# ACTION PLAN FOR THE

# REJUVENATION OF POLLUTED RIVER STRETCH AS PER N.G.T ORDER


## THE KALLOOPARA-THONDRA STRETCH OF MANIMALA RIVER (Priority IV)

**Submitted by District Level Technical Committee (Alappuzha District)**

**Before the River Rejuvenation Committee**

**As per G.O (Ms) No.2/2019/WRD Dated 30/04/2019**

# PREFACE

As per G. O (Ms) No.2/2019/WRD Dated 30.04.2019, a District Level Technical Committee (Alappuzha District) was constituted for preparing Draft Action Plan for the rejuvenation of polluted river stretches. The polluted river stretch in the district was Kalloopara – Thondra stretch of Manimalariver. The members of the committee are as follows:

1. Smt. Rekha R., Superintending Engineer, Kuttanadu Division Circle, Chenganoor.
2. Sri. BijuB., Environmental Engineer, Kerala State Pollution Control Board, Alappuzha.
3. Smt. Lovely M. V., General manger, District Industrial Centre.
4. Sri. Sabeer A. Raheem, Executive Engineer, Kerala Water Authority, Alappuzha.
5. Sri. K. S. Rajesh, District Coordinator, Haritha Kerala Mission, Alappuzha.
6. Sri. Sheri G., Municipal Secretary, Chenganoor.
7. Smt. Binz Thomas, District coordinator, Suchithwa mission, Alappuzha.
8. Shri.Harikumar K.B. Secretary Pandanad Gramapanchayath.

Attended by

1. Smt. Sreekala S. L., Assistant Scientist, Kerala State Pollution Control Board, Alappuzha.
2. Smt. Geetha, P. A. to Executive Assistant, Irrigation Department, Alappuzha.

Considering the Kalloopara – Thondrariver stretch water quality data of last three years show that the quality parameters are within the permissible limits. The committee hereby submits the Draft Action Plan the prevention of any future contamination and preservation of water quality.

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*Manimala River emerges from 'Kolahalamedu' of 'Mothavara' hills of the Western Ghats at a height of about 1257m above MSL. From here it flows initially to south direction up to Mundakkayam and then takes a sharp deviation to south-west direction, and flows to Erumeli. From Erumeli, up to Vizhukithodu the river flows in a north-west direction, and then again takes a turn to south-west direction.*

*During this flow an important tributary 'Chittar' joins with Manimalariver at Vizhukithodu. The Elakkalthodu, an important tributary also joins with the Manimalariver at Thondara. From here the river further flows in a south-west direction. At Kallungal, Manimala joins with Pamba and from here onwards the river flows in a northerly direction till it ends in Vembanadlake. Thus the Manimalariver is a south-west flowing perennial river with 19 tributaries, including major and minor ones.*

*Throughout the river Kerala state pollution control board has established eight water quality monitoring stations. During the year 2016 the water quality station between Kalloopara and Thondra has shown BOD values more than 3 mg/lit for a period of consecutive three months (March, April and May 2016). During that time construction work of new bridge parallel to the existing bridge were done and also illegal waste water discharge were observed. This was the reason for increase in the BOD level. After May 2016 to till now (consecutive three years, 2017, 2018 and 2019) BOD values were found less than 3mg/ltr. Constant vigil has been kept in contact with local panchayaths namely Kalluppara, Kaviyoor, Iraviperoor, Kuttur, Puramattom to prevent further contamination of the river.*

# REPORT

## INTRODUCTION

The Manimala River is a 92km long river in south and central Kerala. It is one of the 4 Major rivers which do not have direct outlet to sea as these rivers (Pamba, Manimala, Meenachil, Achankovil) empty into vast Vembanadu Lake. Manimala is a separate independent river for all geographical purposes. It has its origin on the Muthavara Hills on the Western Ghats in Idukki District of Kerala, India. Manimalariver has been an important waterway of Central Travancore.

### Geology

From a geological point of view the Manimala river basin can be broadly classified into 3 zones

1. Western coastal zone consists of recent sand and silt
2. Middle zone consists of residual laterite formed by the decomposition of Archaen crystalline rocks
3. Eastern zone consisting of charnokite rocks of Archean group Soil in the lower reaches are composed of mainly Clay and sand called greyish Onattukara. In the Midland region laterite soils are found along with batches of riverine alluvium

### River Hydrology

The Manimala river basin has a catch area of 847 sq.km. The whole area is located in the District of Pathanamthitta, Kottayam and Alappuzha. There are 4 rain gauge station. They are located in Thiruvalla, Mundakkayam and Kanjirappally gauge up of the main river is done at Manimala and Thondara. There are no major/medium irrigation projects and there are no major/minor hydro electric power stations and another.

### Land use pattern and agriculture.

The highlands are mostly reserved and protected forest with patches of tea, cardamom, coffee estates. In the midland rubber, coconut, pepper etc are grown. Paddy, coconut, vegetables are cultivated in low land region.

## Cities and Population

There are no big cities in the river basis. Mundakkayam, Erumeli, Kanjirapally and Mallappally are the main towns located in the banks of Manimala river and they are fast urbanizing . The population in the Manimala river basis is mainly concentrated in the mid land and low land regions. The 2 km stretch of Manimalariverparring between the points Kallupara and Thondra through six panchayats

Table 1.1 Details of Panchayaths Near Kalloopara – Thondra Stretch of Manimala River

| Sl no | PANCHAYATH | POPULATION |
|---|---|---|
| 1 | KALLOOPARA | 16,837 |
| 2 | PURAMATTOM | 14,069 |
| 3 | ERAVIPERUR | 25,172 |
| 4 | KAVIYOOR | 16,852 |
| 5 | PERINGARA | 14,440 |
| 6 | KUTTOOR | 19,652 |

## Ground water potential

The river basis has good ground water potential. It has been utilized only to a minimum extent. In the highland region, the presence of forest land and hilly terrain make ground water extraction difficult. The limited extraction is by dug well in midland and coastal land. The density of dug wells in 200-250/sq.km in the low land region, 75-100/sq.km in the midland region and 10-50/sq.km in the high land region of the river basis. The ground water potential in Alappuzha, Pathanamthitta, Kottayam and Idukki districts which form major part of the river basis.

## Pollution due to Industries

The industrialization of the stretch of the river basis is almost nil. There is no larger/medium small-scale industry in this area, no other point source that discharging any significant quantity of

waste were observed. Only few small-scale cement brick manufacturing units are located in the river basis.

**Classification of the River Based on Designated Best Use**

Rivers are the main sources of surface water. Man depends on rivers as sources of supply of water for drinking, irrigation, domestic and waste disposal. It also provides water way for Urban Navigation. Rivers are also used for fishing and recreation. Thus man uses river for a variety of purposes in his day to day life.

Before formulating a water quality, improvement program, it is essential to classify the various stretches of the river in the basis of its designated best use, thus laying down minimum desirable water quality levels for the different stretches. The scheme for zoning and classification of Indian rivers, estuaries and coastal waters evolved by the CPCB lays down the norms to be followed for classification of rivers in the country.

According to the norms evolved by the CPCB, the inland surface water is classified into 5 classes (A to E) on the basis of designated best use. The principle concern here is the end use to which the water quality requirements become progressively lower from A to E. Besides, the quality of any one of 5 categories also satisfies the requirements of categories lower than the chosen one.

Designated best use is that use belonging to the upper most category of the many uses to which the water on a particular stretch of the river is put to by the people. The existing quality status is not the guiding factor. The classification of the inland surface water based on designated best use for fresh waters evolved by the CPCB is as follows.

Table 1.2 Classification of the Inland Surface Water Based on Designated Best Use for Fresh Water

| Sl.no | Designated Best Use | Classification |
|---|---|---|
| 1 | Drinking water source without conventional treatment, but after disinfection | A |
| 2. | Outdoor Bathing, swimming and water contacts sports | B |
| 3. | Drinking water source with conventional treatment followed by disinfection | C |
| 4. | Propagation of wildlife and fisheries | D |

| | | |
|---|---|---|
| 5. | Irrigation, industrial cooling and controlled waste disposal | E |

It is observed almost all along the entire length of Manimala river, water is being put to a mixed pattern of beneficial uses. Bathing, washing clothes and even for cooking and drinking are intensively practiced by rural communities and even by the poorer section of urban community on all stretches of the Stream.

## Classification of Manimala River

Classification of Manimalariver based on the designated best use is as follows. The upstream of the river up to Kallooppara may be classified on the basis of designated best use as A i.e., water is used for drinking is given disinfection as the only treatment. The downstream of the river up to its confluence with Vembanad lake is classified as C, i.e., water is mainly used for irrigation and fishing.

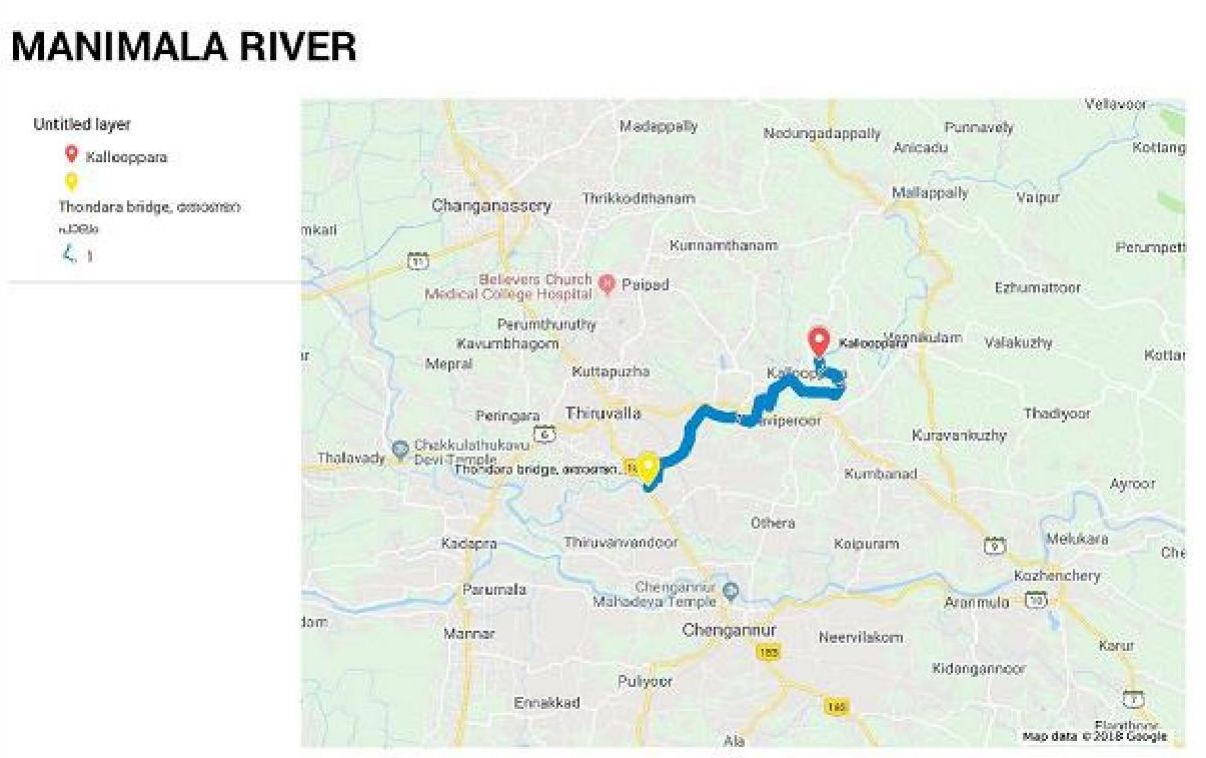


Fig.1.1 Map of Kalloopara-Thondra Stretch

## KalloopparaThondara Stretch Manimala River

The land of Kallooppara was previously known by the name of Perumbranadu, due to its massive storage of rocks and hence being known by the name of 'Perum Parra Nadu', in the previous days and gradually being known as Perumbranad, in the latter days as legend has it. Kallooppara was once the part of Thiruvallataluk and with the formation of the Pathanamthitta district in 1983, a new taluk was created, Mallapallytaluk and Kallooppara became a part of it.

## Details of Kalloopara-Thondra Stations

The land of Kallooppara was previously known by the name of Perumbranadu, due to its massive storage of rocks and hence being known by the name of 'Perum Parra Nadu', in the previous days and gradually being known as Perumbranad, in the latter days as legend has it.Kallooppara was once the part of Thiruvallataluk and with the formation of thePathanamthitta district in 1983, a new taluk was created, Mallapallytaluk and Kallooppara became a part of it.

**Table 1.3 Location Details of the Stations**

| Sl.No | Location | Latitude<br>Longitude |
|---|---|---|
| 1 | Kalloopara | $09^0$ 23’34’’<br>$76^0$38’40’’ |
| 2 | Thondra | $09^0$21’64’’<br>$76^0$35’23’’ |

Evaluating the analysis reports of water samples collected from Kalloopara and Thondra points after May 2016 till now (consecutive three years, 2017, 2018 and 2019) BOD values were found to be higher than 3mg/ltr in 2016. The construction work of new bridge parallel to the existing bridge was going on at that time and that was the reason for increase in the BOD level.

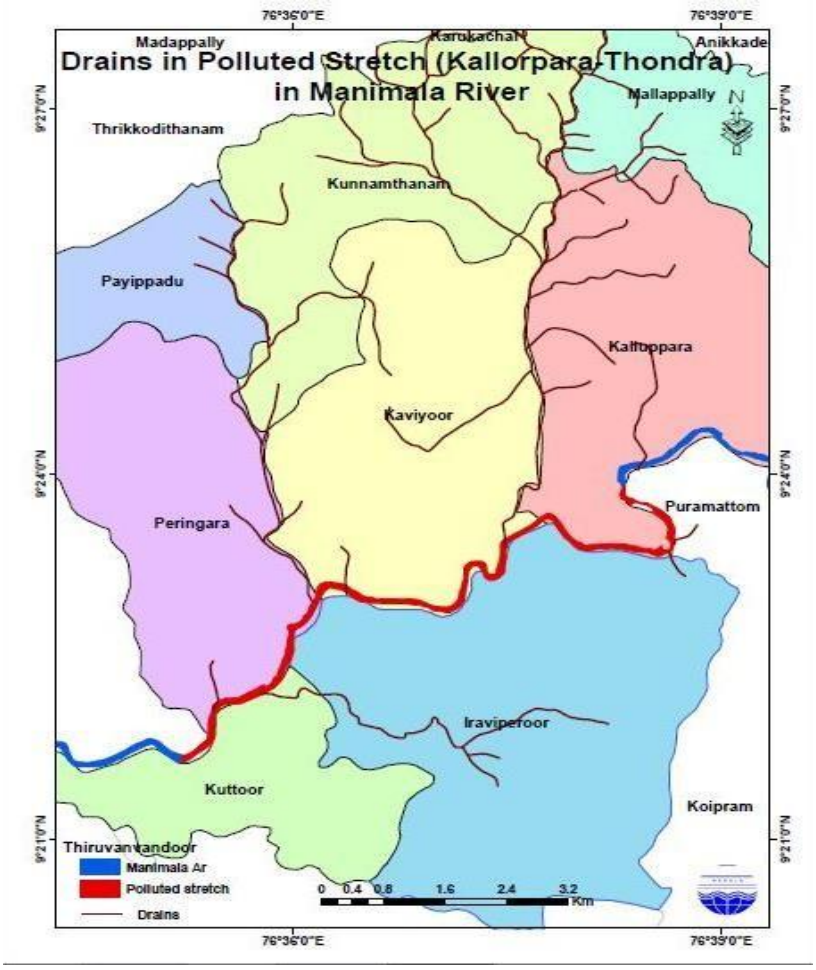


Fig.1.2 Details in Polluted Stretch (Kalloopara-Thondra) in Manimala River

Fig.1.3 Kallooppara Station sampling point

Fig.1.4 Thondra Station sampling point

**Actual Uses of the River Water of the Stretch**

Kallooppara : Domestic activities and used as Kerala Water Authority drinking water source.

Thondara : Domestic activities like washing, residential activities, bathing, etc.

The data on the activities in the nearby area Kalloopara - Thondara Stretch of Manimala River is as follows

1. For bathing and irrigation.
2. Water supply scheme at Kalloopara.
3. No salinity intrusion in this stretch.
4. No industrial discharge and no industries are located in the banks of this stretch of Manimalariver.

Evaluating the analysis report of the samples collected for the month of February, March, April and May 2016, the values of BOD had exceeded from the limit of 3 mg/ltr (Annexure 3). At that time, the construction work of bridge parallel to the existing Thondarabridge was going on, so the bank of this portion, was dumped with building material, organic waste, mud etc. Also the water was

stagnant. This may be a reason for the higher BOD in that stretch. However, a letter has been issued to all the local bodies (Kuttoor, Kalloopara and EraviperoorGramaPanchayath) on the banks of this Kalloopara- Thondara stretch to close all the septage/unauthorized discharges leading to river.

Several streams were found to get connected to Manimalariver between Kalloopara and Thondra points. Bridges like Nelladu bridge (Fig 1,2), Padathu bridge (Fig 3,4) had tributaries that joined Manimala river but now, due to human encroachment most of the regions of these streams had changed for domestic purposes. Hence, flow rate in this region is very low.

Kuttipuzha(Fig 5,6) is another stream connected to Manimala which carries water for cultivation to nearby areas during summer season.

Another stream Panayampalamthodu, 14km long originates from Karukachal in Kottayam district confluences to Manimala river and it is an important source of water for irrigation purposes to panchayats like Aanikaadu, Mallapally, Kunnamthanam, Kaviyoor, and Kalloopara.

Several field visits were conducted in this area and it was noticed that there is no source for any type of industrial pollution.

(a)

(b)

Fig.2 (a) and (b) Images of Nellad Bridge

(a) (b)

Fig.3 (a) and (b) Images of Padathu Bridge

(a) (b)

Fig.4 (a) and (b) Kuttipuzha Stream Connected to Manimala

## Conclusion

Evaluating the analysis reports of water samples collected from Kalloopara and Thondra points from June 2016, 2017, 2018 and 2019 (Annexure 3), BOD values were found to be much lesser than 3mg/ltr. From the field visits, it was found that there were no industries in the banks of the river that could contribute to any type of water pollution. Constant vigil has been kept for the land use/establishment of industries in the area in contact with local panchayaths namely Kalluppara, Kaviyoor, Iraviperoor, Kuttur, Puramattom. Concentration of industries in these panchayaths are very low and even very few cottage industries are there .At present, municipal solid wastes (including plastic) contamination in the river is minimal. Proper awareness will be providing to the respective panchayaths to protect the river in the same manner. Help from the respective department including police will be arranged to prevent the illegal discharge of septage/waste water by waste water collection agencies

CENTRAL POLLUTION CONTROL BOARD
(Water Quality Management Division-I)
Delhi-110032
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**EXECUTING SUMMARY ON PROPOSED ACTION PLANS FOR REJUVENATION OF IDENTIFIED POLLUTED RIVER STRETCH**

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| Sl. No. | DESCRIPTION OF ITEM | | Details |
|---|---|---|---|
| 1. | Name of the identified polluted river and its tributaries | : | Kalloopara – Thondra Stretch of Manimala. |
| 2. | Is river is perineal and total length of the polluted river | : | (Yes)<br>Length 2 km |
| 3. | No of drains contributing to pollution and names of major drains | : | NIL |
| 4. | Whether 'River Rejuvenation Committee (RRC) constituted by the State Govt./UT Administration and If so, Date of constitution of 'RRC' | : | 02/05/2019, 22/05/2019, 15/07/2019 |
| 5. | Major Towns on the banks of the river with population | : | NIL |
| | a. Total water consumption and sewage generation in MLD | : | Total Water consumption<br>40.5 in MLD (By Kerala Water Authority)<br>Kallorpara - 3.5 MLD<br>Kaviyoor - 4 MLD<br>Kattod – 33 MLD<br>Total Sewage generation<br>NIL |
| | b. Total no. of existing STPs and the total capacities in MLD | : | NIL |
| | c. Gaps in sewage treatment in MLD and no. of towns not having STPs | : | NIL |
| | d. Total MSW generation in TPA | : | NIL |
| | e. Existing treatment and disposal facilities and total capacity | : | NIL |

| | | | | |
|---|---|---|---|---|
| 6. | Major industrial estates located with total no. of industries | : | Industrial Estate | No. of Industries |
| | | | NIL | Nil |
| | a. Total water consumption and total industrial effluent generation in MLD<br>NIL | : | Industrial Name | Total water consumption / Effluent quantity |
| | | | NO | NIL / NIL |

| | | | |
|---|---|---|---|
| | b. No. of industries having captive ETPs and their treatment capacity in MLD | : | NIL |
| | c. No of CETP's and their treatment capacity | : | NIL |
| | d. Gaps in treatment of industrial effluent | : | NIL |
| | e. Total HW generation in TPA in the catchment area | : | NIL |
| | f. Existing HW Treatment and Disposal Facilities and total capacity with life span | : | NIL |
| 7. | Action plan includes mainly covering aspect such as (Proposal for utilisation of sewage, ground water recharging or rain water harvesting, measures for the protection and management of flood plain zone, maintaining minimum E-flows and water shed management, plantation on both sides of the river, setting up of bio-diversity parks etc., as per Hon'ble NGT Orders dated 20.09.2018 and 19.12.2018) | : | Action plan is attached as Annexure1. The river stretch is flowing through villages and no industrial/ domestic/ municipal waste water is reaching the river in this stretch. Preventive actions are taken to avoid future contamination. It is also needed to be ensured that no waste water is reaching the river from paddy field or Horticrop farm land located adjacent to the river. The minor rivulet are not flowing or reaching the river even during rainy season. |
| 8. | Min. and Max. required time period for implementation of action plans | | Min – NIL Max - NIL Already Implemented |
| 9. | Total estimated budget in crores towards implementation of proposed action plans with break-up ( e.g. No. of STPs, capacity, total cost; No of CETPs, total capacity, Cost towards interception and diversion of sewage/effluent to STPs/CETPs etc.,) | : | NIL (Corrective action already taken) |
| 10. | Responsible Organisation (s) for implementation of proposed action plans (Please enclose details as annexure ) | : | KSPCB, Irrigation, Panchayath, Police |
| 11. | Proposed Mechanism for execution of action plans | : | Periodic inspection for the prevention of possible future contamination |
| 12. | Expected deliverables with respect to achieving Goals (Please enclose as annexure ) | : | The objective is to keep the river water quality well with the prescribed standard. The same has been achieved as per the water quality analysing result of past three years. Constant vigil has been kept for the landuse/establishment of industries in the area in contact with local panchayaths namely Kalluppara, Kaviyoor, |

| | | | |
|---|---|---|---|
| | | | Iraviperoor, Kuttur, Puramattom. Concentration of industries in these panchayaths are very low and even very few cottage industries are there.<br>At present, municipal solid wastes (including plastic) contamination in the river is minimal. Proper awareness will be provide to the respective panchayaths to protect the river in the same manner.<br>Help from police will be arranged to prevent the discharge of septage/waste water by illegal waste water collection agencies. |

# ANNEXURE 1

| ACTION PLAN | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Sl. No.** | **Ref NGT Order no: 673/2018 Dated 20.09.18** | **Activity** | **Implementing agency** | **Estimated Expenditure in lakhs** | **Source of Fund** | **Timeline** | **Expected Outcome** |
| 1 | A(a) | Monitoring of river water quality by sampling | Kerala State Pollution Control Board | 12.08/year | Ongoing NWMP project | 2019-2020 | Periodical water quality assessment |
| 2 | A(b) | Septage& Sewage Treatment plant | For Chenganoor& Thiruvalla Municipality Localbodies also need to provide common septage treatment facilities to collect, treat and dispose sewage particularly for thickly populated area | 400 | HarithaKeralam/Suchitwa Mission | Tentatively 2019-2021 | Reduce the pollution load and Improve the water quality |
| 3 | C(ii) | Establishment & Modernization of SWM treatment plant (Solid Waste Management) | Chenganoor& Thiruvalla Municipality | To be estimated | Own<br>Central<br>State | 2019-2021 | Better solid waste management (SWM) Reduce the river pollution due to solid waste dumping |
| 4 | C | Material | Chenganoor& | 120 | Own | 2019- | Better |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | collection facility (SWM) | Thiruvalla Municipality and<br><br>Kalloopara, Eraviperoor, Puramattom, Kaviyoor, Peringara, Kuttoorpanchayaths | | Central<br>State | 2021 | solid waste management (SWM) Reduce the river pollution due to solid |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | waste dumping |
| 5 | C | Resource recovery facility | Chenganoor& Thiruvalla Municipality | 20 | Own<br>Central<br>State | 2019-2020 | Better solid waste managem ent (SWM) Reduce the river pollution due to solid waste dumping |
| 6 | C | Installing household and community level solid waste manageme nt units | Kalloopara, Eraviperoor, Puramattom, Kaviyoor, Peringara, Kuttoorpanchay aths | 200 | Central (Swach Bharat Mission – Urban) Through Sichitwa mission | 2019-2020 | Better solid waste managem ent (SWM) Reduce the river pollution due to solid waste dumping |
| 7 | C | Door to Door collection and transportati on of MSW | Chenganoor& Thiruvalla Municipality | 36 | To be found | Tentative ly 2020-2021 | Better solid waste manageme nt (SWM) Reduce the river pollution due to solid waste dumping |
| 8 | C | Preventing illegal discharge of septage and other waste water into the river | Panchayath Police KSPCB | Yet to be estimated | - | 2019-2021 | Local river conservati on or protection group, police and Panchayat h Authorities act hand in glove with |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | | | KSPCB to prevent illegal contamination activities |
| 9 | C | Regulating activities in flood plain zone, protection and management of flood plain zone | Irrigation department | Yet to be estimated | State fund | Tentatively 2020-2021 | Government constituted a river basin conservation and management authority and a committee constituted for drafting river basin conservation act |
| 10 | C | Greenery development- Plantation on both sides of the river, setting up biodiversity parks n flood plains by removing encroachment | Irrigation department | Yet to be estimated | State fund | Tentatively 2020-2021 | Eco-friendly approach will create a positive attitude in public |
| 11 | C(b)(ii) | Green Protocol implementation in all offices, institution & public functions | Kalloopara, Eraviperoor, Puramattom, Kaviyoor, Peringara, Kuttoorpanchayaths | Yet to be estimated | State Plan fund – Suchithwa Mission/ HarithaKeralam Mission | Tentatively 2020-2021 | Reduce the solid waste generation in Municipality |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 12 | D(a) | Issues relating to E-flow, maintaining minimum environmental flow of river (by having watershed management provisions) | Irrigation department | Yet to be estimated | State fund | Tentatively 2020-2021 | Government constituted a river basin conservation and management authority and a committee constituted for drafting river basin conservation act |
| 13 | E | Construction of Thonipurathu kadavu and Kanyan kadav | Manimala Grama Panchayath | 5,46,381/- | Plan fund | Within 1 year | |

# ANNEXURE 2

Table 1.4 Analysis Report of Kalloopara 2016

| Parameters | Unit | MONTHS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
| PH | - | 7.5 | 7.0 | 6.9 | 7.7 | 6.1 | 6.8 | 6.1 | 7.1 | 6.9 | 7.0 | 7.2 | 7.2 |
| Conductivity | µS/cm | 68 | 87 | 80 | 143 | 73 | 54 | 65 | 79 | 51 | 54 | 6.1 | 46 |
| Turbidity | NTU | BDL | 1.7 | BDL | 2.5 | BDL | BDL | 1.5 | BDL | 1.4 | BDL | BDL | BDL |
| DO | mg/l | 7.3 | 7.8 | 7.6 | 2.0 | 7.4 | 6.1 | 6.2 | 6.3 | 6.0 | 7.1 | 6.9 | 7.4 |
| BOD | mg/l | 1.7 | 3.5 | 2.2 | 0.3 | 7.4 | 0.7 | 0.4 | 0.9 | 0.8 | 0.8 | 0.9 | 1.0 |
| COD | mg/l | 3.2 | 9.6 | 9.6 | 22.4 | 6.4 | 22.4 | 3.2 | 3.2 | 3.2 | 6.4 | 3.2 | 3.2 |
| Chloride | mg/l | 10.0 | 20.0 | 20.0 | 30.0 | 20.0 | 10.0 | 20.0 | 20.0 | 10.0 | 10.0 | 10 | 10.0 |
| Sulphate | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Phosphate | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Nitrate Nitrogen | mg/l | 0.14 | 0.03 | 0.07 | 0.08 | 0.20 | 0.18 | 0.07 | 0.00 | 0.01 | 0.02 | 0.002 | 0.2 |
| Amm. Nitrogen | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Alkalinity | mg/l | 10.0 | 30.0 | 20.0 | 50.0 | 10.0 | 10.0 | 10.0 | 20.0 | 20.0 | 20.0 | 20 | 10.0 |
| T.Hardness | mg/l | 20.0 | 30.0 | 20.0 | 60.0 | 20.0 | 20.0 | 20.0 | 30.0 | 20.0 | 20.0 | 20 | 20.0 |
| ca | mg/l | 4.0 | 8.0 | 4.0 | 20.0 | 4.0 | 4.0 | 4.0 | 8.0 | 4.0 | 4.0 | 4 | 4.0 |
| Mg | mg/l | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 | 2.4 |
| T D S | mg/l | 48.0 | 62.0 | 54.0 | 102.0 | 48.0 | 38.0 | 46.0 | 56.0 | 36.0 | 38.0 | 36 | 32.0 |
| T F S | mg/l | 32.00 | 40.00 | 42.00 | 64.00 | 32.00 | 26.00 | 38.00 | 42.00 | 30.00 | 28.00 | 22 | 20.0 |
| Fluoride | mg/l | 0.01 | 0.07 | 0.06 | 0.03 | BDL | BDL | 0.80 | 0.20 | 0.30 | 0.08 | 0.06 | 0.2 |
| Sodium | mg/l | 11.8 | 10.2 | 11.2 | 11.6 | 10.8 | 5.4 | 10.8 | 9.6 | 5.2 | 5.6 | 5.4 | 3.6 |
| Potasssium | mg/l | 1.4 | 1.9 | 1.7 | 2.6 | 2.7 | 1.0 | 1.1 | 1.3 | 0.8 | 1.4 | 1.3 | 1.3 |
| TSS | mg/l | 24.00 | 22.00 | 20.00 | 44.00 | 14.00 | 20.00 | 18.00 | 16.00 | 22.00 | 10.00 | 12 | 12.00 |
| Tcoli | No/100ml | 400 | 900 | 800 | 300 | 200 | 600 | 1000 | 800 | 1000 | 1100 | 400 | 200.0 |
| Fcoli | No/100ml | 240 | 640 | 620 | 200 | 120 | 420 | 840 | 640 | 760 | 840 | 120 | 120.0 |
| Boron | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| TKN | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |

Table 1.5 Analysis Report of Kalloopara 2017

| Parameters | Unit | MONTHS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
| PH | - | 7.8 | 7.5 | 8.3 | 7.9 | 7.9 | 5.4 | 6.8 | 7.2 | 6.3 | 6.9 | 6.7 | 6.3 |
| Conductivity | µS/cm | 73 | 74 | 88 | 128 | 120 | 104 | 156 | 135 | 87 | 174 | 104.25 | 102 |
| Turbidity | NTU | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| DO | mg/l | 7.4 | 7.7 | 4.8 | 7.9 | 5.9 | 6.9 | 8.0 | 7.3 | 7.5 | 6.8 | 6.9 | 5.9 |
| BOD | mg/l | 1.7 | 0.8 | 1.8 | 1.9 | 2.2 | 2.1 | 1.1 | 1.7 | 1.4 | 2.1 | 0.6 | 2.1 |
| COD | mg/l | 3.2 | 32.0 | 22.0 | 6.4 | 16.0 | 9.6 | 12.8 | 16.0 | 16.0 | 22.4 | 6.4 | 25.6 |
| Chloride | mg/l | 10.0 | 20.0 | 22.0 | 10.0 | 20.0 | 20.0 | 30.0 | 20.0 | 20.0 | 40.0 | 20 | 20.0 |
| Sulphate | mg/l | BDL | 1.6 | BDL | BDL | BDL | 10.5 | BDL | 8.9 | 4.3 | 4.6 | 3.81 | BDL |
| Phosphate | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Nitrate Nitrogen | mg/l | 0.03 | 0.02 | 0.06 | 0.05 | 0.01 | 0.20 | 0.21 | 0.17 | 0.19 | 0.17 | 0.176 | 0.1 |
| Amm. Nitrogen | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Alkalinity | mg/l | 30.0 | 20.0 | 20.0 | 80.0 | 100.0 | 40.0 | 70.0 | 50.0 | 40.0 | 40.0 | 140 | 46.0 |
| T.Hardness | mg/l | 30.0 | 20.0 | 20.0 | 80.0 | 70.0 | 40.0 | 70.0 | 60.0 | 60.0 | 70.0 | 50 | 52.0 |
| Ca. Hardness | mg/l | 20.0 | 10.0 | 10.0 | 30.0 | 30.0 | 20.0 | 40.0 | 30.0 | 10.0 | 30.0 | 30 | 28.0 |
| Mg. Hardness | mg/l | 10.0 | 10.0 | 10.0 | 50.0 | 40.0 | 20.0 | 30.0 | 30.0 | 50.0 | 40.0 | 20 | 24.0 |
| T D S | mg/l | 52.0 | 52.0 | 62.0 | 90.0 | 76.0 | 74.0 | 94.0 | 88.6 | 62.0 | 121.2 | 74.05 | 70.0 |
| T F S | mg/l | 34.00 | 30.00 | 30.00 | 32.00 | 30.00 | 24.00 | 22.00 | 24.00 | 22.00 | 20.00 | 26 | 24.0 |
| Fluoride | mg/l | 0.10 | 0.20 | 0.04 | 0.30 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0.0 |
| Sodium | mg/l | 4.9 | 10.9 | 12.1 | 3.0 | 20.0 | 18.0 | 17.3 | 10.9 | 0.9 | 23.4 | 10 | 10.5 |
| Potasssium | mg/l | 1.9 | 1.7 | 2.2 | 2.5 | 3.0 | 1.7 | 1.6 | 3.2 | 1.1 | 1.4 | 0.6 | 0.7 |
| TSS | mg/l | 16.00 | 16.00 | 12.00 | 18.00 | 14.00 | 12.00 | 10.00 | 12.00 | 10.00 | 12.00 | 14 | 12.00 |
| Tcoli | No/100ml | 400 | 440 | 360 | 460 | 400 | 160 | 80 | 72 | 100 | 80 | 100 | 120.0 |
| Fcoli | No/100ml | 230 | 240 | 220 | 260 | 200 | 80 | 0 | 40 | 40 | 0 | 60 | 80.0 |
| Boron | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| TKN | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |

Table 1.6 Analysis Report of Kalloopara 2018

| Parameters | Unit | MONTHS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
| PH | - | 7.3 | 7.7 | 7.3 | 7.4 | 6.9 | 6.8 | 7.1 | 7.8 | 7.7 | 7.8 | 7.4 | 7.2 |
| Conductivity | µS/cm | 96 | 98 | 128 | 146 | 186 | 178 | 76 | 60 | 130 | 430 | 220.8 | 129 |
| Turbidity | NTU | BDL | BDL | BDL | BDL | 0.3 | BDL | BDL | BDL | BDL | BDL | 3.6 | 2.3 |
| DO | mg/l | 7.7 | 7.8 | 6.3 | 6.1 | 7.9 | 7.8 | 6.5 | 5.0 | 7.5 | 7.6 | 6.6 | 7.2 |
| BOD | mg/l | 1.9 | 1.9 | 2.4 | 2.2 | 3.0 | 3.0 | 2.2 | 0.6 | 1.0 | 0.9 | 1 | 0.2 |
| COD | mg/l | 28.8 | 26.0 | 28.8 | 32.0 | 35.2 | 12.0 | 16.0 | 13.0 | 9.6 | 22.4 | 3.2 | 3.2 |
| Chloride | mg/l | 10.0 | 30.0 | 20.0 | 30.0 | 50.0 | 40.0 | 10.0 | 10.0 | 20.0 | 40.0 | 20 | 30.0 |
| Sulphate | mg/l | BDL | 1.6 | 19.7 | 12.1 | BDL | 6.4 | BDL | 6.4 | 16.5 | 31.4 | 60.64 | BDL |
| Phosphate | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Nitrate Nitrogen | mg/l | 0.11 | 0.04 | BDL | 0.10 | 0.19 | 0.19 | 0.18 | 0.08 | 0.04 | BDL | 0.13 | 0.2 |
| Amm. Nitrogen | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Alkalinity | mg/l | 20.0 | 50.0 | 60.0 | 40.0 | 50.0 | 80.0 | 60.0 | 20.0 | 20.0 | 60.0 | 20 | 20.0 |
| T.Hardness | mg/l | 24.0 | 60.0 | 80.0 | 60.0 | 60.0 | 90.0 | 50.0 | 30.0 | 40.0 | 80.0 | 90 | 40.0 |
| Ca. Hardness | mg/l | 10.0 | 40.0 | 10.0 | 30.0 | 20.0 | 60.0 | 20.0 | 10.0 | 30.0 | 60.0 | 50 | 30.0 |
| Mg. Hardness | mg/l | 14.0 | 20.0 | 70.0 | 30.0 | 40.0 | 30.0 | 30.0 | 20.0 | 10.0 | 20.0 | 40 | 10.0 |
| T D S | mg/l | 68.0 | 70.0 | 86.0 | 104.0 | 124.0 | 126.0 | 54.0 | 42.0 | 82.6 | 258.6 | 156.52 | 90.2 |
| T F S | mg/l | 42.00 | 36.00 | 54.00 | 82.00 | 94.00 | 80.00 | 60.00 | 68.00 | 68.00 | 180.00 | 112 | 108.0 |
| Fluoride | mg/l | 0.00 | 0.10 | 0.10 | 0.10 | 0.04 | 0.00 | 0.30 | 0.30 | 0.40 | 0.40 | 0.3 | 0.1 |
| Sodium | mg/l | 5.1 | 14.3 | 10.6 | 12.0 | 28.0 | 23.5 | 10.8 | 3.9 | 10.5 | 28.2 | 7.1 | 9.0 |
| Potasssium | mg/l | 0.5 | 1.5 | 2.4 | 4.1 | 2.2 | 1.4 | 1.9 | 1.2 | 1.1 | 3.8 | 1.2 | 1.1 |
| TSS | mg/l | 10.00 | 12.00 | 10.00 | 8.00 | 10.00 | 10.00 | 10.00 | 12.00 | 14.00 | 14.00 | 12 | 10.00 |
| Tcoli | No/100ml | 220 | 180 | 200 | 240 | 320 | 340 | 20 | 80 | 60 | 0 | 0 | 1400.0 |
| Fcoli | No/100ml | 120 | 60 | 120 | 120 | 160 | 220 | 0 | 40 | 20 | 0 | 0 | 700.0 |
| Boron | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| TKN | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |

Table 1.7 Analysis Report of Thondra 2016

| Parameters | Unit | MONTHS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
| PH | - | 7.0 | 6.8 | 7.3 | 6.9 | 7.8 | 7.0 | 6.9 | 7.5 | 7.9 | 7.3 | 7.2 | 7.6 |
| Conductivity | µS/cm | 52 | 94 | 87 | 81 | 90 | 58 | 54 | 56 | 45 | 57 | 76 | 75 |
| Turbidity | NTU | 0.1 | BDL | BDL | 10.0 | 0.4 | 0.6 | BDL | 0.6 | BDL | BDL | BDL | BDL |
| DO | mg/l | 7.1 | 5.7 | 5.2 | 6.7 | 4.7 | 7.9 | 6.8 | 7.9 | 7.4 | 6.1 | 6 | 5.3 |
| BOD | mg/l | 1.2 | 2.5 | 1.2 | 3.2 | 6.4 | 1.4 | 1.5 | 2.1 | 1.1 | 1.0 | 1.4 | 0.9 |
| COD | mg/l | 6.4 | 3.2 | 3.2 | 12.8 | 25.6 | 3.2 | 3.2 | 12.8 | 3.2 | 3.2 | 16 | 3.2 |
| Chloride | mg/l | 10.0 | 20.0 | 20.0 | 30.0 | 20.0 | 10.0 | 9.0 | 10.0 | 10.0 | 10.0 | 20 | 20.0 |
| Sulphate | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Phosphate | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Nitrate Nitrogen | mg/l | 0.12 | 0.05 | 0.06 | 0.03 | 0.02 | 0.10 | 0.12 | 0.16 | 0.15 | 0.13 | 0.14 | 0.1 |
| Amm. Nitrogen | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Alkalinity | mg/l | 10.0 | 30.0 | 20.0 | BDL | 20.0 | 20.0 | 150.0 | 10.0 | 10.0 | 10.0 | 30 | 20.0 |
| T.Hardness | mg/l | 20.0 | 50.0 | 40.0 | 30.0 | 30.0 | 20.0 | 20.0 | 20.0 | 20.0 | 20.0 | 40 | 40.0 |
| Ca. Hardness | mg/l | 10.0 | 20.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 20 | 20.0 |
| Mg. Hardness | mg/l | 10.0 | 30.0 | 30.0 | 20.0 | 20.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 20 | 20.0 |
| T D S | mg/l | 30.0 | 58.0 | 60.0 | 48.0 | 58.0 | 40.0 | 34.0 | 36.0 | 30.0 | 32.0 | 54 | 52.0 |
| T F S | mg/l | 22.00 | 38.00 | 46.00 | 36.00 | 46.00 | 22.00 | 20.00 | 28.00 | 18.00 | 20.00 | 36 | 40.0 |
| Fluoride | mg/l | 0.10 | 0.08 | 0.06 | 0.08 | 0.10 | 0.09 | 0.04 | 0.04 | 0.10 | 0.07 | 0.06 | 0.1 |
| Sodium | mg/l | 3.1 | 4.1 | 6.1 | 4.0 | 7.0 | 5.6 | 3.6 | 4.6 | 3.2 | 4.1 | 8.5 | 4.0 |
| Potasssium | mg/l | 1.8 | 1.4 | 1.8 | 2.2 | 1.8 | 1.5 | 1.1 | 0.9 | 1.1 | 1.8 | 1.2 | 1.7 |
| TSS | mg/l | 14.00 | 10.00 | 16.00 | 10.00 | 12.00 | 12.00 | 12.00 | 14.00 | 12.00 | 10.00 | 14 | 24.00 |
| Tcoli | No/100ml | 240 | 320 | 200 | 200 | 280 | 280 | 360 | 280 | 200 | 120 | 220 | 260.0 |
| Fcoli | No/100ml | 140 | 200 | 80 | 0 | 160 | 120 | 240 | 120 | 180 | 80 | 100 | 110.0 |
| Boron | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| TKN | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |

Table 1.8 Analysis Report of Thondra 2017

| Parameters | Unit | MONTHS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
| PH | - | 7.6 | 7.4 | 8.2 | 8.4 | 7.6 | 6.4 | 7.0 | 7.5 | 6.9 | 6.5 | 7 | 7.0 |
| Conductivity | µS/cm | 76 | 76 | 80 | 136 | 92 | 210 | 142 | 128 | 58 | 228 | 70.28 | 65 |
| Turbidity | NTU | BDL | BDL | BDL | BDL | BDL | 0.6 | BDL | BDL | BDL | BDL | BDL | BDL |
| DO | mg/l | 5.8 | 6.5 | 6.9 | 6.5 | 6.4 | 6.1 | 6.3 | 7.2 | 7.2 | 6.4 | 6.8 | 6.3 |
| BOD | mg/l | 0.7 | 0.9 | 1.8 | 1.4 | 1.4 | 1.5 | 1.0 | 1.0 | 1.1 | 2.2 | 0.4 | 2.5 |
| COD | mg/l | 3.2 | 32.0 | 32.0 | 6.4 | 9.6 | 9.6 | 19.2 | 16.0 | 12.8 | 25.6 | 6.4 | 28.8 |
| Chloride | mg/l | 20.0 | 20.0 | 12.0 | 10.0 | 20.0 | 70.0 | 30.0 | 20.0 | 10.0 | 60.0 | 10 | 16.0 |
| Sulphate | mg/l | BDL | BDL | BDL | BDL | BDL | 6.9 | 2.6 | 4.3 | 3.0 | 3.3 | BDL | BDL |
| Phosphate | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Nitrate Nitrogen | mg/l | 0.06 | 0.06 | 0.06 | 0.03 | 0.03 | 6.10 | 0.21 | 0.09 | BDL | 0.17 | 0.183 | 0.2 |
| Amm. Nitrogen | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Alkalinity | mg/l | 20.0 | 20.0 | 20.0 | 90.0 | 80.0 | 50.0 | 70.0 | 60.0 | 40.0 | 50.0 | 70 | 32.0 |
| T.Hardness | mg/l | 30.0 | 30.0 | 22.0 | 90.0 | 80.0 | 70.0 | 80.0 | 60.0 | 30.0 | 50.0 | 70 | 36.0 |
| Ca. Hardness | mg/l | 20.0 | 10.0 | 10.0 | 10.0 | 30.0 | 30.0 | 40.0 | 30.0 | 10.0 | 20.0 | 30 | 12.0 |
| Mg. Hardness | mg/l | 10.0 | 20.0 | 12.0 | 80.0 | 50.0 | 40.0 | 40.0 | 30.0 | 20.0 | 30.0 | 40 | 24.0 |
| T D S | mg/l | 54.0 | 54.0 | 48.0 | 96.0 | 62.0 | 144.0 | 88.4 | 72.8 | 40.0 | 159.6 | 48.84 | 44.0 |
| T F S | mg/l | 36.00 | 32.00 | 38.00 | 36.00 | 40.00 | 30.00 | 24.00 | 28.00 | 30.00 | 26.00 | 30 | 32.0 |
| Fluoride | mg/l | 0.04 | 0.10 | 0.06 | 0.05 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0.0 |
| Sodium | mg/l | 7.6 | 7.8 | 6.9 | 3.0 | 10.0 | 38.4 | 16.8 | 11.2 | 5.8 | 36.1 | 7 | 9.0 |
| Potasssium | mg/l | 2.0 | 1.2 | 1.0 | 2.9 | 2.8 | 1.9 | 1.7 | 3.3 | 1.3 | 1.9 | 0.7 | 0.7 |
| TSS | mg/l | 20.00 | 18.00 | 14.00 | 22.00 | 18.00 | 14.00 | 12.00 | 14.00 | 16.00 | 16.00 | 12 | 10.00 |
| Tcoli | No/100ml | 200 | 280 | 200 | 320 | 240 | 200 | 220 | 180 | 200 | 240 | 280 | 240.0 |
| Fcoli | No/100ml | 120 | 120 | 100 | 200 | 160 | 100 | 100 | 90 | 120 | 100 | 180 | 140.0 |
| Boron | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| TKN | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |

Table 1.9 Analysis Report of Thondra 2018

| Parameters | Unit | MONTHS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC |
| PH | - | 6.7 | 7.4 | 6.9 | 7.6 | 7.0 | 6.7 | 7.2 | 7.1 | 7.6 | 7.6 | 7.1 | 7.1 |
| Conductivity | µS/cm | 79 | 74 | 148 | 130 | 102 | 156 | 59 | 62 | 27 | 180 | 110.94 | 191 |
| Turbidity | NTU | BDL | BDL | BDL | BDL | 0.5 | BDL | BDL | BDL | BDL | BDL | 1.2 | 1.1 |
| DO | mg/l | 6.9 | 7.6 | 6.8 | 3.7 | 7.9 | 1.1 | 6.9 | 6.6 | 7.2 | 5.7 | 7.5 | 6.8 |
| BOD | mg/l | 0.1 | 2.0 | 2.5 | 1.9 | 2.0 | 0.6 | 2.9 | 0.5 | 0.9 | 0.2 | 0.9 | 1.1 |
| COD | mg/l | 25.6 | 24.0 | 24.0 | 22.4 | 25.6 | 16.0 | 16.0 | 13.0 | 6.4 | 12.8 | 22.2 | 19.2 |
| Chloride | mg/l | 10.0 | 30.0 | 20.0 | 30.0 | 30.0 | 40.0 | 10.0 | 10.0 | 20.0 | 20.0 | 20 | 60.0 |
| Sulphate | mg/l | BDL | 10.2 | 34.6 | 1.0 | 0.8 | BDL | BDL | 8.9 | 10.5 | 9.8 | 5.39 | 9.5 |
| Phosphate | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Nitrate Nitrogen | mg/l | 0.14 | 0.00 | BDL | 0.07 | 0.19 | 0.20 | 0.17 | 0.07 | 0.03 | 0.00 | 0.13 | 0.2 |
| Amm. Nitrogen | mg/l | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| Alkalinity | mg/l | 24.0 | 50.0 | 70.0 | 40.0 | 30.0 | 90.0 | 50.0 | 30.0 | 20.0 | 30.0 | 40 | 10.0 |
| T.Hardness | mg/l | 26.0 | 60.0 | 100.0 | 45.0 | 40.0 | 90.0 | 40.0 | 40.0 | 30.0 | 50.0 | 60 | 40.0 |
| Ca. Hardness | mg/l | 12.0 | 20.0 | 20.0 | 20.0 | 10.0 | 50.0 | 30.0 | 20.0 | 20.0 | 40.0 | 30 | 30.0 |
| Mg. Hardness | mg/l | 14.0 | 40.0 | 80.0 | 25.0 | 30.0 | 40.0 | 10.0 | 20.0 | 10.0 | 10.0 | 30 | 10.0 |
| T D S | mg/l | 46.0 | 44.0 | 104.0 | 92.0 | 72.0 | 110.0 | 42.0 | 42.0 | 68.0 | 110.4 | 78.26 | 132.4 |
| T F S | mg/l | 24.00 | 28.00 | 60.00 | 68.00 | 72.00 | 60.00 | 52.00 | 64.00 | 62.00 | 58.00 | 48 | 112.0 |
| Fluoride | mg/l | 0.00 | 0.20 | 0.10 | 0.10 | 0.08 | 0.02 | 0.50 | 0.40 | 0.30 | 0.30 | 0.4 | 0.2 |
| Sodium | mg/l | 6.6 | 14.0 | 12.6 | 14.0 | 16.0 | 23.5 | 42.0 | 4.3 | 10.8 | 7.7 | 3.6 | 27.2 |
| Potasssium | mg/l | 0.7 | 3.1 | 2.4 | 3.4 | 2.6 | 1.7 | 1.8 | 1.2 | 3.1 | 0.9 | 1.3 | 1.2 |
| TSS | mg/l | 18.00 | 14.00 | 12.00 | 12.00 | 10.00 | 10.00 | 10.00 | 12.00 | 16.00 | 11.00 | 14 | 14.00 |
| Tcoli | No/100ml | 160 | 220 | 240 | 280 | 240 | 280 | 20 | 80 | 60 | 0 | 600 | 800.0 |
| Fcoli | No/100ml | 80 | 80 | 160 | 140 | 120 | 180 | 0 | 20 | 20 | 0 | 200 | 400.0 |
| Boron | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| TKN | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |

Table 1.10 Water Quality Data of River Manimala at Kalloopara-Thondra in January 2019

| Date of Sampling | Station | Temp ($^0$C) | pH | Conductivity (µmhos/cm) | DO (Mg/L) | BOD (Mg/L) | TC (MPN/100ml) | FC (MPN/100ml) |
|---|---|---|---|---|---|---|---|---|
| **January** 04.01.19 | Kallopara | 28 | 7.4 | 80.1 | 6.4 | 1.6 | 100 | 50 |
| | Thondra | 27 | 7.4 | 84.21 | 6.8 | 2 | 400 | 200 |
| **February** 05.02.19 | Kallopara | 28 | 7.3 | 196.2 | 7.4 | 1.3 | 700 | 450 |
| | Thondra | 27 | 7.1 | 222.24 | 7 | 1.7 | 600 | 400 |
| **March** 05.03.19 | Kallopara | 32 | 7.9 | 284.26 | 5.4 | 1.3 | 800 | 480 |
| | Thondra | 32 | 6.9 | 304.14 | 7 | 2.3 | 700 | 300 |
| **April** 02.04.19 | Kallopara | 32 | 7.6 | 286 | 5.5 | 2.4 | 400 | 180 |
| | Thondra | 32 | 7.4 | 261.24 | 6.1 | 1.7 | 1200 | 800 |
| **May** 03.05.19 | Kallopara | 32 | 7.5 | 304.24 | 6.2 | 2.9 | 800 | 400 |
| | Thondra | 32 | 7.6 | 278.24 | 6.1 | 1.8 | 700 | 370 |
| **June** 01.06.19 | Kallopara | 29 | 7.5 | 330.18 | 6.5 | 2.3 | 400 | 240 |
| | Thondra | 29 | 7.6 | 274.25 | 5.8 | 2.4 | 700 | 350 |

## Annexure -4

## MINUTES OF DISTRICT LEVEL TECHNICAL COMMITTEE MEETINGS FOR REJUVENATION OF POLLUTED STRETCHES IN ALAPPUZHA DISTRICT

Based on the orders of the Hon'ble National Green Tribunal (NGT) and other related document, Government of Kerala, vide G.O.(Ms) No.2/2019/WRD dated 30/04/2019, constituted a District Level Committee for preparing an action plan for rejuvenation of polluted stretches in each district. The committee in Alappuzha district is constituted as follows.

1. Mr.Biju B., Environmental Engineer, Kerala State Pollution Control Board, Alappuzha
2. Smt. Rekha R., Superintending Engineer, Kuttanadu Division Circle, Chenganoor
3. Smt.Lovely M. V., District Industrial Centre
4. Mr. Sabeer A. Raheem, Executive Engineer, Kerala Water Authority, Alappuzha
5. Mr. K. S. Rajesh, District Coordinator, Haritha Kerala Mission, Alappuzha
6. Mr. Sheri G., Municipal Secretary, Chenganoor
7. Smt. Sreekala S. L., Assistant Scientist, Kerala State Pollution Control Board, Alappuzha
8. Smt Geetha, P. A. to Executive Assistant, Irrigation Department, Alappuzha

### 1ST MEETING OF THE DISTRICT LEVEL TECHNICAL COMMITTEE (DLTC) ON 02-05-2019

The first meeting of the committee (DLTC) was held at 11 am on 02-05-2019 at the District Office of the Pollution Control Board (PCB) at Alappuzha. In this meeting, the members expressed the need of two-week time for checking the facts and details available in various department before the preparation of action plans for Manimala River ( Kalloopara-Thondrastrech ) and Pamba River (Mannar-Thakazhi. It was also decided to conduct the next meeting on 22-05-2019 at office of the PCB, Alappuzha for evaluating the rate of pollution in these rivers and the importance of solid waste treatment plant for river protection. It was concluded that the members should carefully consider this matter in the perspective of the respective departments and should present their findings in the next meeting.

## 2ND MEETING OF DLTC DATED 22-05-2019

The meeting was held at 3 pm on 22-05-2019 at the District Office of the Pollution Control Board (PCB) at Alappuzha. The decisions taken in this meeting is as follows:

- It was decided to submit the details of various intake points of Water Authority in the district to the office of PCB, Alappuzha through e-mail for measuring the water quality at these intake points.
- Prepare the master plan for rejuvenating the contaminated streams in the district.
- The members of the meeting reiterated the need and necessity for scientific solid/liquid waste treatment facility in the district for effective prevention of the uncontrolled pollution in public water resources.
- It was unanimously decided that the actions required for preserving the water quality of Manimala river has already been taken and analysis report of last three year shows that the BOD level is well within the limit. So the matter may be reported to NGT.

## 3RD MEETING OF THE DLTC DATED 15-07-2019

The third meeting of the committee (DLTC) was held at 11:30 am on 15-07-2019 at the Collector's Chamber, Collectrate, Alappuzha. The main topic of discussion was Pollution prevention and conservation of Kalloopara-Thondra stretch of Manimala river. It is informed to the members that as per NGT direction CPCB has insisting a report for the conservation of the sipulated stretch of manimala river even if it is not polluted. Different suggestions were made by different members for the prevention and conservation of this river stretch. It was decided to conduct a field visit on 16-07-2019 to Kalloopara-Thondra area for preparing a preventive action report incorporating the suggestions and perspective of all member departments.