing Phytoremediation system is not feasible, a combination of Physical-Chemical treatment which is an apt choice shall be recommended. Here again the installation of pumping mains [collection of outfalls either individually or collectively at the appropriate locations of the rivers] backed with due instrumentation systems to ensure proper pumping at regulated intervals against receipt of flow is mandatory.

Providing of Biological Treatments such as Activated Sludge process, etc., would not yield the desired results, considering the temperate climate prevail in most of the time, the highly skilled man power required requirement and the very high power and operating costs..

10. Field Visit

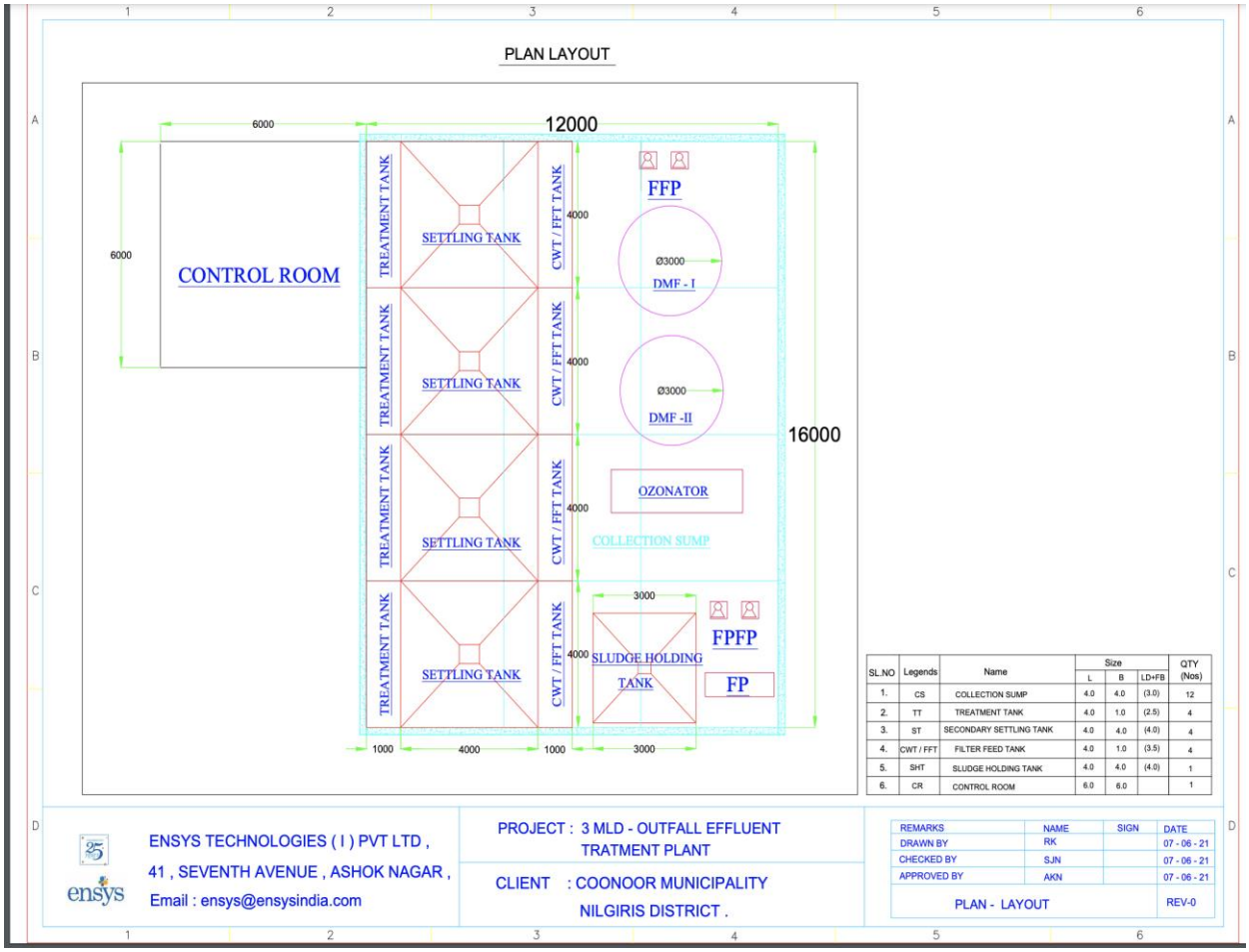
A field visit to Coonoor Municipality was conducted on July 1st to 3rd by Ensys Team. The following observations were derived :

- In Coonoor the land available adjacent to the water bodies is not sufficient for the phytoremediation, so it is not sufficient for the Biological Treatment.
- Considering small pockets of land available will reduce and efficiency of the System and High Possibility of erosion during monsoon season.

Figure: Outfall point in Shanmugapuram River and coonoor River

11. Schematic for Physico Chemical treatment Scheme

Primary aim of treating wastewater is to produce an effluent which would not make any adverse impact when discharged to the environment, thereby preventing, or minimizing the pollution. The proposed treatment scheme adopted for the abatement of pollution in Rivers is a chemical treatment followed by ozonation . The fig below shows the proposed treatment scheme adopted in Coonoor Municipality based on the study conducted and site conditions. However considering the fact that some of the phytoremediation techniques are comparable to the capital cost of the system which we proposed. The fact that the operating cost going to be relatively much lesser comparing to other system. There the system requirement for 2.5-3.0 m2/ m3 of water treating



1 – Collection Tank

2 – Treatment Tank & Agitator

3 – Settling Tank

4 – Clarified water tank / Filter feed Tank

5 – Dual Media Filters

6 – Ozonator

7 – Sludge holding tank

8 – Filter press

Process Description:

The proposed scheme for treatment of sewage is for a capacity of 3000 m3/day (MLD). The operation/ working hour considered for the scheme is 20 hr. So, the total design flow rate of 160 m3/day is considered for the design of proposed sewage treatment plant.

The sewage is pumped from the outfalls of three river, namely Coonoor River, Blue Hill and Shanmugapuram river to a collection tank of capacity 320 m3. The wastewater is pumped at a rate of 40 m3/hr into four pre-fabricated module units which consist of treatment cum settling tanks. Poly electrolytes will be dosed to the treatment tank. Agitators are provided in the pre-fabricated module units where the above added poly electrolytes get mixed with raw wastewater for a contact time of 5-10 mins. Poly electrolytes acts as flocculants and increases the floc formation in the mixed liquor. The mixed liquor is then allowed to settle in the settling tank for a retention time of about 1.5 hr.

The clarified water is collected in filter feed tanks and then pumped for filtration. The water is allowed to pass through sand filter and then carbon filter and finally through an ozonator.

The sludge from the settling tanks are collected in sludge holding tank. The sludge is allowed to settle for a period of ... to facilitate solid liquid separation and then pumped through screw pumps to filter press.

Design capacity of STP

There 2 intersection points in Coonoor river, and one intersection at the meeting point of Shanumugapuram river and Blue Hill River.

The actual flow of the selected sources is 2.43 MLD. So the design of the STP is proposed for 3 MLD considering the rain fall and monsoon season.

The process flow schematic and the layout of the proposed scheme is depicted above. The tentative area requirement for the set up of a waste water treatment plant shall be around 300-350 Sq.mts.

Location of the Plant:

The land in which the Fire and Rescue Services Station is located would be made available by the Coonoor Municipality, for the purpose of providing the Sewage Treatment Plant. An area of around 2400 Sq.mtrs is available which probably could be allotted a reasonable portion to install the plant.

Point of Discharge of Treated Sewage:

The Treated Sewage would be discharged in to Coonoor River adjoining to the location of Sewage treatment Plant, after ensuring that the treated sewage is meeting the standards prescribed for such disposal.

Online Monitoring Parameters by CPCB

Central Pollution Control Board vide its letter No. B-29016/04/06PCI-1/5401 dated 05.02.2014 issued directions under section 18(1)b of the Water and Air Acts to the State Pollution Control Boards and Pollution Control Committees for directing the 17 categories of highly polluting industries such as Pulp & Paper, Distillery, Sugar, Tanneries, Power Plants, Cement, Oil Refineries, Fertilizer, Chloral Alkali Plants, Dye & Dye Intermediate Units, Pesticides and Pharma Sector, Common Effluent Treatment Plants (CETP) and STPs, Common Bio Medical Waste and Common Hazardous Waste Incinerators for installation of online effluent quality and common emission monitoring systems to help track the discharges of pollutants from these units. The real time water quality monitoring systems to monitor parameter such as pH, TSS, COD, and BOD.

The directed envisage:

•Installation of online effluent quality monitoring system at the outlet of the identified units for the measurements of the parameters pH, TSS, COD and BOD as per the guidelines provided and transmitted of online data so generated to SPCB/PCCS and CPCB as well.

- Installation of surveillance system will be industrial grade IP (Internet protocol) cameras having PAN, Tilt Zoom (PTZ) with leased line real time connected for the data streaming and transmission of the same.
- To ensure regular maintenance and operation of the online system tamper proof mechanism having facilities for online calibration.

Accordingly, an OCEMS is proposed as well, which shall measure the following essential parameters

a. pH
b. BOD
c. COD
d. TSS along with Flow meter readings for the factual quantities received and treated.

12 Comparitive Analysis of various treatment options

COMPARATIVE ANALYSIS OF TECHNO COMMERCIAL ASPECTS GOVERNING VARIOUS VIBALE OPTIONS FOR TREATMENT AND DISPOSAL OF THE OUTFALL WASTE WATER @ COONOOR MUNICIPALITY						
S/NO	DETAILS	UNITS / CONSIDERATION	TECHNOLOGY OPTIONS - OUTFALL WASTE WATER MANAGEMENT - 3 MLD DESIGN			
			NBS - NATURAL BIOLOGICAL SYSTEMS		ATTACHED GROWTH	PHYSICO CHEMICAL
			PHYTO REMEDIATION	SOIL BIO TECH	MBBR	ETP
1	PRIMARY REQUIREMENTS		REQUIRED		REQUIRED	
2	LOCALISED COLLECTION		REQUIRED		REQUIRED	
3	ADAPTABILITY TO INSTALL		ANYWHERE		IDENTIFIED DEFINITE PLACE	
4	MODULAR INSTALLATIONS		POSSIBLE		POSSIBLE THOUGH NOT ECONOMICAL FROM BOTH CAPEX AND OPEX POINT OF VIEW	
5	INSTALLATION IN CURRENT CONTEXT		COULD BE INSTALLED ALONG THE RIVER BANKS		POSSIBLE SUBJECT TO AREA AVAILABILITY	
6	PRIMARY TREATMENT UNITS		SIMPLE SCREENING SUFFICE		ELABORATE SCREENING REQUIRED	
7	OUTFALL COLLECTION		LOCALISED AND SIMPLE		LOCALISED WITH AUTOMATION REQUIREMENTS	
8	SHOCK LOADS		ACCOMMODATE		SUSCEPTIBLE	
9	FOOT PRINT AREA REQUIRED - FOR TREATMENT PLANT ALONE	SQ/MT PER KLD	1.5-2.0	1.25-1.50	1.0-1.25	0.5-1.0
10	COST OF COLLECTION AND CONVEYANCE	INR' LAKHS				
A	COLLECTION SUMPS WITH SCREENS		60-70	60-70	60-70	60-70
B	PUMPING SYSTEMS		15-20	15-20	35-40	35-40
C	CONVEYANCE		18-20	18-20	20-25	20-25
10	CAPEX - TURNKEY EXECUTION OF THE TREATMENT PLANT	INR' LAKHS	900-1000	750-800	800-850	550-600
11	OPEX - OPERATING COST	INR' LAKHS / ANNUM				
A	MANPOWER		11-12	11-12	16-18	16-18
B	CHEMICALS AND CONSUMABLES		07-08	07-08	11-12	8-10
C	POWER COST		4-4.5	4-4.5	33-34	23-24
D	MAINTENANCE / SPARES COST		1-2	1-2	6-8	5-6
12	RANKING		2	1	4	3