KERALA ENGINEERING RESEARCH INSTITUTE

കേരള എഞ്ചിനീയറിംഗ് റിസർച്ച് ഇൻസ്റ്റിറ്റ്യൂട്ട്

An Institute of Irrigation Department Under Ministry of Water Resources, Govt. of Kerala

Annual Report

2020 - 2021

Annual Report

2020 – 21

Kerala Engineering Research Institute, Peechi

Publication No. 83

THE EDITORIAL COMMITTEE

C O N T E N T S

PREFACE

The Kerala Engineering Research Institute, established in 1960, is one of the pioneering institutes of its kind in our country. The first Prime Minister of India, Sri. Jawaharlal Nehru laid the foundation stone of the Institute and it was inaugurated by the then Governor of Kerala, Sri. Ramakrishna Rao, with a mandate for seeking solutions to Engineering problems which would arise at different stages of planning and execution of development projects in the field of Irrigation, Navigation, Roads and Bridges and Buildings as well. This is the only Research Institute functioning under Kerala StateIrrigation department. This Institute is publishing its Annual Report every year.

This report has been prepared to provide a brief record of the activities of the Institute during this Financial Year. Details of the organizational set up, personnel, activities of each divisions and the abstract of Financial Statement are included.

This institute is a member of Higher Education Council and involving the formulation of policy decisions. Being a member, the Institute also supporting all technical guidance to coastal studies and protection works. This institute is also listed as a registered Institute for research studies of Calicut University. The institute facilitates training to Engineers and overseers from Irrigation department in Civil Engineering field.

During the year 2020-21, an amount of Rs. 28,00,349/- has been collected as revenue. Out of the total outlay of Rs.99.65 lakhs for this financial year, an amount of Rs.91.11 lakhs (including spillover) has been utilized.

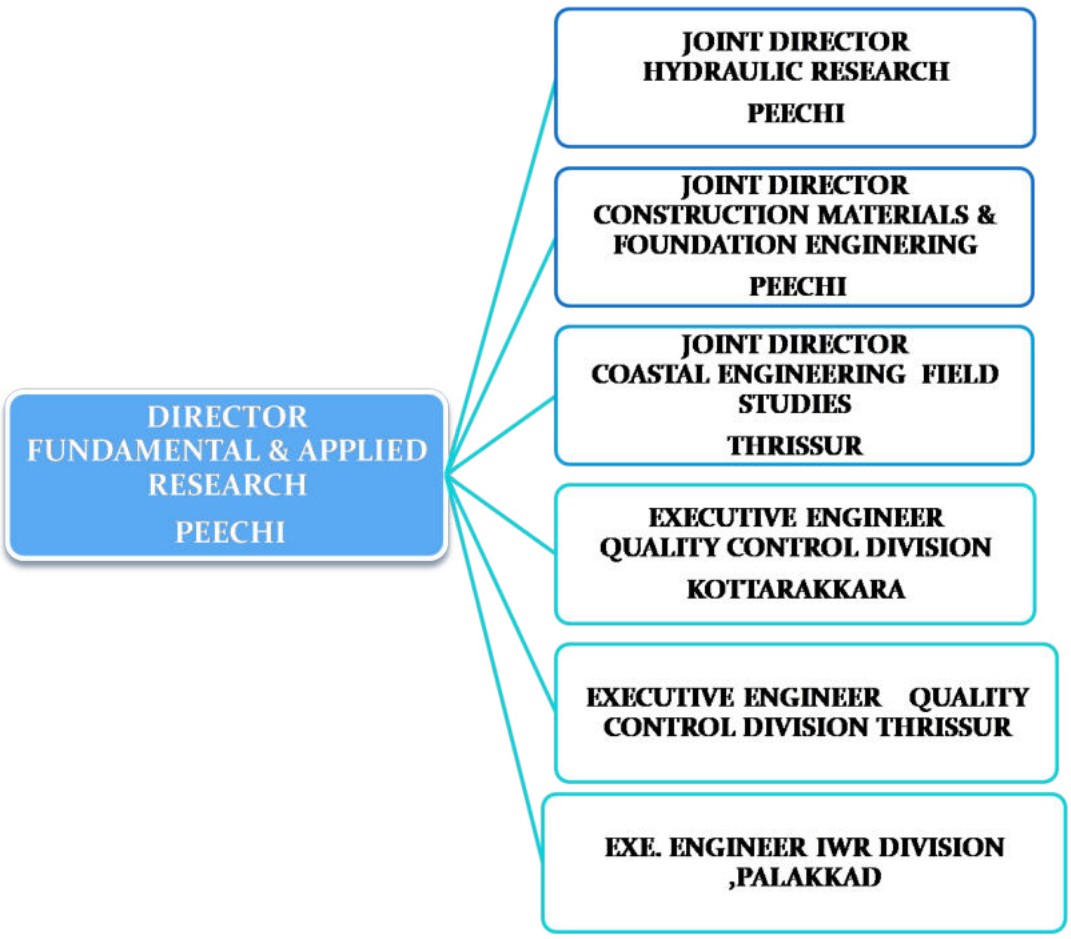
Peechi,

Director

1. ORGANISATIONAL SET UP

The Kerala Engineering Research Institute is under the Directorate of Fundamental & Applied Research, KERI, Peechi headed by the Director in the rank of Superintending Engineer, with two divisions functioning at Peechi, i.e., the Hydraulic Research and the Construction Materials & Foundation Engineering Division and another division namely the Coastal Engineering Field Studies Division at Thrissur, each headed by a Joint Director, an officer in the rank of an Executive Engineer. The Directorate Institute is under I.D.R.B of Water Resources Department under the Chief Engineer, Investigation & Design (IDRB), Thiruvananthapuram.

The organizational set up of each Division is as follows:



I. Joint Director, Hydraulic Research

1. Hydraulics Division
2. Sedimentation Division
3. Coastal Engineering Division

II. Joint Director, CM&FE

1. Construction Materials Division
2. Soil Mechanics and Foundations Division
3. Instrumentation Division
4. Publications Division

III. Joint Director, Coastal Engineering Field Studies, Thrissur

1. Coastal Erosion studies Subdivision, Kozhikkode
2. Coastal Engineering Studies Subdivision, Ernakulam
3. Coastal Engineering Studies Subdivision, Kollam

IV Executive Engineer, Quality Control Division, Thrissur

1. Quality Control Sub Division, Kannur
2. Quality Control Sub Division, Kozhikkode
3. Quality Control Sub Division, Palakkad
4. Quality Control Sub Division, Thrissur
5. Quality Control Sub Division, Muvattupuzha

V Executive Engineer, Quality Control Division, Kottarakkara

1. Quality Control Sub Division, Kottyam
2. Quality Control Sub Division, Alappuzha
3. Quality Control Sub Division, Kottarakkara
4. Quality Control Sub Division, Thiruvananthapuram

VI Executive Engineer, Investigation for Water Resources Division

1. Investigation for Water Resources Sub Division, Palakkad
2. Investigation for Water Resources Sub Division, Thrissur

The first three divisions are doing research works, laboratory testing and collection of field data related to their respective fields and present valuable results and also analyses results having significant implications in different fields of Civil Engineering and Water Resources Management. Each subdivision has a Deputy Director in the rank of an Assistant Executive Engineer as its head and one or two Assistant Directors in the rank of Assistant Engineer to assist in the research activities.

The Quality Control wing attached to this Directorate has been constituted for the purpose of quality assurance of works of Irrigation Department. The jurisdiction of this wing is all over Kerala. There are 18 sections, under 9 Sub divisions, at Thiruvananthapuram, Kollam, Kottarakkara, Pathanamthitta, Allappuzha, Idukki, Kottayam, Aluva, Moovattupuzha, Koothattukulam, Angamaly, Thrissur, Palakkad, Malappuram, Kozhikode, Kalpetta, Kannur and Kasaragod.

Investigation Division for Water Resources Division, Palakkad is a newly formed office, under the control of Chief Engineer, IDRB and the Director, F & AR, KERI, Peechi, is functioning at Palakkad. There are two sub Divisions under this office, one is at Palakkad and other is at Thrissur. There are seven section offices under these two sub divisions.

2. PERSONNEL

The Executive officers who headed the various offices under KERI during the financial year 2020-21 are:

DIRECTORATE OF FUNDAMENTAL & APPLIED RESEARCH		
DIRECTOR	:	Er.Alice Thomas (from 01/04/2020 to 31/05 /2020)
		Er.Poorna S Y (Full additional charge from 01/06/2020 to 06/07/2020)
		Er. Sudha M S (Full additional charge from 06/07/2020 to 06/09/2020)
		Er.Sindhu .B .(from 07/09/2020 FN to 20/ 02/2021 FN)
		Er. Suprabha. N (from 20/02/2020 FN Onwards)
ASSISTANT DIRECTOR		Er. Naveen. C.L (from 01/04/2020 to 31/03/2021)
JOINT DIRECTOR, CONSTRUCTION MATERIALS & FOUNDATION ENGINEERING		
JOINT DIRECTOR	:	Er.Poorna . S.Y (from 1/04/2020 to 03/07/2020)
	:	Er.Saji Samuel (from 04/07/2020 to 20/08/2020 FN)
	:	Er..Beena N (from 20/08/2020 AN to 31/03/2021)
ASSISTANT DIRECTOR	:	Er. Smitha V.R. (from 1/04/2020 to 02/12/2020)
	:	Er. Joyal Scaria (Full addl Charge from 02/12/2020 to 21/12/2020)
	:	Er. Jomy Joseph (Full addl Charge from 22/12/2020 to 22/02/2021)
	:	Er. Rappai V V (Full addl Charge from 22/2/2021 to 05/03/2021)
		Er. Smitha V.R. (from 05/03/2021 onwards)
CONSTRUCTION MATERIALS DIVISION		
DEPUTY DIRECTOR		Er. Mini T.M.(Full additional charge from 01/04/2020 to 31/05/2020)
	:	Er. Ajith Kumar T.V. (01/06/2020 to 31/03/2021)
ASSISTANT DIRECTOR I	:	Er. Siji T.V. (from 01/04/2020 to 31/03/2021)
ASSISTANT DIRECTOR II		Er. Rappai V.V. (from 01/04/2020 to 31/03/2021)
SOIL MECHANICS AND FOUNDATIONS DIVISION		
DEPUTY DIRECTOR	:	Er. Mini T.M. (from 01/04/2020 to 31/05/2020)
		Er. Saji Samuel (Addl.Charge from 01/06/2020 to 06/09/2020)
		Er. Remeshkumar.T.V (from 07/09/2020 to 31/03/2021)
ASSISTANT DIRECTOR I	:	Er. Joyal Scaria (from 01/04/2020 to 31/03/2021)

ASSISTANT DIRECTOR II	:	Er. Joyal Scaria (Addl. charge from 01/04/2020 to 29/04/2020)
	:	Er. Jomy Joseph (from 30/04/2020 to 31/03/2021)
INSTRUMENTATION DIVISION		
DEPUTY DIRECTOR	:	Saji Samuel (from 01/04/2020 to 18/09/2020)
		Er. Saju Varghese (from 23/10/2020 to 31/03/2021)
ASSISTANT DIRECTOR	:	Er. Sreedev.M.S (from 01/04/2020 to 31/03/2021)
PUBLICATIONS DIVISION	:	Post Abolished
HYDRAULIC RESEARCH		
JOINT DIRECTOR	:	Poorna S Y. (Full addl Charge from 01/04/2020 to 02/07/2020)
	:	Er. Shini K K (Full addl Charge from 03/07/2020 to 19/08/2020)
	:	Er.Suja.S.S (from 20/08/2020 Onwards)
ASSISTANT DIRECTOR	:	Er. Joy C C (from 01/04/2020 to 31/05/2020)
	:	Er. Nisha Antony (Full Addl charge 01/06/20 to 31/03/2021)
HYDRAULICS DIVISION		
DEPUTY DIRECTOR	:	Er.Subarban Beegum V (from 01/04/2020 to 31/03/2021)
ASSISTANT DIRECTOR I	:	Er. Sandeep M.N. (from 22/09/2020 to 31/03/2021)
ASSISTANT DIRECTOR II	:	Er. Nisha Antony (from 01/04/2020 to 31/03/2021)
SEDIMENTATION DIVISION		
DEPUTY DIRECTOR	:	Er. Shini K K (from 01/ 04/ 2020 to 18/09/2020)
	:	Er.Roshni S.S(Addl.Charge from 19/ 09/ 2020 to 09/11/2020 FN)
	:	Er.Divya C J (from 09/11/2020 AN to 31/03/2020)
ASSISTANT DIRECTOR I	:	Er. Francy V. Antony (from 01/04/2020 to 31/03/2021)
ASSISTANT DIRECTOR II	:	Er.Roshni S S (from 01/04/2020 to 31/03/2021)
COASTAL ENGINEERING DIVISION		
DEPUTY DIRECTOR	:	Er. Shini.K.K (Addl. Charge from 01-04-2020 to 06/09/20)
	:	Er Raji Thampan (from 07 /09/2020 to 31/3/21)
ASSISTANT DIRECTOR I	:	Er. Sufeera O.B.(from 01/04/2020 to 31/03/2021)
ASSISTANT DIRECTOR II	:	Er. Sufeera O.B.(Addl. Charge from 01/04/2020 to 31/03/2021)
COASTAL ENGINEERING AND FIELD STUDIES		
JOINT DIRECTOR	:	Er. Prema C K (from 01/04/2020 to 31/05/2020)
	:	Er. V K Govindhanunni (Full Addl Charge from 01/06/2020 to 05/07/2020)

	:	Er. Sudha M S (From 06/07/2020 to 07/09/2020)
	:	Er. V K Govindhanunni (Full Addl Charge from 07/09/2020 to 23/09/2020)
	:	Er. Ajmal. E (from 23/09/2020 onwards)
	:	Er. Ushakumari. B (From 01/04/2020 to 31/05/2020)
ASSISTANT DIRECTOR	:	Er. Ajantha V.D. (Full additional charge from 01/06/2020 to 31/03/2021)
COASTAL ENGINEERING SUB DIVISION, KOLLAM		
DEPUTY DIRECTOR	:	Er. Anjana S (from 01/04/2020 to 03/07/2020)
	:	Er. Rajeena M (from 04/0720 to 26/08/2020)
	:	Er. Raji C.T(from 27/08/2020 to 31/03/2021)
COASTAL ENGINEERING SECTION, TRIVANDRUM		
ASSISTANT DIRECTOR	:	Ajinsingh.S (from 01/04/2020 to 31/03/21)
COASTAL ENGINEERING SECTION, KOLLAM		
ASSISTANT DIRECTOR	:	Sri. S. J Shillar (From 01/04/2020 to 30/04/2020)
	:	Smt. ArshaNath.P.R (From 04/05/2020 to 16/07/2020)
	:	Er.Rajeena . M (from17/07/2020 to 31/03/21)
COASTAL ENGINEERING SECTION, THOTTAPPALLY		
ASSISTANT DIRECTOR		Er. Santhosh Kumar C (01/04/2020 to 23/07/2020)
		Er.Jayaprakash . D (from 24/07/2020 Onwards)
COASTAL ENGINEERING SUB DIVISION, ERNAKULAM		
DEPUTY DIRETOR	:	Sri. Rajesh.T.K. (from 01/04/2020 Onwards)
COASTAL ENGINEERING SECTION, ERNAKULAM		
ASSISTANT DIRECTOR	:	Er. Anusree A (from 01/04/2020 to 31/03/2021)
COASTAL ENGINEERING SECTION, CHERTHALA		
ASSISTANT DIRECTOR		Er. Clament Roy . K. R (from 01/04/2020 to 31/03/2021)
COASTAL ENGINEERING SECTION, CHAVAKKAD		
ASSISTANT DIRECTOR		Er. Ajantha V.D (from 01/04/2020 to 31/03/2021)
COASTAL EROSION STUDIES , SUB DIVISION, KOZHIKODE		
DEPUTY DIRECTOR	:	Er. Govindanunni.V.K .(from 01/04/2020 to 31/03/2021)
COASTAL EROSION STUDY SECTION, KOZHIKODE.		
ASSISTANT DIRECTOR	:	Er. Ammad.P.C (Full addl Charge from 01/04/2020 to 05/08/2020)
	:	Er. Jithin.P (From 06/08/2020 31/03/21)
COASTAL EROSION STUDIES SECTION, THALASSERY		
ASSISTANT DIRECTOR	:	Er. Ammad. P.C(Full addl charge from 01/04/2020 to

		14/02/2021)
	:	Er. Jithin.P, (Full addl charge 15/02/2021 to 31/03/21)
COASTAL EROSION STUDIES SECTION, PARAPPANANGADI		
ASSISTANT DIRECTOR		Er. Ammad.P.C (from 01/04/2020 onwards)
QUALTY CONTROL DIVISION, THRISSUR		
EXECUTIVE ENGINEER		Er. Jayarajan Kaniyeri (from 01/04/2020 to 22/02/2021)
	:	Er. Sajeev Kumar V S (from 22/02/2021 onwards)
ASSISTANT EXECUTIVE ENGINEERS		
Q.C. DIVISION, THRISSUR	:	Er. Deepa R (01/04/2020 to 31/03/2021)
Q.C. SUB DIVISION, MOOVATTUPUZHA	:	Er. Kamal Roy K V (01/04/2020 to 31/03/2021)
Q C SUB DIVISION , THRISSUR		Er. Babu M S (01/04/2020 to 31/03/2021)
QC SUB DIVISION , PALAKKAD		Er. Sudhakaran T.S (from 01/04/2020 to 31/03/2021)
QC SUB DIVISION , KOZHIKOD		Er. Rajeev B (From 01/04/2020 onwards)
QC SUB DIVISION, KANNUR		Er. Aravindakshan V.(from 01/04/2020 to 11/09/2020)
	:	Er. Sahadevan Chadayan (from 11/09/2020 onwards)
Q.C SECTION-I, MOOVATTUPUZHA		Er. Anila K.T. (Full addl charge from 01/04/2020 to 21/07/2020)
		Er. Gopu N (from 21/07/20 to 31/03/2021)
Q.C SECTION-II, KOOTHATTUKKULAM		Er. Anila K.T. (from 01/04/2020 to 15/11/2020)
		Er. Gopu N (Full Addl Charge from 16/11/2020 to 20/12/2020)
		Er. Anila K.T. (from 21/12/2020 to 31/03/2021)
Q.C SECTION-III, ANGAMALY		Er. Valsalakumari V.R (from 01/04/2020 to 15/11/2020)
		Er. Gopu N (Full Addl Charge from 16/11/2020 to 13/12/2020)
		Er. Valsalakumari V.R (from 14/12/2020 to 31/03/2021)
Q.C SECTION, THRISSUR		Er. Nirish P P (from 01/04/2020 to 14/03/2021)
		Er. Pathuvi P M (Full Addl Charge from 15/03/2021 to 31/03/2021)
Q.C SECTION, ERNAKULAM		Er. Pathuvi P M (from 01/04/2020 to 31/03/2021)
Q.C SECTION, PALAKKAD		Er. Sulaiman M. (Full addl charge from 01/04/2020 to 31/03/2021)
Q.C SECTION, MALAPPURAM		Er. Sulaiman M. (from 01/04/2020 to 31/03/2021)
Q.C SECTION, KOZHIKODE		Er. Girish Kumar . K (from 01/04/2020 to)
Q.C SECTION, WAYANAD		Er. Nirish P P (from 01/04/2020 to 31/03/2021)
Q.C SECTION, KANNUR		Er. Madhu K.P. (from 01/04/2020 to 31/05/2021)

		Er. Girish Kumar . K (Additional Charge from 31/05/2020 to 01/03/2021)
Q.C SECTION, KASARAGOD		Er. Madhu K.P. (Full addl charge from 01/04/2020 to 31/05/2020)
		Er. Girish Kumar . K (Additional Charge from 31/05/2020 to 01/03/2021)
QUALITY CONTROL DIVISION, KOTTARAKKARA		
EXECUTIVE ENGINEER	:	Er. Abdul Manafh (from 01/04/2020 to 31/05/2020)
	:	Er. Jolly Susan Cheriyan (Full Addl Charge from 01/06/2020 to 14/07/2020)
	:	Er. Sindhu R (from 15/07/2020 to 31/03/2020)
QUALITY CONTROL SUB DIVISION, KOTTARAKKARA		
ASSISTANT EXECUTIVE ENGINEERS	:	Er. Jolly Susan Cheriyan (from 01/04/2020 to 14/07/2020)
		Er. Maya.C.V (full addl charge from 15/07/2020 to 06/08/2020)
		Er. B Deepa (full addl charge from 07/08/2020 to 11/08/2020)
		Er. Sheeja Panicker (full addl charge from 12/08/2020 to 03/09/2020)
		Er. Laly S S Cheriyan (from 03/09/2020 to 06/09/2020)
		Er. Sheeja Panicker (full addl charge from 05/11/2020 to 13/11/2020)
		Er. Laly S S Cheriyan (from 14/11/2020 to 02/02/2021)
		Er. Sheeja Panicker (full addl charge from 03/02/2021 to 31/03/2021)
QUALITY CONTROL SECTION, KOTTARAKKARA		
ASSISTANT ENGINEER		Er.Maya C.V (from 01/04/2020 to 06/08/2020)
		Er. B. Deepa (full addl charge 07/08/2020 to from 11/08/2020)
		Er. Sheeja Panicker (from 12/08/2020 to 31/03/2021)
QUALIYY CONTROL SUB DIVISION, THIRUVANANTHAPURAM		
ASSISTANT EXECUTIVE ENGINEER	:	Er. Aswini Kumar S (from 1/04/2020 to 24/08/2020)
		Er.Leenakumari P. S. (from 25/08/2020 to 31/03/2021)
QUALITY CONTROL SUB DIVISION, KOTTAYAM		
ASSISTANT EXECUTIVE ENGINEER	:	Er. Mollykutty Emmanuel (from 01/04/2020 to 19/08/2020)
	:	Er. Manjusha N K (Full addl Charge from 20/08/2020 to 04/09/2020)
	:	Er. Aravind .G (Full addl Charge from 05/09/2020 to 06/09/2020)

	:	Er. Merin Thomas (Full addl Charge from 07/09/20 to 31/03/2021)
QUALITY CONTROL SUB DIVISION, ALAPPUZHA		
ASSISTANT EXECUTIVE ENGINEER	:	Er. Sabu C D (from 01/04/2020 to 17/07/2020)
	:	Er.Lathakumari.K (full addl charge from 17/07/2020 to 29/07/2020)
	:	Er. Anjana S (full addl charge from 29/07/2020 to 25/08/2020)
	:	Er. Jessy Thomas (from25/08/2020 onwards)
Q.C. SECTION , PATHANAMTHITTA	:	Er.Sindhu K S (from 01/04/2020 to 09/11/2020)
	:	Er.Suji R Chandran (from 09/11/2020 to 26/02/2021)
	:	Er.Deepa B (from 26/02/2020 onwards)
Q.C,SECTION , ALAPPUZHA	:	Er.Lathakumari.K (from 01/04/2020 to 29/07/2020)
	:	Er. Anjana S (from 29/07/2020 onwards)
Q.C SECTION, PATHANAMTHITTA	:	Er.Sindhu K S (from 01/04/2020 to 09/11/2020)
	:	Er.Suji R Chandran (from 09/11/2020 to 26/02/2021)
	:	Er.Deepa B (from 26/02/2020 onwards)
Q.C SECTION, TVPM	:	Er.Renjini Gopinadh (from 01/04/2020 to 31/03/2021)
Q.C SECTION, KOLLAM	:	Er.B Deepa (from 01/04/2020 to 23/02/2021)
	:	Er.Bindhu R (from 24/02/2021 to 31/03/2021)
Q.C SECTION, KOTTAYAM	:	Er. Manjusha N K (from 01/04/2020 to 04/09/2020)
	:	Er. Aravind. G (full adl charge from 05/09/2020 to 02/11/2020)
	:	Er. Joseph Nelson P J (full addl charge from 03/11/2020 to 31/03/2021)
Q.C SECTION, IDUKKI	:	Er. Aravind. G (from 05/09/2020 to 02/11/2020)
	:	Er. Joseph Nelson P J (from 03/11/2020 to 31/03/2021)
INVESTIGATION FOR WATER RESOURCES DIVISION, PALAKKAD		
EXECUTIVE ENGINEER	:	Er.Unnikrishnan K V (from 18/02/2021 to 31/03/2021)
ASSISTANT EXECUTIVE ENGINEER	:	Er. Binni Sukumaran (from 18/02/2021 to 31/03/2021)
IWR SUBDIVISION No.1, PALAKKAD		
ASSISTANT EXECUTIVE ENGINEER	:	Er. Deepa S (From 18/02/2021 to 31/03/2021)
IWR SUBDIVISION NO.2, THRISSUR		
ASSISTANT EXECUTIVE ENGINEER	:	Er. Rajashree R (From 18/02/2021 to 31/03/2021)
ASSISTANT ENGINEERS		

IWR SECTION 1/1, PALAKKAD	:	Er. Anil Kumar (from 18/02/2021 to 25/02/2021)
	:	Er.Hareesh K (Full addl Charge from 25/02/2021 to 31/03/2021)
IWR SECTION 2/1, NILAMBUR	:	Er.Hareesh K (from 18/02/2021 to 31/03/2021)
IWR SECTION 3/1, AGALI	:	Er.Hareesh K (Full addl Charge from 18/02/2021 to 31/03/2021)
IWR SECTION 4/1, KOZHIKODE	:	Er.Hareesh K (Full addl Charge from 18/02/2021 to 31/03/2021)
IWR SECTION 1/2, THRISSUR	:	Er.Sheena Mary George (from 18/02/2021 to 03/03/2021)
	:	Er.Hareesh K (Full addl Charge from 04/03/2021 to 31/03/2021)
IWR SECTION 2/2, PEECHI	:	Er.Sheena Mary George (from 18/02/2021 to 03/03/2021)
	:	Er.Hareesh K (Full addl Charge from 04/03/2021 to 31/03/2021)
IWR SECTION 3/2, MALAPPURAM	:	Er.Sheena Mary George (from 18/02/2021 to 03/03/2021)
	:	Er.Hareesh K (Full addl Charge from 04/03/2021 to 31/03/2021)

3. HUMAN RESOURCES

The human resources of KERI comprise of both technical and non-technical personnel. During its prime, majority of the engineers working in KERI were post graduates in different disciplines of Civil Engineering. The number of fundamental researches was carried out during the period, bear witness to this. KERI was well known all over India and abroad for the research works and experimental studies carried out in this institute, especially in the field of Coastal engineering. In the past three decades, no significant fundamental studies have been carried out and the labs have gradually degenerated to the status of mere testing centres.

At present, out of the fourteen posts of Assistant Engineers, One post are lying vacant. The number of supporting technical staff in the category of draftsman is Twenty One against a sanctioned strength of twenty-five. In the workers category, as it happens to be a vanishing category, just two workers are available at present. Workers are hired on contract basis or on daily wages as per requirement.

However, a sincere and commendable effort is being made by the staff to take up all the projects assigned to it. The vacancy position of KERI is attached as Appendix – I.

4. FUNCTIONING OF THE INSTITUTE

The Kerala Engineering Research Institute consists of seven divisions functioning at Peechi as well as Coastal Engineering and Field studies Division at Thrissur and Quality Control wing of the Irrigation Department. Generally, the activities of each division can be categorized as falling under Routine activities, Fundamental studies and Revamping and Modernization. The routine activities and fundamental studies conducted by each division are enumerated in this chapter.

A. HYDRAULICS DIVISION

A.1. Introduction

Hydraulics division works under Hydraulic Research. Studies on various problems in Applied Hydraulics and Irrigation Engineering are taken up by Hydraulics division and solutions are proposed by the division for the same. The division played an important role in conducting the model studies for major irrigation and hydro electric projects in the state. The studies are conducted on a wide range of parameters related to spillways, sluices, chutes, energy dissipating arrangement, hydraulic behavior of canal structures, river training works etc. From these studies hydraulically sound and economically viable solutions are provided to various problems associated with projects.

There are two model areas under this division which includes a number of previous extensive project models. The maintenance work of this model area is done by this division. The hydraulic models in these model areas help the students to study about dams and also increase possibility of tourism. The division also maintains a three dimensional model of Kerala and it is a centre of attraction in Peechi with lot of people visiting there.

Hydraulics division had the facility previously for calibration of the current meter and it was stopped long years ago due to damage of the testing facility. The renovation work of test facility of calibration of current meter is included in the next action plan which will enable KERI to provide this service for Irrigation department. The division has notch calibration

facility. The duty of operating internet infrastructure facilities of all offices in KERI is entrusted for this office.

Apart from hydraulic studies, the division maintains a meteorological station. It is located on the west bank of Peechi dam, near Peechi House. From the station, measurements of weather parameters such as atmospheric pressure, temperature (Min.& Max), humidity, rainfall, evaporation ,wind speed ,wind direction and sunshine are observed using manual meteorological observations and automatic weather station. The monthly weather data as obtained is submitted to the Joint Director, Director and Superintending Engineer Hydrology, every month.

2. Staff pattern

The division is headed by a Deputy Director and the technical cadre comprises of two Assistant Director, two Research Assistants, one Second Grade Overseer and one Third Grade Overseer. The total sanctioned strength of the office is 9. The present staff details are given below.

Deputy Director	:	Er. Suhurban BeegumV (from 23/11/2018 FN onwards)
Assistant Director	:	1. Er. Sandeep M.N. (from 22/09/2020 FN onwards) 2. Er. Nisha Antony (from 25/01/2019AN onwards)
Research Assistant	:	1. Smt. Rainy A A(from 31/08/2017 onwards) 2. Mr. Radheesh K. (from01/01/2021 onwards)
Second Grade Overseer	:	Smt. Basuna Balakrishnan (from 16/06/2017 onwards)
Third Grade Overseer	:	Kumari Chaithanya M. S. (from 02/11/2019 onwards)
Clerk cum Typist	:	Smt. Radha. M.V
Part time sweeper	:	Vacant

3. Activities for the year 2020-21

During the year 2020-21, with sanctioned budget of 15.04 lakhs, following were the major activities of the division.

i. Hydraulic studies

- Urgent works for initial setting up at Model Lab for starting model study
- Model study of Kuttiyadi Dam

ii. Lab Infrastructure

- Maintenance of Instrumentation workshop building for using as a model lab

iii. Instrumentation
- Maintenance of Meteorological station -Replacing sensors of Automatic Weather Station (AWS)

iv. Routine works of the division
- Routine Maintenance of Model Area I & II for the year 2020 -21
- Routine Maintenance of Kerala Model and building housing Model for the year 2020-21
- Routine works of Hydraulics division office and Meteorological stations for the year 2020-21

3.1 Meteorological Station, KERI, Peechi

Weather observations are necessary to improve meteorological services in the state and enhance the predictive capability of short and long-term information for weather forecasts and climatic changes. The weather data is used for the real-time preparation of weather analysis, forecasts and severe weather warnings, for the study of climates, for local weather dependent operations, for hydrology and agricultural meteorology and for research in meteorology and climatology. The meteorological Station under K E R I, Peechi is located on the west bank of Peechi Dam, near the Peechi House at a latitude of 10º 31'30'' N, longitude 76º 21' 59'' E and height above MSL +96.03 m. The station is equipped with instruments fro manual weather observations and an automatic weather station (AWS) for recording different weather parameters. The weather parameters are observed and recorded daily at 8.30 AM. The station is equipped with the instruments for measuring manually the weather parameters namely Atmospheric Pressure, Temperature, Humidity, Rainfall, Evaporation, Wind speed, Wind direction and Bright Sunshine.

-

Meteorological Station, KERI, Peechi

3.1.1 Automatic Weather Station

As part of modernization, an automatic weather station was installed in June 2014. Time series observations are vital to improve the understanding of weather dynamics and its variability. The automatic weather station (AWS) plays an important role in providing short term and long-term time series weather observations. Automatic weather station is functioning with a solar panel for uninterrupted power supply. During the period 2020-21 the sensors of the AWS were replaced.

The Automatic Weather station collects data related to air temperature, air humidity, barometric pressure, ultrasonic wind speed, ultrasonic wind direction, global radiation and precipitation using different sensors. These data can be accessed using a software HYDRAS. The data collected can be used to gauge current weather conditions and to make weather forecasts like temperature high/lows, cloud cover and the probability of precipitation.

Components of Automatic Weather Station

1. Ultrasonic Wind speed and Direction sensor& Compass
2. Global Radiation Sensor
3. Temperature, Humidity, Barometric Pressure Sensors
4. Rain Gauge

5. Data Logger

Automatic Weather Station - Instruments

3.1.2 Manual Weather Station

Manual measurements of meteorological data are done using the following instruments.

- Temperature – Max & Min Thermometers & Bimetallic Thermograph
- Relative Humidity – Psychrometer (Dry & Wet bulb) & Hair Hygrometer
- Rainfall – Standard Rain Gauge, Self Recording Rain gauge
- Evaporation – Land Pan Evaporimeter
- Wind Direction – Wind Vane
- Wind Speed – Cup Anemometer
- Bright Sunshine – Sunshine Recorder

PSYCHROMETER

HAIR HYGROMETER

BIMETALLIC THERMOGRAPH

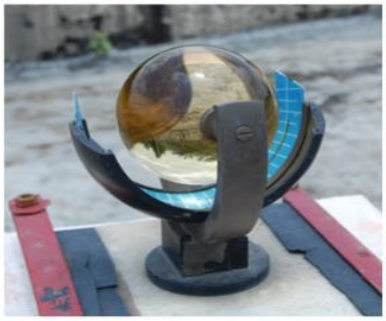
FLOAT TYPE SELF RECORDING RAIN GAUGE

STANDARD RAIN GAUGE

LANDPAN EVAPORIMETER

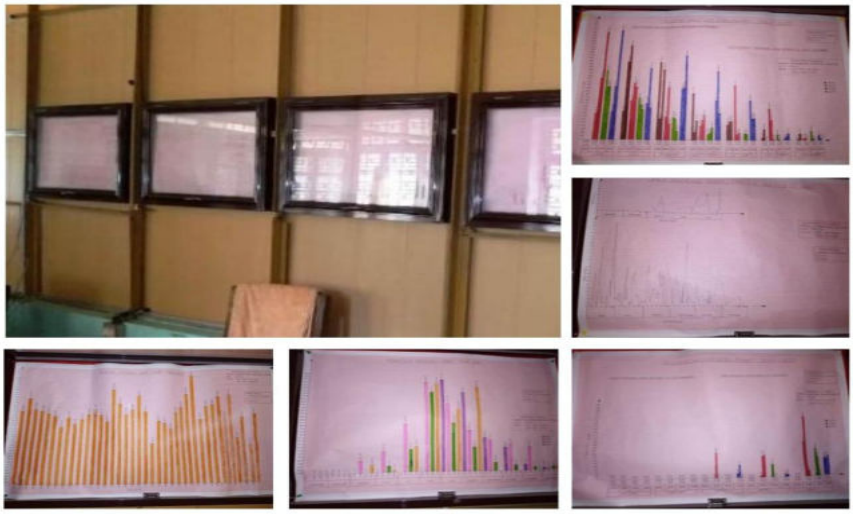
WIND VANE

CUP ANEMOMETER



SUNSHINE RECORDER

Weather Station- Instruments for manual recordings of weather data



Graph for temperature, annual rainfall, 10 days chart for rainfall, monthly chart for rainfall and etc.

3.2. Maintenance of 3D model of Kerala and the building housing the model

The Relief map of Kerala (Kerala model) at K.E.R.I. is a three dimensional model of Kerala and it is a centre of attraction in Peechi, with a lot of people visiting daily. Routine maintenance of the building had been done by this office regularly. In addition to this in this year, artistic painting of model and building was done by arranging a separate work through departmentally. 3D model of Kerala painted with colorful paints for each district and markings for National Highway, State Highway, Railway Line and Rivers with suitable colours. Three display boards also placed on walls of the building displaying details of rivers, and dams in Kerala and National Highways passing through Kerala State. Now this building was rectified and beautified and tourists are allowed to visit.


RELIEF MAP OF KERALA


കേരളത്തിലെ നദികൾ
പടിഞ്ഞാറോട്ടൊഴുകുന്നവ
കിഴക്കോട്ടൊഴുകുന്നവ

Kerala 3D Model after renovation

3.3 Maintenance and routine works of the Hydraulics division

The division conducted the routine works of Hydraulics division office, meteorological stations, routine maintenance of Kerala model & building housing model and routine maintenance of model area I & II for the year 2020 -21.The routine works include office maintenance, maintenance and service of instruments at meteorological station, maintenance and repair works for 3D Kerala model and maintenance and clearing of model areas. Also as part of the development of lab infrastructure for model study, maintenance and repair works of the instrumentation building was done by the division.

Kerala Engineering Research Institute consists of various offices located in the KERI campus. High speed and stable internet connection is essential for smooth functioning of these offices and their activities as most of the processes of the Department are being switched over to

the web platform. The payment of the annual charges for internet provided by BSNL and the routine maintenance and repair works of the internet facility is managed by this office.

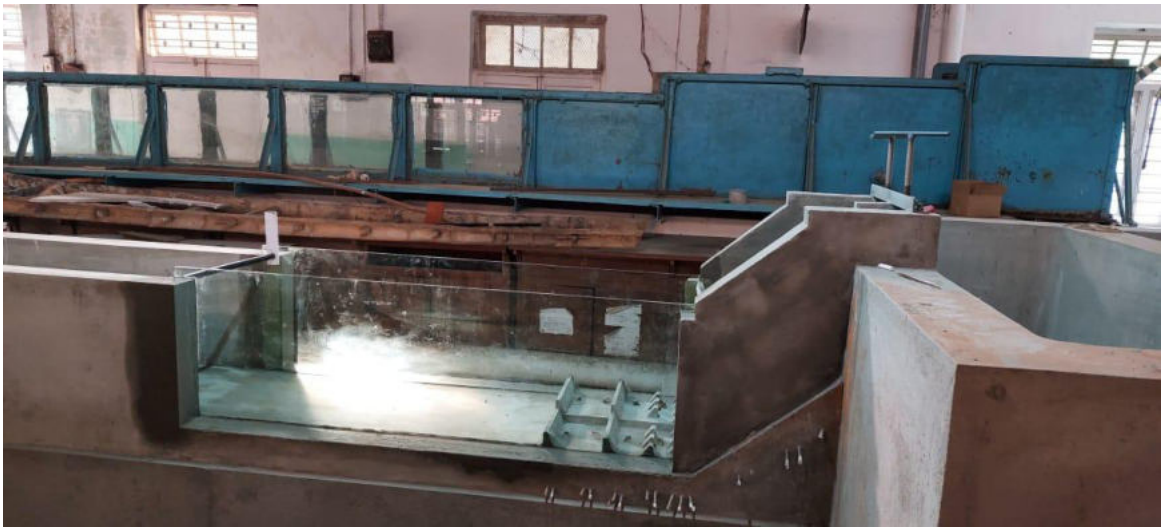
3.4 Initial setup and Physical Model Study of Kuttyadi Dam

The Chief Engineer I&A had instructed KERI to conduct the model studies of spillway and stilling basin of Kuttiyadi dam and the available details were collected from IDRB required to fix the scale of the physical model. As the division has not conducted any physical model studies for the past 15 years owing to different factors like retirement of experienced engineers, lack of skilled labourers etc., proposal for a proper regular guidance from experts was sought for executing the study. Experts in the field of Hydraulic model study from various institutions were contacted for assistance and guidance with regard to physical model study. Based on the enquiry experts from College of Engineering Trivandrum, Prof. Thulasidharan Nair B and Dr. Jayaraj P.G. were engaged as consultants in order to carry out the physical modelling for Kuttiyadi dam.The MoU was signed between CET and Director KERI for this consultation. The experts visited KERI and examined available facilities at lab and at model areas I and II. After discussing various possibilities to restart model study, Professors suggested setting up a dam model at the lab itself utilizing the overhead tank for water storage after maintenance.

Based on their technical advice an initial set up for conduction of physical model study of the dam was constructed in the hydraulics lab. The initial setup included waterproofing of overhead tank, setting up of water circulation system, underground sump for storing water etc.

Construction of Initial setup

Physical model of Kuttiyadi dam



Physical model of Kuttiyadi dam

After completion of the initial set up, the physical model of the spillway, shutters and dissipation system was constructed in a scale of 1:60 using Froude scale law. Out of the 4 bays of the spillway, two bays are constructed considering symmetry. For observing the pressure variations along the spillway profile, separate instrumentation is provided using pressure tappings. For observing the hydraulic jump formation glass panels were provided in the starting part of the side wall portion of the flume as shown in the image above.

3.5 Calibration of notches

Notches are used for measurement of discharge through open channels by placing or constructing them across the stream or channel. The discharge over notch is measured by measuring the head acting over the notch. The actual discharge and theoretical discharge will be equated using a suitable coefficient of discharge and a factor for the head of flow. The process of assessing these constants is called calibration. Once the equation relating discharge and head of flow over the notch is established by calibration experiment, the discharge at any point in a channel can be estimated by fixing the notch across the channel and measuring the head of flow.

Notch Calibration Facility

The notch calibration tank situated at outdoor Model Area I is generally used for the calibration of notches received from various irrigation projects of Kerala. In this year we have not received any new notches for calibration.

4.0 Proposals Submitted - Model studies for Banasurasagar reservoir

In connection with standardization of procedure for computation of discharge through various hydraulic structures of designated reservoirs in Cauvery basin by CWRC (Cauvery Water Regulation Committee), Chief Engineer, ISW had requested to submit a proposal for conducting model studies for Banasurasagar reservoir. After a field visit, a tentative estimate was submitted for physical model study of spillway, tunnel and river sluice. Further a final estimate for the model study of Banasurasagar reservoir was submitted for an amount of Rs.95,58,000/- (Ninety Five Lakh, Fifty Eight Thousand Only) which included the physical and numerical modelling of hydraulic structures in the reservoir.

Field visit at Banasurasagar reservoir

5.0 Papers Published

Paper titled "Assessment of Sedimentation in Reservoir - A Case Study" prepared by the division has been accepted for publication in the conference proceedings of *Virtual Conference on Disaster Risk Reduction - Civil Engineering for a Disaster Resilient Society* organized by NIT Surathkal, Karnataka and published by Springer.

B. COASTAL ENGINEERING DIVISION

B.1 Introduction

Coastal Engineering Division has been started functioning from the beginning of the Kerala Engineering Research Instituteitself.This division was established for the purpose of conducting research works on behavior of Kerala Coast.Several researches on coastal protection measures, experimental study of wave run up on beaches, experiments to evolve suitable artificial blocks, study on waves and currents, mud banks, wave action on beaches, littoral drifts, artificial nourishment,model study of fishing gaps, design of fishing harbours like Mopla bay, Ponnani, Vizhinjam etc. had been conducted by this division during 70's and 80's. Collection of wave data and observation of beach characteristics have been carried out at several stations along the Kerala coast in the new moon day of all month forassessing the changes of Kerala Coast over years. Among these stations, observations at two stations ie.atPadinjareVemballore and Anchangadi in KodungallurTaluk have been carried out by this division till December 2013.After wards these works have been transferred to Coastal Engineering Field Studies Division, Thrissur. Since then this division is engaged in **Topographical investigation with the aid of GNSS** for various irrigation structures.

As a part of modernization of Kerala Engineering Research Institute (KERI), a Smart Station from Leica Geosystems has been procured in the financial year 2013-14 and transferred to this division as per the order of the Chief Engineer (IDRB), Thiruvananthapuram. Smart station is a new revolutionary surveying system in which a high performance Total Station (TS11) and a powerful GNSS Receiver (GS14 satellite receiver) are perfectly integrated. The main components of Smart Station are Base station GNSS and Smart Antenna, RTK Rover GNSS with Pole, Antenna. CS10 Field Controller (Smart Pole) and Total station with back sight Tripod kit. Leica GS14 has been upgraded to Leica GS 18 T model in 2019-20.

Presently this division is engaged in conducting topographical investigationsof various works of Kerala Irrigation Department. Topographical investigation works of other departments are being carried out as Deposit works. Since most of the investigations are executed departmentally using most modern survey equipments with high precision and accuracy, we can

assure quality of the work. Works entrusted to this division are being carried out under various Head of Accounts as per the nature of works and availability of funds.Works carried out by this division under the Head of account 4701-80-800-99-Development of KERI as action plan for the financial year 2020-21 consists of two types of works viz.(I) Fundamental studies using smart station (II)Routine works of Coastal Engineering Division

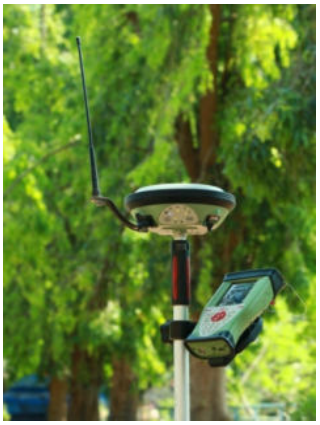
Apart from this, Investigation works under Head of account -4701-80-800-88-Formation of River Basin Organization, 4700-80-005-99-02-Investigation of major irrigation scheme and 4700-80-800-97-02- Dam safety organisation and Dam safety measures werealso carried out in 2020-21.

FEATURES OF GS 18T SMART STATION

Leica GS 18T is the world's fastest GNSS RTK rover and is a part of the Leica Geosystems self-learning GNSS series with advanced signal tracking technologies.With more constellation and L band, GS18T will have more satellites in canopy area. GS18T is fitted with Inertial Measurement Unit (IMU) based tilt sensor, so that no magnetic field can affect the positioning. This can work close to bigger concrete structures with larger reinforcement, Electrical installations etc.Due to the tilt compensating function, it is not required to hold the survey pole in vertical position, that is there is no need to level the bubble for measuring and staking of points. In this the sensor accurately and reliably measures the pole tilt and together with RTK or Smart Link, provides an accurate tilt compensated position.There is savings up to 20 per cent over conventional surveying practices due to the fact that no time is wasted by levelling the bubble. The IMU-based tilt-compensating RTK is applicable at large tilt angles of more than 30 degrees, where a 3D positioning accuracy of 2 cm is still achievable.

Leica GS 18T is integrated with a new Cinterion cellular modem that supports LTE (4G) as well as all existing networks. In Leica GS 18T a self-learning GNSS sensor is being used, hence the best satellite signals and the best available correction data is chosen automatically thus achieving best possible position accuracy and quality. By incorporating sensor heading into 3D visualisation of the surroundings, the user can easily orientate himself in the surveying environment, which improves productivity and user experience. The measurement engine in GS 18T is ME7 (measurement engine generation 7). This gives an ultimate performance in GNSS positioning.

GS14 Base Unit



Rover Unit with Controller

Total Station

GS-18 T Base/Rover

Leica GS18 T GNSS RTK rover with CS20 Field controller.

It includes latest features such as 555 channels, Multi-frequency, Multi constellation, L-band service etc. This allows tracking more satellites compared to GS14 in parallel channels. This sensor is supplied with most modern controller of Leica CS20 with specialized package software called Captivate. Captivate is the most field worthy software with more land survey features compared to CS10 controller.

A. Works under the Head of account -4701-80-800-99-34-03-V-Development of Kerala Engineering Research Institute Stage II

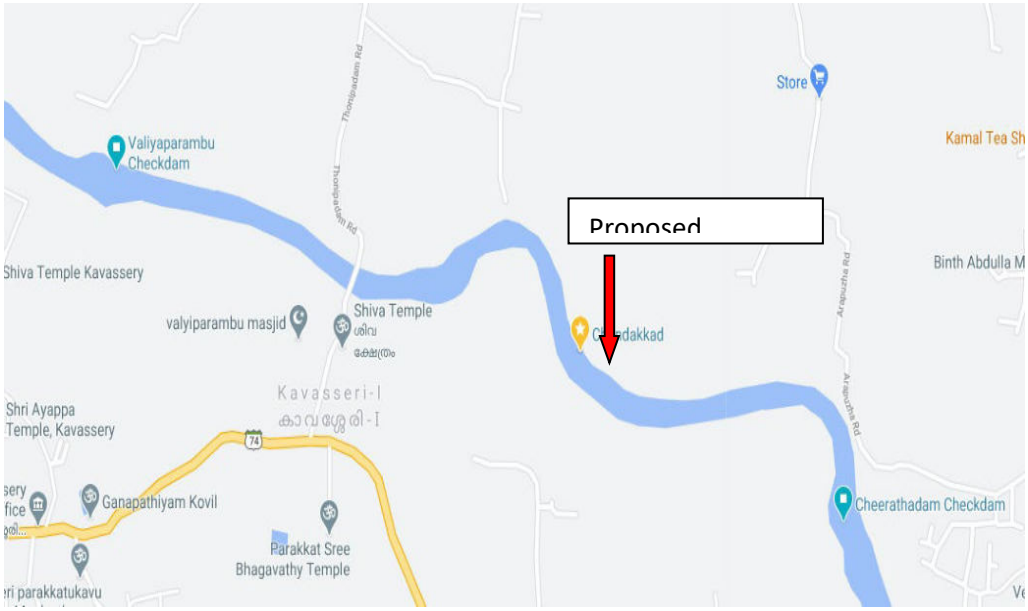
Works under the above head consists of two types of works viz Fundamental studies using smart station and Routine maintenance of offices, model area and survey equipmentsas action plan of Coastal Engineering Division forthe financial year 2020-21.

I. Fundamental Studies using Smart Station for the year 2020-21- Various Investigation survey works in Irrigation Department

All topographical investigation works related to Kerala Irrigation Department carried out using Smart Station has been included in this category. Highlights of works taken up by this division during the year 2020-21 are as follows:

(i) Conducting Topographical investigation for construction of check dam across GayathriPuzha at Choondakkattil in Kavassery Panchayath-2020-2021

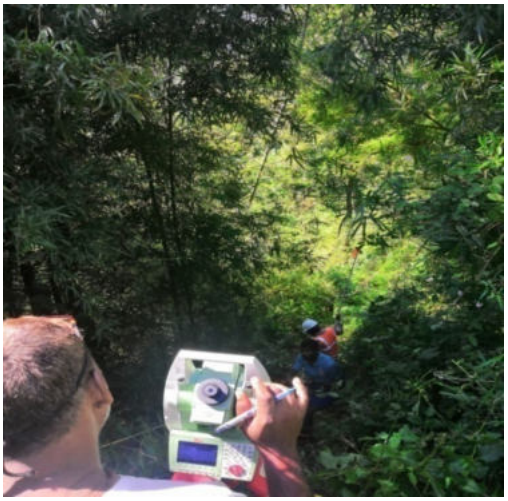
Topographical investigation for the proposed Check dam at Chundakkadu across Gayathripuzha in Kavasserypanchayath of Palakkad District has been done based on the request received from the Executive Engineer, Minor Irrigation Division, Palakkad. The investigation survey includes taking the cross sectional details of the river and bank at the proposed checkdam location including upstream and downstream of the same at particular intervals as per design requirements.



For this work survey has been conducted in river and bank for cross sections at following intervals. At 15m interval for a length of 60m in upstream and downstream, at50m interval for a length of 500m in upstream, 100m interval for the remaining upstream downstream length. A contour map at an interval of 2m has also been prepared. Plan, Cross sections and longitudinal sections, Colour contour map etc. have been plotted.

(ii) Topographical investigation for demarcating submersible area of proposed Attapaddy Valley Irrigation project 2020-21

Topographical Investigation for demarcating the submersible area of proposed Attappady Valley Irrigation Project- 2020-21 has been taken up by this division as per the direction of Joint Director, Hydraulic Research, KERI, Peechi. Scope of the work was to demarcate the submersible area of proposed Attappady Valley Irrigation Project. Full Reservoir Level (FRL) and Maximum Water Level (MWL) of the proposed dam is +611m and +612m respectively as informed by project authorities. As per Annexure-1A of MoWR Guidelines for PREPARATION OF DETAILED PROJECT REPORTS OF IRRIGATION AND MULTI PURPOSE PROJECTS published in 2010, survey extent has been fixed to MWL+5 i.e. +617m.



Proposed dam site was already connected with MSL by this Division in 2019-20 by transferring the levels from Survey of India Bench Mark at Kuttippuram.Base station setup for progressing the survey was done at Community Health Centre, Agali.Surveyed the cross section along the alignment of dam structure aspointed out by the project authorities.Full Reservoir Level +611m, Maximum Water Level +612m and MWL+5 i.e +617m have been identified in the project area and temporarily marked with steel rods. Water spread area at Full reservoir Level (+611m) is 236.65 Ha.Water spread at Maximum Water Level (+612 m) is 244.59 Ha.

(iii) Conducting topographical investigation for assessing the sedimentation in Peringad River in downstream of Idiyanchira regulator in Thrissur Dist.

This investigation has been taken up as per the direction of Joint Director, Hydraulic Research, KERI, Peechi. Scope of the work was to find out the existing levels of Peringad river starting from the immediate downstream of Idiyanchira regulator for a length of 1.50km and width about 150m as intimated by the Project Authorities to estimate the quantity of sediments to be removed. Idiyanchira regulator has been already connected with MSL by this Division in 2019-20 by transferring the levels from Enamavu regulator. Elevation of operating platform of the regulator is 6.318m with respect to mean sea level.

Existing levels of the demarcated portion of Peringadriverwere taken at 25m interval. Cross section, Longitudinal section and layout plan have been prepared.Proposed bed slope of the river as given by the Project authority is 1 in 3000. Bed level at downstream face of Idiyanchira regulator was found to be -1.70m .With this slope as reference, cutting and filling volume for a width of 100m have been calculated.Volume of soil accumulated above the proposed bed slope is about 163403.63 m3. Volume of soil required to fill up existing ditches in the bed to correct the slope was found to be 2637.68 m3.

(iv) Topographical investigation of KIP(RB) Main canal earth slippage at ch.17000m

Topographical investigation of KIP (RB) Main canal earth slippage at ch.17000m has been done as per the direction of Director, KERI, Peechi on account of the letter No. CS/AD3/MFA/1347/2019 of the Chief Engineer, IDRB. Earth slippage has been noticed at chainage 17 km of Right Bank Main Canal of Kallada Irrigation Project at Pathanapuram in Kollam during the flood 2018.

Site has been connected with MSL by transferring the level from Thenmala dam.Temporary bench marks were established at the existing super passages in the upstream and downstream of surveyed area. Cross sections of canal including both the banks at 15 m interval were surveyed and levels were taken. Area surveyed in the left side of the canal with earth slippage extends from the bund road to nearest higher elevation.Plan, Cross sections, longitudinal section and contour maps at 2m interval have been prepared.

(v) Topographical investigation in connection with the holistic linking of IIP and CRDS.

This work has been taken up as per the direction of the Director, Fundamental and Applied Research, KERI, Peechi. There exists a proposal to connect Idamalayar Irrigation Project (IIP) main canal and Left bank main canal of Chalakkudy River Diversion Scheme through a link canal.

It has been directed to conduct the topographical investigation of proposed alignment from Chainage 2000 to 3000 of link canal for an average width of 45 m using the available information from project authorities, where the land had already been acquired. Later it was instructed by the Superintending Engineer, Project Circle, Piravom to limit the survey to certain key points due to time constrains.

Bench Mark at Bhoothathankettu near IB was taken as reference for conducting the survey. Base station set up was done on the top of operating platform of shutter. With base station at Bhoothathankettu, zerochainage of IIP main canal was connected by LTE network of

Smart Station. All other key points were connected from the base station at Bhoothathankettu. Location and level of all boundary stones along the proposed alignment of link canal was established and were detailed in the drawing.Minimum horizontal clearance available between High tension line and canal alignment is 39.84m. Minimum vertical clearance available between High tension line and ground level is 14.416m.

(vi) Connecting Kalyana Krishna Ayyar Checkdam, Raghunatha Counter Checkdam& Paul Souza Checkdam in EruthempathyPanchayath of Palakkad District with MSL

This work has been taken up as per the direction of Joint Director, Hydraulic Research, KERI in response to request from Executive Engineer, Minor irrigation Division, Palakkad. Scope of the work was to connect Kalyana Krishna AyyarCheckdam, Raghunatha Counter Check dam and Paul Souza Check dam of Palakkad district with MSL. These sites were connected with MSL using the alreadyestablished Bench Mark in Malampuzha which is 42 km away from the check dam site.

(vii) Establishing MSL at various stations along Meenachil river in MeenachilTaluk - 2020-21

This work has been taken up as per the direction of Joint Director, Hydraulic Research, KERI as per the request of Superintending Engineer, MVIP Project Circle, Muvattupuzha.

Scope of the work was to establish MSL at various stations along Meenchilriver in MeenachilTaluk. Various stations along the banks of Meenachil river has been connected with MSL with respect to the nearest Bench mark which is at CWC Hydrological Observation Station, Kidangoor.

II. Routine activities of the Coastal Engineering Division office and the Offices of Director, F & AR and Joint Director, Hydraulic Research for the year 2020-21

This work had been included in the action plan for meeting the routine activities of this office and offices of the Director, F & AR and Joint Director Hydraulic Research. Maintenance and repairing of computer and related accessories, purchase of computer related items, maintenance of plumbing works, electric works, purchasing of stationary itemsand additional works that come up at any time etchad been done in this year.

III. Maintenance of the model area of the Coastal Engineering Division in 2020-21

A model area where physical model studies related to Kerala Coast had been conducted in previous years is maintained by this division. All works such as clearing the bushes, routine cleaning of model trays and Engineering museum, overall upkeep of model sheds for keeping this area spick and span and also surroundings of Director's office building etc. had been done.

IV. Annual Maintenance and purchase of accessories for Smart Station

This work is for the annual maintenance of Smart station and for the purchase ofaccessories and any spare parts if required. As the Smart station is a sophisticated electronicequipment, annual calibration and maintenance are essential so as to ensure the accuracy of theposition data given by the instrument.Provision is included in the estimate for AnnualMaintenance Contract of the Total Station TS11.Service and recalibration of PENTAX Total Station R-205 NE was also included. Batteries are one of the essential accessories forprogressing the survey effectively. Any damage in batteries will delay the work. Hence as aprecautionary measure, provision for purchase of additional batteries are included.Provisions are included for the purchase of car battery charger,cables and any other consumables if required in emergency. A lumpsum provision is also given for the purchase andmaintenance of any spare parts of the instrument, consumables and miscellaneous items forsurvey if required in emergency.

B. Worksunder the Head of account -4701-80-800-88-Formation of River Basin Organization

(i) Proposal for survey on Chandragiri River of Kasaragod district using Smart Station phase-II

Natural resources are becoming increasingly scarce while our needs are growing. As timeadvances, water is becoming scarcer and having access to clean, safe, drinking water is limited. Forpreparing a comprehensive water management policy exclusively for Kasaragod District to reduce watercrisis in summers as well as the rest of the year, a proposal of Topographical Survey for preparing basinmaps of 9 rivers in Kasaragod District using Smartstation - a highly advanced surveying system had beensubmitted to Govt. of Kerala for an amount of Rs. 170 lakhs. The results of this investigation can be usedfor optimizing the design of water retaining structures which will bring economic feasibility of newconstructions of water retaining structures in this river. During the meeting of Departmental WorkingGroup held on 25.11.2015 in the chamber of Additional Chief Secretary to Government, Water ResourcesDepartment, it has been decided to recommend to accord Administrative Sanction for the TopographicSurvey of Chandragiri River using Smart station underthe H/a 4700-80-005-99-Investigation of Irrigation Schemes.

The first phase of survey of Chandragiri river of Kasargode for a length of 19km having anaverage width of 130m has been completed in the financial year 2015-16. Scope of the work

was to take c/s at 100minterval including the survey of both banks at the same interval for a width of 50m each, upwards fromthe railway bridge (ie. approximately 1 km from sea mouth).During 2016-17, nearly 11 km of the river u/s of last year's work towards Payaswini branch ofChandragiririver has been conducted under the same Head of account.

As there was no action towards the fund request in 2017-18 and 2018-19 survey of remaining 75 km length of the river could not be completed.Estimate for survey of remaining 75km of Chandragiri River was submitted under the H/A 4701-80-800-88-00-00-00-V Formation of river basin organization in 2019-20. Chief Engineer, IDRB instructed us to carry out the investigation as a Tender work so as to availfund during the desirable working period and to complete the project satisfactorily.Joint Director, Hydraulic Research, KERI,Peechi executed agreement with JAI Groups, Digitalland surveyors, Maradu P.O. Ernakulam as per Agreement No.3/2019-2020/JD-HyR/KERI, PEECHIdated 20.03.2020 for an agreed PAC of Rs. 28,77, 045/-

Due to COVID -19 lock down from 23.03.2020 and then high water level in the river, work could bestarted only on 30.11.2020. Survey works of river as well as bank of the Payaswinibranch and Chandragiri branch has been completed successfully within the stipulated time period and drawings were prepared. 30 Nos of Bench mark stones were also laid along the banks of Chandragiri River for future reference. This survey will help for planning Irrigation and other structures in Chandragiri River.

(ii) Sand Budgeting in Chaliyar River Basin

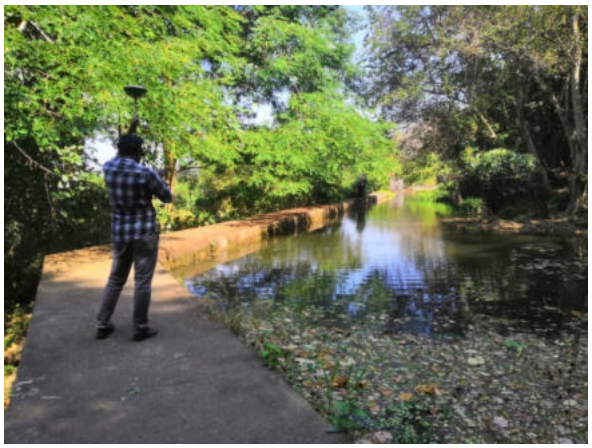
Director, KERI has submitted a proposal specifying the technical method by which an assessment of the quantity of sand available in the river bed, the quantity of sediments being deposited and hence the quantity that can be allowed for mining as per the direction of Chief Engineer, IDRB in 2017-18. The objectives of this study are (i) to ensure that sand and gravel extraction is carried out in a sustainable way (ii) to maintain the river equilibrium with the application of sediment transport principles in determining the locations, period and quantity to be extracted. Chaliyar which is one of the rivers which doesn't get dried up in the drought season was selected for the pilot study. Many other rivers in Kerala get dried up during March and April. Methodology followed for sand auditing are Mapping of the river channel, Ascertaining Pristine Condition of the Rivers, Sediment Sampling, Sediment Transport Model, Model Simulation, Result Analysis includes Sediment Spatial Plot, Sediment Time Series, Sediment Cross section Plot etc.

Since KERI is new to the field of Sediment Transport Modelling and this portion of the proposal is decided to outsource. NIT Kozhikode has already been involved in such studies. Our Institute had discussed with NIT Kozhikode and they expressed their willingness to collaborate with our Institution for a pilot study, which includes capacity building of our Engineers. MoU has been signed between Director, KERI and Director, NIT Calicut 28th November 2019. Hydro-meteorological data, land use map, soil map pertaining to the study area etc. were collectedand made available to NIT Calicut. Shape files marked with tentative locations for taking cross sections along with locations of sand mining kadavu of Chaliyar River were prepared by this division after conductingreconnaissance survey. Numerical modelling part of the study has been started using the above data. Survey for taking cross sections of Chaliyar river has been completed. Bench mark is connected from GTS bench mark at Kuttippuram. The outputs from sedimenttransport model include estimates of suspended sediment concentrations, rates of sediment erosion anddeposition and sediment transport pathways.

C. Works under the Head of account 4700-80-005-99-02-00-VInvestigation of Major Irrigation schemes

(i) Topographical survey for Seetharkundu waterfalls diversion scheme - Stage II

Survey for preparing a tentative alignment for water conveyance system from Athikundu to Meenkara dam was done using Smart station. A tentative pipe alignment from Athikundu to Meenkara dam was prepared and made available to the investigation team. It was informed to realign the pipe network to Chulliyar dam instead of Meenkara dam by the investigation team. It was suggested to take levels additionally in some specified areas of forest land, ahead of existing Palakapandy Weir to avoid drilling and blasting of rocky hills in the forest. Work could not be completed as many more decisions have to be taken regarding the scheme and investigation can only be done accordingly.



D. Works under the Head of account 4700-80-800-97-02 Dam safety organisation and Dam safety measures Works

(i) Conducting topographical investigations in connection with the rectification works of Karapuzha Irrigation Project under DRIP Phase-II -Appendices A& L of Part A

Topographical investigation in connection with rectification of Karapuzha Irrigation project under DRIP Phase II has been taken up by this division as per the direction of Chief Engineer, Project I, Kozhikode and as per the instruction of Director, KERI.Karapuzha Dam located in the Wayanad district of Kerala, is one of the biggest earth dams in India. It is constructed across Karapuzha River which is a tributary of Kabani river. Scope of the work were (i) Carrying out survey for finding the existing profile of Karapuzha Earthen dam by taking cross sections at 30m interval and levels at 10m c/c thereby to calculate the volume of earthfill for restoring the profile of the dam (ii) Survey of emergency access road to dam spillway by taking cross sections at 15m interval and taking points at 3mc/c. Existing profile of Karapuzha Earth dam has been plotted by taking cross sections at 30 m interval and levels at 10m c/c.

Earth fill volume has been calculated by comparing the existing profile with the actual profile of the dam which has been provided by the Project Authority.Volume of earth fill for restoring the profile of earthen dam is found to be 22815.38 m^3.Survey of emergency access road to dam spillway has been conducted by taking cross sections at 15 m interval and levels at 3 m c/c and drawings were plotted.

C. SEDIMENTATION DIVISION

C.1 Introduction

Sedimentation Division conducts studies to compute the present capacity of reservoirs and other water bodies. Such studies are conducted using modern electronic method called 'Integrated Bathymetric System' (IBS). In order to ascertain the underwater profile of the sediment layer anothersophisticated instrument called 'Sub Bottom Profiler' is used. From 2004 onwards, this division has completed 50 studies using IBS which includes Kallada Reservoir, MalampuzhaReservoir, Neyyar Reservoir Mullaperiyar, Vembanad Lake and Kattampally Wetland etc. Sub Bottom profiler was used for 26of the above studies.

Relevance of the study

- *To estimate the present capacity of the reservoirs*
- *To manage the reservoir operations based on the present actual capacity*
- *Vital role in the ongoing Desiltation work of reservoirs for the capacity improvement*
- *To observe the influence of the heavy flood in 2018 and 2019 in the reservoir sedimentation*

THE SURVEY TEAM OF THE YEAR 2020-21

Directors	Er.Sindhu B Er. Suprabha N
Joint Director	Er.Suja S S
Deputy Directors	Er. Shini K K Er. Roshni S S (Addtl Charge) Er.Divya C J

Technical Team

Er.Roshni S S	Assistant Director
Er. Francy V Antony	Assistant Director
Salini C S	Research Assistant
Anusha Das K	Research Assistant
Arun Raj V S	Second Grade Overseer
Divyesh V B	Third Grade Overseer

Crew

Jayakumar T R	Boat Driver (on HR basis)
Sudheesh K C	Departmental Driver
Anitha M M	Office Attendant

Equipmentsof Survey

A. SUB BOTTOM PROFILER

The system SES-2000 sub-bottom profiler, which is a mobile parametric sediment sounder, was used for bathymetric and sub-bottom profiling survey. The SES- 2000 hardware component and transducers are shown in Fig 1 & 2. High frequency signal (HF -100 kHz) and the secondary low frequency signal (LF -6 to 12kHz) are used. The spatial distribution of sediment in each cross section can be analyzed.

Fig1 Top- side Unit

Fig2 Transducer

B. INTEGRATED BATHYMETRIC SYSTEM (IBS)

The components of IBS are

- FRP boat
- DGPS –MX-610
- Echosounder
- Survey P C
- Helms man display

FRP BOAT

Fiber reinforced Plastic (FRP) boat (Fig 3) having two 60 HP petrol out board engines, dimension of 7.5m X 2.66m X 1.20m and 8persons capacity with the equipments is used for the survey.For the power supply, two solar panels of 80Watt each are mounted on the roof of the boat.

Fig 3 FRP Boat

DGPS SIMRAD MX-610

DGPS SIMRAD MX- 610 (Fig 4) is highly reliable and it receives correction from a permanent reference station, which is approved by Govt. of India, Dept. of Light house and Light ship. It can also track up to 12 satellites to achieve maximum positional accuracy. The received position is transferred to Echo Sounder and Sub Bottom Profiler data collection laptop.

Fig4MX610 Navigation System

MIDAS Surveyor - Echo-sounder

The MIDAS Surveyor is a revolution of small boat survey work with an integral GPS receiver (Fig 5). It logs and displays DGPS position data in WGS 84 or Local Grid. This Echo-sounder is designed to measure under water depth up to 1200m. Accuracy of instrument is 1centi meter. The dual frequency echo-sounder is specified to distinguish between fluff top depth and the consolidated bottom. The high frequency (200 KHz) is used to detect the top of the mud/sediment. Under favorable conditions the low frequency signal (33 KHz) can penetrate into the bottom and reveal information about the bottom structure.

Fig 5MIDAS Surveyor Echo Sounder

SURVEY PC

The Qinsy survey software is installed in the laptop for data collection and processing.

All the position data collected using DGPS and the depth of water collected using echo-sounder are recorded in computer and are further processed.

HELMS MAN DISPLAY

This is an extension monitor of the survey PC for guidance of boat driver.

Mobile station set up for data collection is shown in Fig.6

Fig.6 Equipment Set up inside the Boat

Softwares using for the survey

- **QINSY SOFTWARE**

  This software is used for data collection and processing in IBS survey. The Bathymetric software supports NMEA 0183 compatible devices. Local grid UTM (WGS-84) is the projection supported by this software.

- **SESWIN**

  This software is used for the data collection in Sub Bottom Profiler.

- **I.S.E. 2.9.2**

  This is the post processing software used for analyzing the data collected from Sub Bottom Profiler.

- **Surfer software**

  Surfer is a graphic program used for calculating the volume based on the logged data from the IBS and Sub Bottom Profiler.

DATA COLLECTION

The mobile station consists of the DGPS and its antenna, Echo sounder, Sub Bottom Profiler and the transducers etc which are mounted on the FRP boat. The transducer of Sub Bottom Profiler is permanently fixed at the center of the boat. The transducer of Echo sounder is connected to the left side of the boat and is detachable. Proper connections are made between these equipment and the laptops for the data collection. By using the **Planning and presentation** menu in **Qinsysoftware,** chart is prepared by taking UTM co-ordinate at two known points. With these co-ordinates of two points reference lines are drawn. Segment lines are drawn parallel to this reference line at a particular interval such that the entire reservoir area can be covered.The boat is sailed along the planned trackwith a speed of 3 to 4 knots. The data from the Echo sounder and Sub Bottom Profiler is collected simultaneously through two laptops as shown in fig.7.For IBS Survey, the laptop loaded with QINSY survey software is used.For Sub Bottom Profiler, the data is collected using laptop installed with Seswin software.There are three modules in the QINSY Software. Data Acquisition, Data Processing and Data export/ import.

Fig.7 Data Collection set up inside the Boat

The system **SES-2000**(Sediment Echo Sounder) Sub Bottom Profiler is aparametric (non-linear) dual frequency echo sounder. The instrument simultaneously transmits two signals of slightly different high frequencies; their interaction creates a new low frequency signal. It has a large bandwidth and a short signal length, which allows good use in very shallow water and

results a high (~15 - 20 cm) vertical resolution at acceptable sub-bottom penetration up to 10 m or more. Some favorable near sub-bottom seismic and geological conditions permit to achieve a vertical resolution up to 10 cm. Parametric (non-linear) sound generation allows designing acoustical systems with small transducer dimensions and narrow sound beams at low frequencies. An Innomar SES-2000 parametric transducer has an active area of 20 x 20 cm and provides a beam width of less than four degrees (at 3dB), valid for all adjustable low frequencies between 5kHz and 15 kHz. The transmit directivity of the parametric sound beam does not show any significant side lobe characteristic, which reduces ambiguities during the interpretation of individual reflectors. Short transmit signals of single sinusoidal cycles without any ringing and high ping rates of up to 50 pings per second are further advantages. They contribute to a high spatial resolution of this acoustical system and permit to apply it in a shallow basin. Innomar's software tool ISE provides near real-time processing of the collected SES data. The operation procedure can be tuned on-line. A value of the sound velocity in water is used to convert sound travel time to the depth. The depth values are screened online.

ACTIVITIES OF THE DIVISION DURING THE YEAR 2020-21

The reports of the bathymetric studies of Kanjirapuzha, Neyyar,Vazhaniand Malampuzha Reservoirswhich were conducted during the financial year2019-20, has been completed during this year. The hydrographic surveys of Meenkara, Pothundy, Malankara, Pazhassi and Karappuzha reservoirs have been conducted during the year 2020-21. The survey of Poringalkuthu dam under KSEB Pvt Ltd has also been conducted as a deposit work. Apart from that the routine upkeep of the office, survey equipmentsetc has been done in this financial year too. Purchase of a new dongle key for the ISE post processing software has been done as a part of the upgradation of sub bottom profiler.

The details of the completed reports are as follows:

1. Bathymetric Study of Kanjirapuzha Reservoir Using Integrated Bathymetric System & Sub Bottom Profiler

Sedimentation study of Kanjirapuzha reservoir was previously conducted in 2008 and 2017. The repeat study of Kanjirapuzha reservoir using IBS & Sub bottom profiler has been conducted during the year 2019-20 in order to assess the effect of the extra ordinary floods occurred in the year 2018 and 2019 as per the direction of the Chief Engineer, Projects-1.

Results and Discussion

1. ESTIMATION OF CAPACITY

The survey is carried out at water level of 97.1 m. The original water holding capacity at this level is 68.593Mm^3 and water spread area is 5.176 Sq. Km. As per the current IBS study, the volume at the same level is estimated as 51.609Mm^3 and the corresponding water spread area is 4.3 Sq.km. Total capacity reduction of the reservoir is 16.984 Mm^3 in 40 years, i.e. the reduction in capacity at this specified level is 24.76%. The capacity reduction is due to the sediment deposit.

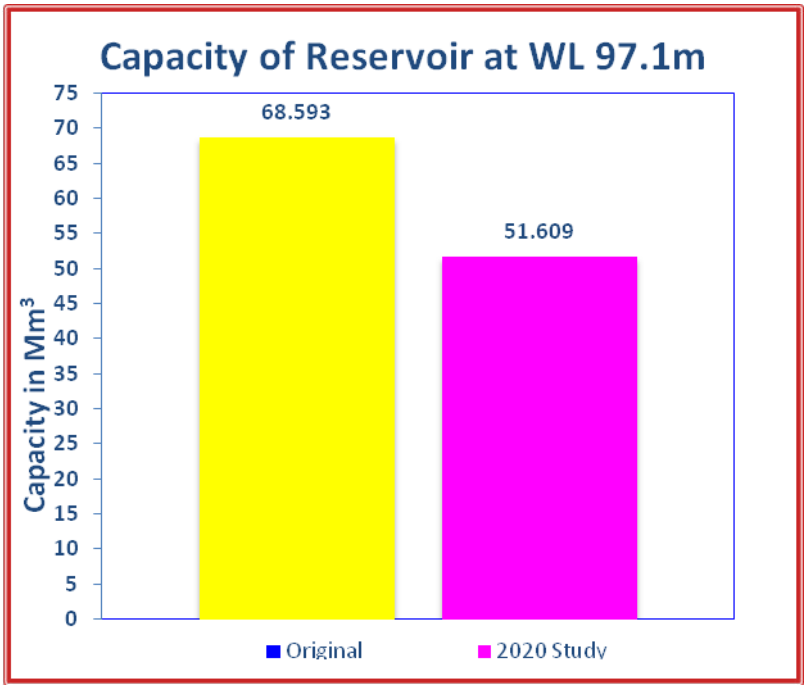


Fig 8Capacity reduction at WL 97.1m

During 2008 and 2017, the survey has been conducted at a water level of 96.0m and the comparison of capacities at that level is as follows.

Table 1.0 Capacity of the reservoir at WL 96.0m

Year of Study	Capacity	Reduction in Capacity w.r.t Original Volume (62.448 Mm^3)	
		In Mm^3	In Percentage
2008	51.869	10.579	16.94
2017	49.160	13.288	21.28
2020	46.677	15.771	25.25

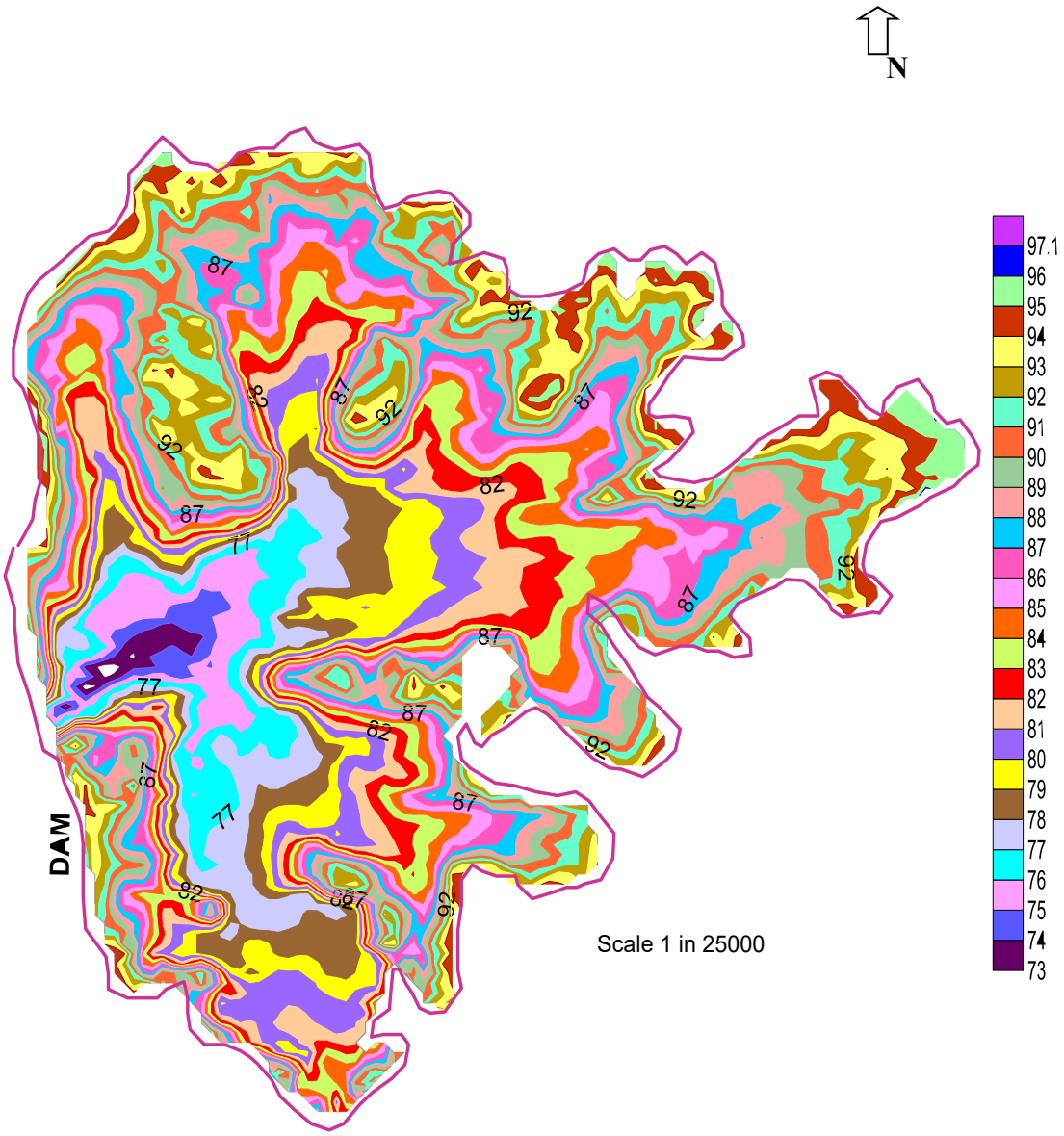


Fig 9 Contour Map based on IBS Survey

2. CAPACITY AT DIFFERENT WATER LEVEL

Reservoir volume at different water levels can be found out using the IBS data in SURFER software. The capacity reduction obtained from the IBS is comparable with the sediment volume calculated from the Sub Bottom Profiler. The present capacity at different level is compared with the original and IBS result in 2008 & 2017and is shown in Table 2.0

Table 2.0 Reservoir Capacity at different water levels

Sl. No.	Water Level	Water Holding Capacity				Percentage Reduction in Capacity
		Original	IBS Survey 2008	IBS Survey 2017	IBS Survey 2020	
	(m)	(M. Cub. m)	(M. Cub. m)	(M. Cub m)	(M. Cub m)	%
1	97.1	68.593			51.609	24.76
2	97	68.034			51.603	24.15
3	96	62.448	51.869	49.160	46.677	25.25
4	95	56.862	46.907	44.660	42.213	25.76
5	94	51.858	42.212	40.213	37.877	26.96
6	93	46.849	37.772	35.913	33.747	27.97
7	92	42.339	33.646	31.112	29.865	29.46
8	91	37.829	29.811	28.249	26.242	30.63
9	90	33.546	26.248	24.768	22.877	31.80
10	89	29.264	22.930	21.530	19.763	32.47
11	88	25.419	19.869	18.535	16.900	33.51
12	87	21.561	17.043	15.785	14.279	33.77
13	86	18.051	14.463	13.288	11.889	34.14
14	85	14.586	12.116	11.027	9.736	33.25
15	84	11.470	9.992	8.990	7.816	31.86
16	83	8.354	8.083	7.180	6.134	26.57
17	82	7.408	6.395	5.584	4.622	37.61
18	81	5.492	4.913	4.191	3.400	38.09
19	80	4.253	3.625	3.001	2.358	44.56
20	79	3.180	2.529	2.022	1.515	52.36
21	78	2.286	1.626	1.248	0.879	61.55
22	77.42*	1.557	1.198	0.894	0.605	61.14
23	77	1.350	0.934	0.683	0.447	66.89
24	76	0.718	0.450	0.323	0.188	73.82

25	75	0.394	0.157	0.125	0.064	83.76
26	74	0.182	0.026	0.040	0.014	92.31
27	73	0.182	0.026	0.014	0.000	100.00

* **Dead Storage Level**

The original storage capacity curve is compared with the same obtained from the IBS surveys in 2008, 2017 and 2020 and is shown in Fig 10.

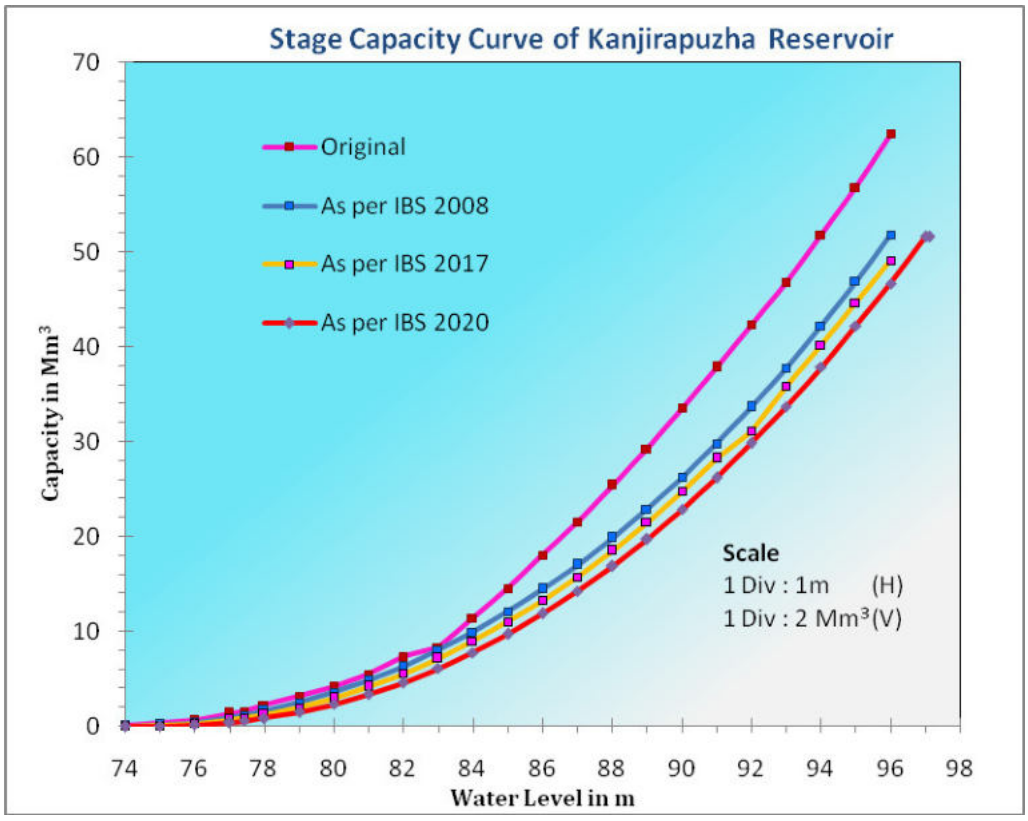


Fig.10 Water level v/s Water holding capacity curve

3. WATER SPREAD AREA AT DIFFERENT WATER LEVEL

The present water spread area at different level is compared with the original and IBS results in 2008& 2017 and is shown in Table3. Fig.11 shows its graphical representation.

Table3 Water spread area at different water levels.

Sl. No.	Water Level	Water Spread Area				
		Original	IBS Survey 2008	IBS Survey 2017	IBS Survey 2020	Percentage Reduction

	(m)	(Sq. Km)	(Sq. Km)	(Sq. Km)	(Sq. Km)	%
1	97.10	5.18			4.30	16.99
2	97.00	5.18			4.30	16.99
3	96.00	5.15	5.20	5.05	4.26	17.28
4	95.00	4.90	4.80	4.47	4.23	13.67
5	94.00	4.74	4.57	4.27	4.12	13.08
6	93.00	4.36	4.29	4.01	3.92	10.09
7	92.00	4.09	3.98	3.70	3.69	9.78
8	91.00	3.87	3.70	3.50	3.45	10.85
9	90.00	3.64	3.44	3.30	3.21	11.81
10	89.00	3.41	3.19	3.07	2.97	12.90
11	88.00	3.09	2.95	2.85	2.72	11.97
12	87.00	2.87	2.71	2.60	2.50	12.89
13	86.00	2.65	2.46	2.36	2.26	14.72
14	85.00	2.35	2.24	2.13	2.03	13.62
15	84.00	2.14	2.01	1.91	1.80	15.89
16	83.00	1.92	1.80	1.69	1.56	18.75
17	82.00	1.69	1.58	1.48	1.37	18.93
18	81.00	1.44	1.39	1.29	1.15	20.14
19	80.00	1.29	1.19	1.08	0.94	27.13
20	79.00	1.07	1.00	0.87	0.74	30.84
21	78.00	0.88	0.80	0.67	0.53	39.77
22	77.42*	0.75	0.70	0.54	0.41	45.33
23	77.00	0.64	0.58	0.45	0.34	46.88
24	76.00	0.45	0.38	0.26	0.19	57.78
25	75.00	0.33	0.21	0.13	0.08	75.76
26	74.00	0.17	0.06	0.05	0.02	88.24
27	73.00	0.17	0.06	0.01	0.00	98.82

*** Dead Storage Level**

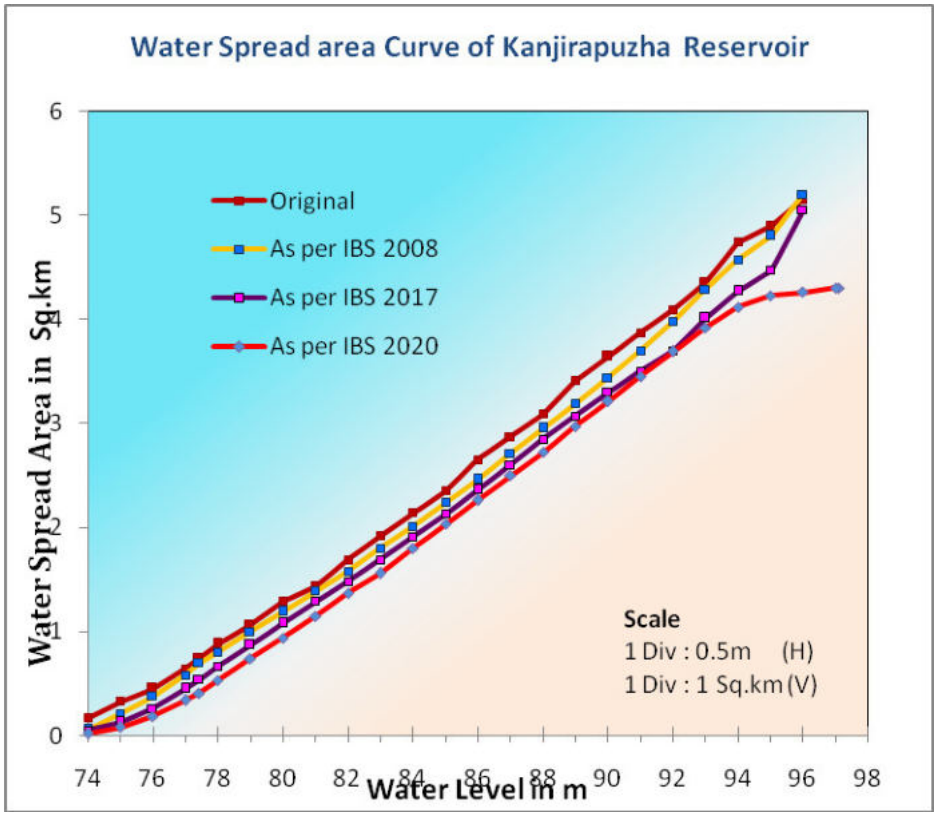


Fig.11 Water level v/s Water spread area curve

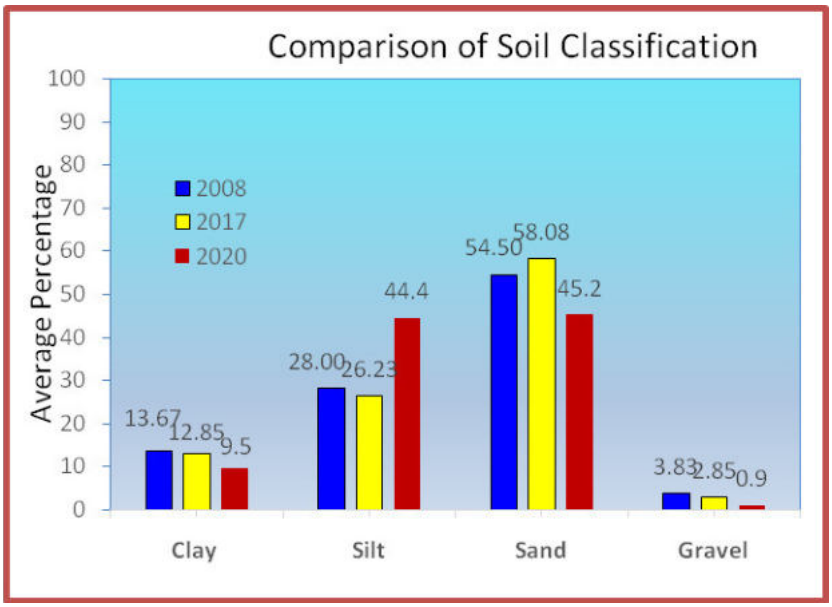


Fig. 12 Comparison of soil particle distribution as per the consecutive studies

Soil samples have been collected from different locations in the reservoir during 2008, 2017 and 2020 and the analysis of the result is shown as above.Since we are analyzing the grab samples the percentages of soil particles are only indicative and not accurate. For accurate assessment of contents in the soil, core sample analysis must be done.

DISCUSSION

The original Capacity of Kanjirapuzha Reservoir at WL97.1m is 68.593Mm^3. The present capacity is 51.609 Mm^3. The capacity reduction of the reservoir is 16.984Mm^3 in 40years at the same level.

- *The IBS **Surveys in 2008** and **2017** were conducted at WL96.0m and the corresponding reservoir capacity was 51.869 Mm^3 and 49.16 Mm^3respectively against the original capacity of 62.448Mm^3.As per the 2008 study, the capacity reduction rate is0.378 Mm^3/per year within 28 years. But in 2017study, the reduction rate is 0.301Mm^3/per year within 9years.*

- *The average thickness of the sediment deposit corresponding to the original water spread area 5.15Sq.km was2.05 m in 28 years, the rate of deposition 7.3cm/Year. Within the next 9 years, the average thickness of the sediment deposit was 0.53m,ie the rate of deposition 5.8 cm/Year.*

- *The original volume at dead storage level (77.42m) was 1.557Mm^3, volume reduced to 1.198Mm^3 in 28 years. Reduction percentage is 23.05 %. Within the next 9 years dead storage capacity reduced to0.894 Mm^3 ie reduction percentage is 19.53 %.*

- *The **present study is conducted at WL 97.1m**,the reservoir capacity is 51.609 $Mm^3$and the capacity is reduced by 16.984 Mm^3 in 40 years @ 0.425 Mm^3/per year.*

- *The average thickness of the sediment deposit corresponding to the original water spread area 5.18Sq.km is 3.28m in 40 years, the rate of deposition 8.2cm/Year.*

- *Volume at dead storage level is 0.605Mm^3, Percentage reduction in dead storage is 61.14% in 40 years. Within the last 2.5 years dead storage capacity reduced by 18.56%.*

- *In the present study, the reservoir capacity corresponding to WL 96.0m is 46.677 Mm^3 and the same obtained from the previous surveys conducted in 2008 and 2017 was 51.869 Mm^3 & 49.16 Mm^3 respectively. For the last 2.5 years the rate of capacity reduction is 0.993 Mm^3/year.*

- *Sediment layer profile of the reservoir area at an interval of 75m is obtained from the Sub Bottom profiler.*

The present sedimentation study is conducted at WL 97.1m and within 40years of the dam life the capacity reduction rate is ***0.62 %***per year.The previous sedimentation studies were conducted at WL 96.0m. Based on the first study conducted in 2008, the capacity reduction rate was ***0.61 %***per year during the first 28 years of the dam life. From the next study in 2017, the capacity reduction rate was estimated as ***0.48%*** per year for the last 9 years after the first study. From the present study conducted in 2020, the capacity reduction rate is ***1.6%*** for the last 2.5 years after the second study. Ie ***There is a huge increase in rate of sedimentation and this is the outcome of the unusual heavy flood occurred in 2018 and 2019.***

After the heavy flood in 2018, sedimentation studies of some reservoirs all over Kerala have been conducted. It is observed that some reservoirs show an increase in capacity based on the previous study results. But in the case of Kanjirapuzha reservoir there is a huge reduction in the capacity after the heavy flood. By enquiry with the dam officials, it is known that there was a huge land slide occurred during the flood in 2019. The huge capacity reduction is the outcome of this land slide occurred. The previous study results of this reservoir also show more capacity reduction compared with the other reservoirs in Kerala.

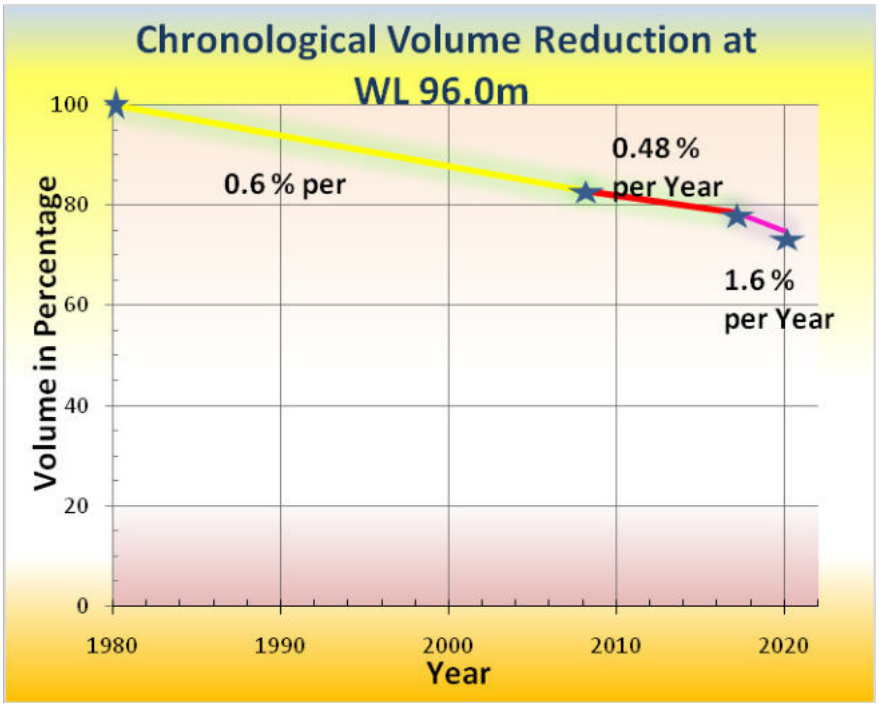


Fig 13 Chronological Volume Reduction

2. Sedimentation study of Neyyar reservoir using Integrated Bathymetric System (IBS) & Sub Bottom profiler

Sedimentation study of Neyyar reservoir was conducted previously in 2011 and 2015. The repeat study of Neyyar reservoir using IBS & Sub bottom profiler has been conducted in the year 2019-20 in order to assess the effect of the extra ordinary floods occurred in the year 2018 and 2019.

Results and Discussion

1. ESTIMATION OF CAPACITY

The survey is carried out at water level of 83.5 m. The original water holding capacity at this level is 95.157Mm3. As per the current IBS study the volume at the same level is estimated

as 83.016Mm3and the corresponding water spread area is 9.03 Sq.km. Total capacity reduction of the reservoir is 12.141 Mm3in 45 years, i.e the reduction in capacity at the specified level is 12.76%. The capacity reduction is due to the presence of sediment deposit. In the previous studies conducted in 2011 and 2015, the reservoir capacity corresponding to this level was 87.408Mm3&86.253Mm3 and water spread area was 9.43Sq.km & 7.87Sq.km respectively.

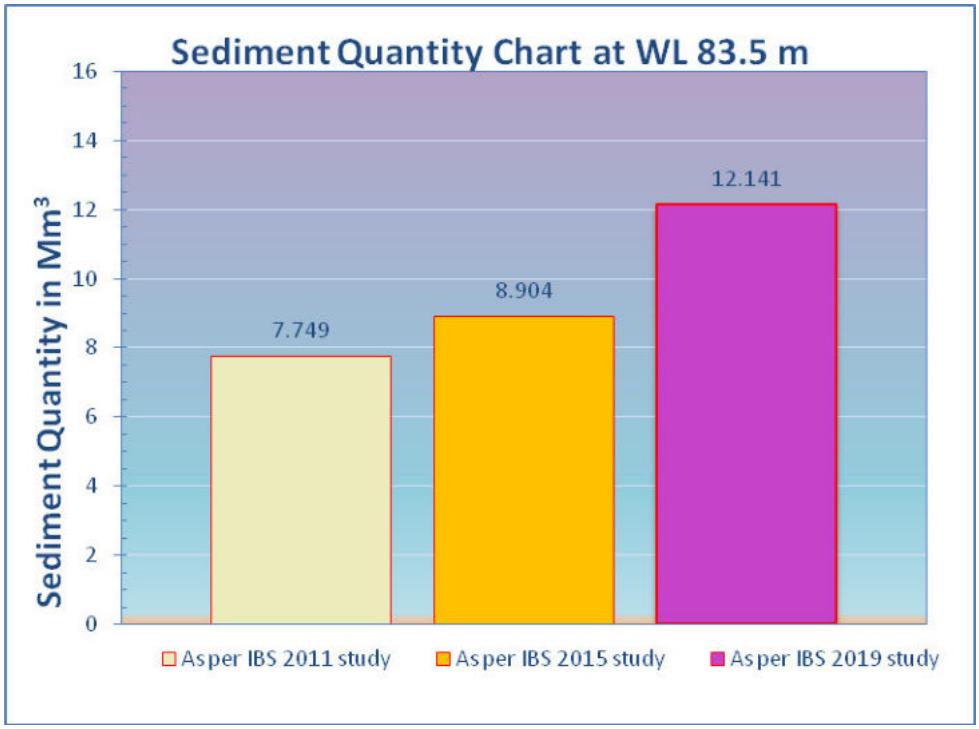


Fig 14 Increase in Sediment quantity

Table4 Capacity reduction of the reservoir at WL 83.5 m

Year of Study	Capacity	Reduction in Capacity w.r.t Original Volume (95.157 Mm^3)	
		In Mm^3	In Percentage
2011	87.408	7.749	8.14
2015	86.253	8.904	9.36
2019	83.016	12.141	12.76

The contour map of water spread area is shown in Fig 15at an interval of 2 m.

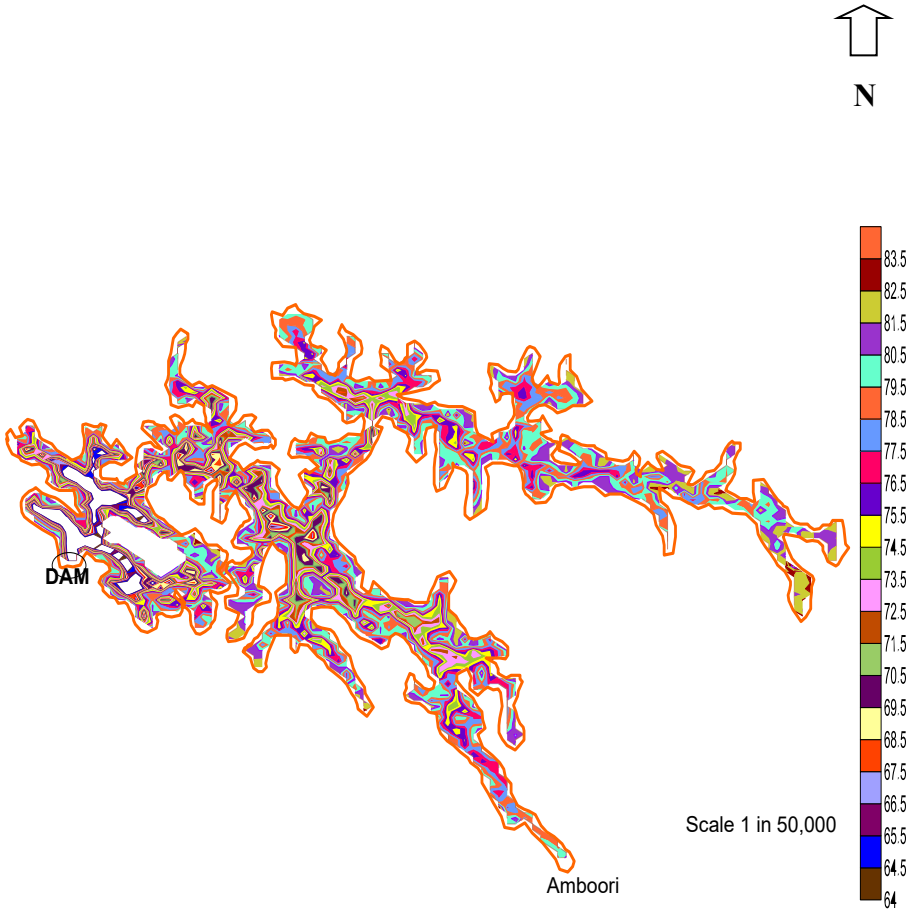


Fig 15 Contour map of Neyyar Reservoir based on IBS survey

2. CAPACITY AT DIFFERENT WATER LEVEL

Reservoir volume at different water levels can be found out using the IBS data in SURFER software. The present capacity at different level is compared with the original and IBS result in 2011 & 2015and is shown in Table 5.0.

Table 5.0 Reservoir capacity at different water levels

Sl. No.	Water Level	Water Holding Capacity				Percentage Reduction in Capacity
		Original	IBS Survey 2011	IBS Survey 2015	IBS Survey 2019	
	(m)	(M. Cub. m)	(M. Cub. m)	(M. Cub m)	(M. Cub m)	%
1	83.5	95.157	87.408	86.253	83.016	12.76
2	83	91.337	81.146	80.648	76.835	15.88
3	82.5	87.605	74.907	74.907	70.664	19.34
4	82	84.213	68.75	68.75	64.555	23.34
5	81.5	81.343	62.767	62.767	58.617	27.94
6	81	78.376	56.101	56.101	52.981	32.40
7	80.5	75.403	51.551	51.551	47.694	36.75
8	80	72.443	46.449	46.449	42.823	40.89
9	79.5	69.463	41.739	41.739	38.431	44.67
10	79	66.577	37.442	37.442	34.526	48.14
11	78.5	63.79	33.562	33.562	31.051	51.32
12	78	61.004	30.053	30.053	27.956	54.17
13	77.5	58.221	26.903	26.903	25.188	56.74
14	77	55.436	24.099	24.099	22.712	59.03
15	76.5	52.63	21.603	21.603	20.493	61.06
16	76	50.086	19.369	19.369	18.498	63.07
17	75.5	47.634	17.367	17.367	16.697	64.95
18	75	45.628	15.582	15.582	15.063	66.99
19	74.5	43.4	13.984	13.984	13.584	68.70
20	74	41.171	12.55	12.55	12.245	70.26
21	73.5	38.942	11.272	11.272	11.028	71.68
22	73	36.77	10.134	10.134	9.932	72.99
23	72.5	34.727	9.121	9.121	8.947	74.24

24	72	32.684	8.22	8.22	8.064	75.33
25	71.5	30.641	7.422	7.422	7.276	76.25
26	71	28.59	6.717	6.717	6.567	77.03
27	70.5	26.556	6.099	6.099	5.941	77.63
28	70	24.552	5.556	5.556	5.387	78.06
29	69.5	22.703	5.076	5.076	4.896	78.43
30	69	20.853	4.647	4.647	4.456	78.63
31	68.5	19.004	4.26	4.26	4.058	78.65
32	68	17.155	3.912	3.912	3.695	78.46
33	67.5	15.536	3.593	3.593	3.359	78.38
34	67	14.457	3.295	3.295	3.046	78.93
35	66.5	13.378	3.016	3.016	2.751	79.44
36	66	12.297	2.754	2.754	2.474	79.88
37	65.5	11.255	2.506	2.506	2.213	80.34
38	65*	10.524	2.27	2.27	1.968	81.30
39	64.5	9.794	2.047	2.047	1.739	82.24
40	64	9.063	1.836	1.836	1.525	83.17

*Dead Storage Level

The original storage capacity curve is compared with the same obtained from the IBS surveys in 2011, 2015 and 2019 and is shown in Fig 16.

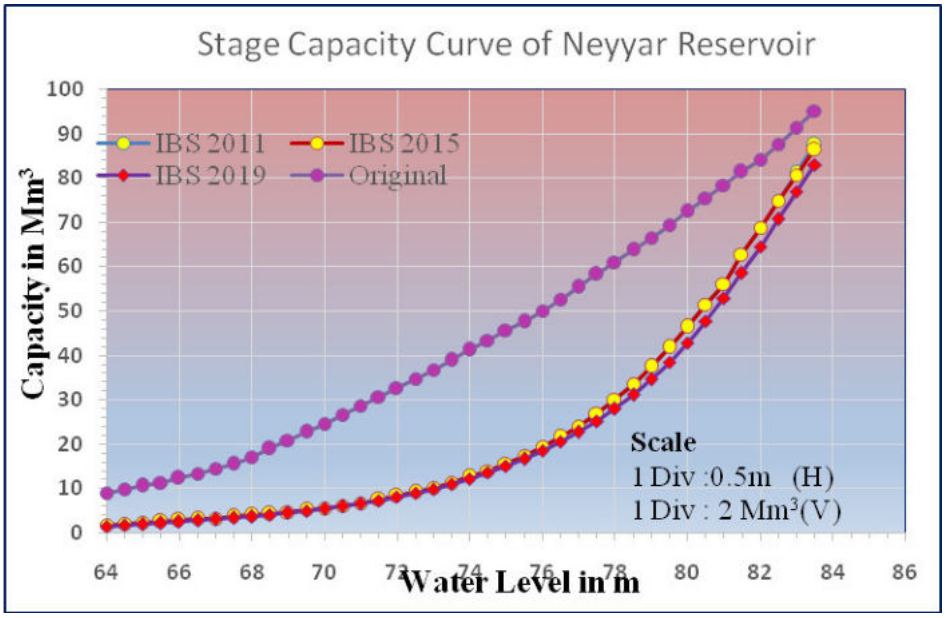


Fig 16 Capacity curve (Water level V/s Capacity)

3. WATER SPREAD AREA AT DIFFERENT WATER LEVEL

The present water spread area at different level is compared with the previous IBS studies in 2011 & 2015 and is shown in Table6.0. Fig. 17 shows its graphical representation.

Table 6.0 Water spread area at different water levels.

Sl. No.	Water Level	Water Spread Area		
		IBS Survey 2011	IBS Survey 2015	IBS Survey 2019
	m	Sq Km	Sq Km	Sq Km
1	83.5	9.43	7.87	9.03
2	83	9.42	7.85	9.03
3	82.5	9.41	7.84	9.01
4	82	9.28	7.81	8.94
5	81.5	9.03	7.73	8.73
6	81	8.71	7.56	8.41
7	80.5	8.29	7.28	7.99
8	80	7.78	6.93	7.47
9	79.5	7.28	6.51	6.84
10	79	6.71	6.08	6.25
11	78.5	6.16	5.64	5.69
12	78	5.62	5.38	5.17
13	77.5	5.11	5.21	4.71
14	77	4.61	4.8	4.27

15	76.5	4.17	4.04	3.87
16	76	3.78	3.72	3.53
17	75.5	3.42	3.42	3.21
18	75	3.09	3.14	2.93
19	74.5	2.79	2.88	2.67
20	74	2.51	2.64	2.43
21	73.5	2.26	2.43	2.2
22	73	2.03	2.23	1.99
23	72.5	1.82	2.04	1.79
24	72	1.61	1.84	1.6
25	71.5	1.43	1.65	1.43
26	71	1.25	1.48	1.27
27	70.5	1.1	1.32	1.13
28	70	0.98	1.17	0.99
29	69.5	0.88	1.03	0.88
30	69	0.79	0.91	0.8
31	68.5	0.72	0.81	0.73
32	68	0.66	0.73	0.67
33	67.5	0.61	0.66	0.62
34	67	0.57	0.61	0.58
35	66.5	0.54	0.57	0.55
36	66	0.51	0.53	0.52
37	65.5	0.48	0.5	0.48
38	65*	0.46	0.47	0.45
39	64.5	0.43	0.44	0.43
40	64	0.41	0.42	0.39

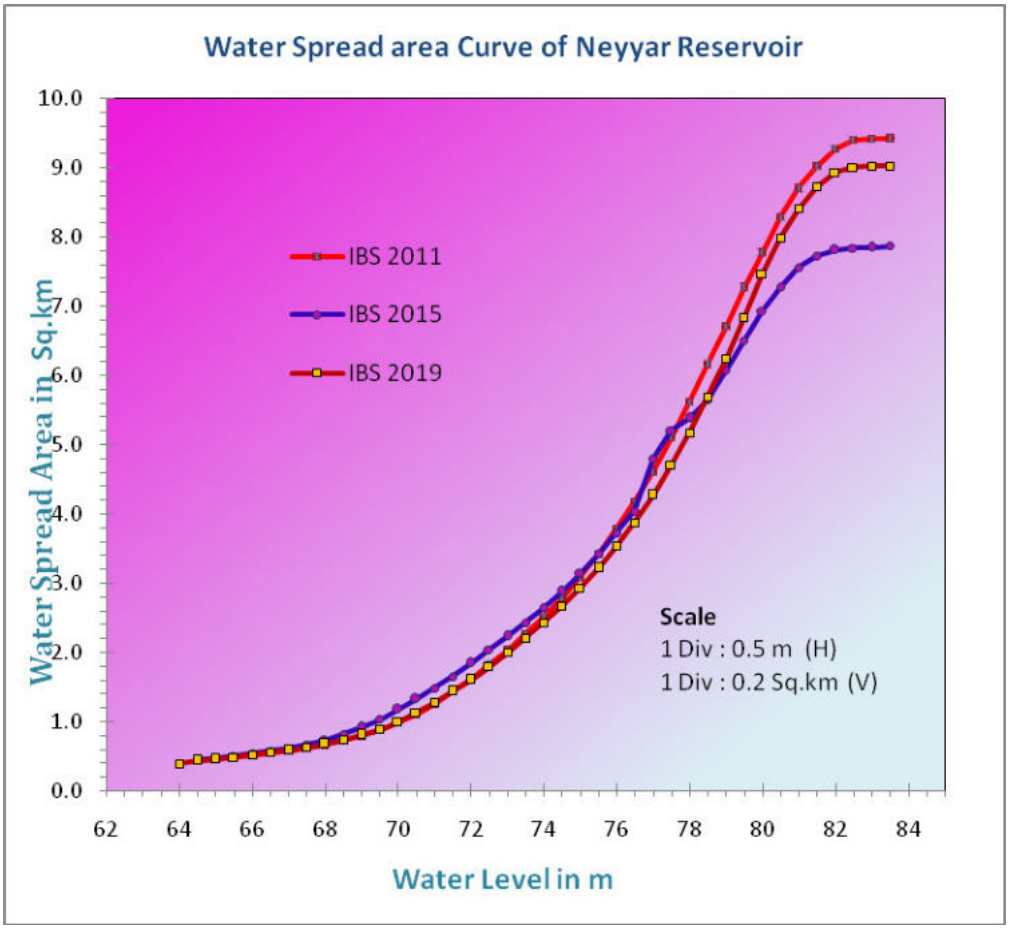


Fig.17 Water level v/s water spread area curve

4.0 ANALYSIS OF SOIL SAMPLE

In the present study 10 Nos of soil samples are collected and analyzed. Soil sample analysis was done in previous survey conducted in 2011. The average percentage of clay, silt, sand and gravel of the analyzed samples in the two consecutive studies are graphically represented in Fig 18. By comparing the results of the studies, it is observed that there is not much variation in the percentage of various soil components by comparing with the previous result.

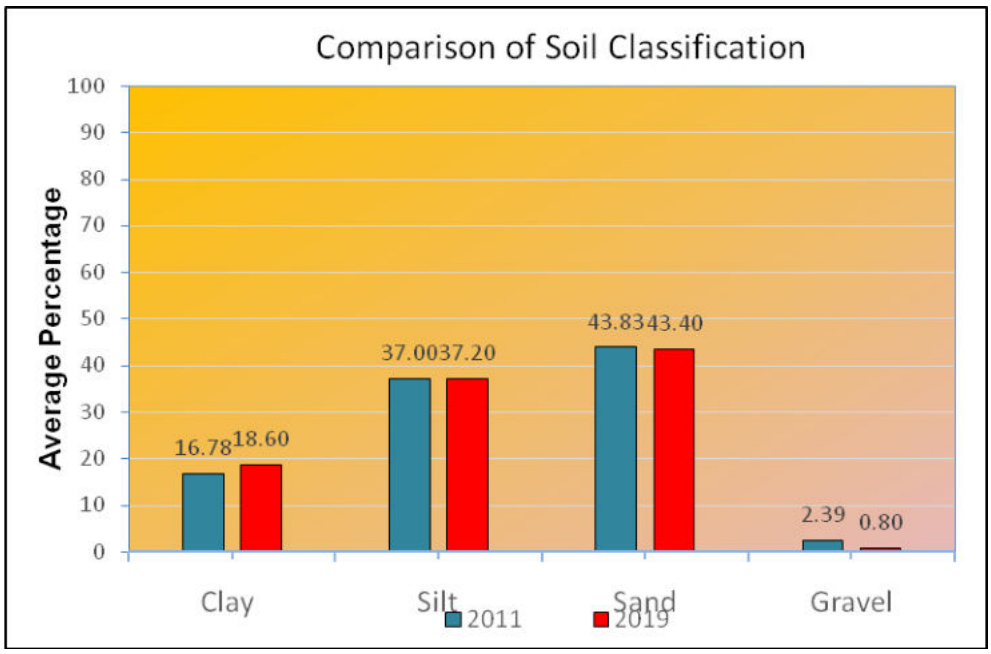


Fig 18 Soil particle distribution of the disturbed samples

Since we are analyzing the grab samples the percentages of soil particles are only indicative and not accurate. For accurate assessment of contents in the soil, core sample analysis must be done.

DISCUSSION

The original Capacity of Neyyar Reservoir at 83.5m level is 95.157 Mm^3. The present capacity is 83.016 Mm^3. The capacity reduction of the reservoir is 12.141Mm^3in 55 years 12.75% of the original capacity.

- *The IBS **Surveys in 2011** and **2015** were conducted at WL83.6m and WL84.75m respectively and corresponding reservoir capacity was 88.66 Mm^3 and 97.345 Mm^3 against the original capacity of 96.034$Mm^3$and 106.188 Mm^3respectively. As per the 2011 study, the capacity reduction rate is0.16 Mm^3/per year within 47 years. In basis of 2015 study, the reduction rate is 0.173Mm^3/per year within 51 years.*
- *The original volume at dead storage level (65 m) was 10.524Mm^3, volume reduced to 2.27 Mm^3within 51 years. Reduction percentage is 78.43 %.*
- *The **present study is conducted at WL 83.5m**, the reservoir capacity is 83.016$Mm^3$and the capacity is reduced by 12.141 Mm^3 in 55 years @ 0.221 Mm^3/per year ie 0.23% of the original capacity per year.*
- *Volume at dead storage level is 1.968 Mm^3, Percentage reduction in dead storage is 81.3 % in 55 years. Within the last 4 years after the second study the dead storage capacity is reduced by 2.87 %.*

- *In the previous studies conducted in 2011 and 2015, the reservoir capacity corresponding to the WL 83.5m was 87.408 Mm^3 &86.253 Mm^3 respectively. For the last four years the rate of capacity reduction is 0.809 Mm^3/year ie 0.85% of the original capacity per year.*
- *Sediment layer profile of the reservoir area at an interval of 100m is obtained from the Sub Bottom profiler.*

Based on the first study conducted in 2011, the capacity reduction rate corresponding to WL 83.5m was ***0.17 %***per year during the first 47 years of the dam life. From the next study in 2015, the capacity reduction rate was estimated as ***0.30%*** per year for the last 4 years after the first study. From the present study conducted in 2019, the capacity reduction rate is ***0.85%*** for the last 4 years after the second study. Ie***There is a huge increase in rate of sedimentation and this is the outcome of the unusual heavy flood occurred in 2018 and 2019.***

After the heavy flood in 2018, sedimentation studies of some reservoirs all over Kerala have been conducted. It is observed that some reservoirs show an increase in capacity based on the previous study results. But in the case of Neyyar reservoir there is a huge reduction in the capacity after the heavy flood. In case of Kanjirapuzha reservoir also shows a huge reduction in capacity.By enquiry with the dam officials, it is known landslides were occurred in the catchment area during the floods in 2018 & 2019. The huge capacity reduction is the outcome of this landslides occurred.

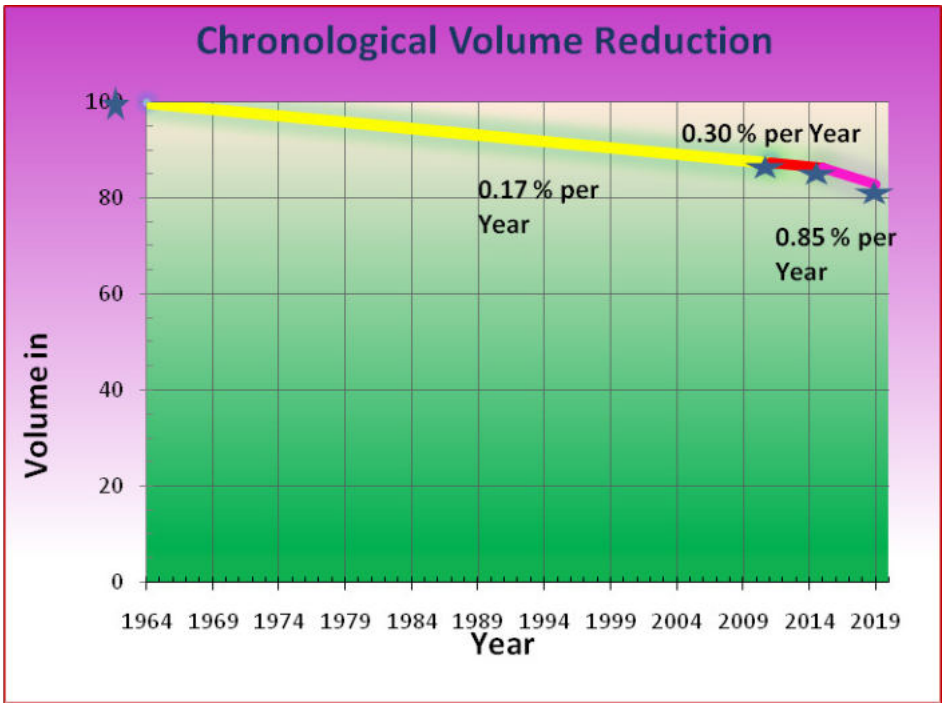


Fig 19Chronological Volume Reduction

3. Sedimentation study of Vazhani reservoir using Integrated Bathymetric System (IBS) & Sub Bottom profiler

The survey of Vazhani reservoir has been conducted previously in 2009. The survey has again conducted during 2019 to know the changes in sedimentation after the floods of2018 and 2019. The details are as follows:

Results and Discussion

1. ESTIMATION OF CAPACITY

The survey is carried out at the water level of 60.55 m. As per the previous survey conducted in 2009, the water holding capacity corresponding to this level was 13.912Mm^3. In the present study the volume at the same level is estimated as 15.143$Mm^3$and the corresponding water spread area is 1.54Sq.km. Since the original capacity at the WL 60.55 is not available, the present capacity can be compared with the previous survey result and it is observed that the capacity of the reservoir increased by 1.231 Mm3.

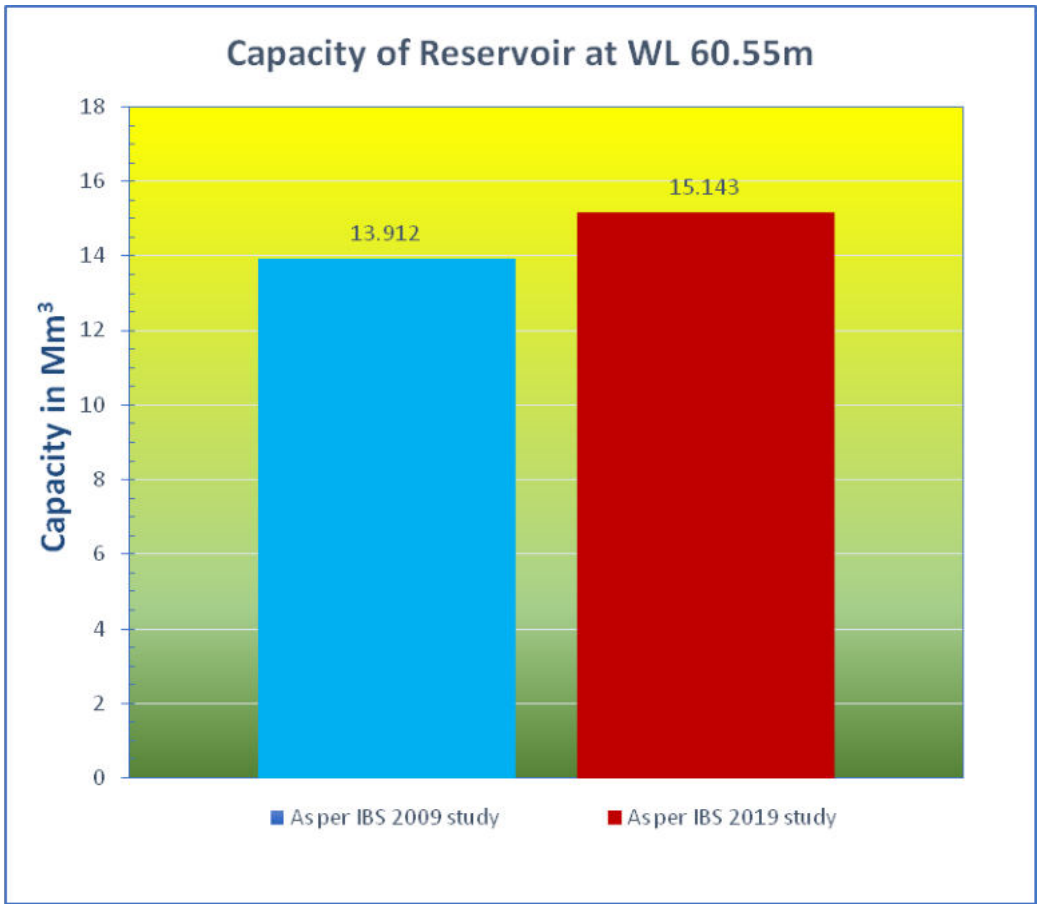


Fig 20Increase in reservoir capacity

The contour map of water spread area is shown in Fig 21.

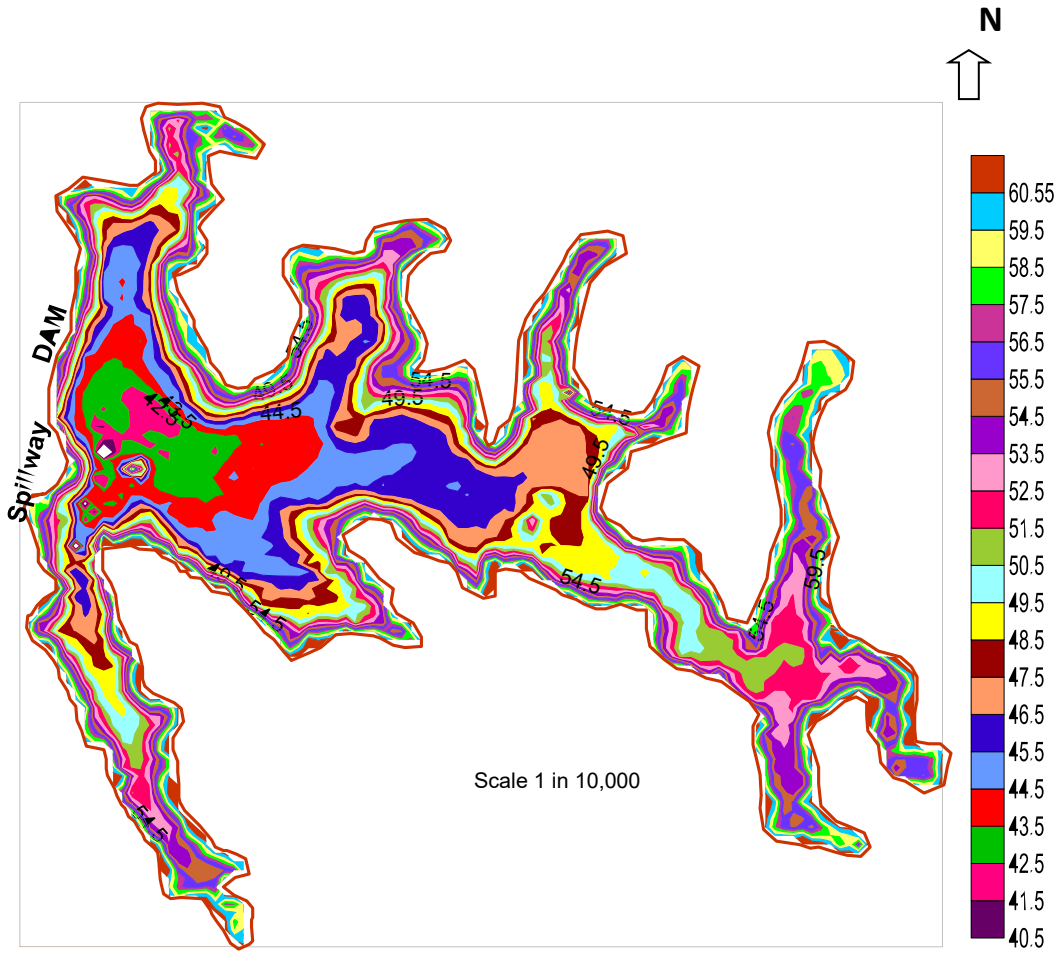


Fig 21 Contour Map based on IBS Surveyof Vazhani

2. CAPACITY AT DIFFERENT WATER LEVEL

Reservoir volume at different water levels can be found out using the IBS data in Surfer software. The present capacity at different water levels are compared with the IBS result in 2009 and is shown in Table 7.0

Table 7.0 Reservoir capacity at different water levels.

Sl No	Water Level	Water Holding Capacity		Percentage increase in capacity wrt 2009 result
		IBS Survey 2009	IBS Survey 2019	
	m	M. Cub. m	M. Cub. m	%
1	60.55	13.912	15.143	8.85
2	60.5	13.835	15.06	8.85
3	60	13.085	14.245	8.87
4	59.5	12.358	13.454	8.87
5	59	11.656	12.686	8.84
6	58.5	10.978	11.945	8.81
7	58	10.328	11.23	8.73
8	57.5	9.701	10.539	8.64
9	57	9.097	9.87	8.50
10	56.5	8.514	9.224	8.34
11	56	7.949	8.599	8.18
12	55.5	7.403	7.997	8.02
13	55	6.874	7.417	7.90
14	54.5	6.362	6.859	7.81
15	54	5.869	6.322	7.72
16	53.5	5.395	5.807	7.64
17	53	4.94	5.311	7.51
18	52.5	4.504	4.836	7.37
19	52	4.085	4.382	7.27
20	51.5	3.683	3.949	7.22
21	51	3.299	3.538	7.24
22	50.5	2.933	3.147	7.30
23	50	2.583	2.777	7.51
24	49.5	2.249	2.428	7.96
25	49	1.934	2.099	8.53
26	48.5	1.636	1.787	9.23
27	48	1.359	1.5	10.38

28	47.5	1.105	1.234	11.67
29	47	0.877	0.988	12.66
30	46.5	0.678	0.771	13.72
31	46	0.512	0.582	13.67
32	45.72*	0.433	0.493	13.86
33	45.5	0.378	0.425	12.43
34	45	0.271	0.301	11.07
35	44.5	0.185	0.204	10.27
36	44	0.116	0.128	10.34
37	43.5	0.064	0.078	21.88
38	43	0.03	0.045	50.00
39	42.5	0.01	0.026	160.00

*Dead Storage Level

The stage capacity curve obtained in the present survey is compared with the same in the previous year as shown in Fig 22.

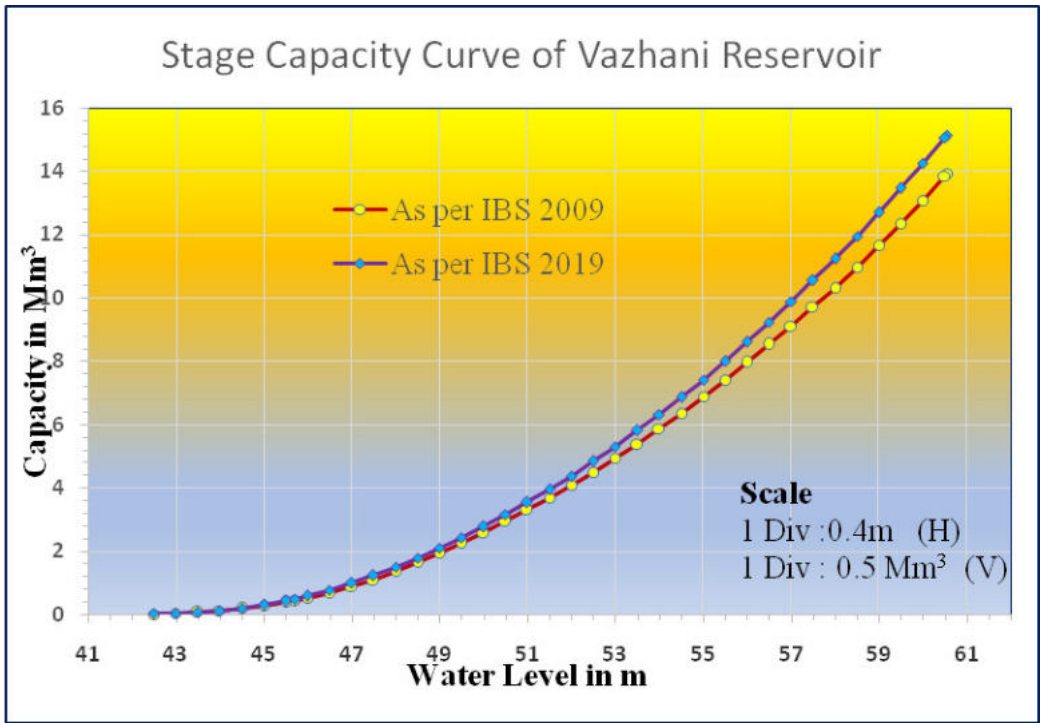


Fig 22 Water level v/s Water holding capacity curve

3. WATER SPREAD AREA AT DIFFERENT WATER LEVEL

The present water spread area at different level is compared with the same obtained in 2009 IBS survey and is shown in Table 8.0. Fig 23 shows its graphicalrepresentation.

Table 8.0 Water spread area at different water levels.

Sl. No.	Water Level	Water Spread Area	
		IBS Survey 2009	IBS Survey 2019
	M	Sq.km	Sq.km
1	60.55	1.49	1.54
2	60.5	1.49	1.53
3	60	1.47	1.52
4	59.5	1.44	1.49
5	59	1.4	1.46
6	58.5	1.36	1.43
7	58	1.32	1.39
8	57.5	1.28	1.34
9	57	1.24	1.31
10	56.5	1.2	1.27
11	56	1.16	1.23
12	55.5	1.12	1.18
13	55	1.09	1.14
14	54.5	1.05	1.1
15	54	1.01	1.05
16	53.5	0.97	1.01
17	53	0.93	0.98
18	52.5	0.89	0.93
19	52	0.85	0.89

20	51.5	0.81	0.84
21	51	0.77	0.8
22	50.5	0.73	0.76
23	50	0.7	0.72
24	49.5	0.67	0.68
25	49	0.63	0.64
26	48.5	0.59	0.59
27	48	0.56	0.55
28	47.5	0.52	0.52
29	47	0.48	0.47
30	46.5	0.43	0.41
31	46	0.38	0.35
32	45.72	0.35	0.31
33	45.5	0.33	0.28
34	45	0.27	0.22
35	44.5	0.22	0.18
36	44	0.19	0.13
37	43.5	0.14	0.08
38	43	0.09	0.05
39	42.5	0.05	0.02

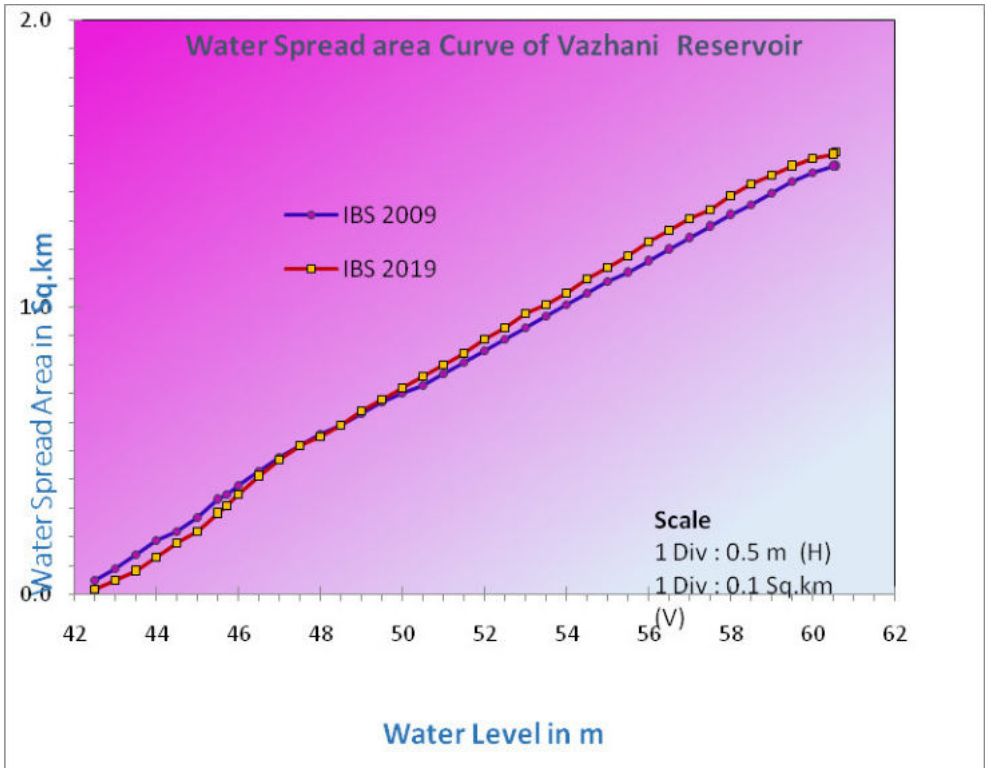


Fig 23 Water Level v/s Water Spread Area curve

4. ANALYSIS OF SOIL SAMPLE

In the sedimentation study conducted in 2009, 3 No of disturbed soil samples were analyzed. In the present study 4 No of soil samples are analyzed. The samples for both the studies were collected from different locations. By comparing the results of two studies, it is observed that there is not much variation in the percentage of clay. But the percentage of Silt is more than the percentage of Sand in the present study and it is vice versa in the previous study. The average percentage of clay, silt, sand and gravel of the analyzed samples in the two consecutive studies are graphically represented in Fig 24.

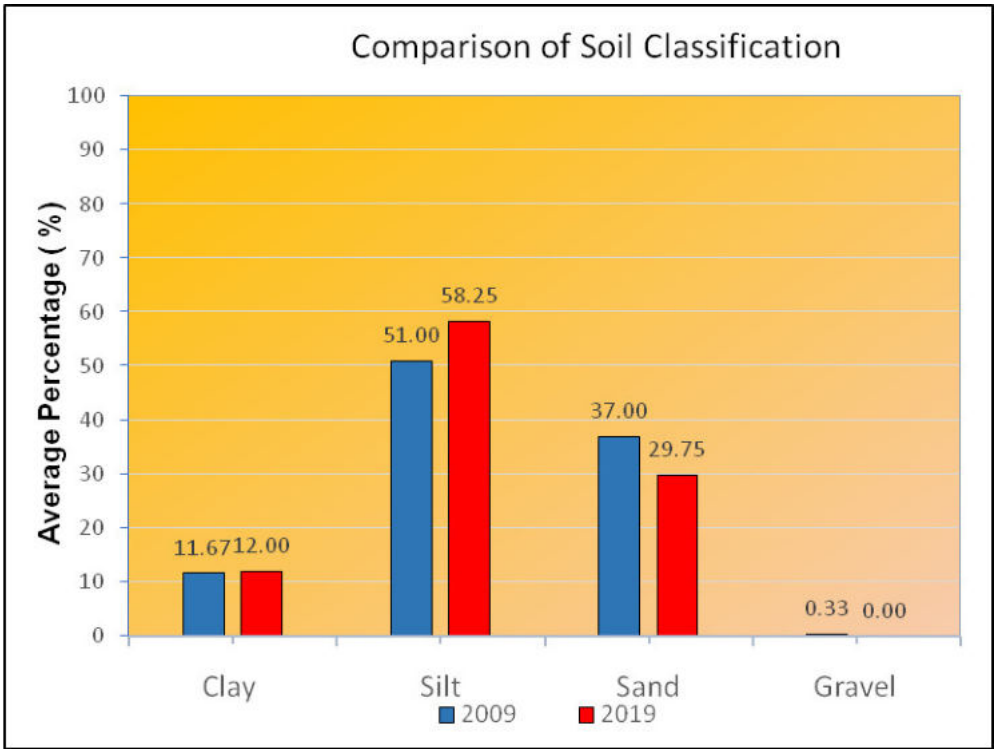


Fig 24 Comparison of soil particle distribution as per two consecutive studies

Since we are analyzing the grab samples the percentages of soil particles are only indicative and not accurate. For accurate assessment of contents in the soil, core sample analysis must be done.

DISCUSSION

As per the previous survey conducted in 2009 the Capacity of Vazhani Reservoir at 60.55m level was estimated as 13.912 $Mm^{3.}$ The present capacity at this level is 15.143 Mm^3. The capacity of the reservoir is increased by 1.231 Mm^3 in 10 years at the same level.

- *The IBS **Survey in 2009**, was conducted at FRL 62.48m and the corresponding capacity of the reservoir was 17.118 $Mm^{3.}$ The capacity corresponding to the present survey water level of 60.55m was 13.912Mm^3.*

- *The water spread area corresponding to WL60.55m was 1.49 Sq.km.*
- *The volume at dead storage level (45.72m) was 0.433 Mm^3*

- *The **present study** is conducted at water level 60.55m and the reservoir capacity is 15.143Mm^3 and capacity is increased by 1.231Mm^3 in 10 years.*

- *The water spread area corresponding to 60.55m is 1.54 Sq.km and within 10years the area is increased by 0.05Sq Km.*

- *Volume at dead storage level is 0.493 Mm^3andit is increased by 13.86 % compared with the same obtained in the previous study.*
- *Comparing with the previous study result, the storage capacity shows anincrease in all the water levels. In case of water spread area, it shows an increase from 60.55m to 48.5m and deceases below this level comparing with the previous study result.*
- *Sediment layer profile of the reservoir area at an interval of* ***50m*** *is obtained from the Sub Bottom profiler.*

The above observations need to be explained. Major part of the sediment load from the heavy floods must have been carried away due to the high inflow rate and velocity during the extra ordinary flood of 2018. Hence, the net volume of sediment trapped from the inflow and land slide inside the reservoir, was less than the volume of soil mass lost by land slide. This led to an increase in the capacity of the reservoir.This increase in volume is once again make sure by the sediment deposit found in the Vadakkanchery river and chiras in the downstream side of the reservoir occured after the heavy flood. It is also known that the concerned authorities have removed the deposited sediments from different reach of the river and chiras.

The storage capacity between two consecutive levels from the WL 60.55m to 42.5m were compared for the surveys in 2009 and 2019 and it is shown in Fig. 25

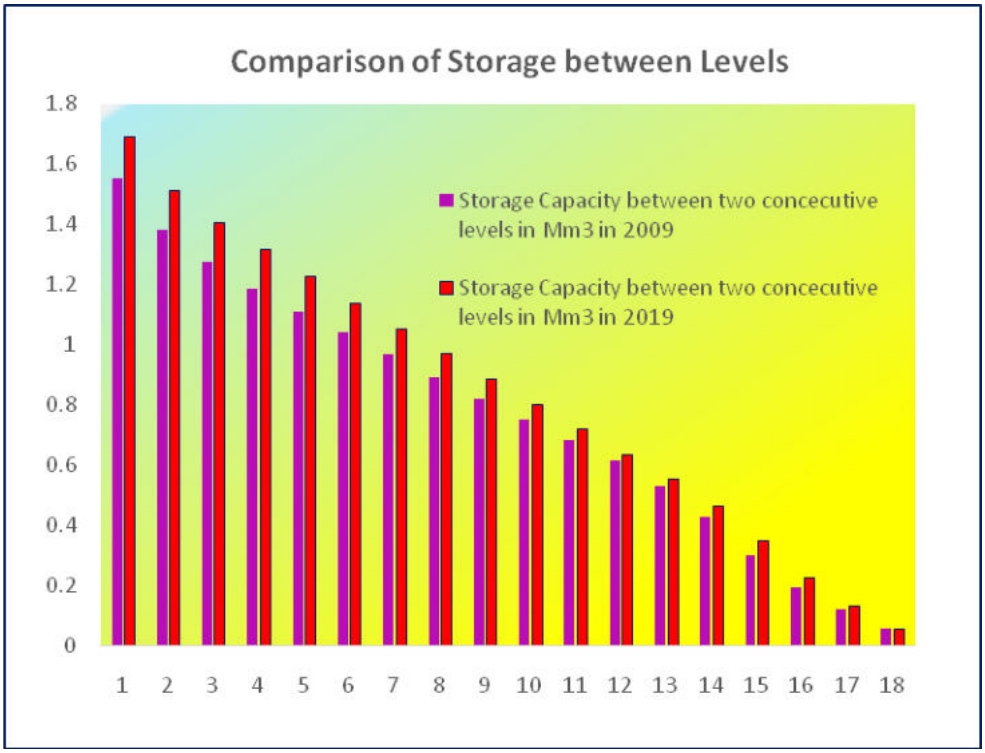


Fig 25 Bar chart showing reservoir storage between consecutive water levels

By analysing the storage capacity between the levels from the two studies, it is clear that they follows almost the same pattern in the variation of the storage capacity between the two cosecutive levels.

5. Sedimentation study of Malampuzha reservoir using Integrated Bathymetric System (IBS) & Sub Bottom profiler

Sedimentation study of Malampuzha reservoir has already been conducted in 2005 and 2015. The repeat study of Malampuzha reservoir using IBS & Sub bottom profiler has been performed in 2019 in order to assess the effect of the extra ordinary floods occurred in the year 2018 and 2019.

Results and Discussion

1. ESTIMATION OF CAPACITY

The survey is carried out at water level of 113.0 m. The original water holding capacity at this level is 176.167Mm^3. As per the current IBS study the volume at the same level is estimated as 127.8 Mm^3 and the corresponding water spread area is 19.92 Sq.km. Total capacity reduction of the reservoir is 48.367 Mm^3in 64 years, i.e. the reduction in capacity at the specified level is 27.46 %. The capacity reduction is due to the presence of sediment deposit. In the previous study conducted in 2005, the reservoir capacity corresponding to this level was 148.995 $Mm^3$and water spread area was 21.24Sq.km. The next survey was conducted in 2015 as a pilot study at WL 111.0 m and the corresponding capacity obtained was 109.456 Mm^3.

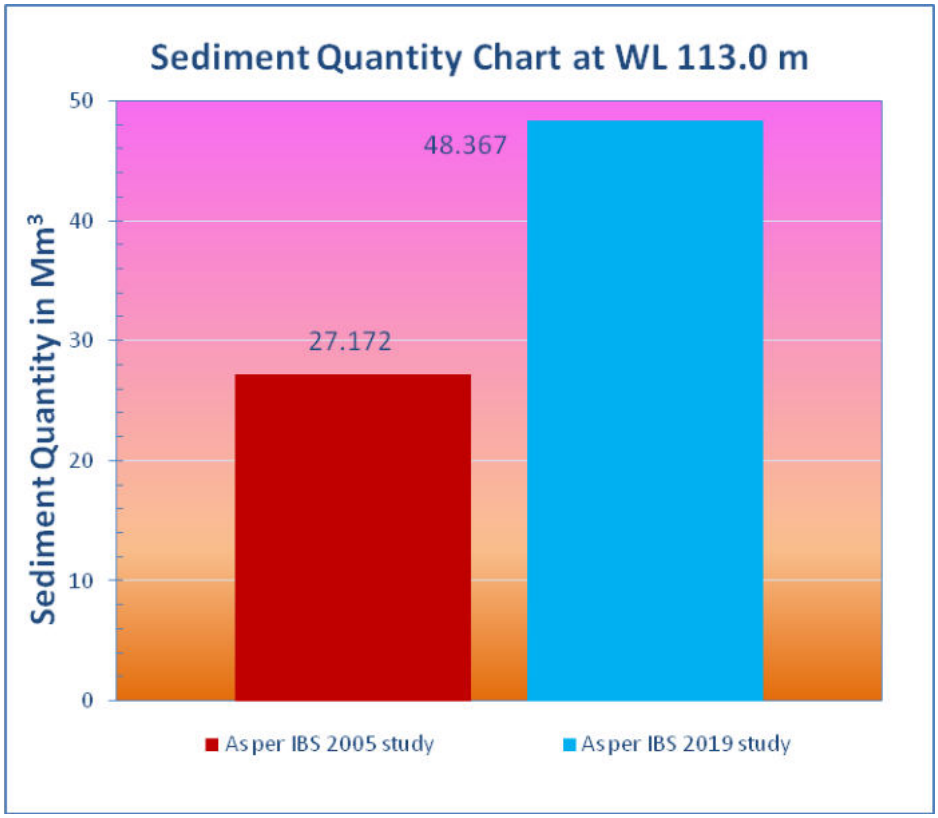


Fig 26 Increase in Sediment quantity

Table 9.0 shows the comparison in capacity of the reservoir between the two consecutive studies conducted in 2005 and 2019 and Fig 26 shows its graphical representation.

Table 9.0 Capacity reduction of the reservoir at WL 113 m

Year of Study	Capacity	Reduction in Capacity w.r.t Original Volume (176.167 Mm^3)	
		In Mm^3	In Percentage
2005	148.995	27.172	15.42
2019	127.800	48.367	27.46

The contour map of water spread area is shown in Fig 27 at an interval of 2 m

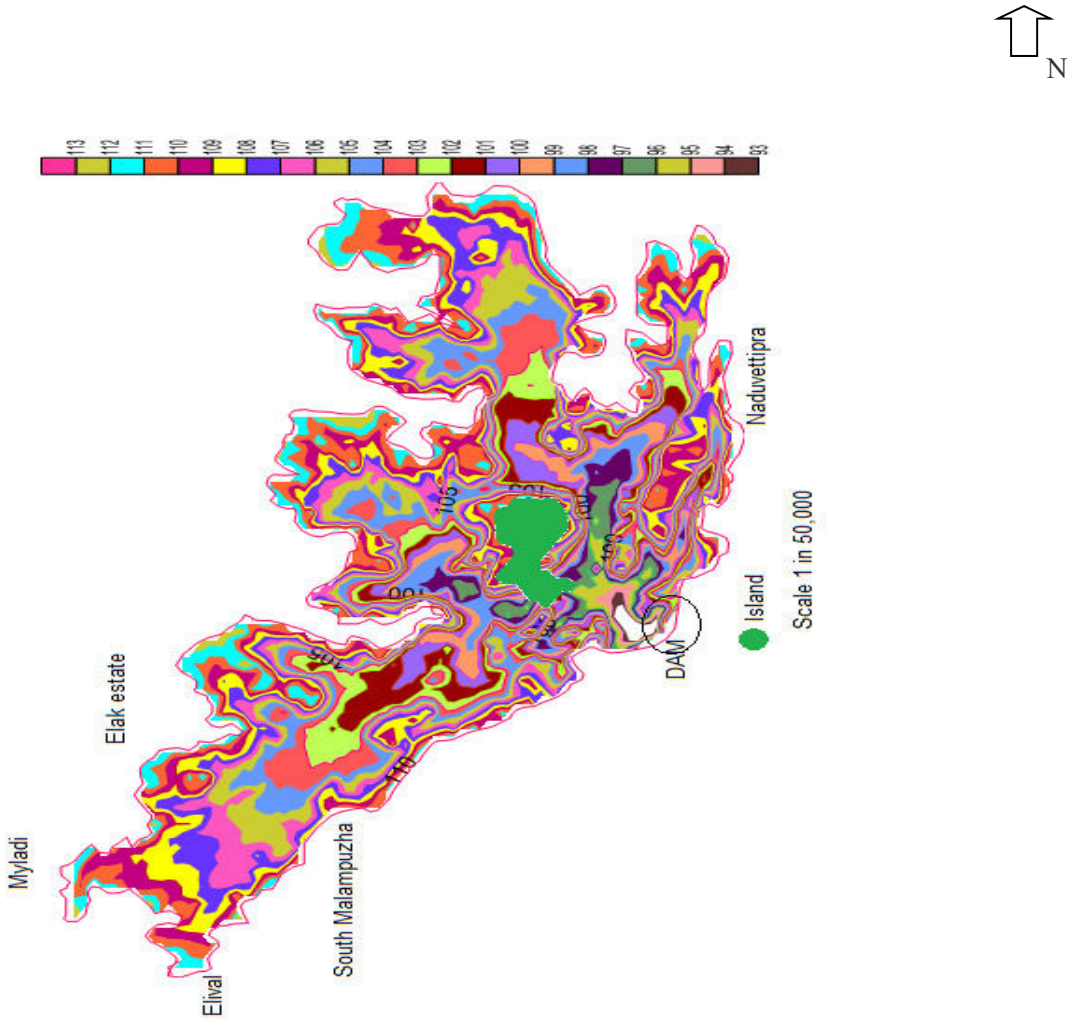


Fig 27 Contour map based on IBS survey

2. CAPACITY AT DIFFERENT WATER LEVEL

Reservoir volume at different water levels can be found out using the IBS data in SURFER software. The present capacity at different water level is compared with the original and IBS result in 2005 and is shown in Table 10.0

Table 10.0 Reservoir capacity at different water levels

	Water Level	Water Holding Capacity			Percentage Reduction in Capacity
			IBS Survey 2005	IBS Survey 2019	

	(m)	(M. Cub. m)	(M. Cub. m)	(M. Cub m)	%
1	113.00	176.167	148.995	127.800	27.46
2	112.00	156.813	128.350	107.181	31.65
3	111.00	137.716	109.147	88.166	35.98
4	110.00	120.710	91.707	72.536	39.91
5	109.00	104.308	76.291	59.365	43.09
6	108.00	90.125	62.805	48.012	46.73
7	107.00	76.276	50.963	38.262	49.84
8	106.00	64.452	40.592	29.971	53.50
9	105.00	53.186	31.541	22.997	56.76
10	104.00	43.500	23.859	17.296	60.24
11	103.00	34.757	17.473	12.745	63.33
12	102.00	27.120	12.351	9.145	66.28
13	101.00	20.857	8.342	6.359	69.51
14	100.00	15.500	5.241	4.293	72.30
15	99.00	10.877	2.982	2.797	74.29
16	98.00	7.125	1.509	1.661	76.69
17	97.00	4.654	0.719	0.917	80.30
18	96.00	3.118	0.330	0.482	84.54
20	95.50*	2.400	0.213	0.359	85.04
19	95.00	1.612	0.129	0.270	83.25
21	94.00	0.985	0.040	0.148	84.97
22	93.00	0.358	0.007	0.073	79.61

*Dead Storage Level

The original storage capacity curve is compared with the same obtained from the IBS surveys in 2005 and 2019 and is shown in Fig 28.

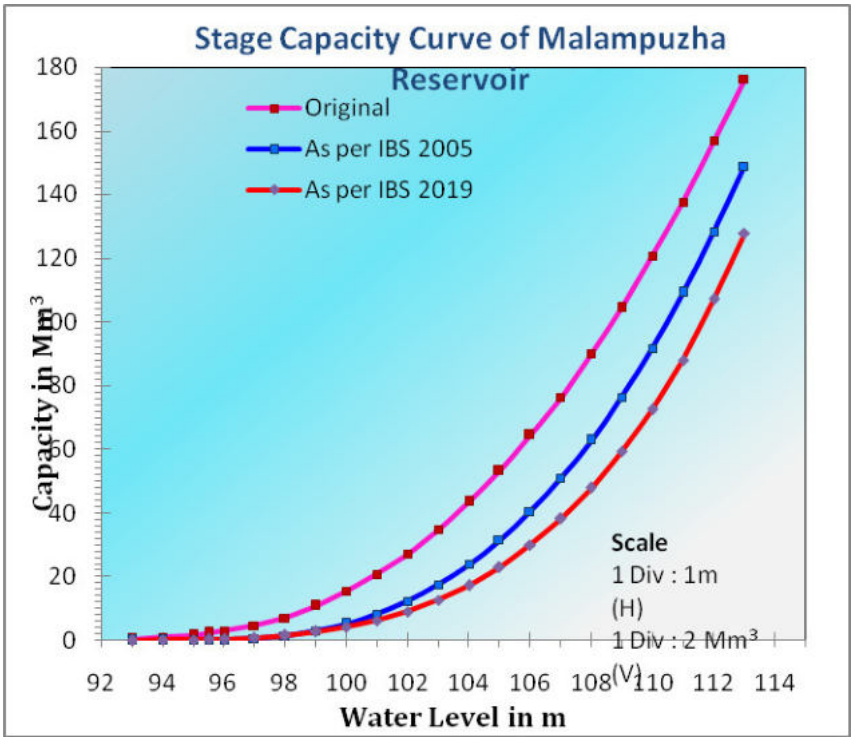


Fig 28 Water Level v/s Water holding capacity curve

3. WATER SPREAD AREA AT DIFFERENT WATER LEVEL

The present water spread area at different level is compared with the original (not available in all 1m interval WL) and is shown in Table 11.0. Fig 29 shows its graphical representation.

Table 11.0 Water spread area at different water levels.

Sl. No.	Water Level	Water Spread Area	
		Original	IBS Survey 2019
	(m)	(Sq Km)	(Sq Km)
1	113.00	20.12	19.92
2	111.00	17.65	17.06
3	109.00	15.63	12.13
4	107.00	13.02	8.97
5	105.00	10.42	6.29
6	103.00	8.79	4.02
7	101.00	6.08	2.37
8	99.00	3.99	1.29
9	97.00	2.54	0.57
10	95.00	1.27	0.15
11	93.00	0.58	0.06

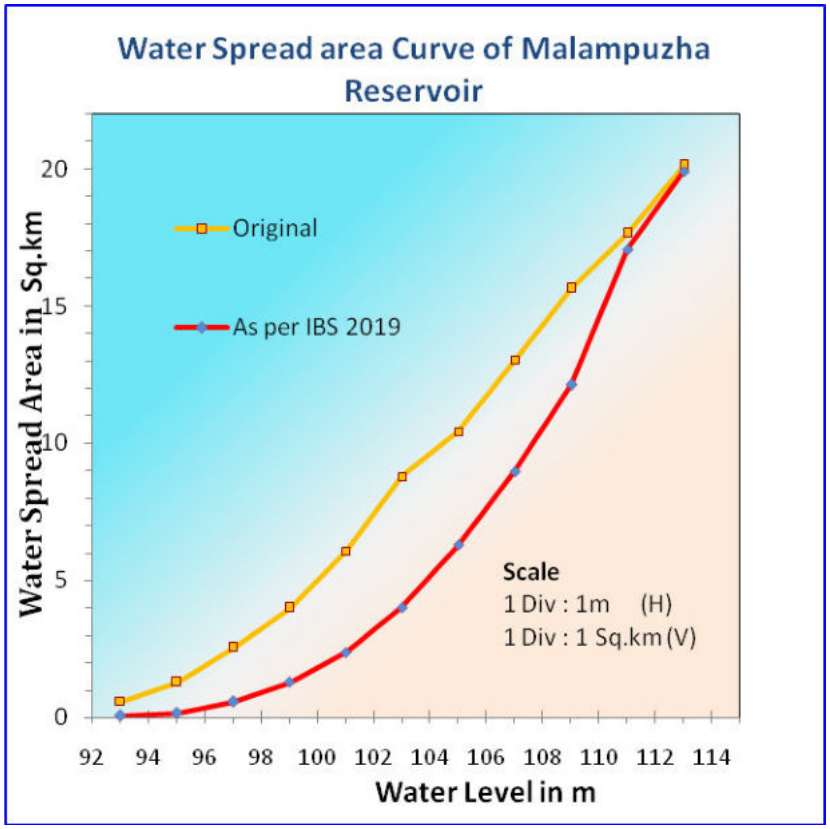


Fig 29 Water level v/s water spread area curve

ANALYSIS OF SOIL SAMPLE

In the present study 15 Nos of soil samples are collected and analyzed. Soil sample analysis was done in previous survey conducted in 2005. The average percentage of clay, silt, sand and gravel of the analyzed samples in the two consecutive studies are graphically represented in Fig 30. By comparing the results of the studies, it is observed that there is not much variation in the percentage of various soil components by comparing with the previous result.

Since we are analyzing the grab samples, the percentages of soil particles are only indicative and not accurate. For accurate assessment of contents in the soil, core sample analysis must be done.

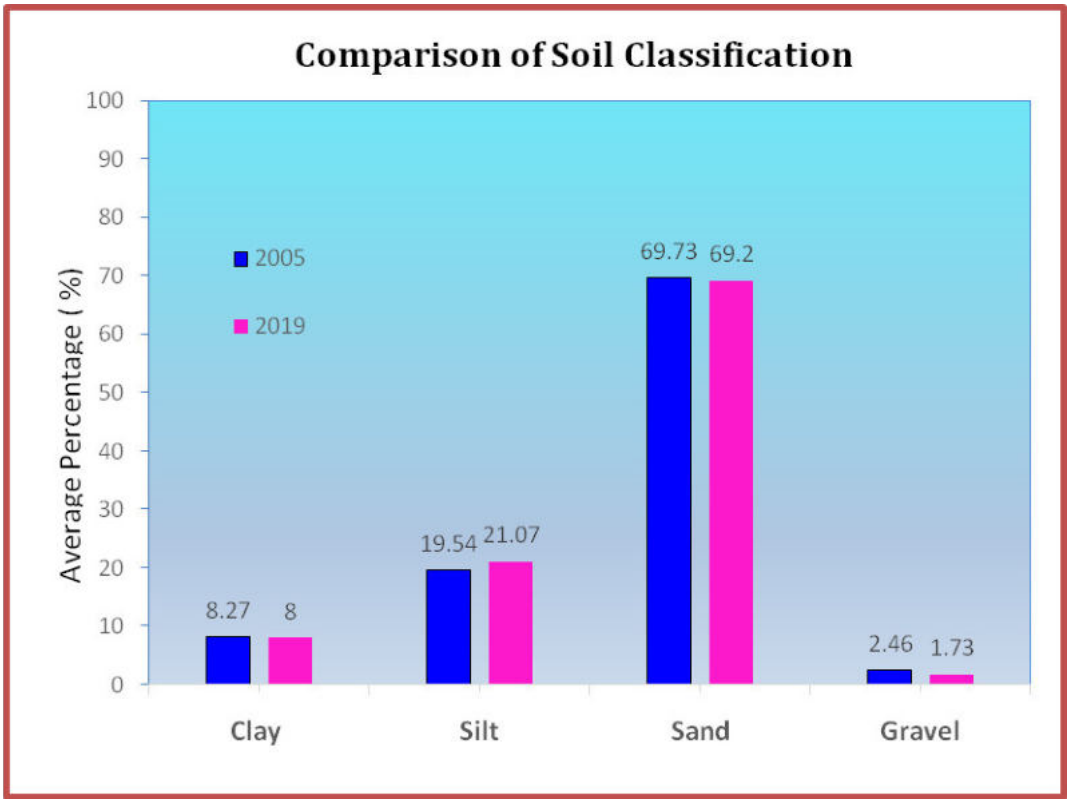


Fig 30 Comparison of Soil particle distribution as per two consecutive studies

DISCUSSION

The original Capacity of Malampuzha Reservoir at 113.0 m level is 176.167 $Mm^{3.}$ The present capacity is 127.8 Mm^3. The capacity reduction of the reservoir is 48.367Mm^3 in 64 years ie. Capacity reduction is 27.46% of the original volume.

- *The IBS **Surveys in 2005was conducted at WL115.06m** and corresponding reservoir capacity was 195.328 Mm^3 against the original capacity of 226.0Mm^3. As per the 2005 study, the capacity reduction rate is 0.271 Mm^3/per year within 50 years.*
- *The original volume at dead storage level (95.5 m) was 2.40 Mm^3, volume reduced to 0.213 Mm^3 within 50 years. Reduction percentage is 91.12 %.*
- *The **present study is conducted at WL 113.0m**, the reservoir capacity is 127.80$Mm^3$and the capacity is reduced by 48.367 Mm^3 in 64 years @ 0.756 Mm^3/per year ie 0.43% of the original capacity per year.*
- *Volume at dead storage level is 0.359 Mm^3, Percentage reduction in dead storage is 85.04 % in 64 years.*
- *In the previous study conducted in 2005, the reservoir capacity corresponding to the WL 113.0m was 148.995 Mm^3. For the last 14 years the rate of capacity reduction is 1.514 Mm^3/year ie0.86 % of the original capacity per year.*
- *Sediment layer profile of the reservoir area at an interval of 100m is obtained from the Sub Bottom profiler.*

Based on the first study conducted in **2005**, the capacity reduction rate corresponding to WL 113.0m was ***0.31%***per year during the first 50 years of the dam life. From the present study conducted in **2019,** the capacity reduction rate is ***0.86%*** for the last 14 years after the first study. Ie***There is an increase in rate of capacity reduction and this is the outcome of the unusual heavy flood occurred in 2018 and 2019.***

After the heavy flood in 2018 and 2019, sedimentation studies of some reservoirs all over Kerala have been conducted. It is observed that some reservoirs show an increase in capacity based on the previous study results. But in the case of Neyyar and Kanjirapuzha reservoirs, there is a huge reduction in their capacity after the heavy flood. Similarly, in case of Malampuzha reservoir also there is a huge reduction in capacity. The capacity reduction rate corresponding to WL113.0m is graphically represented in Fig 31.

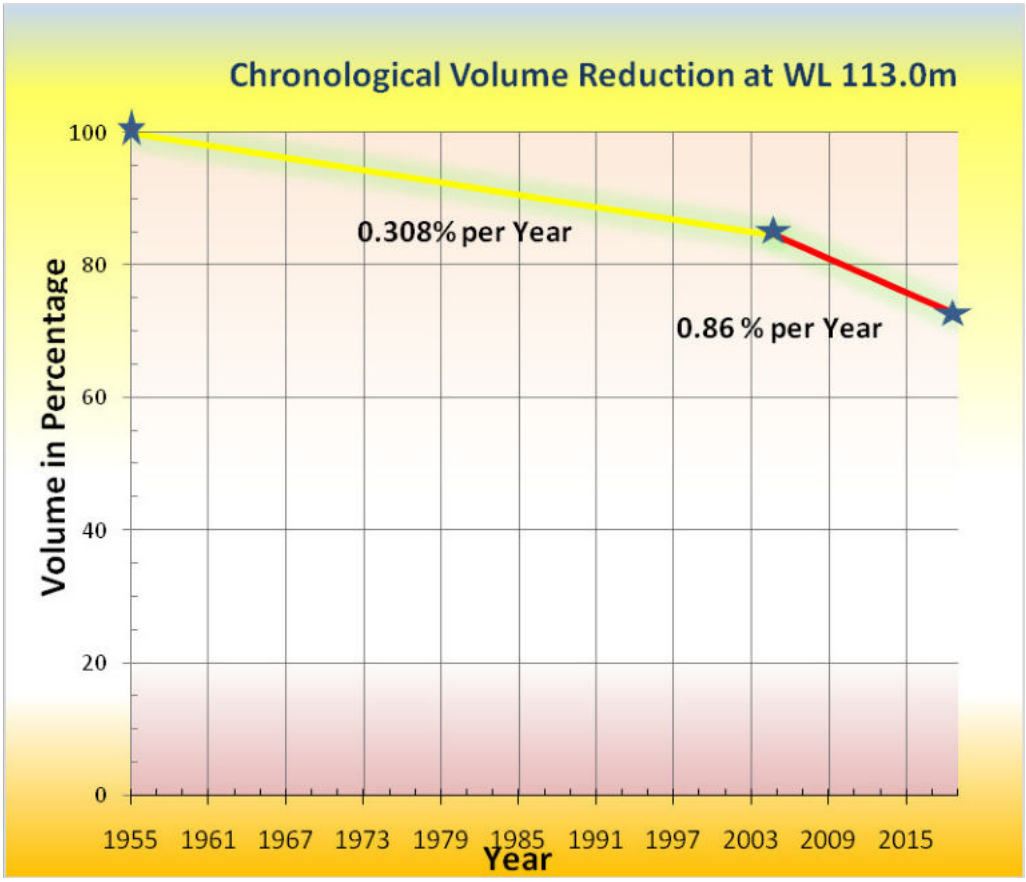


Fig 31 Chronological Volume Reduction

In general, it has been observed worldwide that the reservoir capacity decreases with time. The life of reservoirs is determined by its trap efficiency. The sedimentation in reservoirs is dependent on many factors such as the size of the reservoir relative to the volume of sediment flowing in which in turn depends on river discharge, sediment load carried by the stream, topographical and physical features of the catchment area, duration of rainy season etc.

Considering the accuracy of methodology adopted, the survey conducted in 2005 can be taken to determine the average rate of sedimentation. From 1955 to 2013, the reservoir volume had decreased from 176.167 Mm3 to 148.995 Mm^3 at WL 113.0m in 50 years. Therefore, the average rate of sedimentation can be considered as 0.543 Mm^3 /year ie, 0.31%/year. This rate is more comparing with the average value of 0.2 percent in USA.

At the prevailing rate, the reservoir capacity should have been reduced to 141.393 Mm^3in the year 2019. But the reservoir capacity has reduced to 127.8Mm^3. Between 2005 and 2019 the reservoir capacity has reduced by 21.195Mm^3. This much huge reduction may be due to the effect of flood occurred in 2018 & 2019.

Similarly by comparing the capacity at the dead storage level it is observed that the capacity shows an increase from 0.213Mm^3 to 0.359Mm^3 in the studies in 2005 and 2019 respectively. The storage capacity between two consecutive levels from the WL 113.0m to 93.0 m are compared for the surveys in 2005 and 2019 and it is shown in Fig. 8.2

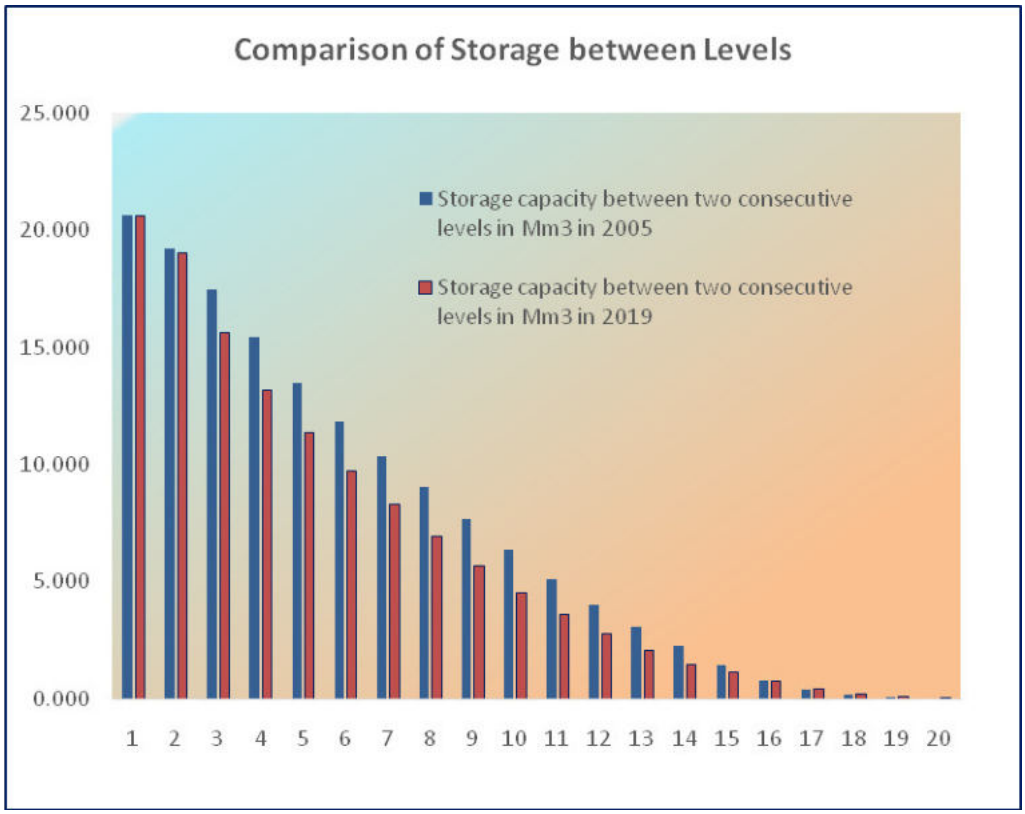


Fig 32 Bar chart showing reservoir storage between onsecutive water levels

By analysing the storage capacity between the levels from the two studies, it is clear that there is not much variation in water holding capacity at higher levels from 113m to 111m and lower levels from 98.0m to 93.0m.

The Details Of The Bathymetric Surveys Conducted During The Year 2020-21 Are As Follows:

The objectives of the studies were:

- ***To quantify or determine the present capacity of the reservoir using IBS***
- ***Prepare the present Elevation – Storage curve of the reservoir to regulate the outflow of the reservoir***
- ***Prepare the present Elevation – Area curve of the reservoir***
- ***To find the quantity of sediment and its Distribution in the reservoir using Sub Bottom Profiler***

- *To observe the influence of the heavy flood in 2018 and 2019 in the reservoir sedimentation*
- *Study the soil particle distribution of sediment deposit in the reservoir area*

1. Sedimentation Study of Meenkara Reservoir Using Integrated Bathymetric System&Sub Bottom Profiler

The survey of Meenkara reservoir has been done in the year 2015. The survey has been again conducted during this year mainly to assess the storage capacity changes after the floods in 2018 and 2019. Survey has been done with IBS and Sub Bottom Profiler and the data has been collected along different profiles 60m apart. 4 nos of soil samples have been collected and analysed. Data collection and data validation has been completed. Report is under preparation.

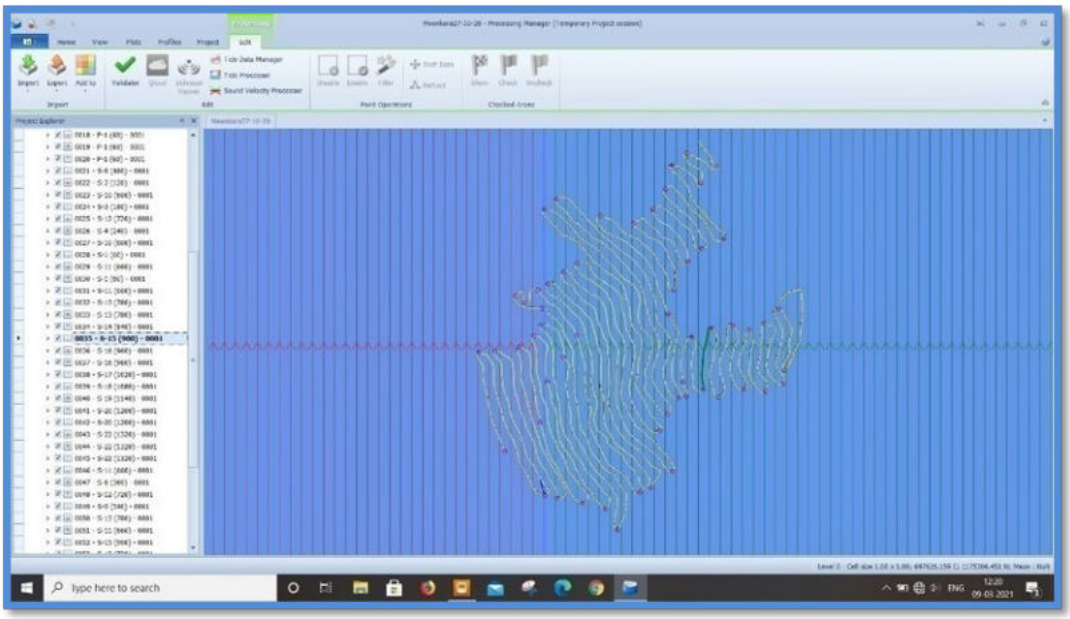


Fig 32 Plan of Meenkara reservoir showing the sections surveyed

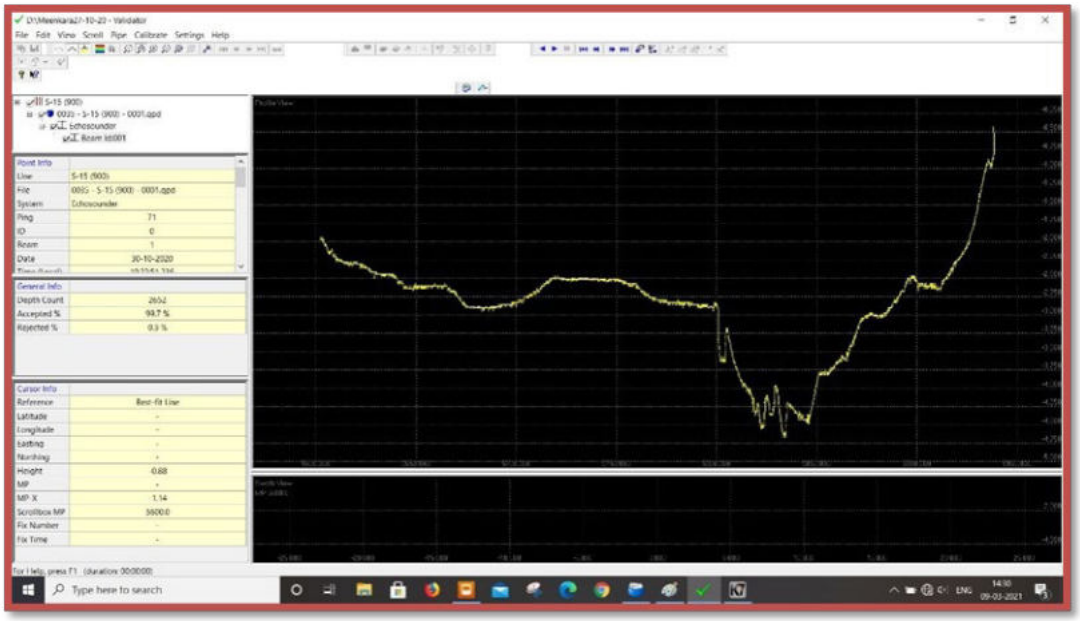


Fig. 33 Meenkara_Profile 1-1 in IBS{(E 697784.023, N 1174877.479) (E 697827.624, N 1175212.751)}

2. Sedimentation Study of Pothundy Reservoir Using Integrated Bathymetric System & Sub Bottom Profiler

Sedimentation study of Pothundy reservoir was conducted in 2009 using IBS. In 2017 the repeat sedimentation study was conducted using IBS and Sub Bottom Profiler. As per direction of Chief Engineer, Projects-1, the study is again included in the action plan of FY2020-21 inorder to assess the effect of heavy flood in 2018 and 2019. Survey has been done with IBS and Sub Bottom Profiler and the data has been collected along different profiles 60m apart.Soil samples (5 nos) have been collected from different parts of the reservoir and analysed. Data collection and data validation has been completed. Report is under preparation.

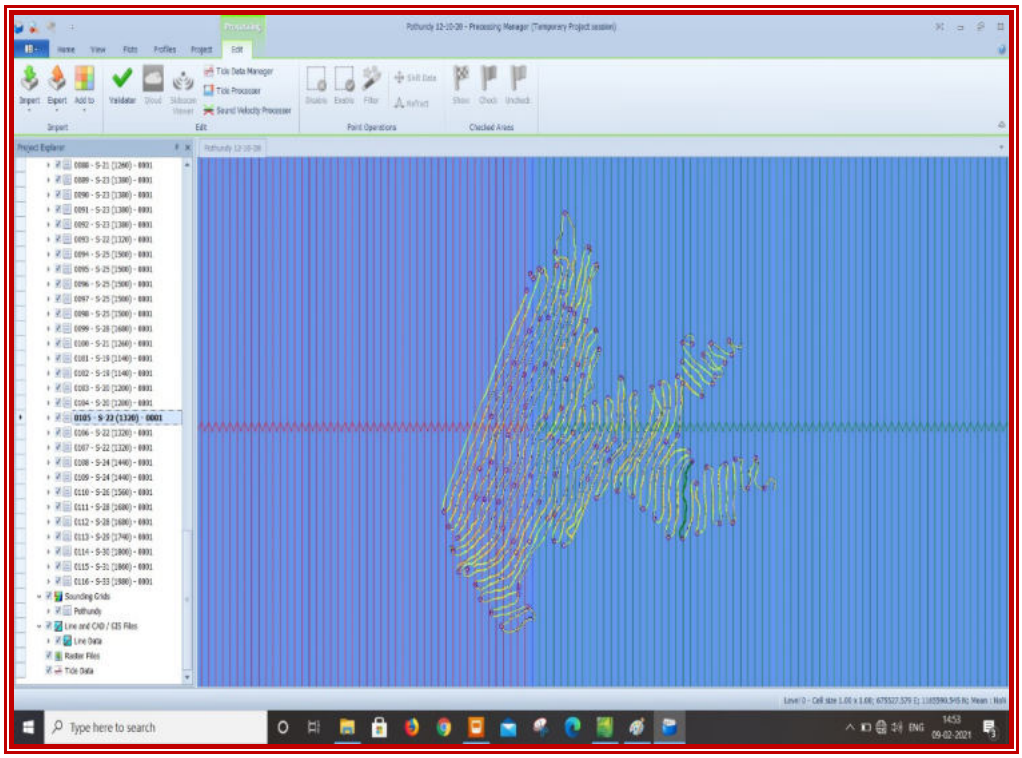


Fig 34 Plan of Pothundy Reservoir showing sections surveyed

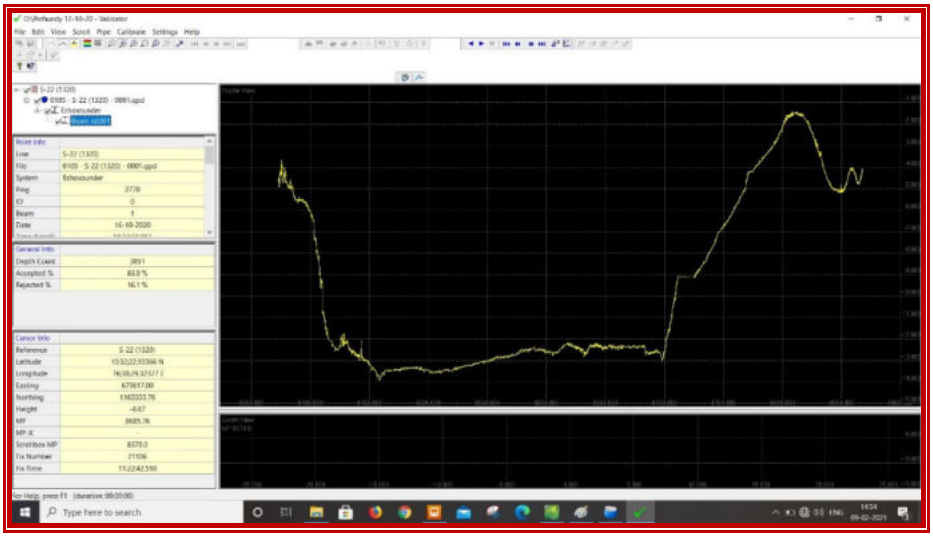


Fig 35 Profile 1-1 in IBS {(E-679544.101, N-1165248.253) (E-679639.423, N-1165737.861)}

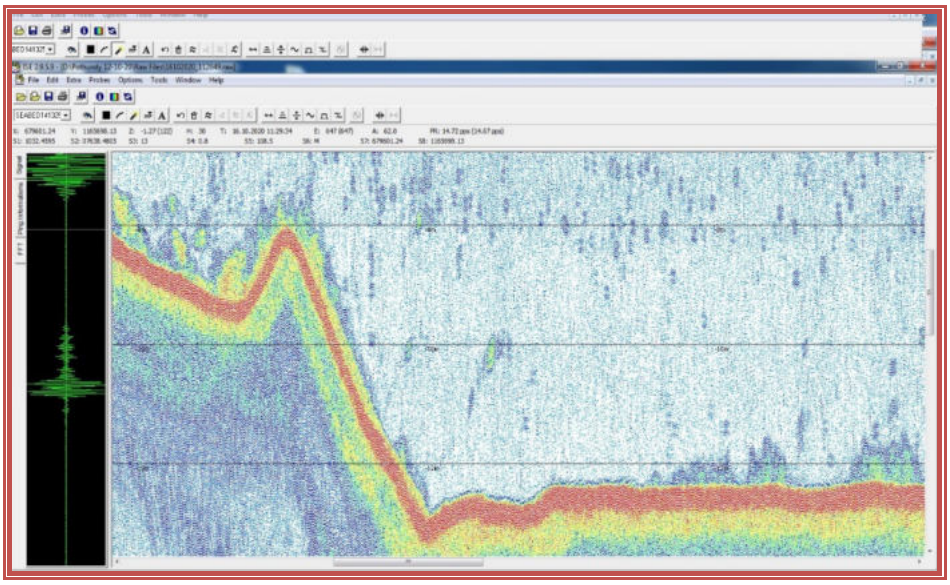


Fig 36 Profile 1-1 in Sub Bottom Profiler {(E-679544.101, N-1165248.253) (E- 679639.423, N-1165737.861)}

3. Sedimentation Study of Malankara Reservoir Using Integrated Bathymetric System & Sub Bottom Profiler

The bathymetric study of Malankara reservoir has not been conducted yet. The work has been done during this year as per the request of the project authorities.Data collection has been completedalong different profiles at aspacing of 75m.Data processing is also completed. Report is under preparation.

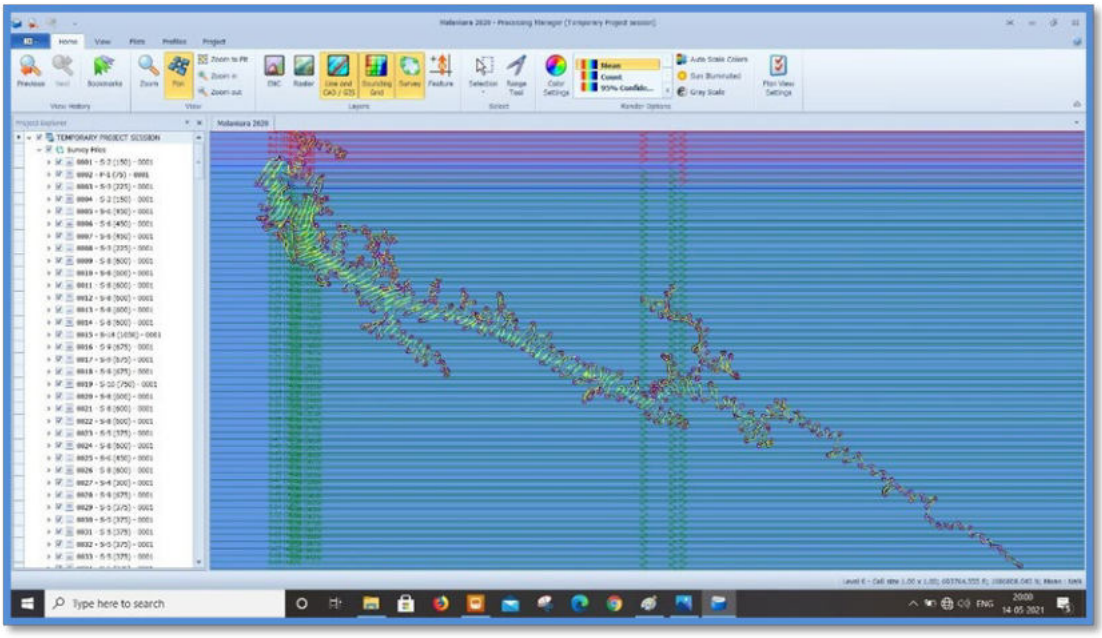


Fig 37 Plan of Malankara Reservoir showing sections surveyed

4. Sedimentation Study of Pazhassi Reservoir Using Integrated Bathymetric System & Sub Bottom Profiler

The survey of Pazhassi reservoir has been previously done in the year 2016. The survey has been again conducted during this year mainly to assess the storage capacity changes after the floods in 2018 and 2019. Survey has been done with IBS and Sub Bottom Profiler and the data has been collected along different profiles 100m apart. Soil samples have been collected and analysed. Data collection and data validation has been completed. Report is under preparation.

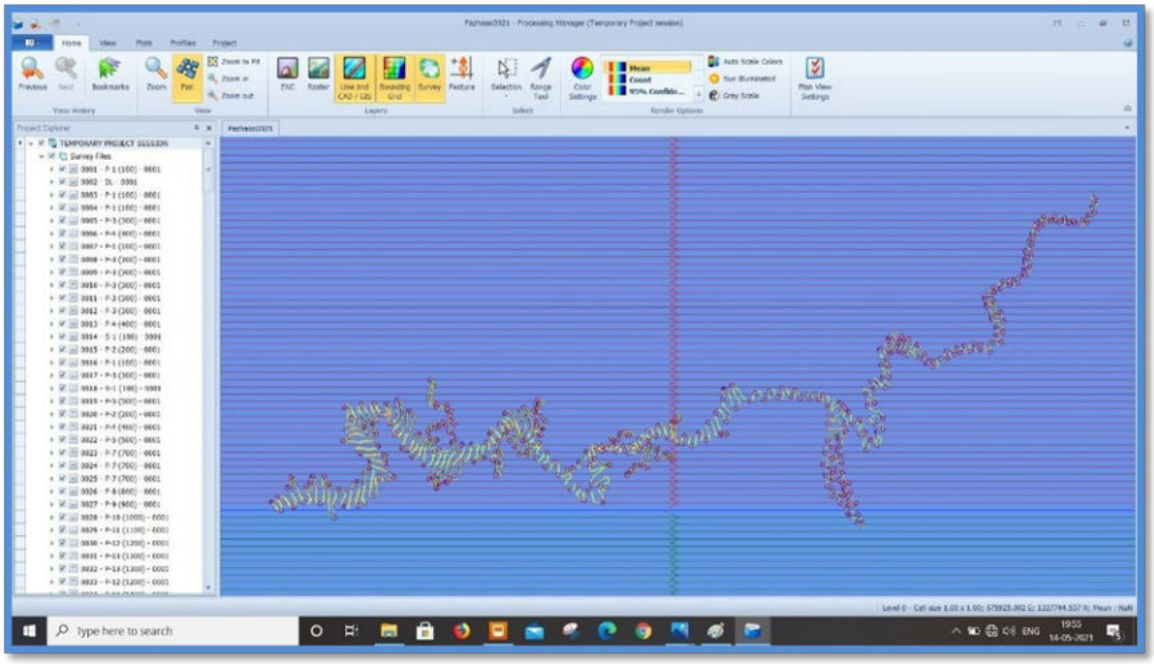


Fig 38 Plan of Pazhassi Reservoir showing sections surveyed

5. Sedimentation Study of Karappuzha Reservoir Using Integrated Bathymetric System & Sub Bottom Profiler

The survey of Karapuzha reservoir has been done in the year 2015. The survey has been again conducted during this year mainly to assess the storage capacity changes after the floods in 2018 and 2019. It has also been directed by the CE, I&A to conduct the study to know whether desiltation is needed for the reservoir. Survey has been done with IBS and Sub Bottom Profiler and the data has been collected along different profiles 75m apart.Soil samples have been collected from different locations of the reservoir and analysed. Data collection completed and data validation is in progress. Report is also under preparation.

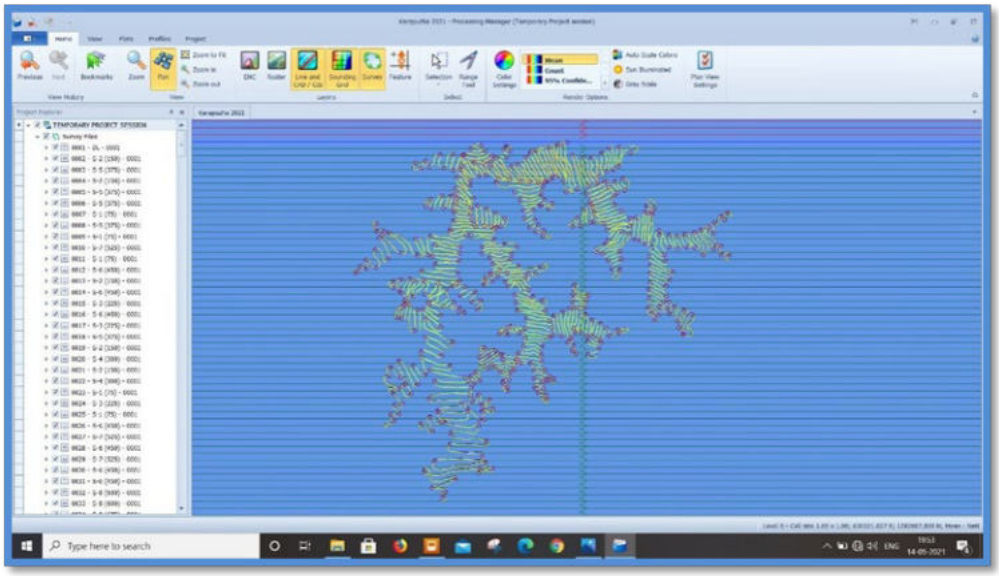


Fig 39 Plan of Karappuzha Reservoir showing sections surveyed

6. Sedimentation Study of Poringalkuthu Reservoir Using Integrated Bathymetric System & Sub Bottom Profiler

The Deputy Chief Engineer (R&DSO & DRIP), Kerala State Electricity Board Ltd. Pallom Kottayam, had requested KERI, Peechi to conduct Integrated Bathymetric Survey of Poringalkuthu reservoir vide letter No. CE(C-DS&DRIP)/DRIP/31/GNL/2015-16/1857 dated 11.03.2020. Hence the sedimentation study of Poringalkuthu HEP has been conducted as a deposit work during the year 2020-21.

ABOUT THE STUDY AREA

Poringalkuthu reservoir is formed by constructing a masonry dam across Chalakudy river for Poringalkuthu Hydro Electric Project (4x9MW). The construction is completed in 1957. The storage provided at reservoir is 32Mm^3. The catchment area of the dam is 512 Km^2. The water from the reservoir is directed through a tunnel and penstock to generate power. The tail water of the scheme is discharged into the Chalakudy river and this is utilized for irrigation purpose through Thumburmuzhy Diversion Weir under irrigation department. The dam is located at Longitude 76^0 38'40"E and Latitude 10^{0}18'45"N. It is a straight Gravity masonry dam with length 365.76m. The water spread area is 2.85 km^2. The Full Reservoir Level (FRL) is 423.98m.

DETAILS OF THE SURVEY

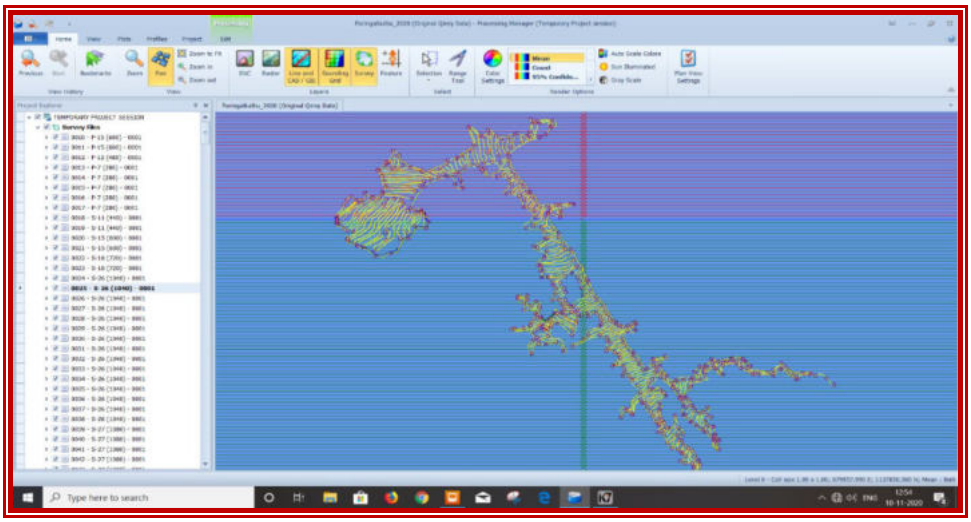


Fig 40 Plan of Poringalkuthu Reservoir showing sections surveyed

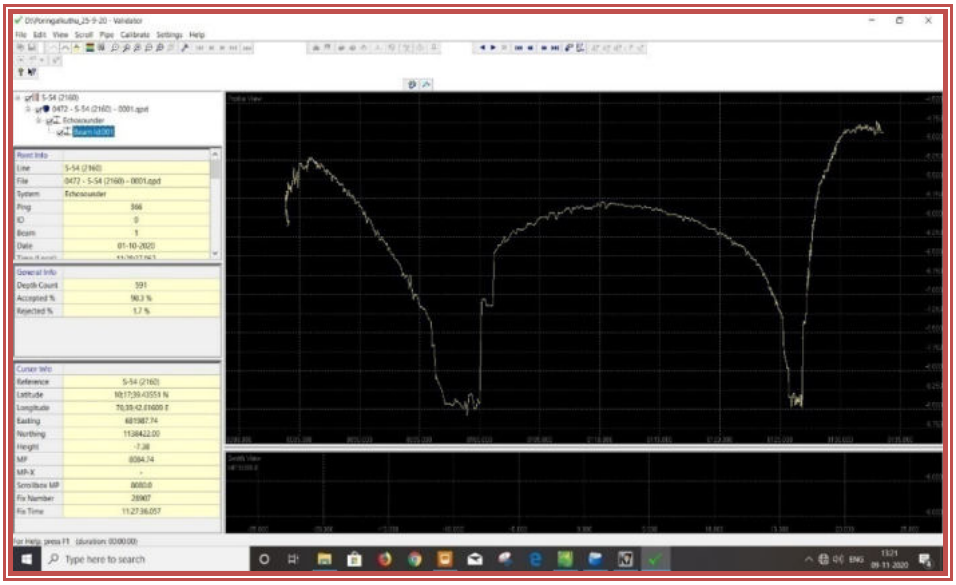


Fig 41 Profile 1-1 in IBS {(E 681987.00, N 1138411.74), (E 682036.54, N 1138378.64)}

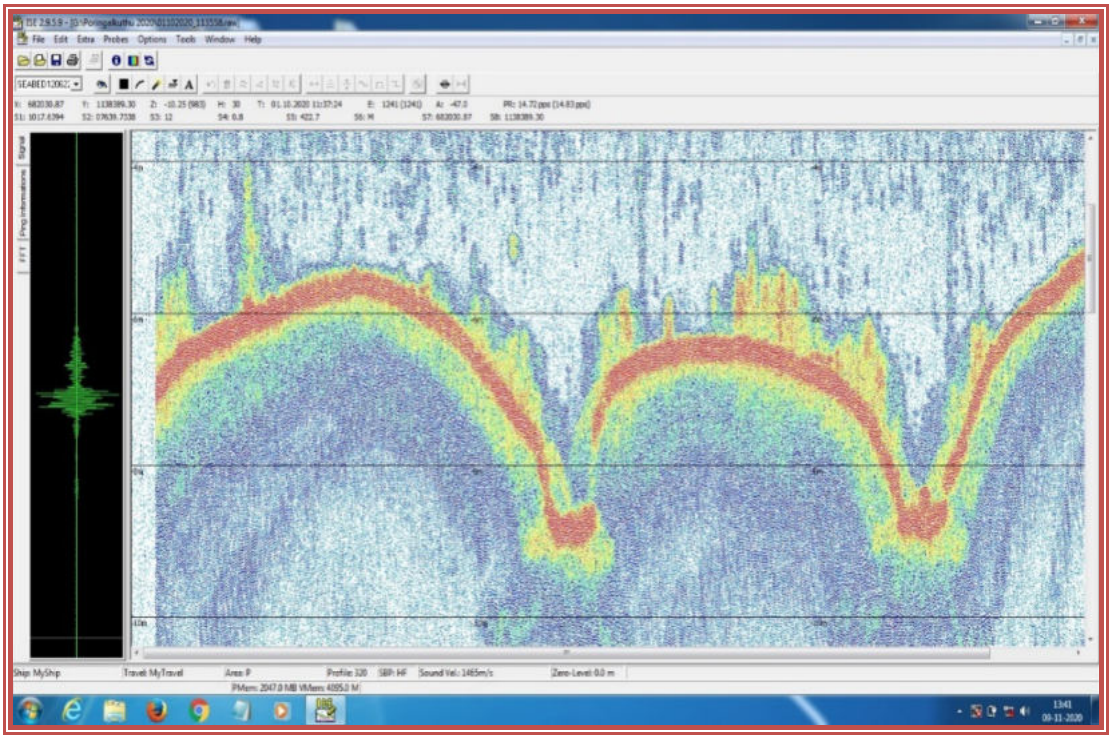


Fig 42 Profile 1-1 in Sub Bottom Profiler {(E 681987.60, N 1138411.74), (E 682036.54, N 1138378.640}

Results and Discussion

ESTIMATION OF CAPACITY

The survey is carried out at full reservoir level (FRL) of 423.98 m. The original water holding capacity at this level is 32Mm^3. As per the current IBS study the volume at the same level is estimated as 27.236Mm^{3}and the corresponding water spread area is 2.71 Sq.km. Total capacity reduction of the reservoir is 4.764 Mm^{3}in 63 years, i.e. the reduction in capacity at the specified level is 14.89%. Table 12.0 shows the comparison in reservoir capacity. Fig 43 shows its graphical representation. The capacity reduction is due to the presence of sediment deposit.

Fig 43 Comparison of Reservoir Capacity at FRL

Table 12.0 Capacity of the reservoir at FRL

Year of Study	Water Level (m)	Capacity In Mm^3	Reduction in Capacity w.r.t Original Volume ($32Mm^3$)	
			In Mm^3	In Percentage
2020	423.98	27.236	4.764	14.89

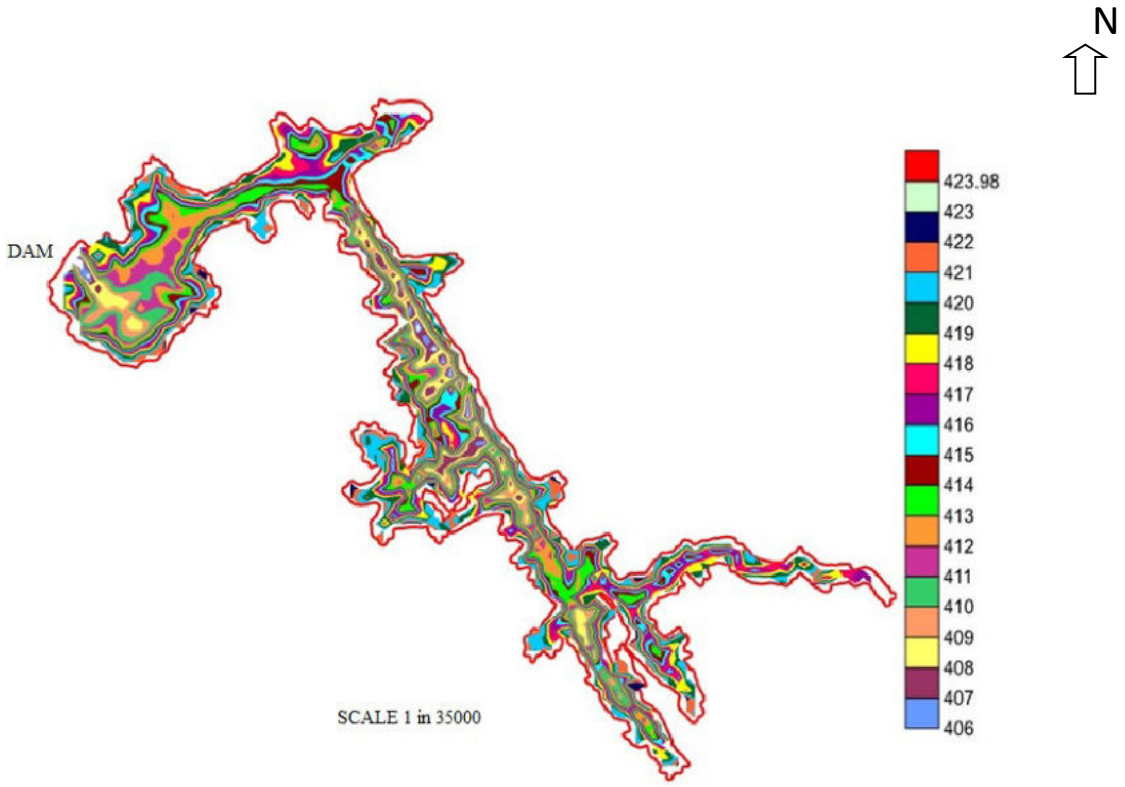


Fig 44 Contour Map based on IBS Survey

CAPACITY AT DIFFERENT WATER LEVEL

Reservoir volume at different water levels can be found out using the IBS data in SURFER software. The present capacity at different water level is compared with the original and is shown in Table 13.0.

Table 13.0 Reservoir capacity at different water levels

Sl. No.	Water Levelwrt MSL	Water Holding Capacity		Percentage Reduction in Capacity
		Original	IBS Survey 2020	
	(m)	(M. Cub. m)	(M. Cub m)	%
1	423.98	32.000	27.236	14.89
2	423.5	30.400	25.547	15.96
3	423.0	28.950	23.858	17.59
4	422.5	27.700	22.170	19.96
5	422.0	26.450	20.490	22.53
6	421.5	25.200	18.835	25.26
7	421.0	23.950	17.229	28.06
8	420.5	22.700	15.696	30.85
9	420.0	21.450	14.257	33.53
10	419.5	20.200	12.917	36.05
11	419.0	18.950	11.668	38.43
12	418.5	17.800	10.505	40.98
13	418.0	16.800	9.419	43.93
14	417.5	15.800	8.404	46.81
15	417.0	14.800	7.459	49.60
16	416.5	13.800	6.586	52.28
17	416.0	12.800	5.781	54.84
18	415.5	11.900	5.039	57.66
19	415.0	11.150	4.357	60.92
20	414.5	10.400	3.735	64.09
21	414.0	9.650	3.173	67.12
22	413.5	8.900	2.670	70.00
23	413.0	8.150	2.225	72.70
24	412.5	7.450	1.831	75.42
25	412.0	6.800	1.487	78.13
26	411.5	6.200	1.194	80.74
27	411.0	5.600	0.941	83.20
28	410.5	5.100	0.728	85.73
29	410.0	4.600	0.548	88.09
30	409.5	4.150	0.399	90.39
31	409.0	3.700	0.278	92.49
32	408.5	3.300	0.185	94.39
33	408.0	2.900	0.119	95.90
34	407.5	2.550	0.071	97.22
35	407.0	2.300	0.041	98.22
36	406.5	2.050	0.021	98.98
37	406.0	1.800	0.011	99.39
38	405.69*	1.700	0.007	99.59

The original storage capacity curve is compared with the same obtained from the present IBS survey.

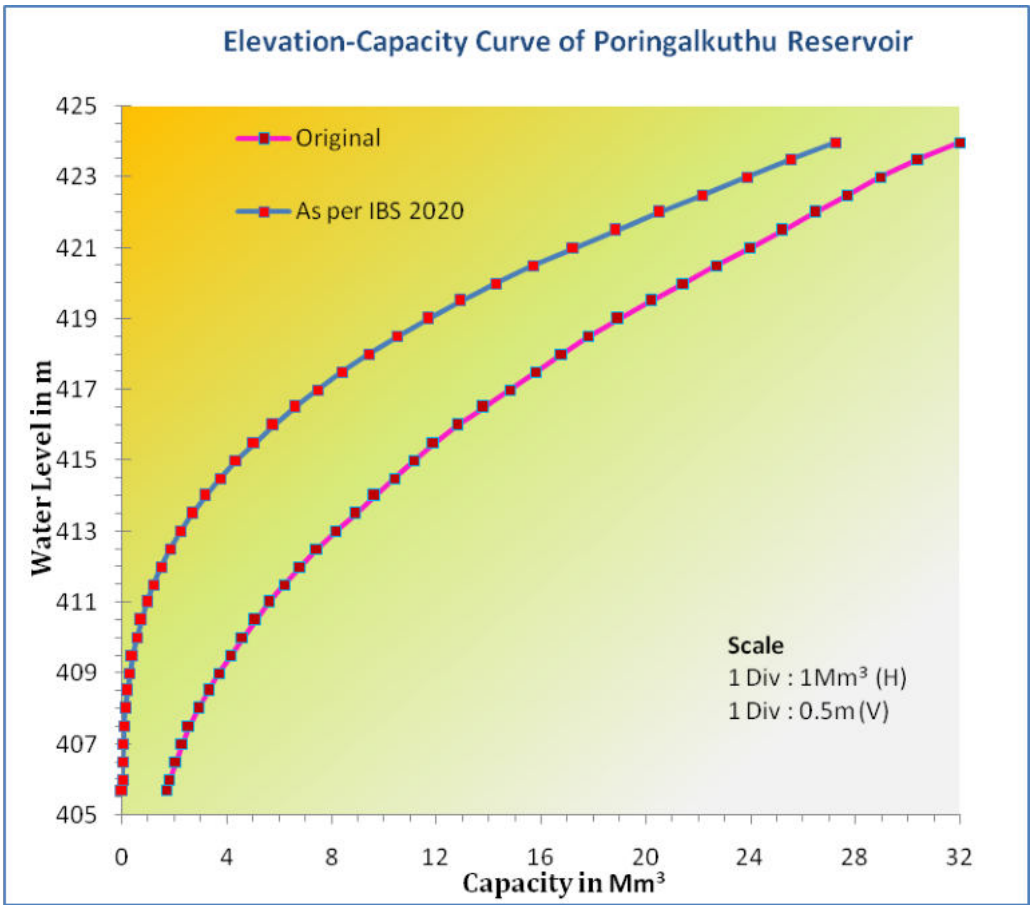


Fig 45 Water Level v/s Water holding capacity curve

WATER SPREAD AREA AT DIFFERENT WATER LEVEL

Since the original water spread area is not available. the present water spread area at different level is shown in Table 14.0. Fig 46 shows its graphical representation.

Table 14.0 Water spread area at different water levels.

Sl. No.	Water Level	IBS Survey 2020
	(m)	(Sq Km)
1	423.98	2.71
2	423.5	2.70
3	423.0	2.69
4	422.5	2.68
5	422.0	2.67
6	421.5	2.66
7	421.0	2.61
8	420.5	2.54
9	420.0	2.43
10	419.5	2.31
11	419.0	2.21
12	418.5	2.09
13	418.0	1.97
14	417.5	1.86
15	417.0	1.75
16	416.5	1.63
17	416.0	1.51
18	415.5	1.40
19	415.0	1.28
20	414.5	1.17
21	414.0	1.05
22	413.5	0.93
23	413.0	0.83
24	412.5	0.73
25	412.0	0.63
26	411.5	0.54
27	411.0	0.46
28	410.5	0.39
29	410.0	0.33
30	409.5	0.27
31	409.0	0.21
32	408.5	0.16
33	408.0	0.11
34	407.5	0.08
35	407.0	0.05
36	406.5	0.03
37	406.0	0.01

38	405.69	0.000

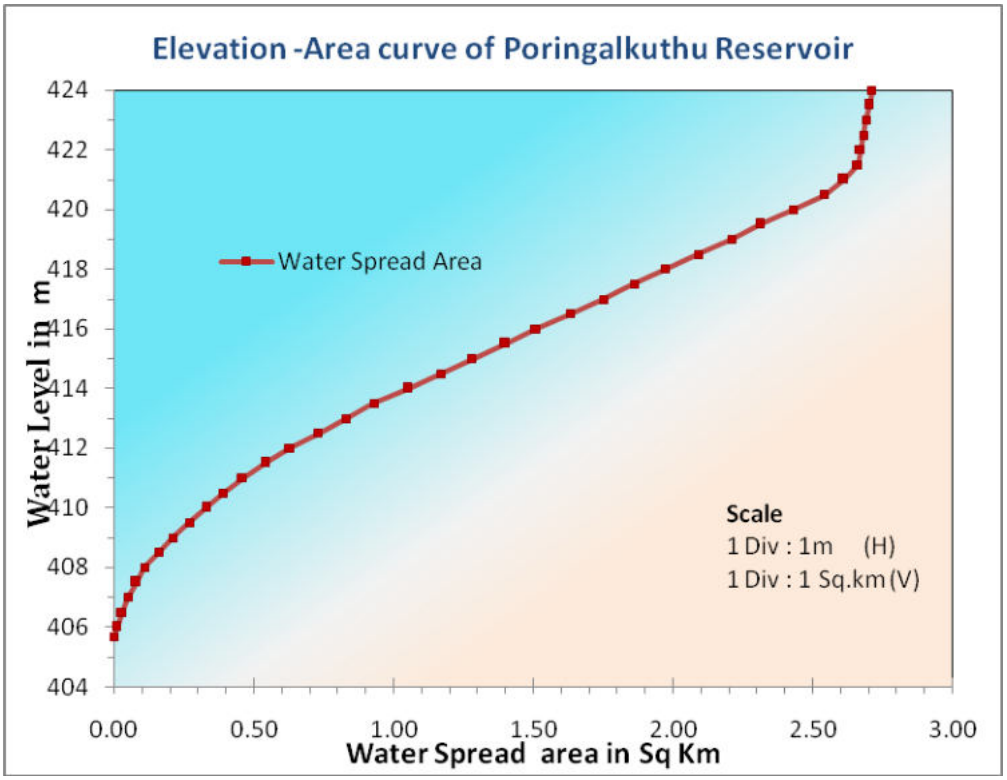


Fig 46 Water level v/s water spread area curve

ANALYSIS OF SOIL SAMPLES

Disturbed soil samples were collected using grab type mud sampler (only surface soil) from 6 locations in the reservoir and analysed. The average percentage of clay, silt, sand and gravel of the analyzed samples are graphically represented in Fig 47.

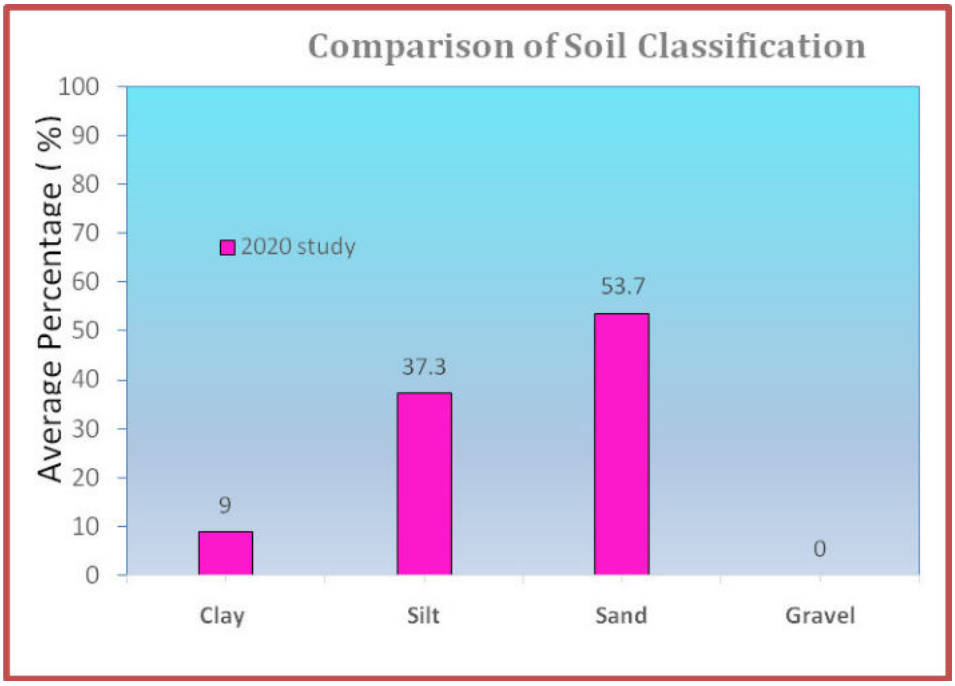


Fig 47 Comparison of Soil particle distribution

CONCLUSIONS

The conclusions of the survey are as follows:

The FRL of Poringalkuthu Reservoir is 423.98m and the corresponding original storage capacity is 32 Mm^3.

- *The **present study is conducted at WL 423.98m** andthe present capacity is 27.236 $Mm^3$and the capacity is reduced by 4.764Mm^3in **63** years.ie 0.076 Mm^3 per year.The percentage of reduction in capacity after 63 years is 14.89 % of the original volume. ie 0.24% per year.*
- *The capacity at the minimum drawdown level of 405.69m is 0.007Mm^3 against the original capacity of 1.70Mm^3. Percentage reduction in dead storage is 99.59% in 63 years. ie the dead storage area is almost filled with sediment and should be cleared to maintain the dead storage in reservoir to increase the life of reservoir.*
- *The percentage capacity reduction is more than 80% below the level of 411.5m*
- *Sediment layer profile of the reservoir area at an interval of 40m is obtained from the Sub Bottom profiler.*

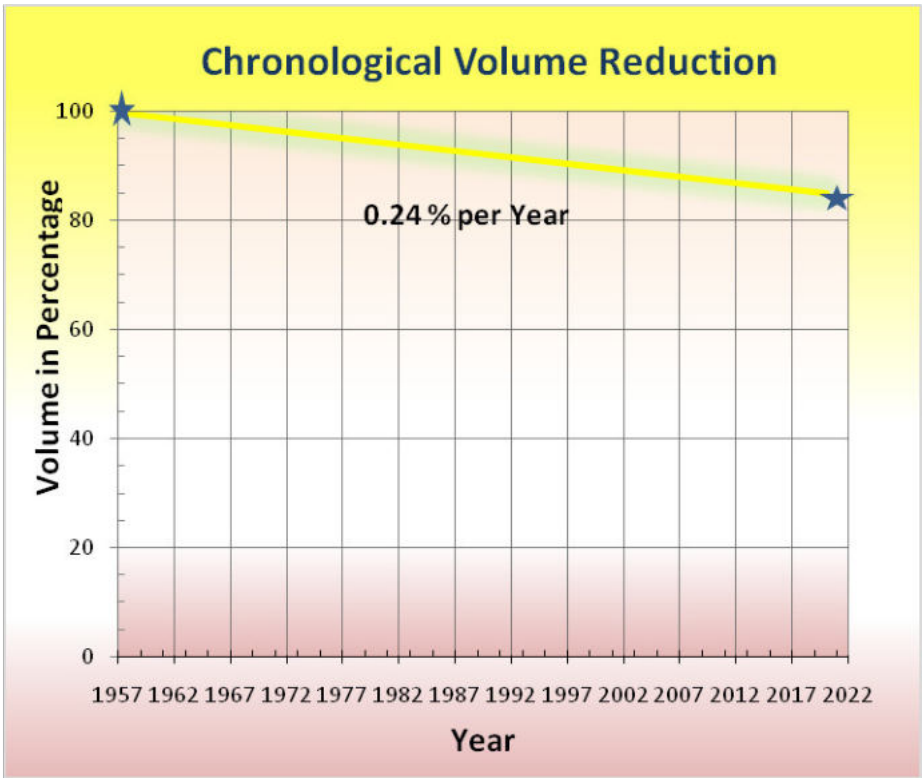


Fig 48 Chronological Volume Reduction

D. CONSTRUCTION MATERIALS DIVISION

D.1 Introduction

Construction Material Division is one of the sub unit of Kerala Engineering Research Institute (KERI) basically engaged in material testing. Testing of construction materials is an essential part for ensuring quality in construction. In addition to the testing of Irrigation dept works, other Government Departments, Central Government Departments, Public Undertakings and various Private agencies are utilizing the facilities of lab for ensuring quality construction. The CM Lab continued to contribute healthy revenue every year to the Government through various tests conducted for clients. The Lab is also functioning as a training centre of the Irrigation Department and providing training programmes and refresher courses for the benefit of department engineers. The training facility extends to other department engineers also. Now the CM Lab is on the process of getting assessment and accreditation of Testing and Calibration Laboratories by the National Accreditation Board Testing and Calibration Laboratories (NABL) in accordance with the international standards. The accreditation from NABL will boost up the status of the Lab and likely to increase the revenue to Govt.

Report of Tests conducted in CM Lab

Construction materials division of KERI deals with testing of construction materials such as cement, aggregates, steel, tiles, bricks, rock, concrete etc and design of concrete mixes. The essentials tests for getting the physical properties of above materials are carrying out at this lab. During the year 2020-21, tests were conducted for 633 samples of concrete cubes, 6 nos cylindrical concrete specimens, 216 samples of steel rods, 98 samples of coarse aggregates, 6 samples of rock core, 127 samples of solid blocks, 54 samples of paver blocks, 74 samples of cement, 46 samples of clay/fly ash bricks, 18 samples of tiles, 11 samples of steel tube sections, 6 nos HT stay wires, 3 samples of sheet piles, 13 samples of 11KV hardware fittings in this lab. 34nos Mix designs were carried out for various agencies.

The lab is equipped with NDT instrument for Pile Integrity Test and have done one Pile Integrity Test. Nondestructive tests like core compressive strength are being conducted to check the strength of concrete of the existing structures.

Three Hundred and eighty test reports were generated from this division during the Financial year 2020-2021 earning a revenue of **Rs. 11,82,250**/- (Rupees Eleven lakhs eighty two thousand two hundred and fifty).

Other Activities

1. Process of NABL Accrediation

a. Training in Laboratory Quality Management System and Internal Audit as per IS/ISO/IEC 17025:2017

Acquiring trained personalities are essentially required for applying NABL accreditation. Selected a NABL facilitator and continuous trainings were arranged to all the technical staffs in the Lab to get familiarize with procedures of accreditation. Er. Siji. T.V., Assistant Director I have attended the above training organized by Bureau of Indian Standards at Bangalore during February 2020.

b. INFRASTRUCTURE WORKS

An amount of Rs.11.5lakhs was sanctioned in the year 2019-20 for updating the old electrical wiring in the Lab and the updation was completed in the financial year 2020-21 along with installation of generator. The following arrangements were completed during the previous financial years to apply for NABL accreditation. Completed the renovation works of the lab building and steel structural roofing over the building. Laying of paver blocks completed in the courtyard. Separate material reception area was maintained for receiving materials for testing. Separate concrete mix design yard was made for keeping dust free environment in the lab. Necessary fire extinguishers were installed in the lab for safety.

2. Minor Irrigation Census

The Assistant Director I and Overseers of this Lab were assigned supervision and enumeration duty in association with Minor Irrigation Census.

3. Trainings

The Division was part of the training programme "Online Capacity Building Programme for Minor Irrigation Engineers" held during 01-31 October 2020 (18 days) for Assistant

Engineers and Assistant Executive Engineers of the Minor Irrigation conducted by Publication Wing, KERI.

Snaps of Activities

Fig 1. Inside CM Lab

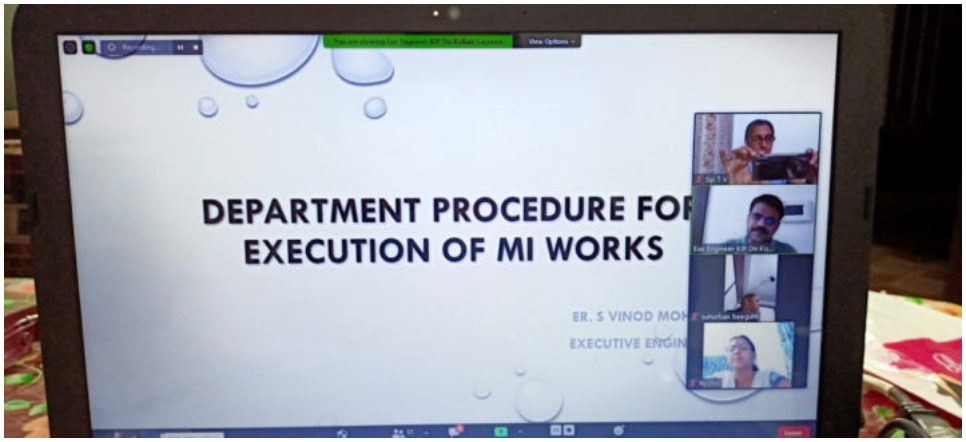
Fig 2. Pile Integrity Testing at Karichal Kadavu, Kunnamkulam

Fig 3. Mix Design

Fig 4. Testing of Cement

Fig 5. Abrasion Testing of Paver blocks

Fig 6. NABL Training class



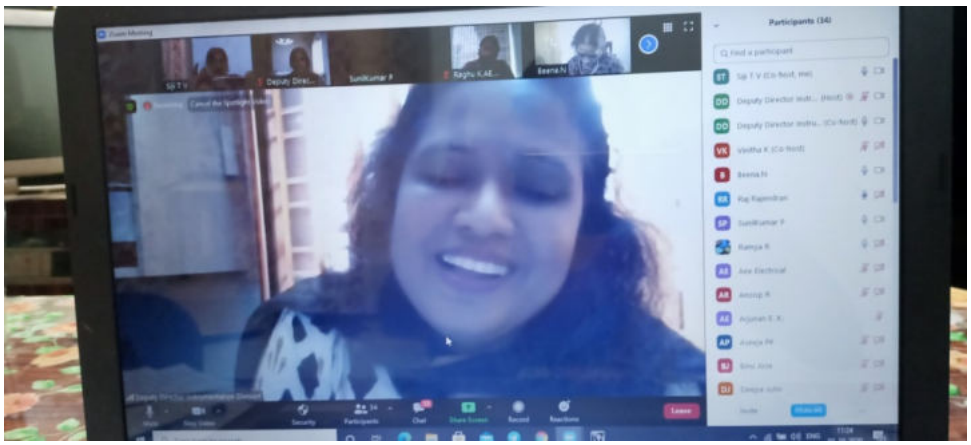


Fig 7&8. Snaps of Online Training Session for MI Engineers

E. SOIL MECHANICS AND FOUNDATIONS DIVISION

Introduction

Soil, the most unpredictable of all engineering materials also happens to be the all-important material in civil engineering because all structures need to be founded on earth. In addition to being the founding medium, soil is also used as a material of construction. As in the case of other materials, properties of soil cannot be generalized since basically soil is a combination of different constituents having different properties. Therefore the study of the technical and structural aspects of soil is all important.

Major difficulties encountered in foundation work are due to the nature of soil. The investigation for any foundation engineering problem may range from a simple examination of soil to a detailed study of the soil and ground water by means of bore holes and laboratory tests on the materials encountered. The extent of the work depends on importance and foundation arrangement of structures, the complexity of the soil conditions and already available information of existing foundations on similar type of soils.

The physical characteristics of soils can be investigated by means of laboratory tests on samples taken from boreholes or trial pits. Results from lab tests can be used to derive important parameters in the design of substructure. The results of shear strength tests can be used to calculate the ultimate bearing capacity. Soil parameters so obtained by means of investigations can be utilized to design safe structures.

Soil Mechanics Laboratory under K.E.R.I. is fully equipped to determine the index as well as the engineering properties of soil samples. The soil mechanics laboratory undertakes work from Government agency and private agencies.

investigation, the soil samples are collected and tested in the laboratory, for finding out index properties and engineering properties like Maximum Dry Density, Optimum Moisture Content, Permeability, Shear strength parameters, Consolidation and Swelling characteristics and relevant parameters are furnished to design the proposed structures. The laboratory is assisted by the Instrumentation Division which is equipped with field testing equipment for boring to collect undisturbed soil samples. .

Soil samples received from various projects of Irrigation Department, PWD Roads and Buildings, Panchayati Raj institutions, Power Grid, Kerala State Electricity Board, Housing

Board and Non-Government bodies are being tested as per the codes of Bureau of Indian Standards.

The Lab contributes healthy revenue every year to the Government through various tests conducted for clients. The Lab is also functioning as a training centre of the Irrigation Department and providing training programmes and refresher courses for the benefit of department engineers. Now the Lab is on the process of getting assessment and accreditation of Testing and Calibration Laboratories by the National Accreditation Board Testing and Calibration Laboratories (NABL) in accordance with the international standards. Also research activities are being conducted at this division.

Tests conducted in the Lab

Soil samples were tested from various projects of Irrigation department, other departments and private agencies. During the year 2020-21, 571 sample tests were conducted in 28 works for revenue of Rs. 16,18,099 /- (Rupees Sixteen Lakh Eighteen Thousand and Ninety Nine) and the details of works are appended.

INFRASTRUCTURE

The important equipment's available in the laboratory are

i) Hydrometer test with accessories
ii) Atterberg's limit devices
iii) Direct Shear apparatus
iv) Automatic Compactor
v) Light and Heavy compaction testing apparatus
vi) Laboratory CBR test apparatus
vii) Digital soil cone penetrometer
viii) Constant head permeability test apparatus
ix) Variable head permeability test apparatus
x) Tri-axial Shear Apparatus
xi) Unconfined Compression Test Apparatus
xii) Consolidation Apparatus
xiii) Sample extruder
xiv) Standard set of sieves

Modernizing the lab will come true with the addition of modern Instruments. This lab is equipped with Engineering Seismograph and is used for subsurface characterization by seismic

refraction method. Seismograph is also used for Seismic Tomography Survey to determine compactness in dams.

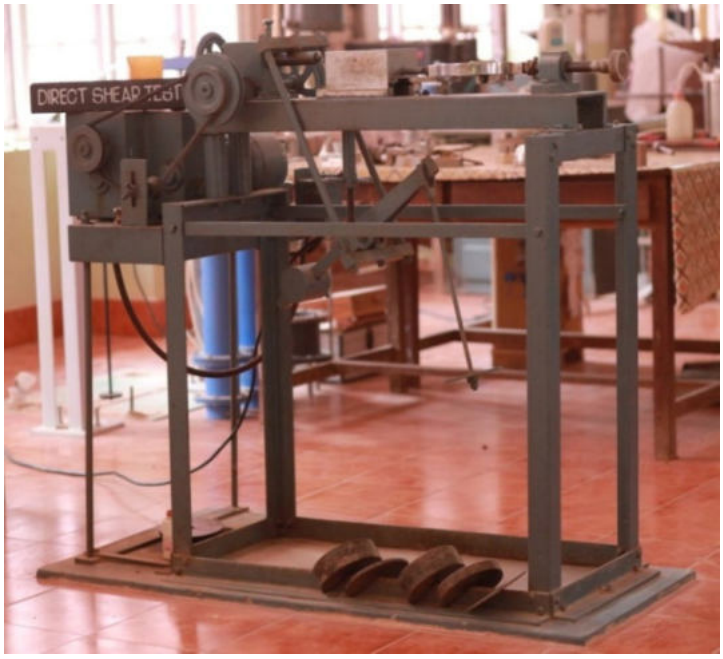


Fig 1. Direct Shear Apparatus

Fig 2. Consolidation Test Apparatus

Fig 3. Unconfined Compression Test Apparatus

Fig 4. Compaction Test Apparatus

Fig 5.Digital Soil Cone Penetrometer

CONDUCTING SEISMIC REFRACTION SURVEY USING ENGINEERING SEISMOGRAPH

Seismic refraction survey is a reconnaissance survey used to determine wave propagation velocities through various soil layers in the field and to obtain the thickness of each layer. This method is based on the fact that seismic waves have different velocities in different types of soils (or rock). In this method, seismic waves are produced by mechanical blow with a sledge hammer at ground surface. These waves travel deep into the ground and get refracted at the interface of two different materials and to the ground surface. The time of arrival of these waves at different locations on the ground surface are recorded by geophones, which pick up the refracted waves. The geophones convert the ground vibrations into electrical impulses and transmit them to a recording apparatus (seismograph). Finally seismic refraction data were analysed using PS Lab software. It is a widely used method for the determination of bedrock depth.

Equipments Used For Seismic Refraction Survey

1. X610S 24 bit Seismograph
2. Vertical geophones
3. Sledge Hammer
4. Battery
5. Plate for seismic energization
6. Cable/array
7. Starter geophone
8. Starter extension cable 220m

Fig 6. Apparatus used for Seismic Refraction Survey

Seismic refraction survey was conducted on a study basis using Engineering Seismograph at following places during 2020-21.

1. KainoorChira (Test Conducted in both Land and Water)
2. KambalatharaEri
3. VenkalakayamEri
4. Munayam
5. Alppara
6. Chimoni Earthen Dam

7. Echippara Ground

As a part of research work, Seismic Refraction Survey was conducted in water at KainoorChira with the existing machineries and infrastructures. Hydrophones were used as receiver instead of geophones for data acquisition. But unfortunately results were not obtained at KainoorChira in Water due to poor data quality.

Fig 7.Engineering seismograph

Fig 8.Seismic refraction survey at KainoorChira (in land)

Fig 9.Seismic refraction survey at Alppara

Fig 10.Seismic refraction survey at Munayam

Fig 11.Seismic refraction survey at Echippara Ground

Fig 12.Seismic refraction survey at Chimoni Earthen Dam

Fig 13.Seismic refraction survey at VenkalakayamEri

CONDUCTING SEISMIC TOMOGRAPHY SURVEY AT CHIMONI DAM

The ageing and degradation of dam structures is an inevitable problem and its consequences on the safety of the structure are important. Seismic Tomography technique is generally used for detecting the deteriorated zones inside the dam (masonry and concrete) body. Seismic tomography surveys are generally conducted across vertical upstream-downstream cross sections. Seismic signals are generated with a sledge hammer, by hitting directly on the

dam body. Hydrophones and geophones are arrayed in vertical on upstream side of the Dam and shot position fixed on downstream face of the Dam. Typically, tomography images are analysed to look at the velocity changes within the masonry or concrete. Areas with lower velocity correspond to weaker, less dense concrete, while those with higher velocities are considered to be sound concrete. The results also can show areas with cracking damage or other discontinuities.

Seismic tomography survey was conducted at Chimoni Dam on a study basis during March 2021.Sensor of the sledge hammer was damaged while conducting seismic tomography at Chimoni Dam, so work had to be stopped. Hence tomography study of only 9 cross section could complete out of 17 cross sections in dam body. Also tomography study of only 1 longitudinal section could complete in inspection gallery.

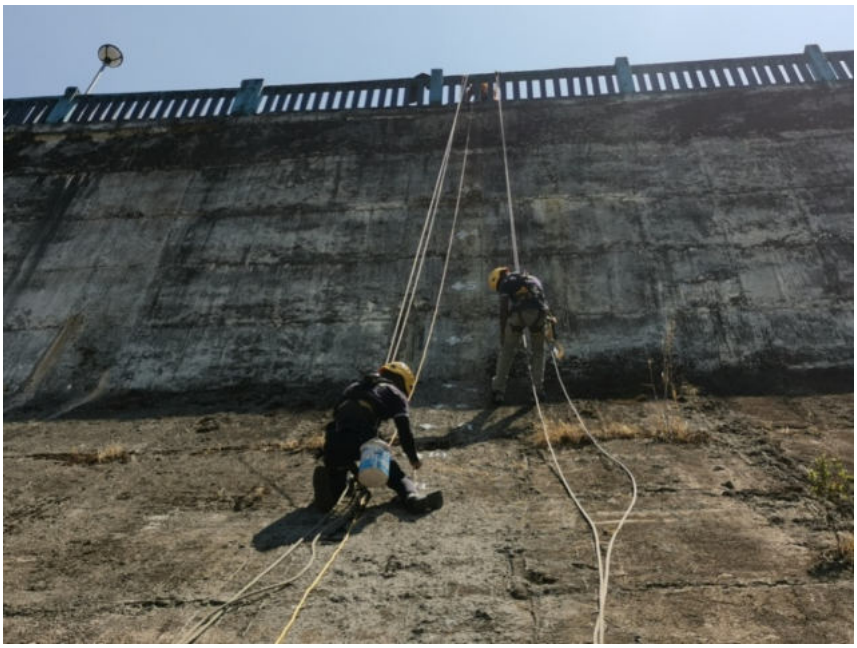


Fig 14.Sesismic Tomography study at Chimoni Dam

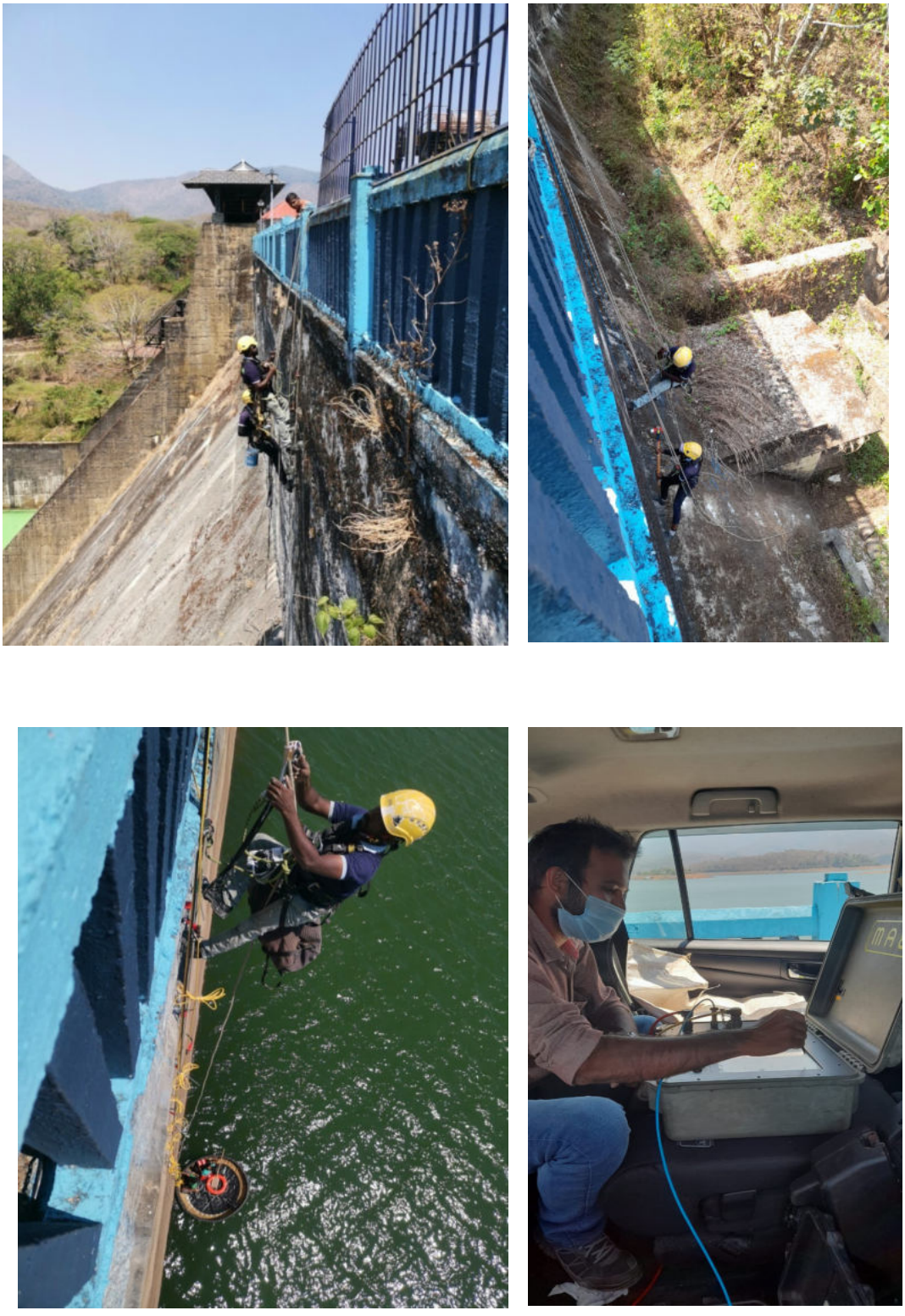


Fig 15.Sesismic Tomography study at Chimoni Dam

OTHER ACTIVITIES

Field work conducted

Site Visit was carried out along with other officials of KERI for the investigation of KunnampidariEri, KambalatharaEri and VenkalakayamEri.

NABL Accreditation

Soil Mechanics lab is striving for achieving NABL accreditation, which will greatly enhance the credibility of test results provided by the lab. As part of this, many sessions were conducted regarding the various procedures and documents to be maintained in the lab for applying NABL accreditation. This will make the lab compliant to the ISO 17025:2017 standards.

Completed Courses

- Er. JoyalScaria, Assistant Director has completed the online course in "Geophysical Investigations for Dam Safety" organised by Aqua Foundation Academy, New Delhi held during 11 June 2020 to 14 September 2020.
- Er. JoyalScaria, Assistant Director has completed the 3 Month's Online Course on "Ground Penetrating Radar" organised by Aqua Foundation Academy, New Delhi.

Internship programmes

Internship trainings were given to M Tech (in Geotechnical Engineering) students of IES Engineering College, Thrissur in the areas of Seismic Refraction and Seismic Tomography as part of their curriculum.

Fig 16. Internship training to M Tech students of IES Engineering College, Thrissur

Infrastructure work

An amount of Rs.7.75 lakhs was sanctioned in the year 2019-20 for the updating old electrical wiring of the lab and work completed in this financial year.

LABORATORY INVESTIGATION

Soil samples analysis for undisturbed and disturbed samples were tested is attached in Appendix IV.

TECHNICAL PERSONNEL

Deputy Director

Miny T.M From 01/04/2020 to 31/05/2020

Saji Samuel Addl.Charge from 01/06/2020 to 06/09/2020

Rameshkumar T V From 07/09/2020 to 31/03/2021

Assistant Director I

JoyalScaria From 01/04/2020 to 31/03/2021

Assistant Director II

JoyalScariaAddl.charge from 01/04/2020 to 29/04/2020

Jomy Joseph From 30/04/2020 to 31/03/2021

F. INSTRUMENTATION DIVISION

F.1 Introduction

Instrumentation Division acts as the mobile unit of Soil Mechanics Division and conducts various field tests. The foundation is the lowest part of a structure. It transmits the load to the soil below. The extent of exploration depends on the importance of the structure, the complexity of the soil conditions and the budget available for exploration. A detail soil exploration programme involves deep boring, field tests and laboratory tests for determination of different properties of soils required for the design of any structure.Site investigation is essential for judging soil suitability for proposed engineering work and preparing adequate design. It also helps for selecting suitable and economic construction materials as well as methods. Site exploration reveals reliable information about soil and ground water which will help the Engineer for an intelligent planning.

Bore hole drilling – Making Bore holes is commonly used method for field investigations and they are executed by various devices ranging from simple hand operated augers to drilling machines.

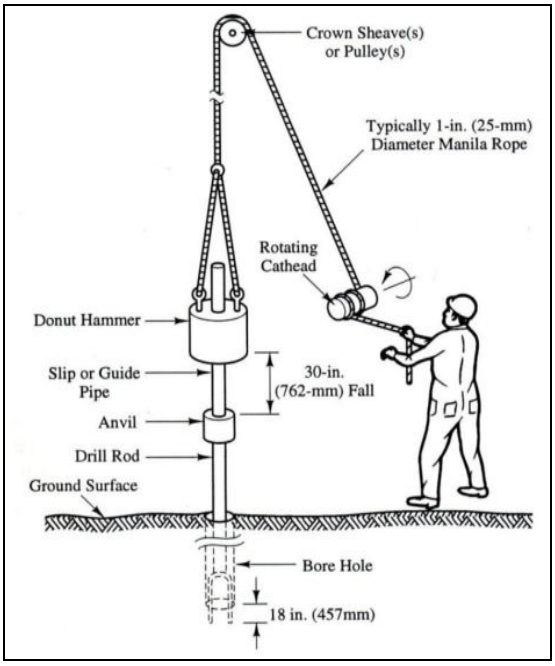
1) Instrumentation division is in possession of two **rotary type, clayx type drilling machines**. These machines are used for drilling in soil, soft rock and hard rocks for a depth of 50 m to 60 m. SPT Tests are also conducted during the process of drilling. Disturbed and undisturbed samples are also collected during the course of drilling. Drilling in rocks are carried out by using diamond core bit. The samples collected are transferred to SM& F Division for carrying out various tests in soil for finding the engineering properties.

2) **Insitu vane shear test apparatus** – In-situ vane shear test apparatus instrument is used for conducting in-situ vane shear tests to determine the shear characteristics of the soil.

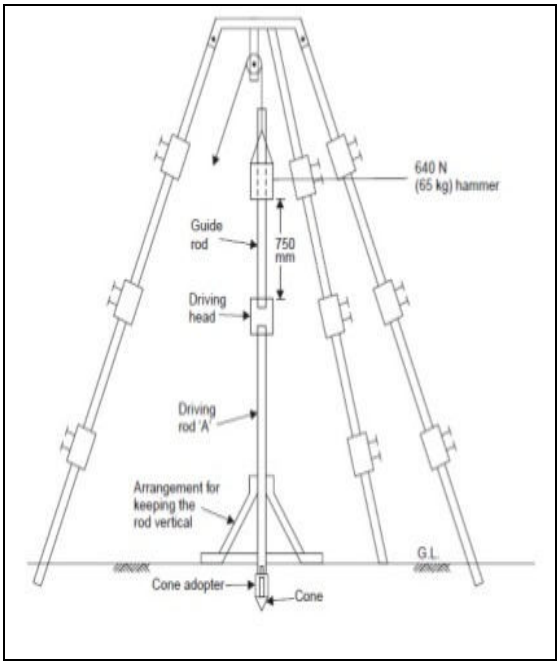
3) **Permeability tests** – Instrumentation division has also in possession of screw pumps and other related accessories for conducting field permeability tests of hard rock strata. Permeability tests have not yet been carried out by this division.

Soil samples are taken from sites on request and are transferred to Soil Mechanics and Foundations Division for testing. The following field tests are conducted by this division;

1. Standard Penetration Test.
2. Dynamic Cone Penetration Test.
3. Collection of disturbed and undisturbed soil samples by hand auger andmachine boring.
4. In situ Vane Shear test



Standard Penetration Test



Dynamic Cone Penetration Test

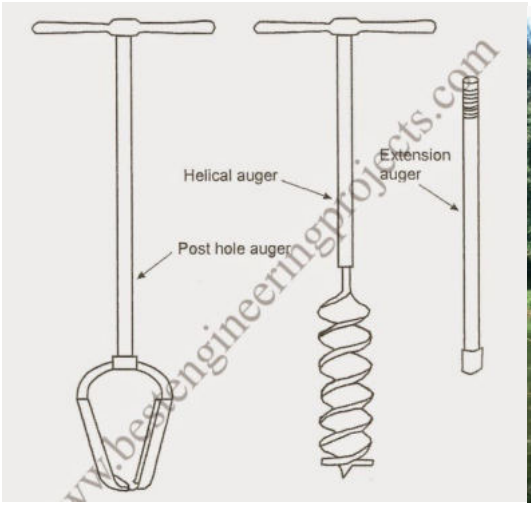
F.2. Infrastructure

The important equipments available in the Division are

- Equipments for hand augering.
- In situ Vane shear test apparatus
- Diesel boring plant.- 2 No.s
- Gravity corer sample collector unit

Vane Shear Apparatus

Gravity Core Sampler



Hand Auger

Diesel Boring Plant

F.3. Activities of the division during the current year

This Division took part in the following work;

F.3.1. Investigation for the rectification of existing Regulators at Enamakkal and Idiyanchira, Thrissur District

The above investigation work has been carried outas per the letter no WP2-7186/2018/D3 dated 06.05.2020 of Chief Engineer, Projects 2, Thiruvananthapuram for the investigation of existing regulators at Enamakkal&Idiyanchira in Thrissur Districtfor proposing any maintenance to these structures. Four nos. of Bore holes were taken from each site.The investigation work was carried out from 06/07/2020 to 15/09/2020. AS and TSwas for an

amount of Rs.6,70,000/- and the expenditure amount for the work was Rs.6,50,698/- under the head of account 4700-80-005-99-02-00-V (INVESTIGATION OF MAJOR IRRIGATIONSCHEMES).

F.3.2 Soil investigation for the proposed RCB at Kainurchira, Nadathara GP, Thrissur District.

The above investigation work was carried out as per the Lr. No. WP2-7444/2017/D10(D15) dt. 7.9.19 of The Chief Engineer, projects 2, Thiruvananthapuram.The soil investigation was conducted for the proposal of a new RCB by dismantling existing VCB which is nearly 37m long built at Kainurchira across the Manali River in Nadathara GP, Thrissur District. 14 no.s of Bore holes were explored.The Investigation work was carried out from 05/11/2020to 04/01/2021.Total amount expended for the works is Rs5,33,846/-. FS, AS&TS was for an amount ofRs8,00,000/- under the head of account 4700-80-005-99-02-00-V (INVESTIGATION OF MAJOR IRRIGATION SCHEMES).

F.3.3 Soil investigation at Ch.17 km at KIP main canal, Pathanapuram, Kollam District

The above works was taken up based on the letter No.D2-738/2018/ISEC dated 16.08.2019 of the Chief Engineer, Projects–II informing the Chief Engineer, IDRB, regarding the earth slippage at Ch.17 km of KIP main canal at Pathanapuram, Kollam District occurred during the 2018 flood. Six boreholes were drilled for soil exploration. The investigation work was carried out from 21/12/2020 to 14/01/2021. Total amount expended for the works is Rs.4,49,113/-. FS, AS and TS was for an amount of Rs.4,50,000/- under the head of account 4700-80-005-99-02-00-V (INVESTIGATION OF MAJOR IRRIGATION SCHEMES).

F.3.4 Soil investigation for projects in Irrigation Department - For retaining wall & Approach Road of proposed regulator at Munayam.

The proposal is for the soil investigation work to construct an approach road and retaining wall for the proposed MunayamRegulator located in Thrissur District. Executive Engineer, Irrigation Division, Thrissur vide Lr. No A11-2896/2012 dated 12/11/2020 has directed for carrying out soil investigation work. 8 bore holes were drilled for the exploration during the period from 15/12/2020 to 04/01/2021.Total Amount Expended is Rs.4,45,349/-. FS, AS & TS was for an amount of Rs.4,50,000/- under the head of account 4701- 80- 800-99-00-00-V Development of KERI stage II.

F.3.5 Soil Investigation Works - Development of Fish Seed Hatchery at Bhoothathankettu

The above work was conducted as per the request of the Executive Engineer, PVIP Division No 1, Perumabavoor to the the Director, KERI vide Lr.No.A1-314/2019 20 dated 28.12.2020 to conduct soil investigation for the proposed Development of Fish Hatchery (Phase II) at Kurukulam near Bhoothathankettu. The project involves construction of 18 no.s of rearing pond, 2 No.s of broodstock pond, 9 No.s of rearing ponds, quarters, compound wall & overhead water tank. Three boreholes [one each for the proposed overhead tank, proposed quarters and proposed rearing pond of size – 102m X 43.20m] and 6 open pits [for the proposed rearing pond, brood stock pond and earthern pond] were taken for investigation.

Investigation works such as boring, excavation of open pits, collection and testing of soil samples etc. are conducted. The investigation work was carried out from 28/02/2021 to 08/03/2021. The FS, AS & TS was for an amount of Rs.1,67,000/- under Head of A/C – 8443-00-108-00-00-00-V(PW Deposit).

F.3.6 Investigation for Eris

There are three storage reservoirs, locally known as Eris, associated with the Chitturpuzha project viz. Kamabalathara, Venkalakkayam and Kunnampidari. There is acute drought situation in the ayacut area of Chitturpuzha project. This issue can be addressed by either by creating new storage systems or enhancing the storage capacity of existing system.

A basic level survey has been conducted in the aforesaid three Eris to assess the scope of capacity enhancement. The survey was conducted during the year 2014. Existing contour pattern of the Eris were plotted and probable quantity of earthwork is calculated. Based on this, the DPR was prepared and tendered, but no Bids were received. Hence the work was retendered. The empowered committee suggested to reconsider the estimate and hence as per technical committee meeting held on 16/12/2020,it is decided to collect undisturbed samples for the analysis and decided to conduct detailed qualitative analysis by the collecting the undisturbed samples by boring. As per the Instruction given by the Hon'ble minister Sri.K.Krishnankutty on 11.01.2021through video conference, supervision for the soil investigation work for 3 Eri's was carried was carried by Instrumentation Division .

Kamabalathara Eris:-Soil investigation work was conducted at Kambalathara ERI from 14.01.2021 to 03.02.2021. 22 Bore holes were selected in a grid of size 200 x 200 m and 70 Nos samples were collected and sent for testing.

Kunamapidari Eris:-Soil Investigation work conducted at Kunnampidari Eri from 15/01/2021 to 30/01/2021. 39 numbers of soil samples from 10 boreholes were brought for testing.

Venakalakayam Eris:-Investigation work started at Venkalakayam Eri on 27/01/2021 and ended on 09/02/2021 68 numbers of soil samples from 25 boreholes were brought to the laboratory by Instrumentation Division for testing. Borehole locations have been selected based on 200 m x 200m grid.

F.3.7 Supervision of the soil Investigation of Karapuzha Dam

As per the Lr No.1088/DS-AD3/2020/IDRB dated 12/06/2020 of Chief Engineer, IDRB to the Chief Engineer, Project I, Kozhikkode, had recommended to conduct the soil sample collection& testing from the cross section of KarapuzhaDam, in consultation with KERI. Soil Testing was required for reviewing the stability analysis of the existing Earth dam. For this purpose undisturbed soil samples were taken from the cross section of the earth dam to obtain unit weight of soil samples (moist, saturated, submerged) & effective Shear parameters of soil samples which has to be determined by triaxial testing.

The soil investigation of the eathern dam by exploring 8 boreholes and collection of soil samples were conducted by the project authorities under the supervision of KERI.

Soil Investigation at Enamakkal Regulator, Thrissur District

Soil Investigation at IdiyanchiraRegulator, Thrissur District

Soil investigation for the proposed RCB at Kainurchira, Nadathara GP, Thrissur Dt.

Soil investigation at Ch.17 km at KIP main canal, Pathanapuram, Kollam District

Soil investigation for theretaining wall & Approach Road of pro.regulator at Munayam, Thrissur

Soil Investigation Works - Development of Fish Seed Hatchery at Bhoothathankettu

Soil Investigation Works - Development of Fish Seed Hatchery at Bhoothathankettu

Soil Investigation at Kambalathara Eri

Soil Investigation at Kunnampidari Eri

Soil Investigation at Venkalakkayam Eri

Supervision of the soil Investigation of Karapuzha Dam

G. PUBLICATIONS WING

G.1 Introduction

Publications Wingis acting as the information bureau of the Kerala Engineering Research institute. This wing provides necessary technical information to all other divisions through its technical library containing around 10000 (ten thousand) books and a number of latest periodicals. This wing conducts seminars and training programs for the benefit of staff of the Institute. Also, the wing conducts Trainings and Refresher courses for the staff of the Irrigation Department. Publications Division was deployedwith effect from 31/01/2017 and the activities are now being taken up under Instrumentation Division.

G.2 Activities of the Wing

During the financial year 2020-21 the main areas of work attended by this wing are:

- Maintenance and development of Library.
- Editing and publishing of Annual Report 2019-20.
- Conducting webinars for the benefit of the technical hands and staff in the institute.
- Conductingonline training programmefor the Engineers and technical staff of the department.
- Routine works of Publications Wing.

G.3 Library Service

This Wing has an excellent technical library attached to it. Latest publications on topics of interest to research workers are being regularly added.The library is being used by many technical persons in different Government Departments and also by a number of students from different Engineering Colleges and Polytechnics. Books are issued to officers attached to KERI using Library software.The card system is also being maintained.Facilities are also extended to Engineers working in various Departments and Institutions for referring the books.

The books are arranged in different shelves according to the subjects

G.3.1 Periodicals

A total of 5numbers of Indian periodicals were subscribed by this Wing. The following journals were purchased by subscription during the year.

G.3.1.1. Indian Periodicals

1. Indian Concrete Journal
2. Electronics for You
3. Indian Journal of Power & River Valley Development
4. Civil Engineering and Construction Review
5. Down to earth

G.4 Publication of Annual reports

Annual Reports for 2019-20 was published and copies were sent to important institutions and personnel.

G.5 Visit of the Special Secretary Sri. PranabjyothiNath IAS, Water Resources Department &Sri Biju D, Chief Engineer, IDRB on 29.11.2020

Honorable Special Secretary of Water Resources, Sri. PranabjyothiNath IAS visited KERI along with Sri Biju D, Chief Engineer, IDRBon 29.11.2020 and presided the meeting related to up gradation and review of the activities of KERI.

The meeting started at 8.50 am with prayer. Er. Sindhu B., Director, KERI,Peechi welcomed the chief guests and participants. Er. Suja S.S., Joint Director, Hydraulic Research presented a brief description about the organizational set up of KERI,Peechi followed by the presentation of Er. Saju Varghese, Deputy Director, Instrumentation Division regarding the detailed activities of KERI,Peechi. Er. Kamal Roy, Assistant Executive Engineer, Quality Control Sub Division, Muvattupuzha detailed the functional activities under Quality Control Wing. Er. Geetha E.S., Assistant Executive Engineer, Head Works Sub Division Peechi, under Irrigation Central Circle, Thrissur has made a detailed presentation about Peechi Irrigation Project. Er. Ajmal.E, Joint Director, Coastal Engineering & Field Studies (CEFS), Thrissur has presented detailed report of their activities. Er. Arun C., Assistant Engineer, JWR Section had made a presentation regarding enhancement of research activities of KERI. Mr. Johar, Scientific Assistant, Water Quality lab Thrissur had made a presentation about the functions and activities of level I & II labs of Water Quality assessment all over kerala under Hydrology wing.

On conclusion of the session, the Special Secretary had advised the following recommendations;

- new instruments can be procured under DRIP scheme.
- conduct synchronized training on advance technologies for Engineers in KERI and suggested that the trained Engineers should be retained in KERI itself.
- KERI Engineers to visit similar research Institutes all over India like GERI, MERI, IHH etc. and to attend trainings in their respective fields.
- Monthly review of individual offices should be conducted and reported to Government through the Chief Engineer, IDRB.

Honourable Special Secretary, Chief Engineer, IDRB and the whole team also visited the KERI infrastructure and acquainted with the facilities available at KERI. The meeting ended at 6.30 pm with vote of thanks.

G.8.1 Online Capacity Building Programme for Minor Irrigation Engineers

Due to Covid Pandemic, physical trainings were not advisable and it is proposed to conduct online training programmes as per the instructions from Additional Chief Secretary, WRD, Kerala. This training was initiated as a first step to conduct an Online Training Programme for the department. The objectives of this training to build the Capacityof Minor

Irrigation Engineers and to provide support and guidance from the in house experienced &senior engineers of the department as well as subject experts from other government departments. Overall 18 sessions were conducted from 01.10.2020 to 31.10.2020. The training was helpful to the engineers which gave them a better outlook of the projects usually entrusted to the MI engineers, from conceiving these projects till its financial auditing including the possibilities to convert the existing LIschemes to micro irrigation ones. This training is intended for selected 41 Assistant Engineers/ Assistant Executive Engineers from Minor Irrigation.The training was conducted using Zoom Meeting Application.

The programme schedule and the details of the resource persons are as follows;

Program Schedule

Date	Session	Title	Resource Person
30.09.2020	6.00 pm-8.00pm	Preparatory Session	All Resource persons, KERI officials & participants
01.10.2020	8.30 am-9.00 am	Inaugural Session	
	9.00am-11.00am	1. Planning of MI Schemes	Er. BajiChandran R, SE, Minor Irrigation Central Circle, EKM
03.10.2020	9.00am-11.00am	2. An overview of DPR preparation for MI schemes	Er. Saji Samuel, DD, KERI
06.10.2020	9.00am-11.00am	3. Practical approach to investigation methods of Irrigation structures	Er. Saju Varghese, AEE, Irrigation Division, TCR & Er. Sufeera O B, AD, KERI
08.10.2020	9.00am-11.00am	4. Departmental procedures for execution of MI works	Er. Vinod Mohan. S, EE, KIP LB Division No. V, Kollam
09.10.2020	9.00am-11.00am	5. Financial resources for MI Schemes	Sri. Salil T.B, DA Harbour Engineering Division, kozhikkode
13.10.2020	9.00am-11.00am	6.. Quality audit of MI Schemes	Er. Babu, AEE, Quality Control Sub Dn, TCR
15.10.2020	9.00am-11.00am	7. General maintenance guidelines and operations of LI schemes	Er. Ramya R, AEE, MI Sub Division, Aluva& Er. MuhammedAjmal U, AE, MI Section, Kalady
16.10.2020	9.00am-11.00am	8. Basic awareness of electrical components and operations in MI schemes	Er. Seeja K R, AEE, Electrical wing, Aluva
17.10.2020	9.00am-11.00am	9. Basic awareness of mechanical components and operations in MI schemes	Er. SatheeshChandran V, AE(Mechanical), Malampuzha

	3.00pm -5.00pm	10. Liaisoning procedure with other departments	Er. Faizal K, AE, Kyip O&M Section
20.10.2020	9.00am-11.00am	11. Organizational set up for fixing Revenue / Irrigation cess	Sri Harilal Irrigation Planning, O/o CE, I&A
21.10.2020	9.00am-11.00am	12. Hydrological analysis for planning and design of MI Schemes	Er. Shibu George, AEE, Hydrology Division, TCR
22.10.2020	9.00am-11.00am	13. Introduction to QGIS & Mapping	Er. RajiThampan, DD, KERI
23.10.2020	9.00am-11.00am	14. Economic feasibility of MI Projects	Er. Suseela R, EE MI Division, Kottayam
27.10.2020	9.00am-11.00am	15. Estimation of crop water requirement and Irrigation Scheduling for crops	Dr. Jasmin I, AD Hydrology Section, Manjeri
28.10.2020	9.00am-11.00am	16. Review of financial auditing of projects	R. Thulaseedharan Pillai, Senior Audit Officer (Retd), AG (audit), Tvpm
29.10.2020	9.00am-11.00am	17. Conversion of LI schemes to Micro Irrigation Schemes	Er. Sreelekha B, AEE, Irrigation Planning, O/o CE, I&A
30.10.2020	3.00pm -5.00pm	18. Design guidelines for Minor Irrigation Projects	Er. Sreedevi P, DCE (Irrigation), Tvpm
31.10.2020	9.00am-11.00am	Concluding Session & Feed Backs	

The following Engineers participated in the program;

Sl No	**Name of Officer**	**Designation**	**Office Address**
1	Ramya R.	Assistant Executive Engineer	Minor Irrigation Sub Division, Aluva
2	Sherin Mary Sam	Assistant Executive Engineer	Minor Irrigation Sub Division, Moolamattom
3	Josey V A	Assistant Executive Engineer	Minor Irrigation Sub Division, Harippad
4	Binu Jose	Assistant Executive Engineer	Minor Irrigation Sub Division, Kottayam
5	Arjunanan E.K	Assistant Executive Engineer	Minor Irrigation Sub Division, Manjeswaram, Kasarkode
6	Rethnakaran P	Assistant Executive Engineer	Minor Irrigation Sub Division, Kasarkod
7	Jayakrishnan B	Assistant Executive Engineer	Minor Irrigation Sub Division, Palakkad
8	SumanChandran T. K.	Assistant Executive Engineer	Minor Irrigation Sub Division, Chittur, Palakkad

9	Anil G.	Assistant Executive Engineer	Minor Irrigation Sub Division, Kollam
10	Rekha S.L.	Assistant Executive Engineer	Minor Irrigation Sub Division, Kottarakkara
11	Hussein Cholakkal	Assistant Executive Engineer	Minor Irrigation Sub Division, Shornur
12	Sina P. Raveendran	Assistant Executive Engineer	Minor Irrigation Sub Division, Thrissur
13	Sujith D. S.	Assistant Executive Engineer (PA to EE)	Minor Division, Palakkad
14	Remya Ramesh	Assistant Engineer	MI Section no.1, Ernakulam
15	Deepa Susan John	Assistant Engineer	MI Section, Kollam
16	Muhammad Sadique N V	Assistant Engineer	MI Section, Kumbla
17	Suji R Chandran	Assistant Engineer	MI Section, Haripad
18	Sabitha S G	Assistant Engineer	MI Section, Mavelikkara
19	Dhanya R	Head Draftsman	MI Division, Chengannur
20	SoumyaSudarsan C	Assistant Engineer	MI Section, Chathannoor
21	Aswathy S.	Assistant Engineer	Works Division, O/o the CE (I&A), Thiruvananthapuram
22	MuhammedAjmal U	Assistant Engineer	MI Section, Kalady
23	Dhanya K. Sankar	Assistant Engineer	MI Section, Moolamattom
24	Raj Rajendran	Assistant Engineer	MI Section, Thrithala
25	Suresh	Assistant Engineer	MI Section I, Mananthavady, Wayanad
26	Devi B. J.	Assistant Engineer	MI Section, Mulanthuruthy
27	ArshaNath P.R.	Assistant Engineer	MI Section, Karunagappally
28	Varun V.	Head Draftsman	MI Division, Kollam
29	Aseeja P.K.	Assistant Engineer	MI Section, Payangadi Section
30	Seena P.M.	Head Draftsman	Minor Irrigation Central Circle, Ernakulam
31	Sunilkumar P	Assistant Engineer	MI Section, Pattambi
32	Dhanya K.S	Assistant Engineer	MI Section, Thrissur
33	Anoop R.	Assistant Engineer	MI Section, Kodakara
34	Raghu K.	Assistant Engineer	MI Section, Mannarkkad
35	Sreehari M.	Assistant Engineer	MI Division, Mallappilly
36	Shyla Mathew	Assistant Engineer	MI Section, Thiruvalla
37	AmithaBaiju	Assistant Engineer	MI Section, Pathanamthitta
38	Devanarayanan K	Head Draftsman	MI Division, Palakkad
39	AswinSubin	Assistant Engineer	MI Section, Venkalakkayam
40	Santhakumar V.	Assistant Engineer	MI Section, Thathamangalam
41	Sabna Thomas B.L.	Assistant Engineer	MI Section, Palakkad

G.8.2 Online Training Programme for Quality Monitoring & Quality Control of Works

After the first series of online training organized for 41 Engineers of Minor Irrigation during the period 01/10/2020 - 31/10/2020, a second set of Online Training Programme for Quality Monitoring and Quality Control of works for the Engineers and Overseers of Quality Control Division of our department was organised by KERI on 03.12.2020 & 04.12.2020. The training was presented by Sri.Babu M S, Assistant Executive Engineer, Quality Control Sub Division, Thrissur. This training was conducted for 57 Overseers on 03.12.2020 and 24nos of Assistant Executive Engineers / Assistant Engineerson 04.12.2020 of theQuality control divisions. The training was conducted using Zoom Meeting Application.

The following Overseers of Quality Control Division attended the program on 03.12.2020;

Sl. No	Name of Officer	Designation	Office Address
1	Rahim S	I Gr D/Man	Quality Control Division, Kottarakkara
2	Hari Kumar M	I Gr D/Man	Quality Control Division, Kottarakkara
3	Lincy T Elezabeth	I Gr D/Man	Quality Control Division, Kottarakkara
4	M S Shaji ,	II Gr D/Man	Quality Control Division, Kottarakkara
5	Sanish S	II Gr D/Man	Quality Control Division, Kottarakkara
6	Sajeev V	II Gr D/Man	Quality Control Division, Kottarakkara
7	Rajendra Prasad P	I Gr D/Man	Quality Control Sub Division, Thiruvananthapuram
8	PreethaRajan	I Gr D/Man	Quality Control Section, Kollam
9	Arun V	I Gr D/Man	Quality Control Section, Thiruvananthapuram
10	RemlaBeegom S	II Gr D/Man	Quality Control Sub Division, Thiruvananthapuram
11	Pradeep Kumar A	IIIrd Grade Overseer	Quality Control Section, Thiruvananthapuram
12	Abhini Rani S	IIIrd Grade Overseer	Quality Control Section, Thiruvananthapuram
13	Sreekala C	IIIrd Grade Overseer	Quality Control Section, Kollam
14	Lal C	IIIrd Grade Overseer	Quality Control Section, Kollam

15	Laila Beevi .B	I Gr D/Man	Quality Control Sub Division, Kottarakkara
16	Mumthas S	II Gr D/Man	Quality Control Sub Division, Kottarakkara
17	Jayanthy..R,	IIIrd Grade Overseer	Quality Control Section Kottarakkara
18	Sreelekshmi .R,	IIIrd Grade Overseer	Quality Control Section Kottarakkara
19	Nissar M	I Gr D/Man	Quality Control Sub Division, Alappuzha
20	Jose P Daniel	I Gr D/Man	Quality Control Section Pathanamthitta
21	Mohanan N	I Gr D/Man	Quality Control Section Alappuzha
22	Ajithakumari A.T	II Gr D/Man	Quality Control Sub Division, Alappuzha
23	Divya A R	IIIrd Grade Overseer	Quality Control Section Alappuzha
24	BindhuBalakrishnan	IIIrd Grade Overseer	Quality Control Section Alappuzha
25	Binu Benjamin	IIIrd Grade Overseer	Quality Control Section Pathanamthitta
26	LekshmiMohanan	IIIrd Grade Overseer	Quality Control Section Pathanamthitta
27	Aleyamma Mathew	I Gr D/Man	Quality Control Section, Kottayam
28	Saji C Markose	II Gr D/Man	Quality Control Sub Division, Kottayam
29	JayasuryaGandhilal	IIIrd Grade Overseer	Quality Control Section, Iddukki
30	LigiPothen	IIIrd Grade Overseer	Quality Control Section, Kottayam
31	Savitha T.K	I Gr D/Man	Quality Control Sub Division, Kottayam
32	Pushkaladevi.K.B,	IstGr.D'man	QC Division, Thrissur
33	JobiLazar.M,	, Ist.Gr.D'man	QC Sub division,Palakkad
34	Pankajakshan.AM,	Ist.Gr.D'man	QC Sub division, Kozhikode
35	JacinthaMary.A,	Ist.Gr.D'man	QC Sub division, Kozhikode
36	Gangadharan.O.P,	, Ist.Gr.D'man	QC Sub division, Kasargod
37	Sreelatha.M.V	, Ist.Gr.D'man	QC Sub division,Muvattupuzha
38	Abdul Salam.P.M,	Ist.Gr.D'man	QC Sub division, Muvattupuzha

39	Jobson P. Cheriyan,	2nd Gr.D'man	QC division, Thrissur
40	Francy.P.A,	2nd Gr.D'man	QC division, Thrissur
41	Jestina.K.Jose	2nd Gr.D'man	QC Sub division, Thrissur
42	Parameswaran.M.M,	2nd Gr.D'man	QC Section, Thrissur
43	Shajitha.C.M,	2nd Gr.D'man	QC Section, Ernakulam
44	MoideenKunji.K.K	,2nd Gr.D'man	QC Section, Kozhikode
45	Surenderan.P.E,	2ndGr.D'man	QC Section, Koothattukulam
46	Thulasi.P,	2nd Gr. D'man	QC Section, Angamaly
47	Sreeja.K.R,	3rd. Gr.Overseer	QC Section, Thrissur
48	Resmi. P.N	,3rd.Gr.Overseer	QC Section, Thrissur
49	Latha.K.T,	3rd. Gr.Overseer	QC Section, Aluva
50	Asha.S,	3rd. Gr.Overseer	QC Section, Palakkad
51	Fasna.K	3rd. Gr.Overseer	QC Section, Malappuram
52	Sajeesh.V,	3rd. Gr.Overseer	QC Section, Kozhikode
53	Ahammad.A,	3rd. Gr.Overseer	QC Section, Kozhikode
54	SoniyaKuriyakose,	3rd.Gr.Overseer	QC Section, Kannur
55	Labeeb.T,	3rd. Gr.Overseer	QC Section, Kasargode
56	Aneesh.F,	3rd. Gr.Overseer	QC Section, Muvattupuzha
57	Sreekanth.M,	3rd. Gr.Overseer	QC Section, Koothattukulam

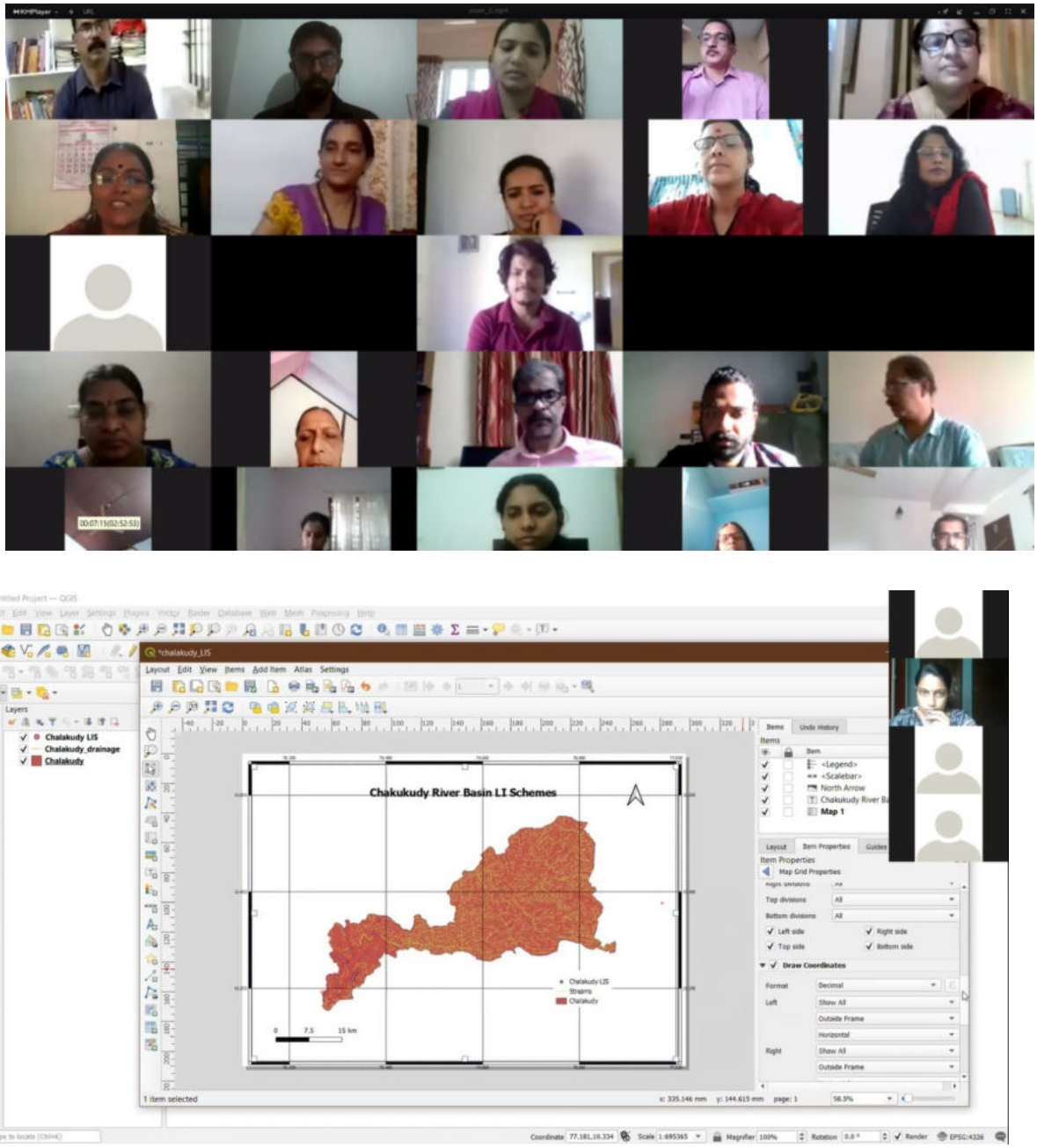
The following Engineers of Quality Control Division attended the program on 04.12.2020

Sl. No	Name of Officer	Designation	Office Address
1	LeenaKumari P S	Assistant Executive Engineer	Quality Control Sub Division, Thiruvananthapuram
2	RenjiniGopinath	Assistant Engineer	Quality Control Section, Thiruvananthapuram

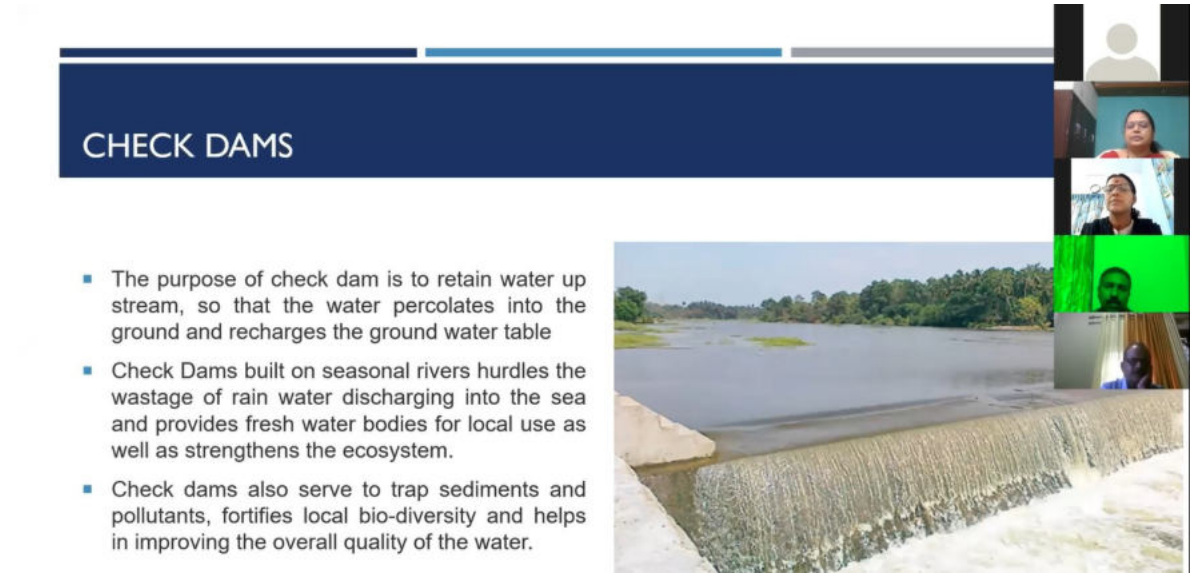
3	Deepa B	Assistant Engineer	Quality Control Section, Kollam
4	Laly S.S,	Assistant Executive Engineer	Quality Control Sub Division, Kottarakkara
5	SheejaPanicker P.K,	Assistant Engineer	Quality Control Section Kottarakkara
6	Jessy Thomas	Assistant Executive Engineer	Quality Control Sub Division, Alappuzha
7	Anjana S	Assistant Engineer	Quality Control Section Alappuzha
8	Sindhu K S	Assistant Engineer	Quality Control Section Pathanamthitta
9	Merin Thomas	Assistant Executive Engineer	Quality Control Sub Division, Kottayam
10	Joseph Nelson.P.J	Assistant Engineer	Quality Control Section, Iddukki
11	JayarajanKaniyeri,	Executive Engineer	QC Division, Thrissur
12	Deepa.R,	Technical Assistant	QC Division, Thrissur
13	Babu. M.S,	Asst.Exe.Engineer	QC Sub Division, Thrissur
14	Sudhakaran.T.S,	Asst.Exe.Engineer	QC Sub Division, Palakad
15	Rajeev.B	Asst.Exe.Engineer	QC Sub Division, Kozhikod
16	SahadevanChadayan	Asst.Exe.Engineer	QC Sub Division, Kannur
17	Kamal Roy	Asst.Exe.Engineer	QC Sub Division, Moovattupuzha
18	Pathuvi.P.M,	Asst.Engineer	QC Section ,Ekm
19	Sulaiman.M,	Asst.Engineer	QC Section Malappuram
20	Girishkumar.K,	Asst.Engineer	QC Section Kasargode
21	Nirish.P.P,	Asst.Engineer	QC Section Kalpetta
22	Gopu.N	Asst.Engineer	QC Section Moovattupuzha
23	Anila. K.T,	Asst.Engineer	QC Section Koothattukulam
24	Valsalakumari.V.R	Asst.Engineer	QC Section Angamaly

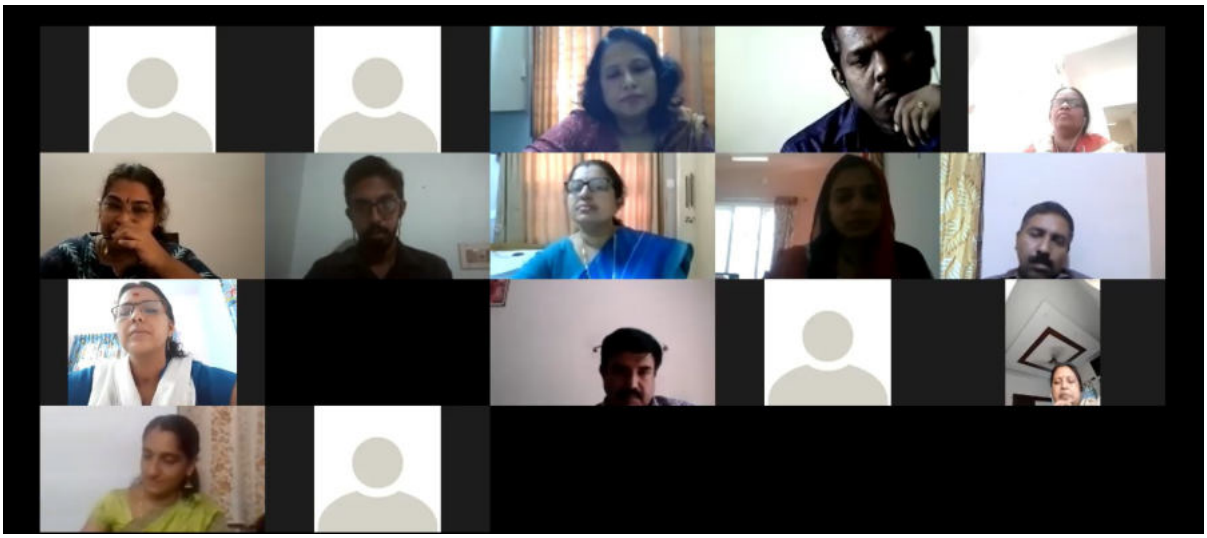
G.8.3 Online Training on Coastal structure Design & Construction

This online training was conducted by KERI as a part of initiative to organise Webinars for the Engineering Wing of the Irrigation Department, Kerala. The program was conducted on 24.02.2021 from 3PM- 5PM. It was mainly targeted for the Engineers of Major Irrigation Division. Session was handled by Sri.Tijo C Mathew, Chief Engineering Manager & Head, Engineering Design & Research Centre - Ports and Harbours, L&T, Construction, Chennai. The objectives of this training were to provide a general idea on the modern methods and innovations adopted in the field of Coastal Structure design and construction methods. The webinar was conducted using Zoom Webinar Platform and 76 participants registered for participation.

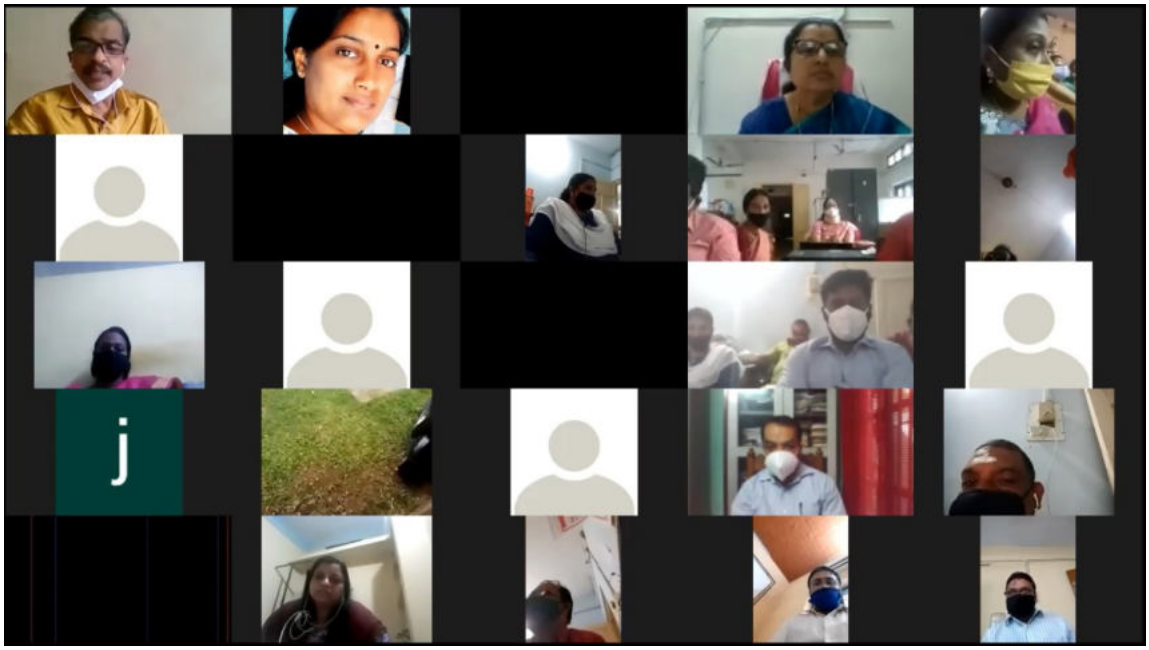


Screenshots of the training on Online Capacity Building Program for Minor Irrigation Engineers





Screenshots of the training on Online Capacity Building Program for Minor Irrigation Engineers



Screenshots of the Online Training Program for Quality Monitoring & Quality Control of Works

H. COASTAL ENGINEERING FIELD STUDIES, THRISSUR

I. Introduction

The Coastal Engineering Field Studies was formed in 1973 and is engaged in the collection of data and field studies on Coastal Erosion along the Kerala Coast. The coast of Kerala extending 576 Km. in the south west coast of India, is Characterized by a narrow longitudinal barrier strip of low-lying land, sand-witched between the Arabian Sea and a continuous chain of lagoons and back waters with connection to sea at several points. This strip is formed of alluvial deposits. In considerable stretches, the space between the sea and the back waters is very narrow and even less than a few hundred meters at many places. Any break in this narrow strip would expose the back water to the fury of the waves and could endanger the entire disappearance of the barrier beaches.

The coastal zone has the maximum concentration of population and is even many times the State average at several places. Many of the foreign exchange earning industries, residential

localities, a number of district headquarters, good number of ports, fishing harbours and extensively cultivated land also exist along this narrow coastal zone.

The coastline of Kerala is subjected to severe erosion in a major portion of its length during the monsoons, when the sea becomes rough due to consistent attack of waves. The coastline is sometimes subject to tidal overflow also, when adjoining low lying lands get submerged. Erosion is very severe in the coastal areas during the south west monsoon period. During the worst monsoon period, the highest waves average 2,3 metres and wave periods range from 9 to 12 sec. and they come mostly from west. Storm tides occur all along the coast during the monsoon season. During the monsoon, the high waves coupled with storm surges, cause overflow and flooding of the low lying backshore lands all along the coast, resulting in considerable loss of property, destruction of private and Government buildings, communications, dislocation of life of lakhs of population and disruption of other activities affecting economy. The influence of saline water through mouth of rivers also affects agriculture and industry.

New CP stones have been planted throughout the Kerala coast except about 25km length of north extreme end at Manjeswaram. The GPS Co-ordinates of all CP stones and seawalls have been recorded.

All aspects of the coastal erosion problems of the State, the necessity for immediate protection of vulnerable stretches, efforts made in collection of coastal data for long periods in conducting studies and in getting expert advice from all over the world and achievements made so far in tacking the erosion problem.

Many experts who visited this State, to study the behavior of the coast and also for periodical evaluation of the performance of completed sea walls, were all of the same opinion that the sea wall damage, mostly due to improper maintenance is as important as the construction of sea wall.

For proper construction and to understand the performance of the sea wall during and after construction, proper monitoring is necessary. This requires consideration of the field staff with the staff engaged in coastal erosion studies. Whenever a new sea wall is to be constructed, the research staff must be informed of the different stages of construction, starting from alignment of the sea wall forming filter, core, armour layers, etc, so that the performance of it during construction and after construction can be watched.

The field staff also must keep a date-war record of construction details starting from alignment, excavation, putting filter, forming core, armour layer, etc, as per lines and level. The distance and levels of stones in front of sea wall also must be watched regularly with the progress of construction of sea wall. All chainages of sea wall must be made with reference to the Km/C.P stone available at site

The concerned Assistant Engineers must give all relevant details to the concerned Assistant Directors in charge of Coastal Engineering field Studies from time to time, as per the above guideline and also keep a copy of the same for reference. The offices under this office are

1. **Coastal Engineering Sub Division Kollam**
   a) Coastal Engineering Section, Thiruvananthapuram: The jurisdiction of coastal area comprises of Kollamkode to Paravoor pozhi (CP 0000 to CP 0287)
   b) Coastal Engineering Section, Kollam: Jurisdiction of coastal area comprises of Paravoor pozhi to Kayamkulampozhi (CP 0288 to CP 0499)
   c) Coastal Engineering Section, Thottappally: Jurisdiction of coastal area comprises of Kayamkulampozhi to Alapuzha pier. (CP 0500 to CP 0710)

   The total coastal area of Kollam Sub Division is **164.596 Km.**

2. **Coastal Engineering Sub Division Ernakulam**
   a) Coastal Engineering Section, Cherthala: Jurisdiction of coastal area comprises of Alappuzha pier to Ponnani. (CP 810 to CP 975)
   b) Coastal Engineering Section, Ernakulam: Jurisdiction of coastal area comprises of Chellanam to Munambam. (CP 975 to CP 1187)
   c) Coastal Engineering Section Chavakkad: Jurisdiction of coastal area comprises of Azhikode to Ponnani. (CP 1188 to CP 1549)

   The total coastal area of Ernakulam Sub Division is **151.6311 Km.**

3. **Coastal Erosion Studies Sub Division Kozhikode**
   a) Coastal Erosion Studies Section, Parappanangadi: Jurisdiction of coastal area comprises of Padinjarekkara to Kadalundi (CP No. 1555 to CP 1743)
   b) Coastal Erosion Studies Section, Kozhikode: Jurisdiction of coastal area comprises of Kadalundi to PoozhithalaMahipalam. (CP 1745 to CP 2120)

c) Coastal Erosion Studies Section, Thalassery: Jurisdiction of coastal area comprises of Mahi River to Thalapady river Manjeswaram. (CP 2140 to CP 2412 in Kannur District and CP 2507 to 2750 of old CP in Kasargode District).

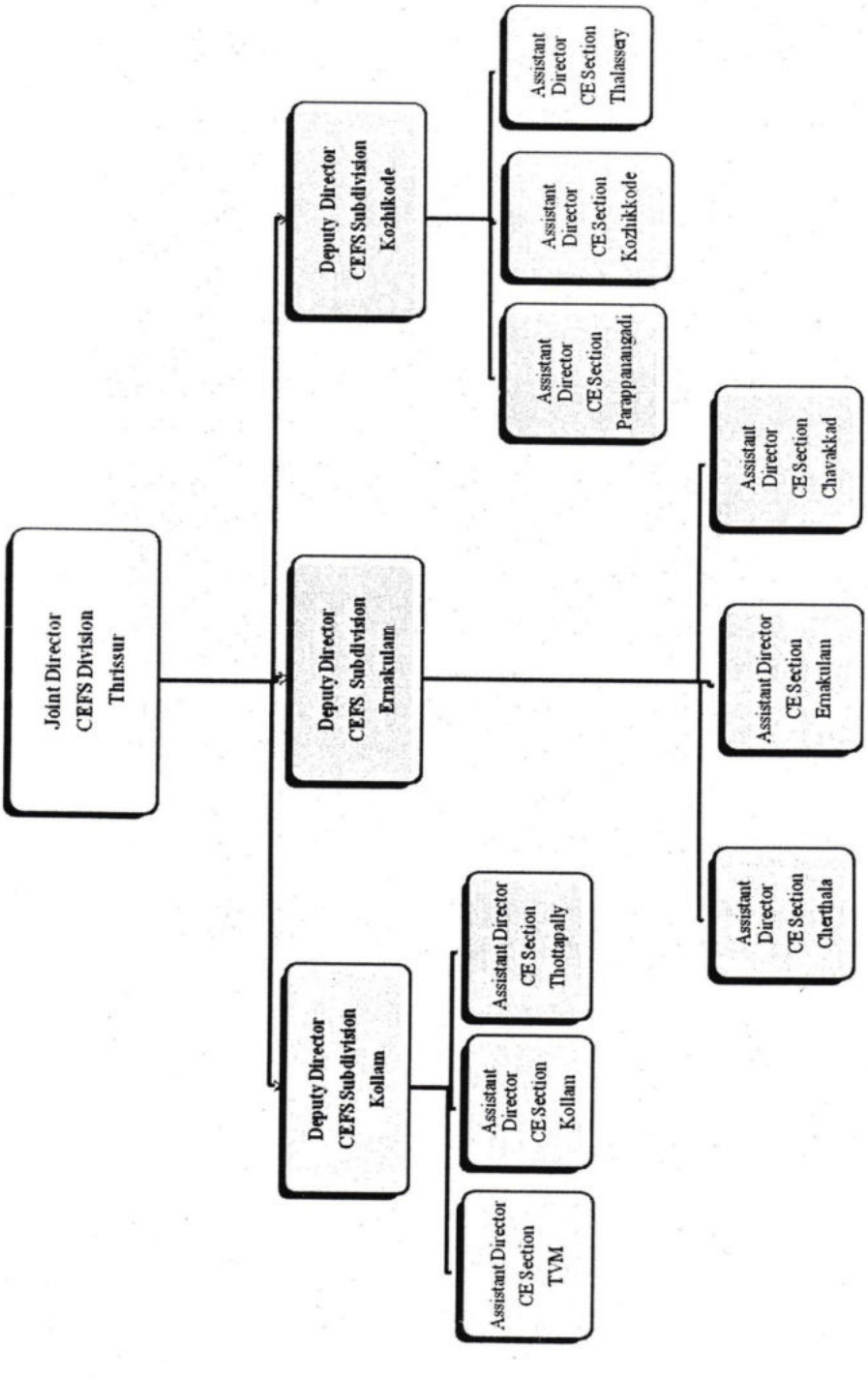
The total coastal area Kozhikode Sub Division is 260.1 Km.

II. GENERAL ARRANGEMENTS AND FIELD STUDIES

For the detailed study of the characteristics and behavior of the beach, the 576 Km of the Kerala coast is divided into three regions viz., Southern region, Central region and Northern region. Each of these regions is under the control of Deputy Directors and further sub divided into the control of Assistant Directors. The three regions come under the Coastal Engineering Field Studies, headed by Joint Director who works under the guidance of Director, Fundamental and Applied Research, Kerala Engineering Research Institute, Peechi.

ORGANISATIONAL SET UP

Name of Sub Divisions and Sections Under Coastal Engineering Field Studies Division, Thrissur



III. TECHNICAL PERSONNEL

COASTAL ENGG. FIELD STUDIES, THRISSUR.

1. Joint Director	: Sri. Ajmal.E
2. Assistant Director	: Smt. Ajantha.V.D (Full additional charge from 01/06/2020 onwards)
3. IstGr.Draftsman	: Smt. Bindu.K.C (From 21/04/2020 onwards) Smt. Beena.K.D (From 04/05/2020 onwards) : 1 No. vacant
4.Head Clerk	: Sri. Yesudas.P.T (From 01/01/2019 to 25/07/2019) Sri. Vasudevan.K.M(Additional charge from 25/07/2019 to 01/08/2019) Sri. Yesudas.P.T (From 01/08/2019 onwards)
5 Senior Clerk	: Smt. Rose Johny (working arrangement from / /2020
6. Clerk	: Smt. Rinny.M.D (From18/12/2020 onwards)
7. Senior Grade Typist	: Smt. Seema Jose
7. Driver	: Sri. Denny. N.J
8..Office Attendant	: Smt.Nigi T.K

C.E.S. SUB DIVISION, KOZHIKODE

1. Deputy Director	: Sri. Govindanunni.V.K
2. IstGr.Draftsman	: Smt. Preethi.K (retired on 31/05/2021)
3. Senior Clerk	: Smt. Preetha.T.K. : Smt. Hameeda. M.A
4.Senior Grade Typist	: Smt. Prameela.K
5. Driver	: Sri. Mohammed Iqbal.P
6. Office Attendant	: Sri. Logesh N.P.

C.E.S.SECTION, KOZHIKODE

1. Assistant Director	: Sri. Abdul Rasheed.K.P(Retired on 29/02/2020) Sri. Ammad.P.C(From 01/03/2020 to 05/08/2020) Sri. Jithin.P (From 06/08/2020 onwards)

2. IstGr.Overseer : Sri. Sakkeer Ali. A

3. IIndGr.Overseer : Smt. Rejula.K

4. Office Attendant : Smt. Seema Mol. K.C

C.E.S. SECTION, THALASSERY

1. Assistant Director : Sri. Abdul Rasheed.K.P (In charge upto 29/02/2020)
Sri. Ammad. P.C (from 01/03/2020 to 14/02/2021)
Sri. Jithin.P, (15/02/2021 onwards) In charge

2. IIndGr.Overseer : Smt. Seena. P.P
: Sri.Haneefa.K. (01/03/2021 onwards)

3. L.D.Clerk : Sri.Siju.N

4. Office Attendant : Smt.Remani.P

C.E.S.SECTION, PARAPPANANGADI

1. Assistant Director. : Sri. Ammad.P.C

2. IIndGr.Overseer : Smt. RehnaSulthana.K :
Smt. Shajna.P.V

3. Office Attendant : Vipin.D

C.E SUB DIVISION, ERNAKULAM

1. Deputy Director : Sri. Rajesh.T.K (From 06/08/2019 onwards)

2. IstGr.Draftsman : Sri. Sajeev Kumar.B (01/08/2020 to 26/08/2020)
Smt. Letha.K.V(from 27/08/2020 onwards)

3 .Senior Clerk : Smt. Nisha.K.N

4 .Clerk : Smt. Suja.K.S

5. Typist :Sri.VinodKumar.K

6 .Driver : Sri.Anoop.P.G

7 .Office Attendant : Smt.Jayanthi.T.T (15/10/2016 to 04/11/2020)
Smt. Alphonsa.K.X(05/11/2020 onwards)

8. Part Time Sweeper : Smt. Rugmini.N.T

C.E.S.SECTION, ERNAKULAM

1. Assistant Director	: Smt. Anusree.A (24/02/2021 onwards)
2.IstGr.Draftsman	: Sri.Muraleedharan.G (05/09/2019 to 04/05/2020)
	Sri. Binu.K (02/02/2021 onwards)
3.2nd Gr.Draftsman	: Smt.LekhaJoseph.P (01/01/2018 to 30/01/2021)
	Smt. Kamalamma.K (08/02/2021 onwards)
4 . Office Attendant	: Sri.Saji.T.T

C.E.SECTION, CHERTHALA

1. Assistant Director	: Sri. Clement Roy.K.R
2. IInd Gr.Overseer	: Sri. Kunjumon.P
	Smt. Anjana.Prakash
3. LD CLERK	: Sri. Ajayakumar.P
4. Office Attendant	: Sri. Ashimon.P.T (22/07/2015 to 16/11/2020)
	Sri. Solaman.P.R (18/11/2020 to 27/02/2021)
	Smt. Sali.P.V (01/03/2021 onwards)

C.E SECTION, CHAVAKKAD

1. Assistant Director	: Smt. Ajantha.V.D
2. 2nd Gr. Draftsman.	: Sri. Babunath.S
	Smt. Thulasi.E.C
3. SENIOR CLERK	: Smt. Rose Johny
4. Office Attendant	: Sri. Shaji.M.K

C.E SUB DIVISION, KOLLAM

1. Deputy Director	: Smt. Raji.C.T
2.IstGr.Draftsman	: Smt. Aseena.S
3 .Senior Clerk	: Smt. Jaya.D
	: Sri. Anil Raj.K
5 .Typist	: Sri.GopakumaranNair.C
6 .Driver	: Sri.Ajipushpangathan
7 .Office Attendant	: Sri.Vickraman.P

C.E SECTION, KOLLAM

1.Assitsant Director	: Sri. S. J Shillar (From 30/08/2017 to 30/04/2020)
	Smt. ArshaNath.P.R (From 30/04/2020 to 17/04/2020)
	Smt. Rajeena.M (From 17/04/2020 and continuing)
2.Ist Gr. Overseer	: Smt. Shiji.P.R (16/08/2019 onwards)
3. 2nd Gr.Overseer	: Sri. VenugopalanNair.B (08/11/2019 to 27/08/2020)
	Smt. Anithakumari.. S (from 28/01/2021)
4.Office Attendant	: Sri.Sanilkumar.J
5. Apprentice Trainsee	: Sri. Arun Prabha(from 19/08/2019 to 18/08/2020)

C.E.SECTION, THOTTAPPALLY

1. Assistant Director	: Sri.Jayaprakash.D (24/07/2020 onwards)
2.2nd Gr. Overseer	: Sri. Raju.T 24/07/2020 onwards) .
	: Sri. Jaimon.T.J (15/02/2021 onwards)
3. L.D.Clerk	: Smt.Rejani.S
4. Office Attendant	: Sri. Premesh.G

C.E.SECTION, THIRUVANANTHAPURAM

1. Assistant Director	: Sri.Ajinsingh.S
2.2nd Gr.Draftsman	: Sri.Arunraj.F.L (08/12/2017 to 02/02/2021)
	: Smt. Neenamma. A.R (02/02/2021 onwards)
	Sri. Godlin.J.J
3. L.D.Clerk	: Sri.Salin.S

V. PROGRAMME OF STUDY

In coastal environment, waves, tides, currents and winds are the important parameters which need to be considered for any development. It is very much essential to understand the physics of these processes. Coastal erosion is the wearing away of land by the action of waves, current and wind. Coastal erosion is accompanied with landward recession of the sea shore and loss of land area. It is a common problem faced in almost all coastal areas. Only the magnitude and nature of erosion changes from place to place. Along the most part of Kerala coast, the erosion observed is seasonal in nature, that is, beach gets eroded during mansoon and regains its

original profile during fair weather season. However, at some places erosion is of permanent nature.

1. Simultaneous Wave Observations

Simultaneous wave observations are being conducted at 18 specified location along Kerala Coast on all new moon days to understand characteristics of wind, wave and tide details such as width of back shore, fore shore, slope of fore shore, composition of each materials, characteristics of littoral drifts, shore history and they are recorded on standardized format.

1.1 Study of littoral drift

Littoral transport is the movement of sediments in the near shore zone by waves and currents. This transport of suspend and bed load particles are both in parallel to the sea shore and perpendicular to sea shore. This transport of suspended materials is called littoral drift. It has been ascertained from the past studies that the dominant direction of littoral drift in Kerala coast is from north to south. However the directions, an annual quantity of net and gross quantity are important in developing shore protection arrangements. Now only the direction of drift is being studied at selected at points along the shore.

1.2 Study of Wind and Waves

Winds are the natural generators of wave and their study is necessary. An understanding of the nature of the tidal phenomenon is necessary for the study of coastal behaviors. The top level of the coastal protection structures depend on the tidal level and their data must be collected.

Wave causes sand to move along the coast as well as on to or off a beach. Due to refraction, wave energy is concentrated in certain reaches of the coast where erosion became naturally severe. Hence the design of coastal protection structures primarily depend on wave characteristics and since these studies are essential.(Predominant direction of waves is from west or north west)

Dates and places of observations

In order to have more detailed idea of the behavior of factors affecting the shore line changes, three consecutive points are taken for reference. At a particular study reach five readings are taken in all three points at definite timing. Nearly 20 to 25 Km apart straight

reaches without much external disturbances are selected for taking these simultaneous observations. The dates in the year 2020 and places of observations with timing and CP Nos. are listed in Appendix V & VI.

Due to Covid-19 Lockdown Simultaneous Observation not conducted during the month April 2020.

2. Study of Mud banks

Mud banks, a phenomenon peculiar to the coast of Kerala are those in shore region where wave energy is dissipated completely as a result of the colloidal mud suspension mud bank protect the coast immediately near it, but causes erosion in the down-drift side due to diffraction of waves.

Many rivers in Kerala exhibit a continuous migrating tendency. Such migration influences the beach characteristics in the adjacent areas considerably.

3. Periodical measurement of shore line changes:

Periodical surveys are taken to determine the shore line changes of the coast. The offset measurement of the shore line with respect to Control point and Alignment stones are taken every month and recorded. It provides very important data to understand the shore line fluctuation of the coast.

4. Collection and Study of beach samples

Pre-monsoon (May) and post-monsoon (November), beach samples are collected from specified places for testing grain size distribution and specific gravity since the erosion and accretion of coast depends up on the nature of beach material to a certain extent. Also for natural nourishment materials can be supplemented to the beach and thereby the erosion can be reduced. Beach samples are important variables determining the beach characteristics. Study of beach materials, characteristics and sources is essential for the evolution of a long term shore protection plan.

5. Report on Coastal damages and Taking photographs

The details of damages at various places in the coastal beaches have been collected from time to time and photographs are taken to understand the details of erosion, coastal damages occurred during monsoon and drastic changes in the shore line.

6. Taking cross section profile of the beach

Cross section profiles taken using leveling instrument and leveling staff (Taken up to wading depth of waters)

7. Alignment fixation of sea walls:

The Joint Director inspected the sites for fixing alignment of sea wall (construction and reformation) with the concerned Irrigation officials, Deputy Director and Asst.Director of the Coastal Sub Division & Sections concerned, and approved the alignments of sea walls along Kerala Coast, considering the last 5 year shore line measurements and the alignment of the sea.

Alignment approval has been given to the following works by the Joint Director, Coastal Engineering Field studies, Thrissur during the year 2020

Sl.No	Name of sub Division	Alignment approved during 2020	Essentiality certificate issued during 2020
1	CE SubDivision, Kozhikode	Nil	Nil
2	Ernakulam CE SubDivision	Nil	Nil
3	Kollam CE SubDivision	Nil	Nil

VI. PERFORMANCE OF THE DIVISION IN THE YEAR -2020

With in the limitations of availability of funds, availability of field staff and modern instrument, this division has taken up all the possible studies in the year 2020. The performance can be summarized as follows.

Types of works

1. Topographic survey conducted for Determining beach profiles : Nil
2. Periodical measurement of shoreline changes : 3508.268 Km
3. Simultaneous observations : 177 Set

4. Soil sample collected : 58Set.

5. Cross section profiles : Nil

6. Levels connected : Nil

7. C.P Stones planted : Nil

8. Alignment stones planted : Nil

9. Kilometre stones planted : Nil

10. Bench mark stones plant : Nil

11. Alignment fixed by Joint Director : 1No

12. Details of damages at various places in the Coastal beaches collected : 43 Nos

13. Mud bank study : Nil

Sub Division-wise Coastal studies performance are as follows

1. Topographic survey conducted

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

2. Periodical measurement of shoreline changes

Kollam sub Division	:	1428.00 Km
Ernakulam Sub Division	:	807.268 Km
Kozhikode Sub Division	:	1273 Km

3. Simultaneous observations

Kollam sub Division	:	65 Set.
Ernakulam Sub Division	:	56 Set
Kozhikode Sub Division	:	56 Nos

4. Taking photograph

Kollam Sub Division	:	21Nos

Ernakulam Sub Division	:	7 Nos
Kozhikode Sub Division	:	15 Nos.

5. Soil sample collected

Kollam sub Division	:	20 Set
Ernakulam Sub Division	:	24 Set
Kozhikode Sub Division	:	14 Set

6. Cross section profiles

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

7. Levels connected

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

8. C.P Stones planted

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

9. Alignment stones planted

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

10.Kilometer stones planted

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

11.Bench mark stones planted

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

12.Guard stones planted

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

13. Details of damages at various places in the

Coastal beaches collected

Kollam sub Division	:	Nos.
Ernakulam Sub Division	:	Nos.
Kozhikode Sub Division	:	Nos.

14.Study of Mudbank

Kollam sub Division	:	Nil
Ernakulam Sub Division	:	Nil
Kozhikode Sub Division	:	Nil

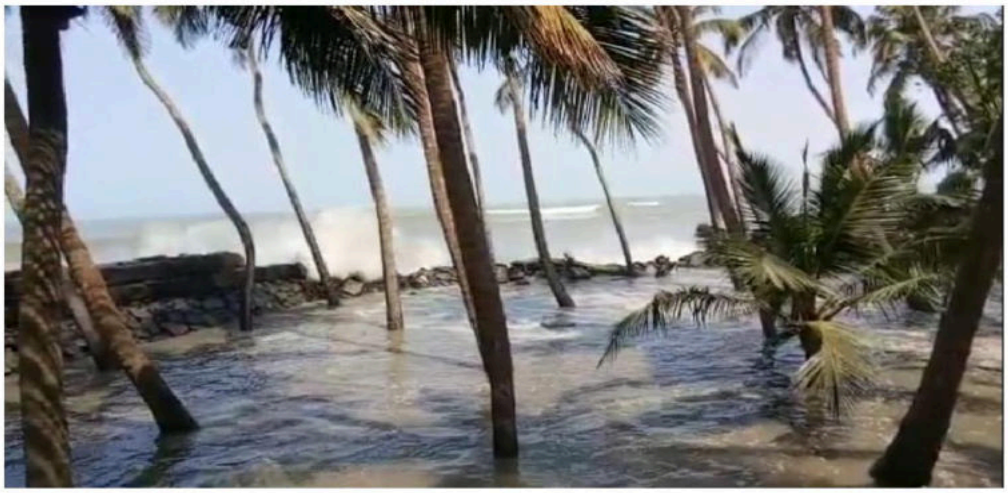
The coastal data of Periodical measurements which backs to 1990 has been digitized and the digitization of available data of sled survey.

Coastal Damages under Kozhikode sub division

1. CES SECTION PARAPPANANGADI (MALAPPURAM DISTRICT)

CP 1704 CHAPPAPADI

CP 1724 ARIYALLUR BEACH



CP 1698 : PUTHANKADAPPURAM

CP 1713 ALUNGAL BEACH

2. CES SECTION KOZHIKODE (KOZHIKODE DISTRICT)

BUTT ROAD BEACH CP 1846

KANNAN KADAVU CP 1893

PARAKKAL THAZHA CP 1918

THOOVAPPARA CP 1916

3. CES SECTION THALASSERY (KANNUR DISTRICT)

KAKKADANCHAL CP 2391

NEEROZHUKKUCHAL CP 2394

MATTOOL CP 2387

4. CES SECTION THALASSERY (KASARGOD DISTRICT)

KAPPIL BEACH CP 2685

KASABA CP 2733

THAIKADAPPURAM CP 2562

THAIKADAPPURAM CP 2566

Damages under Kollam SubDivision

A.Coastal Engineering Section Thiruvananthapuram

Reach 1- Kollamkodu to Panathura(CP No.0000 to 0070)

Damages at Kollamcode near CP 0000

Kollamkodu at CP NO.0000 is the starting point. The area between CP NO.0000 to CP NO. 0008 is protected by sea wall. The above area is thickly populated and is situated very near to the sea wall. Many numbers of Groynes are now under construction of Tamil nadu Government from last week of November 2019near the South of CP.0000 at Kollamkode. The construction of Groynes are seriously affected the north side of this Groynes, that is CP.0000 to 0008.Contionous sea attack is occurred in this region due to the after effect of this Groynes construction. Many damages takes place such as about 5 nos of Houses are damaged and one net winding centre is fully damaged and collapsed. Moreover, the existing sea wall between CP 0000 to CP 0008 is fully damaged and in collapsed condition. Due to the continous sea attck without season, this coastal region is now changed as one of the vulnerable reach. The Poovarpozhi is situated in between CP No.0010 and 0011. The Adimalathurapozhi is situated near to CP No.0044. CP No.0011 to 0044 is having good beach maintained in all the seasons. New Vizhinjamharbor&Kovalam tourist place belong to this reach. CP No. 0057 to

0070(Panathura) is protected by sea wall. The sea wall at CP 0057 to 0060(Samudra beach) has been dilapidated and spreaded due to severe sea attack and overtopping and the remaining portion of sea wall maintained in good condition. Two numbers of groins situated between CP 0069 &0070.

Damaged sea wall at Kollamkode

Damaged seawall atSamudra beach

Reach 2- Panathura to Thumba (CP No.0070 to 0137)

This reach includes the vulnerableareas such as Poonthura, Beemapally, Valiathura and Sankhummugham.

At Poonthura, (CP No.0080 to 0085), Beemapally(0085 to 0092),Valiathura (0092 to 0101) and Sankhumugham(0101 to 0107) ,the entire sea wall is in dilapidated condition due to severe sea wave attack. The above area is thickly populated and in monsoon seasons, the sea waves attack to nearby houses and cause damages especially in Valiyathura area. Valiyathura bridge is situated in between CP No.0094 and 0095 at Valiyathura. 15 nosof groynes has constructed at Beemapally area(Between CP 0085 and 0092). The famous Sangumugam beach was fully washed due to the sea attack including the approach road and the beach footpath. The construction work for protecting the coast and regain the beach in this area is going on.The CP No.0112 ,0114 & 0116 are simultaneous observation points of this office. The Velipozhi is situated in between CP No.0127 and 0128. The CP No.0128 to 0135 is protected by sea wall.

Damaged sea wall at Poonthura

Damaged sea wall at Beemapally

Damaged sea wall at Valiyathura

Maintenance work going on at Sangumukham

Reach 3- Thumba to Perumathura (CP No 0137 to 0211).

Beach at 0210(Near Perumathura Breakwater)

Since the distance of CP between 137 to 150(about 2.6 km) are under the control of ISRO and has been declared as Restricted area, the details of coast of this area is unknown. The area under this reach is very calm and maintains good beach in all the seasons. Between CP No 0210 & 0211, the harbor engineering department has constructed the breakwater at Perumathura. Hence, very large shore was created between CP No 0195 to 0211.

Reach 4- Perumathura to Paravoorpozhi (0211 to 0288)

The harbour engineering department has constructed breakwater for fishing harbor and also constructed a groyne between CP No.0211 and 0212. Another most vulnerable areas such as Poothura and Anjuthengu are comes under this reach. The coastal area between CP 0211 to CP 223 is protected by sea wall. But the sea wall between 0211 to 0215 is partially damaged and between 0215 to 0223 is heavily damaged and treated as most vulnurable reach. This portion occures heavy sea attack and also have thick populated area. Hence special attention has to be given to this area and also to be taken the advanced coastal protection methods. The CP stones have not been planted in between CP No 0259 to 0260 (approx 8.4 km) at Varkala. The Varkala cliff, a beautiful place, is slowly disappearing due to severe sea attacks. The above places are in cliffs and some protection work is needed since some times the soil erosion has been occurred in the cliff area during the heavy rainy season and due to the heavy sea attack

Hence the portion of cliff is also treated as vulnerable. The portion between CP 0262 to 0267 at Edava, the sea wall is fully damaged and in collapsed condition and this location is also treated as vulnerable.

Damaged sea wall at Poothura

Damaged houses at Anjuthengu

Damaged and collapsed sea wall at Edava

Coastal Engineering Section Kollam

Reach No. 1

This reach is from Paravoor Pozhi in the south to Thangasseri having control points numbering from CP 0288 to CP 0340.Thangasseri off shore fishing harbour is coming in this reach In . between CP from0288to 0 309 ,17numbers of groynes were completed and 5numbers of Groynes are under construction. The works under the control of Major Irrigation Division,which are.in progress

.Reach No. 2

This reach is from Thangasseri to Karithura, having control points numbering from CP 0340 to .0394Shakthikulangara fishing harbour, Neendakara fishing Harbour, Neendakara bridge and Neendakara Azhi are located in this reach. 5 numbers of groynes are constructed along this .reach

Reach No. 3

.This reach is from Karithura to Panikkarukadavu having control points from CP 0394 to 0442 IRE Guest house, Kovilthottam Light house, I R E, KMML factories and their mining areas, Kattilmekkathi templeare situated in this reach.In this Reach CP No 415 to CP No. 428 were .missing due to mining 6 nos Groynes are under construction.

.Reach No. 4

This reach is from Panikarukadavu to Kayamkulam Pozhi and having control points from CP to 0499. Amrithananthamayee Matt, Kayamkulam fishing harbour are situated in this 0442 .reach 22.numbers of groynes are constructed along this reach

Between CP 310 &311 (Eravipuram)

CP 317 Kakkathoppu

CP 319 Kakkathoppu

CP 409 Kovilthottam light House

CP 446 Cheriyazheekkal

CP 448 Cheriyazheekkal

CP 452 Near Cheriyazheekkal Fishing Gap

CP 498 Azheekkal Beach

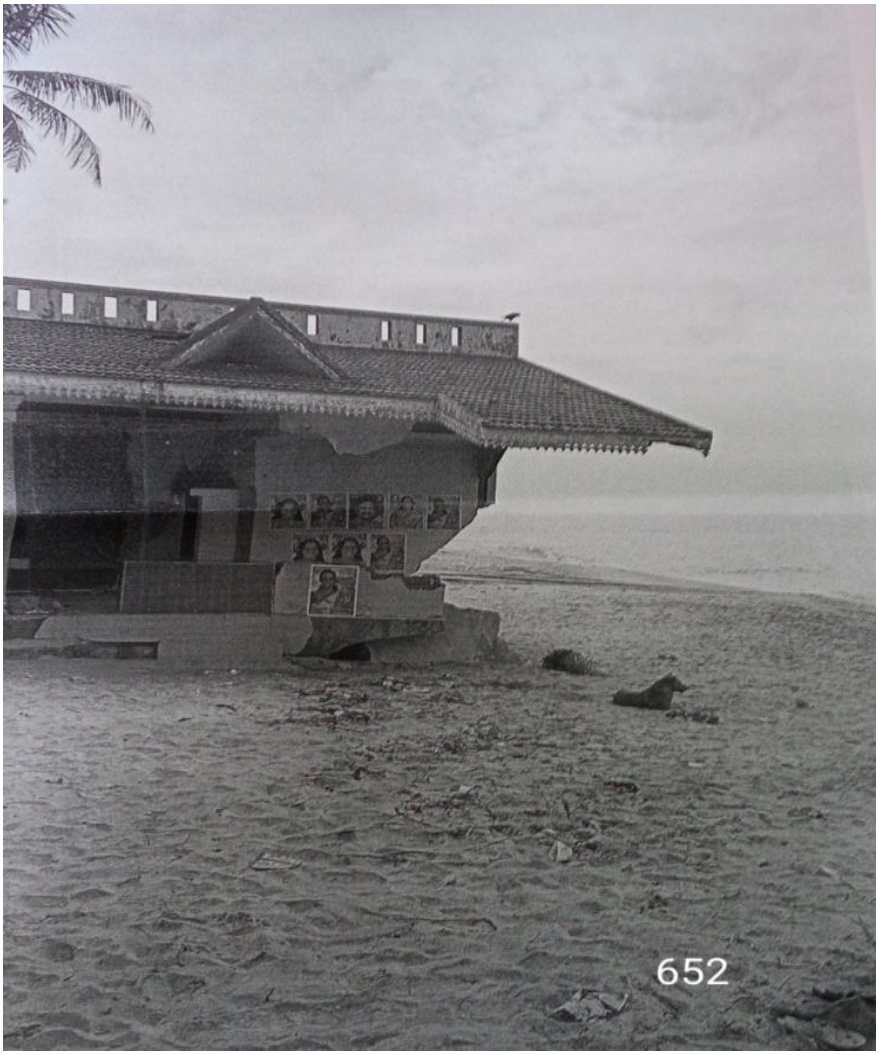
C. Coastal Engineering Section Thottappally

Reach No. 1

This reach is from Kayamkulam Pozhi to Thottappallyhaving control pointsnumbering from CP 0500 to CP 0604. CP No. 511, 520,522, 545 , 564&589and Alignment stones AS .AS 545 are seen missed,522

.Reach No. 2

This reach is from Thottappally to AlapuzhaPierhaving control points numbering from , CP 0605 to 0710and 810(711).Thottappally pozhi starts after CP 604 for about a length of 471 M towards North. During monsoon this pozhi is cut opened and the water head up at the kayal side of spillway in Thottappally kayal is let into the sea by which the flooding of Kuttanad area at upstream of this spillway could be controlled. CP No. 609, 637, 645, 646, 651, 652, 655, 656, 657, 658, 659, 660, 661, 663, 664, 697 & 702 and AS 656,657,658,659,660,664,674&702 are


652


652

Damages under Ernakulam Sub Division

Details of coastal Damages

Coastal Damages occurred within the jurisdiction, were closely monitored and were reported every week during the monsoon. Details of coastal damages are reported once every month during off-monsoon months. During thefinancial year 2020-21 severe coastal damages and heavy coastal beach erosions were reported from Thanky(Ottamassery: 921-927).NearThanky more than 5 coconut trees fell down and beach eroded for a width of more than 25m.Besides R/W slided down near CP.926 and beach lost from CP.924 to CP.927.Alsomore than 80 small “kaattadi” trees were lost from CP.891 to CP.892 as a result of severe coastal erosion.

Fig 2: Overtopping and Under scouring witnessed at the Edavanakkad region during monsoon

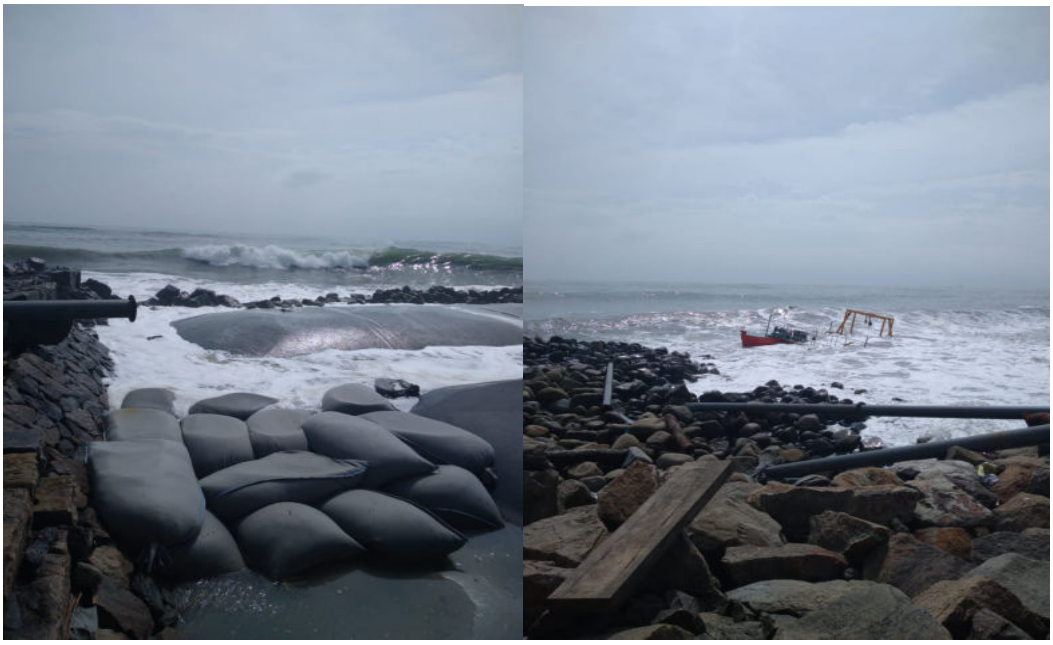


Fig 3: Coastal Damages occurred at the Geotube installation site near Vellankanny Church during monsoon

VII. DETAILS OF DIFFERENT STONES

Sl. No.	Description	Thiruvananthapuram	Kollam	Thottapally	Cherthala	Ernakulam	Chavakkad	Parappanangadi	Kozhikode	Thalassery	Total
1.	C. P. Stones	288	212	211	166	212	362	189	372	524	2536
2.	Alignment Stones	288	212	211	166	212	362	189	372	524	2536

3.	Guard Stones	48	36	32	28	36	52	28	64	84	408
4.	K. M. Stones	79	42	42	30	43	69	39	76	105	525
5.	B. M. Stones	12	9	8	7	9	13	7	16	21	102

VIII. LIST OF IMPORTANT STRUCTURES

Coastal Engineering Cherthala Section

Sl.No.	Name of important structures	Place	Between CP
1	Light house	Alappuzha	CP810
2	Bishop house	Alappuzha	CP811-812
3	Recreation club	Alappuzha	CP810
4	Fish landing centre	Pollethai	CP857-858
5	Fish landing centre	Arthunkal	CP910-911
6	Arthunkal church	Arthunkal	CP904-905
7	Church	Ottamassery	CP926
8	Church	Thankey	CP929-930
9	Light house	Andhakaranazhi	CP951-952
10	Church	South Chellanam	CP975

Coastal Engineering Chavakkad Section

1.	Coastal Police Station at AzhikkodeNear CP. 1188
2	Light House AtAzhikkodeBetween CP .1201 – 1202
3	Beach Park At Snehathiram Near Thalikkulam Between CP. 1334 – 1336
4	Groyene At Chettuva Near CP.No. 1380
5	Groyene at Chettuva (N) Near CP. 1381
6	Light House at Thottappu Near Blangad Between CP. 1406 – 1407
7	A MultyStoryed Lodge Building AtBlangadBetween CP. 1419 –1420
8	Single Storey Building Of Fisheries Department Between CP.1499 -1500 (Damaged)
8	MultyStorey Building Hatchery at Veliancode for Fisheries Between CP. 1510 – 1512
9	BeeviJaram At Puduponnani near CP.1514
10	Light House AtPonnaniBetween CP. 1548 -1549

A. C. E.S Section, Parappanangadi

1.Azhimugham CP 1555
2.Road and Mosque CP 1562
3. MMM HS Koottayi CP 1575
4. Koottayi School CP 1581
5. Kootaiyi Town CP 1585
6. KoottayiBadar Masjid CP 1595
7.Vakkad CP 1604
8. Malayalam Univercity CP 1606
9. Arikkanchira CP 1613
10 Paravanna Beach CP 1617
11. Unniyal Beach CP 1626
12. Puthiyakadappuram South CP 1631
13.Puthiya Kadappuram CP 1640
14. PuthiyaKadappuram North CP 1650
15. Tanur harbor CP 1660,1661,1662,&1663
16. PandaraKadappuram CP 1668
17. PoorapuzhaAzhi CP 1684
18. Parappanangadi CP 1705
19. Chettipadi CP 1711
20. Anangadi Turtle hatchery CP 1724
21.Kadalundy Nagaram CP 1730
22. Kadalundy CP 1743

B. C. E. S Section, Kozhikode

1.	Kadalundi CP 1745	38.	Cheriya-Mangad CP 1930
2.	NechkkattuParamba CP 1750	39.	Koyilandy CP 1935
3.	Kappalangadi CP 1755	40.	ValiyathPalli Beach CP 1940
4.	Anchukudikkal CP 1760	41.	Kollam Beach CP 1945
5.	Thai Kadappuram CP 1765	42.	Parappally Beach CP 1951
6.	Chaliyar CP1770	43.	Manda Mangalam CP 1955
7.	Chaliyar CP1771	44.	UrupunyaKavu Beach CP 1960

8. Beypore Port CP 1772	45. MoodadiBeach CP 1965
9. Savakandyparamba CP 1775	46. MuthayamKadapuram CP 1970
10. Gotheeswaram Beach CP 1780	47. Kunhi-ThayyilPalli CP 1975
11. Kaithavalappu CP 1785	48. Palliparmba ,Kadalur CP 1980
12. Marad S Beach CP 1790	49. Kodikkal South CP 1985
13. Marad N Beach CP 1795	50. Kodikkal CP 1990
14. Payyanakkal Beach CP 1800	51. Kodikkal UP School CP 1995
15. ChamundiValappil CP 1805	52. Kodikkal North CP 2000
16. Kothi Beach CP 1810	53. Thokkodi CP 2005
17. Mukhadar Beach CP 1815	54. Melady Beach CP 2010
18. Kozhikode South Beach CP 1820	55. Bhagavan –Mukku-CP 2020
19. Kozhikode Beach CP 1825	56. Ayanikkad CP 2025
20. Kozhikode North Beach CP 1830	57. Kolavi –Palam Road CP 2030
21. Thoppayil Beach CP 1835	58. KolaviPalam CP 2035
22. KonadBeach CP 1840	59. Iringal CP 2040
23. Butt Road CP 1845	60. Moorad CP2043
24. Puthiyangadi Beach CP 1850	61 .Moorad CP2044
25. Edakkal Beach CP 1855	62. Moorad CP 2045
26. Puthiyappa CP 1860	63. Sandbanks Vadakara CP 2046
27. Puthiyappa Harbour CP 1865	64. Kottakkal CP 2050
28. Narachal Beach CP 1850	65. Vadakara CP 2055
29. Elathur CP 1875	66. Anati-Bhagam CP 2060
30. ElathurAzhi CP 1880	67. Mukachery CP 2065
31. Korappuzha CP1883	68. Kuriyadi CP 2070
32. Korappuzha CP1884	69. ThazhePalli CP 2075
33. Korappuzha CP 1885	70. Muttungal Beach CP 2080
34. Kannankadavu CP 1890	71. MaliyekkalBeach CP2085
35. Munambath Beach CP 1895	72. Karuvachalil CP 2090
32. Kakkachikandi CP 1900	73. MadakkaraBeach CP 2095
33. Kappad Beach CP 1905	74. MukkaliBeach CP 2100
34. Kappad North Beach CP 1910	75. AvikkaraBeach CP 2105
35. Thuvappara CP 1915	76. ErikkalChalil CP 2110
36. ParakkalThazhe CP 1920	77. AzhiyurChungam CP 2115
37. Ezhuku-dikkal CP 1925	78. PoozhithalaMahi CP 2120

A. Coastal Engineering Section, Thiruvananthapuram

CHURCH

Sl. No.	CP Stone b/w	Name
1	0000 & 0001	KollamcodeKochupalli
2	0004& 0005	St.Mathew's Church
3	0005 & 0006	St.Marry"sMagdelence Church
4	0019 & 0020	St.Berthodony Church
C	0024 & 0025	St.Andrews Church
6	0025 & 0026	Church of God
7	0029 & 0030	St. Anthonys Church kochuthura
8	0036 & 0037	
9	0078 & 0079	St.ThomasChuchPoonthura
10	0088 & 0089	St.AssemptionChuchCheriyathura
11	0094 & 0095	St.Antony'sForance Church
12	0110 & 0111	St.Peter's Church
13	0115 & 0116	Vettukadu Church
14	0122 & 0123	St.Joseph Church
15	0128 & 0129	St.Thomas Church Veli
16	0152 & 0153	Pallithura Church
17	0153 & 0154	St.Thomas Aquinas Church
18	0156 & 0157	
19	0160 & 0161	St.Dominic Church
20	0163 & 0164	St.Andrews Church
21	0171& 0172	Puthenthope Church
22	0187 & 0188	St.Joseph's Church
23	0197 & 0198	St.Micheal's Church
24	0220 & 0221	St.Roche's Church
25	0226 & 0227	St.Joseph Church
26	0233 & 0234	St.Antony's Church
27	0234 & 0235	Holy Sprit Church Mampally

TEMPLE

Sl. No.	CP Stone b/w
1	0062 & 0063
2	0063 & 0064
3	0064 & 0065 (2 numbers)
4	0068 & 0069
5	0234 & 0235
6	0238 & 0239
7	0239 & 0240
8	0242 & 0243
9	0282 & 0283
10	0283 & 0284
11	0284 & 0285

MAZJID

Sl. No.	CP Stone b/w
1	0056 & 0057
2	0062 & 0063
3	0084 & 0085
4	0204 & 0205
5	0209 & 0210
6	0253 & 0254
7	0256 & 0257
8	0260 & 0261
9	0274 & 0275 (2 numbers)
10	0281 & 0282
11	0283 & 0284(2 numbers)

KURISADI

Sl. No.	CP Stone b/w
1	0009 & 0010
2	0018 & 0019
3	0027 & 0028
4	0036 & 0037
5	0038 & 0039
6	0042 & 0043
7	0093 & 0094
8	0123 & 0124
9	0157 & 0158
10	0163 & 0164
11	0210 & 0211
12	0213 & 0214
13	0218 & 0219
14	0228 & 0229

FISH LANDING SHED

Sl. No.	CP Stone b/w
1	0000 & 0001
2	0002 & 0003
3	0004 & 0005
4	0008 & 0009(2 no)
5	0018 & 0019
6	0019 & 0020
7	0020 & 0021
8	0024 & 0025
9	0025 & 0026
10	0026 & 0027
11	0027 & 0028 (2 no)
12	0028 & 0029
13	0030 & 0031 (2 no)

14	0031 & 0032 (2 no)
15	0032 & 0033 (2 no)
16	0033 & 0034 (2 no)
17	0034 & 0035 (3 no)
18	0035 & 0036 (2 no)
19	0037 & 0038
20	0039 & 0040
21	0040 & 0041 (2 no)
22	0041 & 0042 (3 no)
23	0042 & 0043
24	0043 & 0044 (4 no)
25	0183 & 0184
26	0189 & 0190 (2 no)
27	0193 & 0194
28	0194 & 0195 (2 no)
29	0223 & 0224
30	0253 & 0254
31	0256 & 0257
32	0257 & 0258

ANGANAVADI

Sl. No.	**CP Stone b/w**
1	0008 & 0009
2	0035 & 0036
3	0043 & 0044
4	0130 & 0131
5	0281 & 0282

OTHERS

Sl. No.	CP Stone b/w	Name
1	0000 & 0001	Rajiv Gandhi centre for Aqua culture
2	0002 & 0003	V.R food enterprises Pvt. Ltd
3	0011 & 0012	Mini park
4	0012 & 0013	Coastal Police station
5	0020 & 0021	Foot ball ground
6	0029 & 0030	Foot ball ground
7	0031 & 0032	Foot ball ground
8	0036 & 0037	Matsyabhavan
9	0036 & 0037	St. Xavior's library & sports club
10	0037 & 0038	Kala Sagar Arts & sports club
11	0039 & 0040	Pulluvila fish market
12	0041 & 0042	Mini park
13	0044 &0055	Somatheerambeach,Vizhinjamport,Vizhinjam light house,Kovalambeach,Leela resort.
14	0055 & 0056	Kovalam beach
15	0056 & 0057	KTDC Resrot
16	0057 & 0059	Bait Resort
17	0057	Samudra beach
18	0062 & 0063	Coir factory
19	0094 & 0095	Valiyathura bridge
20	0103 & 0107	Sangumugam beach
21	0103 & 0107	Airport
22	0105 & 0106	Art museum
23	0106 & 0107	Sangumugam palace
24	0107 & 0108	Holy cross hospital &Pratheeksha De addiction centre
25	0118 & 0120	Titanium factory
26	0125 & 0127	VeliTouist villa
27	0131 & 0132	Primary health centre
28	0137 & 0149	ISRO (VSSC compound)
29	0152 & 0153	Pallithura higher secondary school

30	0157 & 0158	L P School
31	0161 & 0162	St. Xavior'scicket stadium
32	0162 & 0163	St. Xavior's college
33	0171 & 0172	Stella Marry's convent
34	0178 & 0179	Sea boy fisheries Pvt.Ltd.
35	0210 & 0211	Perumathura break water & bridge
36	0211 & 0212	Fishing harbor,Coastal police station,Harbour Engineering sub division.
37	0223 & 0224	Anjuthengu fort, Anjuthengu light house, community health centre,Sacret heat convent.
38	0225 & 0226	School
39	0226 & 0227	Foot ball ground
40	0227 & 0228	AnjuthenguPanchayath office
41	0228 & 0229	St. Thomas library
42	0229 & 0230	Anjuthengu service co-operative Bank
43	0233 & 0234	St.Antony's L P School
44	0238 & 0239	KayikkaraAsanSmarakam&Asan memorial L P School
45	0240 & 0241	Community health centre
46	0250 & 0251	Arivalam Tourist Park
47	0259 & 0260	Varkkala beach & cliff
48	0268 & 0270	Kappil beach
49	0273 & 0274	Mini park
50	0281 & 0282	Library
51	0287 & 0288	Mini park

B. Coastal Engineering Section Kollam.

Sl. No.		
1	PWD Kadavu at Mukkam	CP 0292
2	Temple at Thanni	CP 0302
3	Church at Thanni	CP 0303
4	Church near Eravipuram	CP 0315
5	Pier of Port Department at Garfill Nagar	CP 0317

6	Gandhi Park at Kochupilamoodu	CP 0331
7	Church at Pallithottam	CP 0336
8	Kollam Port	CP 0336
9	Church at Vadi (MoothakkaraPalli)	CP0341
10	Fishing Harbour at Thankasseri	CP 0343
11	Light House at Thankasseri	CP0347
12	Temple at Thirumullavaram	CP 0357
13	Church at Thirumullavaram	CP 0359
14	Church at Sakthikulangara	CP 0376
15	GTS Benchmark at Neendakara	CP 0381
16	Fishing Harbour Port (Breakwater and Bridge) at Neendakara	CP 0381
17	P.B.M and M.C Health Centre at Neendakara	CP 0393
18	St. Francis Church at Karithura	CP 0402
19	Light House and IRE Company at Karithura	CP 0408
20	KMML Ltd at Kovilthottam	CP 0409
21	Church at Kovilthottam	CP 0414
22	St. Francis Church at Karithura	CP 0415
23	Temple at Kattilkadavu	CP 0421
24	Parayakadavu Church	CP 0437
25	Parayakadavu Bridge	CP 0439
26	Temple at Cheriyazheekkal	CP 0446
27	Cheriyazheekkal Football Association Club	CP 0452
28	Govt. Homoe Dispensary at Kuzhithura	CP 0463
29	SreeAmruthanandamayee Matt and Ayurveda Treatment Centre	CP0470
30	Pachimeswaram Temple	CP 0477
31	Govt. LP School at Srayikadu	CP 0490
32	Fishing Harbour Port (Breakwater near KayamkulamPozhi)	CP 0499
33	PWD Kadavu at Mukkam	CP 0292
34	Temple at Thanni	CP 0302
35	Church at Thanni	CP 0303
36	Church near Eravipuram	CP 0315

37	Pier of Port Department at Garfill Nagar	CP 0317
38	Gandhi Park at Kochupilamoodu	CP 0331
39	Church at Pallithottam	CP 0336
40	Kollam Port	CP 0336
41	Church at Vadi (MoothakkaraPalli)	CP 0341
42	Fishing Harbour at Thankasseri	CP 0343
43	Light House at Thankasseri	CP0347
44	Temple at Thirumullavaram	CP 0357
45	Church at Thirumullavaram	CP 0359
46	Church at Sakthikulangara	CP 0376
47	GTS Benchmark at Neendakara	CP 0381
48	Fishing Harbour Port (Breakwater and Bridge) at Neendakara	CP 0381
49	P.B.M and M.C Health Centre at Neendakara	CP 0393
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51	Light House and IRE Company at Karithura	CP 0408
52	KMML Ltd at Kovilthottam	CP 0409
53	Church at Kovilthottam	CP 0414
54	St. Francis Church at Karithura	CP 0415
55	Temple at Kattilkadavu	CP 0421
56	Parayakadavu Church	CP 0437
57	Parayakadavu Bridge	CP 0439
58	Temple at Cheriyazheekkal	CP 0446
59	Cheriyazheekkal Football Association Club	CP 0452
60	Govt. Homoe Dispensary at Kuzhithura	CP 0463
61	SreeAmruthanandamayee Matt and Ayurveda Treatment Centre	CP0470
62	Pachimeswaram Temple	CP 0477
63	Govt. LP School at Srayikadu	CP 0490
64	Fishing Harbour Port (Breakwater near KayamkulamPozhi)	CP 0499

C. Coastal Engineering SectionThottappally

1.	Port building at Alappuzha	CP 710
2.	W&C Hospital	CP 708
3.	Village office building	CP 706
4.	ESI hospital	CP 703
5.	SSV LP School Vadakkal	CP 697
6.	Catholic church Paravoor	CP 687
7.	Catholic church Punnapra	CP 680
8.	Industrial unit Khadi and Village Industries-Punnapra	CP 676
9.	Auction hall of Harbour Engineering - Valanjavazhi	CP 656
10.	Railway line at Kakkazham	CP 651
11.	Malsyafed building at Ambalappuzha	CP 646
12.	LP School at Anandeswaram	CP 619
13.	ThottappallyHarbour	CP 609
14.	Health Centre at Thottappally	CP 609
15.	Coastal Engineering Section at Thottappally	CP 604
16.	Spillway at Thottappally	CP 605
17.	Mosque and Church at Chelakkad	CP 578
18.	Thrikkunnappuzha Temple	CP 573
19.	Mosque at Pathiyankara	CP 563
20.	Mangalam Water Tank	CP 557
21.	Corporation Bank, Arattupuzha	CP 547
22.	Nallanickkal Church	CP 535
23.	Break water at Valiyazheekkal	CP 500

IX. TOURISM DEVELOPMENT PROJECTS UNDER THIS SUBDIVISION

Sl No	Particulars	District	Nearby Town/ City	Old CP No	New CP No	Contro-lling Authority	Status (Existing or to be develope)	Remarks
1	Purathoor Azhimugham Beach	Malappuram	Padinjarekkara	3365	1555	Tourism Dept	Exising Tourism project	River Bharathapuzha& TirurPuzha joins Arabian sea. Jankar service available to Ponnani
2	Poorapuzha Azhimugham Beach	Malappuram	Thanoor	3116	1682	Tourism Dept	Tourism to be developed	River Poorapuzha joins Arabian sea.
3	Kadalundi Beach	Malappuram & Kozhikode	Kadalundi	2997	1742	Tourism Dept	Exising Tourism project	River Kadalundi joins Arabian sea. This is a bird sanctuary with more than 60 species of migratory birds
4	Beypore Beach	Kozhikode	Kozhikode	2948	1769	Harbour Engineer-ing &Toursim Dept	Exising Tourism project	walk way (Pulimuttu) constructed into the sea for 1 km. Has traditional Ship Building centre, famous for BeyporeUru . & Dolphin view point
	Kozhikode Beach	Kozhikode	Kozhikode	2840	1826	Tourism Dept	Exising Tourism project	Famous for sunset view. Has light house and two damaged iron screw pile pier platform, ,run into the sea for 120m . Adjacent to beach is Lions Park and marine water aquarium

6	Korappuzha Estuary	Kozhikode	Kozhikode	2727	1882		Tourism to be developed	Korapuzha backwaters joins sea. Offers a splendid and scenic view of natural beauty
7	Kappad Beach	Kozhikode	Kozhikode	2695	1910	Tourism Dept	Exising Tourism project	16 km from Kozhikode towards north. Portuguese explorer Vasco-Da Gama landed here in 1498. This is a rock studded beach
8	Velliyamkallu	Kozhikode	Payyoli	2483	2025		Tourism to be developed	A massive rock called Velliamkallu associated with KunhaliMarakkar situated 13km off sea cost (into the sea). This was the hiding ground for Marakkar to attack the invading Portuguese
9	Kolavipalam beach	Kozhikode	Iringal	2451	2041	Forest Dept	Tourism to be developed	Also called turtle beach. Every year olive ridley turtle comes from Pacific ocean to lay the eggs here. Turtle hatchery centre
10	Muzhippilangad Drive- in Beach	Kannur	Thalassery	1057/62	2224	Tourism Dept	Exising Tourism project	Largest drive in beach in Asia.15 km south of the town. Has beach festival

11	Dharmadam Island	Kannur	Dharmadam		2208	Private	Tourism to be developed	The island has backwaters covered with coconut groves and dense bushes .During low tide one can walk from the Muzhippi-langad beach
12	Kizhunna Ezhara beach	Kannur	Kizhunna		2245		Tourism to be developed	11 km form kannur , Good tourist spot to spend vacations and relish beautiful surroundings
13	St Angelo's Fort	Kannur	Kannur cantonment		2282	Archeological survey	Exising Tourism project	Built in 1505 by Don Francisco de Almeida, the first portuguese viceroy of India. important historical monument and beautiful tourist spot
14	Payyambalam Beach	Kannur	Kannur	1046 to 1031	2302 to 2309		Tourism to be developed	Has approx. 4 km of shore line, a flat laterite cliff and beautifully landscaped sculpture of mother and child .Mappila bay, the harbor, has boat rides which offers spectacular view
15	Meenkunnu beach	Kannur	Meenkunnu		2339		Tourism to be developed	located in Azhikode village. Got vast stretch of golden sand and coconut trees. Famous for fish (meen -fish kunnu -small hill)

16	Ezhimala beach	Kannur	Ezhimala		2430	Naval Academy	Tourism to be developed	about 55 km from Kannur. Between Payannurand Payangadi route . Serene environment and good for peace loving visitors
17	Bekal Fort	Kasaragode	Bekal		2657	Archeological survey	Exising Tourism project	Fort spread over 40 acres has massive walls of 12 m height runs into the sea with fine bay towards south. Voids in walls were used for placing cannons

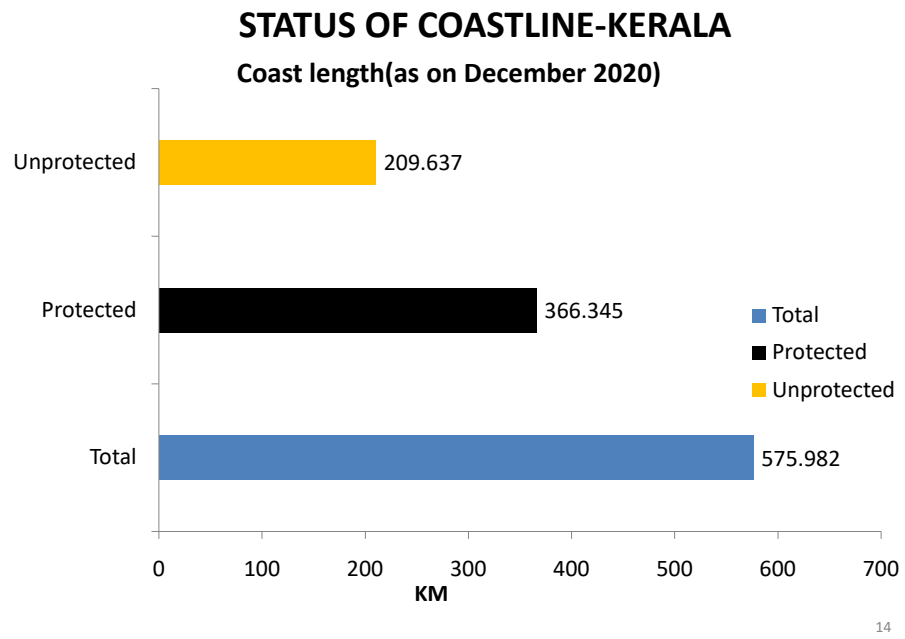
XI. DETAILS OF WORKS

1. PLANTING OF NEW CONTROLPOINT STONES, ALIGNMENT STONES, KILOMETER STONES AND BENCH MARK STONES ALONG THE SEA COAST

Control Point Stones and Alignment Stones are the most important reference points for all the collection of data and for carrying out the protection works. In most area, levels are also established on those stones. The regions are referred by the Control Point stones. The references in certain reaches are made on BLS ie Base Line Stones. Shore line measurements, fixing of levels, topographic survey and similar important factors are based on these stones. Similarly, K.M. Stones are established to ear mark each region. BM stones are planted along the shore as permanent level marks. The levels on Control Point Stones are further checked on the basis of the B.M. stones. Many of the Control point stones and alignment stones are seen missing and damaged due to various reasons.

2. INVESTIGATION WORKS

Field studies and collection of data on coastal erosion have been conducted on all Sections under this Division.



Coastal Status during the year 2020 is under preparation

DETAILS OF CP & ALIGNMENT STONES UNDER KOLLAM SUB DIVISION

REGION	CONTROL POINTS			ALIGNMENT STONES			REMARKS
	EXISTING	LOST	TOTAL	EXISTING	LOST	TOTAL	
Thiruvananthapuram	221	67	288	244	44	288	
Kollam	171	41	212	175	37	212	
Thottapally	192	20	212	202	10	212	

DETAILS OF CP & ALIGNMENT STONES UNDER KOZHIKODE SUB DIVISION

REGION	CONTROL POINTS			ALIGNMENT STONES			REMARKS
	EXISTING	LOST	TOTAL	EXISTING	LOST	TOTAL	
Parappanangadi	167	22	189	178	11	189	
Kozhikode	337	35	372	337	35	372	
Thalassery	462	250	712	467	245	712	

DETAILS OF CP & ALIGNMENT STONES UNDER ERNAKULAM SUB DIVISION

REGION	CONTROL POINTS			ALIGNMENT STONES			REMARKS
	EXISTING	LOST	TOTAL	EXISTING	LOST	TOTAL	
Cherthala	154	12	166	157	9	166	
Ernakulam	177	35	212	197	15	212	
Chavakkad	292	71	362	309	53	362	

XII. BOTTLENECK FACING

Coastal Engineering Field Studies is the one and only institution entrusted with the collection of coastal field data and field studies connected with the erosion of the entire sea coast of Kerala, the functions assigned to which are vital & essential. The Chairman, Coastal Protection and Development Advisory Committee (CPDAC) had advised the Chief Secretaries of all Coastal States to create a separate department for dealing with the Coastal Engineering works of the respective states vide Lr.No:4(5)/2000 CED dated 9.6.2000 to organize a coordinated program of collection, compilation, evaluation and publication of coastal data. Hence this wing is to be made permanent.

The staff strength of the wing is insufficient even for the routine performance. The CEFS Division is not having the posts of PA/TA., DA., The only two posts of clerks were declared as supernumerary.

Coastal Engineering Section, Thalassery coming under the control of Deputy Director, Kozhikode Sub division extends from Mahe to Manjesweram with a length of 148 km. At present only 90 km is under study reach. No study is being conducted in the remaining 58 km (excluding Naval Academy and Bakel fort). Assistant Director of each section is collecting field data and doing survey works for an average length of about 60Km with the assistance of 2 Draftsman/Overseer.

As far as Kerala Coast is concerned, the sea is turbulent, especially during monsoon and coastal erosion is a common phenomena along the sea coast for which continuous field study in all aspects is essential. But it is regretted to state that the budget provision, which was around 100 lakhs during the nineteen nineties, has got reduced considerably in the recent years to 5 lakhs bringing the survey works to almost stand still. At present the wing is collecting data on shoreline measurements, simultaneous observation, preparation of coastal damage reports with photographs and collecting soil samples only. Training programs on Coastal Engineering and

allied subjects to update and train the technical personnel of the department regarding the latest development in this field is essential. No training has been conducted under this wing due to lack of funds. The study wing now follows old conventional method of observations like visual observations, tape measurements etc. High derivative modern instruments are now available in this field.

25 Kms of stones are not planted on the Northern Side of Kerala ie, in North of Kasargode District. So no details of sea have been taken in that area. That is to be rectified immediately.

Also some stones are missing in the rest of the area, and it should be replanted immediately. Maintenance of the stones are not done till date. It is also to be done urgently.

As per the direction of Chief Engineer, I&A, TVM, the Jeep under CEFS Division has been transferred to MI Division Thrissur, the non-availability of vehicle affects the inspection of the sites.

XIII. SUGGESTIONS/RECOMMENDATIONS

Sufficient fund has to be made available in time for conducting the entire study of coastal erosion. The coastal length coming under the jurisdiction of Thalassery section is 148km, and for studying the entire reach an additional section is to be formed.

The location of new International Port at Vizhinjam is between CP45 to55 and the construction work is in progress.The construction authority has formed artificial shore and road by using materials drilled from the sea and breakwater construction is in progress.This area needs some specific studies for shoreline charecteristics before and after the construction of VizhinjamPort..Here due to terrain of land CP Stones have not been planted.

Some of the CP stones have been swallowed by the sea waves and some got destroyed by the weathering actions.As the new CP stones have not been planted for the continuous stretch, that profile could not be adopted for aligning sea walls etc. Hence CP stone planting and its timely maintenance is essential.

For getting the sufficient staff strength and for their maximum efficiency this wing is to be made permanent, considering the importance of this Division. Sufficient fund should be

allocated for the training of technical staff and for procuring the modern scientific equipments for the collection of coastal data.

XIV. CONCLUSION

Specific studies are necessary for studying the behaviour of shore protection works like seawall, groynes and break water.The study has to be conducted for analyzing the shore particulars before and after the construction of the groyne field. The construction of new international Vizhinjam harbour was started in between CP No. 0044 to 0055 and the construction work is in progress. This area needs some specific studies.

The main constrains is the lack of modern equipments and the shortage of fund for the study work of Coastal Engineering Department. It is also required to study the possibility of artificial nourishment and other protection works like geotube construction. The existing coastal protection works are being watched. The general behaviour including its failure if any is studied for modification.

Since the study of the coastal characteristics is the base for all constructions of anti-sea erosion structures and also for the other construction work, the data collection could not be stopped. If it is stopped the entire data collected till date will be futile. Now many numbers of CP &AS stones are missing /damaged and hence these are to be replanted and also to be reestablished the Reduced Level (RL) and their locations (Latitude & Longitude).

The studies and data collection on coastal erosion are being continued during 2019-2020 possible erosion causes are wave action, tidal action, storm surge and manmade causes. Latitude and Longitude of all Control Point Stones and Alignment Stones and Seawall are taken for Coastal Atlas Preparation. Special studies if any required shall be done as directed. Hence Coastal Engineering and Field studies take inevitable part for the developing of coastal region of Kerala.

I. QUALITY CONTROL DIVISION, THRISSUR

I.1 Introduction

The quality control wing under Irrigation Department was formed in 1995 as per G.O.(MS)No. 87/1995/Irrgn dated 13.06.1995 to ensure quality of the works executed by Irrigation Department (WRD)There are two Division offices under the wing one at Thrissur with jurisdiction extending from Ernakulam to Kasargod (8 districts) and the other at Kottarakkara with jurisdiction extending from Thiruvananthapuram to Kottayam (6 districts).

Quality Control Division, Thrissur.

Quality Control Division, Thrissur was formed with effect from 15-11-2000 for Checking and maintaining the quality of works under taken by the Irrigation Department, after abolishing KIP (MCS Division) 2 at Charumoodu as per Govt. order (RE) No.891/2000/IRD Dated: 12-07-2000. Up to 04-03-2010, this division was functioning under the control of Superintending Engineer, I&P Circle, Thrissur. From 05-03-2010 onwards this division is functioning under the direct control of the Director, F& AR,KERI Peechi as per the Govt. Order No. 10 /2010 Dated: 1-2-2010.

The Quality Control Division, Thrissur comprises of a division office at Thrissur and 5 Sub Division Offices at Muvattupuzha, Thrissur, Palakkad, Kozhikode and Kannur. Monitoring of works executed by the Irrigation Department in Ernakulam, Thrissur, Palakkad, Malappuram, Kozhikode, Wayanad, Kannur and Kasargod are carried out by Quality Control Division, Thrissur.

The main objects of the formation of 5 Subdivisions under the Quality control Division, Thrissur and its functions.

- **Muvattupuzha** Sub Division was formed on deploying the Chimoni Dam Project in Thrissur District on 1-1-1992 as per GO(Rt) 717/91 Dt. 07-10-1991. The main object of this sub division is to check the quality of works in two divisions of MuvattupuzhaVallley Irrigation Project and two divisions of Idamalayar Irrigation Project. There are three sections at Muvattupuzha, Koothattukulam, and Angamaly for this purpose. The quality of works of

Muvattupuzha division of Muvattupuzha Valley Irrigation project is checked by the Muvattupuzha Quality Control Section. The quality works under taken by the Piravam Division of Muvattupuzha Valley Project is done by the Koothattukulam Quality Control Section. Quality Control Section Angamaly is checking the quality of works undertaken by the Angamaly Division and Chalakudy Division of Idamalayar Irrigation Project.

- **Thrissur** Sub Division and its two sections at Thrissur and Ernakulam are envisaged to check the quality of works under taken by the various Execution divisions and subdivisions of the irrigation department in Thrissur and Ernakulam Districts. 2nd tier quality control activities of all 9 Nos major and minor Irrigation divisions, except works under Muvattuuzha, Idamalayar and Chalakkudy Irrigation projects, are coming under this office.
- **Palakkad** Sub Division and its two sections at Palakkad and Malapuram are intended to check the quality of works under taken by the various 9 Divisions and sub divisions of the Irrigation Department in Palakkad and Malapuram Districts.

- **Kozhikode** Sub Division and its sections namely Kozhikode and Kalppetta are intended to check the quality of works under taken by the various Divisions and sub divisions of the Irrigation Department in Kozhikode and Wyanad Districts.

- **Kannur** sub division and its two sections at Kannur and Kasargod are intended to check the quality of works undertaken by the various Divisions and subdivisions of Irrigation department in Kannur and Kasargod districts.

Division office at Thrissur

Apart from compiling monthly and quarterly inspection reports received from the five subdivisions, comparing test results with IS and other approved standards, recommending necessary suggestion if any are the duties of Division office. Random inspections of major and important woks are to be done by the Division office.

Duties of the Division office also include effective coordination and supervision of these sub divisions which have such a vast area of operation in the field of quality maintenance of works under Irrigation Department and smooth functioning of the day to day activities such as

personnel and official needs of the staff of the sub divisions, especially at the present scenario of introducing the new scheme 'Modernization of Quality Control Wing'.

Present functional activities of the Division and Sub divisions

Apart from inspections conducted by the Quality Control sections and Quality Control Sub Division offices, random inspection in major and important works are also being conducted by the Division Office. Irregularities noticed are brought into the notice of the execution wing with clear direction to rectify the same.

One of the major projects coming under WRD is Dam Rehabilitation and Improvement Project (DRIP) of major dams of Kerala. Since 2013, the wing is engaged in the Quality Control testing of DRIP works also. DRIP is implementing with financial assistance of World Bank. As per the direction of the Chief Engineer (I & D) IDRB, we are participating in the discussions conducted by CWC Consultant at DRIP sites. As per the norms of DRIP, KWRD is to conduct timely inspection and certify the quality of work executed under the projects.

The list of dams that are coming under the Dam Rehabilitation and Improvement Project (DRIP) are as follows.

Sl. No.	DAM	Name of District
1	Pothundy	Palakkad
2	Malankara	Muvattupuzha
3	Vazhani	Thrissur
4	Peechi	Thrissur
5	PeriyarVallyBerrage	Ernakulam
6	Chulliar	Palakkad
7	Meenkara	Palakkad
8	Walayar	Palakkad
9	Pazhassi	Kannur
10	Kanhirapuzha	Palakkad
11	Chimoni	Thrissur
12	Kuttiadi	Kozhikode
13	Malampuzha	Palakkad
14	MoolatharaRegulater	Palakkad (Chitturpuzha)

As part of modernization of quality control wing, setting up of full-fledged laboratories with most modern equipments and machineries etc. under H/A 2701-80-005-93-00-00-V (Modernization of Design wing) is in progress.

Proposal for setting up of a new quality control lab at Thrissur, under this sub division was submitted in the year 2017 and A.S. for an amount of Rs. 43.30 lakhs was obtained. Now the lab works, including the installation and demonstration of machines and equipments has been completed and the lab is now started partially functioning with the existing staff under quality control section, Thrissur. With the posting of lab staff, the lab can function in full swing.

Various facilities are available in the lab for compressive strength testing of concrete cubes, rocks and bricks, various tests on soil etc. Facilities are also available in the lab for Rebound hammer tests and concrete core drilling cutting and its testing.

As the part of setting up of a mini quality control lab at Aluva under Ernakulam section office, some of the essential lab equipments such as hand operated sieve shaker, digital weighing balance, cubical and cylindrical moulds for making concrete specimens, Le-Chatlier apparatus, slump cone etc were already procured and lab setting activities in the existing room of quality control section, Eranakulam is under progress. A proposal for setting up of a mini QC Lab including construction of a new buiding at Aluva, under QC section, Ernakulam has been proposed in the five year plan.

New proposals for procuring some of the essential lab equipments and machines required for the proper functioning of the lab at Thrissur are now included in the action plan 2021-2022 and preparation of the estimates are under progress.

Construction of a new Quality Control Lab for Kannur is proposed at Pallikkunnu Village in R.S.No. 72/12. 23Cent land under Pazhassi Irrigation Project was sanctioned as per GO(MS) No. 8/2019/WRD dtd 28/03/2019 Thiruvananthapuram. But the handing over the site is not completed. Detailed estimate for the construction and setting up lab will be prepared and submitted soon after taking charge of the land. Now the various tests are conducted at Engineering Colleges and Polytechnic Colleges.

An amount of Rs. 2381800/- has been allotted for the necessary modifications and maintenance works of building used by GIRIVIKAS earlier, owned by Irrigation department under “Modernisation of Quality control wing Phase II” for new quality control lab at Palakkad. The said work is completed in all respects and the Lab will start functioning after posting of necessary lab staff.

Annual maintenance for Lab equipments, Calibration charge for Compression Testing Machine (CTM), Routine works for Quality Control Lab, Hiring Charge Vehicle for sample

collection, Procurement of Computer and accessories for all five Sub Division offices were included in the financial year 2020-21which incurred expenditure of Rs 45.6 Lakhs under Head of Account H/A 2701-80-005-93-00-00-V (Modernization of Design wing) and setting up of lab in Palakkad is completed and expenditure incurred in 2020-21 comes to Rs 10 Lakhs under Head of Account 2701-80-005-97-00-00-V (Investigation and Design).Some payments are yet pending with EMLI

Inspection conducted (2020-21):

Sl. No.	Name of Sub Division	No. of Agreement Schedule received	No. of Inspection report	Test Conducted.
1	Quality Control Sub Division, Muvattupuzha	196	211	188
2	Quality Control Sub Division, Thrissur	353	351	304(Tests)
3	Quality Control Sub Division, Palakkad	215	345	243(Tests)
4	Quality Control Sub Division, Kozhikode	224	195	273(Cubes)
5	Quality Control Sub Division, Kannur	241	185	372(Cubes)

Budget Allotments and expenditure

The needs of this division is met with the provisions allotted under the head of account 2701-80-005-97 Investigation & Design & 2701-80-005-93(Modernisation of Design Wing) under Plan and from 2701-80-004-96 for Non Plan wing.

Expenditure (For Thrissur Division)

Plan / Non Plan	Heads of A/c	2020-21
Plan	2701-80-005-97	Rs 10 Lakhs
	2701-80-005-93	Rs 45.6 Lakhs
Non Plan	2701-80-004-96	Rs 530 Lakhs

Various Test facilities available in the QC Lab Muvattupuzha

SI No.	Name of Test	Remarks
1	Compressive strength test (Concrete)	
2	Compressive strength test (Mortar)	
3	Slump test	

Various Test facilities available in the QC Lab Thrissur

SI No.	Name of Test	Remarks
	CEMENT	
1	Fineness by seiving	
2	Test for consistency	
3	Setting time (Initial & Final)	
4	Determination of compressive strength	
	Testing of Aggregates	
5	Sieve Analysis of fine/ Coarse aggregates	
6	Unit weight, Bulk Density and Voids	
7	Water Absorption	
8	Specific gravity	
9	Aggregate Impact value	
10	Aggregate Crushing value	
11	Bulking of sand	
	Testing of Concrete and Mortar Cubes (Where material is supplied)	
12	Testing of 70.6mm cubes for compressive strength test	
13	Testing of 100mm cubes for compressive strength test	
14	Testing of 150mm cubes for compressive strength test -	
	Tests on Bricks and Tiles	
15	Water Absorption for bricks/tiles	
16	Compressive strength of bricks of all kind	
17	Effective length and width of tiles	
18	Efflorescence test	
	Tests on Steel	
19	Finding the diameter and weight per meter length	
	Tests on Building Stones	
20	Compressive strength test of building stones of 5 cm or nearest size cubes	
21	True Specific gravity	
22	Water Absorption test (stone blocks)	

23	Compressive strength of building stones, cutting and sizing the specimen in rock cutting machine	
24	Compressive strength of building stones, 50mm cutting and sizing the specimen in rock cutting machine and grinding uneven surfaces to line and level	
25	**NDT Test** --Rebound hammer test	
26	Concrete core Drilling ,Cutting and its compressive test	
	SOIL TEST	
27	Specific gravity test	
28	Moisture content determination	
29	Bulk density, void ratio & porosity	
30	Atterberg limits, LL,PL,ws	
31	Atterberg limits LL,PL	
32	Light Compaction test	
33	Heavy compaction	

Details of test/ Services available in QC Lab Palakkad

SI No.	Name of Test	Remarks
1	Compression Test of Concrete Cube/ Brick Etc	
2	Sieve analysis/ Grading	
3	Initial and Final Setting of Cement	
4	Soundness of Cement	
5	Slump Test	
6	Aggregate Impact Test	
7	Tensile Strength of Cement	

Details of test/ Services available in QC Lab Kozhikode

Sl No	**Name of Test/Services**	Remarks
1	Compression Test / Cube test on concrete blocks	
2	Sieve Analysis of sand (using Electrical , Manual sieve shaker)	
3	Slump Test	
4	Vicat Apparatus -Initial Setting Time, Final Setting Time of cement	
5	Le-Chatlier Apparatus- for soundness of cement	

6	Liquid Limit ,Plastic Limit & Shrinkage Limit for soil	
7	Compaction Factor Test	
8	Specific Gravity Test (Pycnometer & Specific Gravity Bottle) for soil	
9	Cone Penetro Meter (Digital) Test for soil	
10	Aggregate Impact Test	
11	Crushing value - coarse aggregate	
12	Hydrometer analysis	
13	Tensile Test cement	

Present staff strength

1.Muvattupuzha Sub Division

Sl. No.	Category	Sanctioned strength	Existing strength	Vacancy	Remarks
1	Asst. Exe. Engineer	1	1	0	
2	Asst. Engineer	3	3	0	
3	1st Grade D'man	2	1	1	
4	2nd Grade D,man	3	3	0	
5	3rd Grade D'man	3	2	1	
6	Head Clerk	1	1	0	
7	Senior Clerk/Junior Clerk	3	3	0	
8	Typist	2	1	1	
9	Driver	1	0	1	
10	Office Attendant	3	2	1	
11	Lascar	0	0	0	
12	Worker	1	1	0	
13	Part Time Sweeper	0	0	0	
14	Total	23	18	5	

2. Thrissur Sub Division

Sl. No.	Category	Sanctioned strength	Existing strength	Vacancy	Remarks
1	Asst. Exe. Engineer	1	1	0	Continuance sanction upto 31-10-2021
2	Asst. Engineer	2	1	1	
3	1st Grade D'man	1	1	0	
4	2nd Grade D,man	3	2	1	
5	3rd Grade D'man	3	3	0	

6	Head Clerk	1	1	0	
7	Senior Clerk/Junior Clerk	2	2	0	
8	Typist	1	1	0	
9	Driver	1	1	0	
10	Office Attendant	2	2	0	
11	Lascar	2	1	1	
12	Part Time Sweeper	1	1	0	
13	Total	**20**	**17**	**3**	

3. Palakkad Sub Division

Sl. No.	Category	Sanctioned strength	Existing strength	Vacancy	Remarks
1	Asst. Exe. Engineer	1	1	0	
2	Asst. Engineer	2	1	1	
3	1st Grade D'man	1	1	0	
4	2nd Grade D,man	3	3	0	
5	3rd Grade D'man	2	1	1	
6	Head Clerk	1	1	0	
7	Senior Clerk/Junior Clerk	3	1	2	
8	Typist	1	1	0	
9	Driver	1	0	1	
10	Office Attendant	1	1	0	
11	Lascar	2	1	1	
12	Part Time Sweeper	1	1	0	
13	Total	**19**	**13**	**6**	

4.Kozhikkode Sub Division

Sl. No.	Category	Sanctioned strength	Existing strength	Vacancy	Remarks
1	Asst. Exe. Engineer	1	1	0	
2	Asst. Engineer	2	1	1	
3	1st Grade D'man	1	0	1	
4	2nd Grade D,man	2	2	0	
5	3rd Grade D'man	3	3	0	
6	Head Clerk	1	1	0	
7	Senior Clerk/Junior Clerk	3	3	0	
8	Typist	1	1	0	
9	Driver	0	0	0	
10	Office Attendant	2	2	0	
11	Lascar	0	0	0	
12	Part Time Sweeper	1	1	0	
13	Total	17	15	2	

5.Kannur Sub Division

Sl. No.	Category	Sanctioned strength	Existing strength	Vacancy	Remarks
1	Asst. Exe. Engineer	1	1	0	
2	Asst. Engineer	2	0	2	
3	1st Grade D'man	2	1	1	
4	2nd Grade D,man	0	0	0	
5	3rd Grade D'man	2	2	0	
6	Head Clerk	1	1	0	
7	Senior Clerk/Junior Clerk	3	3	0	
8	Typist	1	1	0	
9	Driver	1	1	0	
10	Office Attendant	2	2	0	
11	Lascar	0	0	0	
12	Part Time Sweeper	0	0	0	
13	Total	15	12	3	

6.Thrissur Division

Sl. No.	Category	Sanctioned strength	Existing strength	Vacancy	Remarks
1	Exe. Engineer	1	1	0	
2	Asst. Exe.Engineer/Tech. Asst.	1	1	0	
3	1st Grade D'man	1	1	0	
4	2nd Grade D,man	2	1	1	
5	Blue Printer	1	1	0	
6	Divisional Accountant	1	1	0	
7	Junior Supdt	2	2	0	
8	Senior Clerk/Junior Clerk	8	8	0	
9	Typist	1	1	0	
10	Office Attendant	3	2	1	
11	Watchman	1	1	0	
12	Part Time Sweeper	1	1	0	
13	Total	23	21	2	

***The sanctioned strength given above is as per GO(Rt.)50/2015/WRD Dated: 19.1.2015& GO(MS) No. 12/2018/WRD Dated: 20-01-2018**

Additional staff requirement in the newly set up QC Labs

1.Quality control lab at Thrissur

Sl.No.	Category	Required strength
1	First Grade D'man	1
2	Third Grade Overseer	1
3	Worker Grade I/Lascar	2

2.Mini quality control lab at Aluva, Ernakulam

Sl.No.	Category	Required strength
1	Third Grade Overseer	1
2	Worker Grade I/Lascar	1

3.Quality control lab at Palakkad

Sl.No.	Category	Required strength
1	First Grade Overseer	1
2	Worker Grade I/Lascar	1
3	Night Watchman	1
4	Sweeper	1

4. Quality control lab at Kozhikode

Sl.No.	Category	Required strength
1	First Grade Dman/Lab in charge	1
2	Worker Grade I/Lascar	2

Measures taken for quality improvement awareness

As a part of enhancing the quality monitoring skills of field offices under both execution and quality control wing, Assistant Executive Engineer, Quality control Sub Division, Thrissur has shared his valuable knowledge as a resource person in the state level online training program on Quality monitoring and Quality control of works conducted on 13/10/2020, 03/12/2020 and 04/12/2020, organized by KERI Peechi.

Conclusion

The testing of materials and concrete etc. as the part of routine first tier quality control process by the execution wing are now done in the outside laboratories. Such test results can be more credible, authoritative and trustworthy if these are done in Quality Control Labs under our control. After posting necessary Lab staff, additional revenue can be generated, through consultancy works and doing tests of private agencies, other Departments and for contractors conducting tests as per agreement.

J. QUALITY CONTROL DIVISION, KOTTARAKKARA

J.1 Introduction

At Present Quality Control Division Kottarakkara have Four Sub Divisions at Thiruvananthapuram, Kottarakkara, Alappuzha and Kottayam and Seven sections which are Thiruvananthapuram, Kollam, Kottarakkara, Alappuzha, Pathanamthitta, Kottayam and Idukki under its control. This Division has jurisdiction over six districts namely, Thiruvananthapuram, Kollam, Alappuzha, Pathanamthitta, Kottayam and Idukki.

J.2 Activities

The field investigations, enquires and regular quality tests are conducted under the supervision of Assistant Executive Engineers of Quality Control Wing on the basis of intimation received from the execution wing regarding the works.Routine inspections and collection of samples are carried out accordingly. Samples of Sand and metal are collected from sites and Sieve tests are conducted to ensure the quality of coarse aggregate and fine aggregate. Concrete cube samples also collected in standard moulds and compressive strength is tested after proper curing. Water samples are also collected for testing the Quality. The test resultsreceived from the quality control labs are strictly scrutinized by the quality control wing. If any deficiencies in the execution of works and test result were found are brought to the notice of the concerned authorities for taking corrective measures. Apart from Inspection conducted by the Quality control Section and Subdivision offices, random inspection in major important works are also being conducted by the Division office. In 2020-21 totally about 820 Nos of Inspection and 730 Nos of test results were conducted under this Division.

J.3 Achievements during the yesr 2020-2021

The works which got Financial Sanction during the financial year 2020-21 were almost completed and necessary steps have been taken tocompleting the remaining works. Most of the quality control tests under the subdivision are being conducted at nearby Engineering Colleges or Poly Technics. New Quality Control lab building under Quality Control Sub Division, Kottarakkara is completed and from January 2021 Quality Control Section office is functioning

in this building. With in the period of 2020-2021 the Compression Testing Machine can has been established in this building and working has started from the month of March 2021. All the quality tests under the jurisdiction of this section are carried out through this lab. In addition to that necessary arrangements have taken to test the quality of works under the jurisdiction of Pathanamthitta and Kollam section under this lab. During the period 2020-2021 Compression Testing Machine are installed in the two section of Quality Control Sub Division, Kottayam. From May 2021 Compressive Strength of concrete sample cubes are tested in these lab itself.

J.4 Goals

The main goal is to establish the well equipped laboratories under all subdivisions for ensuring the quality of raw materials, works and workmanship. Presently no such laboratory is functioning under Quality Control Sub Division, Thiruvananthapuram. A proposal for infrastructure facilities required for establishing Irrigation Quality Control laboratory under Quality Control Sub Division, Thiruvanathapuram at VIP Building Nedumangad is included in theAction Plan 2021-22 and accorded sanction. For fulfilling the well equipped laboratories, more lab equipments are needed in the existing labs. If full-fledged laboratories are established we can conduct tests in our lab itself. If permitted we can also conduct test for other Government Department and Private agencies there by originating revenue.

Details of Inspection and Test conducted under Quality Control Division, Kottarakara During the year, 2020-2021

INSPECTION						TEST RESULT				
Month	**Thiruvananthapuram**	**Kottara-kkara**	**Kottayam**	**Alappuzha**	**Total**	**Thiruvana-nthapuram**	**Kottara-kkara**	**Kottayam**	**Alappuzha**	**Total**
2020										
April	L/D	L/D	L/D	L/D		L/D	L/D	L/D	L/D	
May	9	2	6	27	44	9	0	06	25	40
June	14	10	11	41	76	14	11	11	21	57
July	5	11	10	28	54	5	0	10	22	37
August	4	6	10	15	35	4	9	10	10	33
September	8	17	9	19	53	8	21	9	16	54
October	12	17	18	30	77	12	16	18	24	70
November	21	21	15	27	84	21	27	15	24	87
December	23	22	18	34	97	23	30	18	32	103
2021										0
January	29	12	16	38	95	12	12	14	34	72
February	17	16	21	31	85	8	16	21	31	76
March	47	4	36	33	120	29	4	35	33	101
Total	**189**	**138**	**170**	**323**	**820**	**145**	**146**	**167**	**272**	**730**

K. INVESTIGATION FOR WATER RESOURCES DIVISION, PALAKKAD

K.1 Introduction

- Investigation for Water Resources division office is formed for investigation projects under the Irrigation department.
- The new office is formed by abolishing Kuttanad Development Division Kottayam and subordinate office, vide GO(P) No.97/2021/WRD/ dated 10/02/2021 and it is inaugurated by the Honorable Minister Sri. K. Krishnankutty on 18-02-2021.
- The office is formed to under the control of Chief Engineer, IDRB and the Director of Fundamental Applied Research, KERI, Peechi.

K.2 Orgnizational Set up

- Kuttanad Development Division office in Kottayam District and its two Sub-Division offices and their 6 offices and a section office in Minor Irrigation Department is abolished and office posts are sanctioned as detailed below.
- The division office head quarter at Palakkad and having two sub Division offices one at Thrissur and other at Palakkad. There are four section offices functioning in Kozhikkode, Nilambur, Palakkad and Agadi under the sub division Palakkad and three sections offices under Thrissur sub divisions at Thrissur, Peechi and Malappuram.

Sl.No.	Post	Sanctioned strength	Actual Strength	Remark
1.	Executive Engineer	1	1	
2.	Assistant Executive Engineer	3	3	
3.	Assistant Engineer	7	1	
4.	Divisional Accounts Officer	1	1	
5.	Junior Superintendent	2	2	

6.	Head Clerk	2	2	
7.	Senior Clerk	6	3	
8.	Clerk	12	4	
9.	Typist	4	4	
10.	Draftsman Grade 1	6	5	
11.	Draftsman Grade 2	5	4	
12.	Overseer Grade 3	12	7	
13	Tracer	1	1	
14	Office Attendant	7	7	
15	Lascar	9	5	
16	Driver	1	0	
17	Blue Printer	1	0	
18	Part Time Sweeper	1	0	

K.3 Office works

- The aim of the office is prepare investigation reports for Irrigation structures in the department.
- Investigation works of the Irrigation projects will be carried out as and when necessary instructions are received.

K.4 Finance

- No funds allotted for the functioning of the office in the financial year 2020-2021.

Fig. Inauguration of IWR Division by the Honorable Minister Sri. K. Krishnankutty

L. COLLABORATION WITH OTHER INSTITUTIONS

As part of collabartation with other institutions, KERI conducted a study on "Abatement of pollution in Kechery river" in collaboration with SCMS college of engineering, Karukkutty, Ernakulam. A brief overview of the study is given below.

Kechery River or Kechery Puzha also known as Wadakanchery puzha is a west flowing river that has its origin at Machad hills in Thrissur District. The river is 51 km in length and empties to Arabian sea at Chettua Lake. The river irrigates 3560 Hectares of land in Thalappilly taluk in Thrissur District through Vazhani irrigation Project. The National Green Tribunal (NGT) passed a landmark order on 20 September 2018 about increasing polluted river stretches in the country (NGT 2018). The river coming under priority No: IV as per NGT norms and the most polluted stretch assigned is from Puliyannur to Kechery. To assess the level of pollution in the river a study has been conducted jointly by Kerala Engineering Research Institute, Peechi and SCMS School of Engineering and Technology, Ernakulam. As part of the investigation water samples were collected from different locations in the identified stretch of Kechery River. Detailed lab tests were conducted to assess the water quality of the river based on multiple parameters. The results and remedial measures for the abatement of pollution in the river are suggested.

Kechery is a town in Thrissur district, Kerala, India. It is 16 kilometers away from Thrissur and 7 kilometers from Kunnamkulam. The stretch of Kechery river from Puliyannur to Kechery bridge is taken for pollution abatement. The length of this stretch is 8.5 km.

Causes of pollution: Apart from the fluctuation in water availability during the lean season, pollution is caused by various other factors. Urbanization, change in land use pattern, use of excess chemical fertilizers, change in lifestyle, unscientific waste disposal system including that of letting out sewerage to water bodies are some of the main reasons to be highlighted with. The pollutants mostly include water from households and shops. Various study reports suggest that a large number of wastes are let out to rivers from hotels, markets,

slaughterhouses, colonies, workshops, etc. Also, along the curves in the rivers, meandering has resulted in the formation of small island portions that obstruct the flushing out of pollutants, something even resulting in a change in the river course. Encroachments and filling-up of rivers for commercial purposes have also resulted in pollution. Hence, there is an urgent need to regulate and control the above-said actions which significantly contribute to the pollution of water bodies.

The main objective of the Action Plan is to restore the water quality of priority IV polluted stretch of Kechery river (Puliyannur to Kechery) to Class B (IS 2296:1992). The outcomes envisaged after the implementation of the Action Plan include:

- Enhancement in river water quality to Class B
- Maintenance of minimum environmental flow
- Improvement in river biodiversity

Fig. Water Sample Collection from different locations of Kechery River

Fig. Meeting with SCMS officials at KERI campus

Fig. Abatement Of Pollution Of Kechery River- Submission Of DPR To The

Honorable Ministor Of Water Resources In Presence Of ACS,WRD

5.FINANCE

In the budget for the financial year 2020-21 an outlay of Rs. 99.65 Lakh (Rupees Ninty Nine Lakhs Sixty Five Thousand Only) had been allotted under the Head of Account '4701-80-800-99-Development of KERI Stage II'. The proposal for the amount was grouped under three heads viz., Routine activities, modernization and revamping. The details of sanctioned amount and expenditure are given below. From the routine works carried out in the laboratories an amount of Rs. 28,00,349/- (Rupees twenty Eight lakhs three hundred & forty nine only) has been collected as test charges and the amount was remitted in the treasury.

Details of sanctioned Amount and Expenditure

Sl. No.	Divisions	A.S. Amount
I	**Joint Director, C.M.&F.E., KERI, Peechi.**	
1	Construction Materials Division	17.36 lakhs
2	Soil Mechanics and Foundations Division	9.55 lakhs
3	Instrumentation Division	14.41 lakhs
	Total amount received	**41.32 lakhs**
	Expenditure	35.54 lakhs
	Q bill Amount (Expenditure)	6.63 Lakhs
	Total Expenditure	**42.17 lakhs**
II	**Joint Director, Hydraulic Research, KERI, Peechi.**	
1	Coastal Engineering Division	16.15 lakhs
2	Hydraulics Division	15.04 lakhs
3	Sedimentation Division	15.12 lakhs
	Total amount received	**46.31 lakhs**
	Expenditure	43.55 lakhs
	Q bill Amount (Expenditure)	5.38 Lakhs
	Total Expenditure	**48.93 lakhs**

Details of Expenditure statement for the year 2019 – 20 had been allotted under the Various **Head of Account are given below.**

Sl. No.	Head of Account	Division	A.S Amount	Expenditure
I	**Joint Director, C.M.&F.E., KERI, Peechi**			
1	Head of Account: 4700-80-005-99-02-00-Investigation of Major Irrigation Schemes (Plan Scheme)	Instrumentation Division	19.20 Lakhs	17.79 Lakhs
2	Head of Account: 2701-80-005-93-00-00-PV modernaisation of design wing (Plan Scheme)	Soil Mechanics and Foundations Division	7.50 Lakhs	5.65 Lakhs
3	Head of Account: 2101-01-101-98-0018-00-NE Peechi Schemes	Construction Materials Division		31.83 Lakhs
II	**Joint Director, Hydraulic Research, KERI, Peechi.**			
1	Head of Account: 4700-80-005-99-02-00-Investigation of Major Irrigation Schemes (Plan Scheme)	Coastal Engineering Division	2.10 Lakhs	0.61 Lakhs
	Q bill Amount (Expenditure)	Sedimentation Division		1.15
	Q bill Amount (Expenditure)	Coastal Engineering Division		2.11
2	4701-80-800-88 -00-00 Formation of River Basin Organization (Spill over)			
	2018-19 (Spill over)	Sedimentation Division	15.00 Lakhs	14.73 Lakhs
	2018-19 (Spill over)	Coastal Engineering Division	33.00 Lakhs	5.52 Lakhs
	2019-20 (Spill over)		43.00 Lakhs	27.26 Lakhs
	2020-21 (Spill over)		21.66 Lakhs	21.25 Lakhs

6. SUMMARY

In the annual report for the current financial year a general introduction about the institute, organization set up, division wise functioning of the institute, implementation of modernization scheme and details regarding budget allotment and expenditure have been explained in detail.

The bottlenecks or hindrance in the development of the institute as a full-fledged research organization are:

- ***Insufficient number of technical personnel.***
- ***Lack of well qualified engineers.***
- ***Lack of up-gradation of technical knowledge of engineers through training.***
- ***Insufficient number of projects/underutilizations of the facilities available at the institute.***
- ***In the case of Field studies division, sufficient fund has to be made available in time for conducting the study of coastal erosion and high derivative modern equipments has to be made available.***
- ***The building of CEFS, Thrissur which is in a dilapidated condition has to be modified.***

All these require intervention from the part of the Government and it is hoped that the up gradation of the personnel of the institute will be taken up as a continuation of the modernization scheme.

Appendix – I

VACANCY DETAILS OF TECHNICAL STAFF FOR THE MONTH OF MARCH 2021
Fundamental and Applied Research, KERI, Peechi

Sl. No.	Name of Post	Sanctioned Strength	Present Strength	Place of Vacancy
1	Director	1	1	
2	Joint Director/Executive Engineer	6	6	
3	Deputy Director/ Assistant Executive Engineer	21	21	
4	Assistant Director/Assistant Engineer	49	39	IWR Section 3/1 Agly-1, I WR Section 4/1 Kozhikode-1 Quality Control Section Thrissur-1 Quality Control Section,palakkad-1 Quality Contol Section,Aluva,Ernakulam-1 Quality Control Section,No.2,Koothattukulam-1 JD:Coastal Engineering Field Studies,Thrissur-1 IWR Section 1/2Thrissur-1 IWR Section 2/2Peechi-1 IWR Section 3/2 Malappuram-1 IWR Section 3/1 Agly-1 IWR Section 4/1 Kozhikode-1
5	Research Assistant/1st Gr. D'man	53	39	F&AR,KERI,Peechi-1 Deputy Director Hydraulic Division KERI,Peechi-2, Deputy Director,Coastel Engineering Division-1 Deputy Director Sedimentation Division-2 Deputy Directoor,S M & F Dividion,KERI Peechi-2 Deputy Directoor,C M Dividion,KERI Peechi-1 Deouty Director,Instrumentation Division KERI Peechi-1 Coastal Erosion Studies Section , Kozhikode -1 Coastal Engineering Sub Division Kollam-1 Coastal Engineering Section Kollam-1 QC Sub division,Alappuzha-1 QC Sub division,kottayam-1 QC Sub division,Muvattupuzha-1 QC;Sub Division Kozhikkode-1 QC:Section,Kozhikkode-1 QC:Section,Kollam-1

				QC:SubDivision Kottarakkara-1 IWR Division Palakkad-1 IWR Sub Division No.1 Palakkad-2 IWR Sub Division No.2 Thrissur-1
6	2nd Grade D'man/Overseer	49	40	F & A R,KERI Pechi-1 Deputy Director,Sedimentation Division KERI,Peechi-1 Quality Control Section Kalpetta-1 Qualiyt Control Division Thrissur-2 Quality Control Section No.2,Koothattukulam-1 JD:CM & FE KERI Peechi-1 DD:CM,Division,KERI,Peechi-1 IWR Division Palakkad-1 IWR Sub division No 1 Palakkad-2 IWR Sub diviosion no 2 Thrissur-1
7	3rd Grade Overseer	44	33	Deputy Director,CM Division, KERI, Peechi-1 QC:Section Kasargode-1 QC: Section No.3,Angamaly-1 QC:Section,Palakkad-1 QC:Section,Kalpetta-1 IWR section 1/2 Thrissur-2 IWR section 2/2 Peechi-1 IWR section 3/2 Malappuram-1 IWR section 1/2 Thrissur-1
8	Scientific Assistant	2	0	Deputy Director,SM&F Division, KERI, Peechi-1 Deputy Director,Hydraulic Division, KERI, Peechi -1
9	Lab Attender	2	0	Deputy Director,,Hydraulic Division, KERI, Peechi -1 Deputy Director C M Division KERI Peechi-1
10	Tracer	2	1	Joint Director,Hydraulic Research, KERI, Peechi -1
11	Blue Printer	3	1	Joint Director,Hydraulic Research, KERI, Peechi -1 IWR Division Palakkad-1

Appendix – II

An abstract of the Weather data collected from Automatic Weather Station for the period from April 2020 to March 2021 is given below

Abstract of the weather data from April, 2019 to March, 2020

STATION: K.E.R.I, PEECHI

Latitude- 10º 31' 30" N Longitude- 76º 21'59" E MSL- +96.03 M.

Sl.No	Weather Elements	Range of the Weather Data
1.	Atmospheric pressure	Maximum atmospheric pressure observed was 1004.6 millibars in February, 2021 and minimum atmospheric pressure was 993.0 millibars in March,2021
2.	Temperature	The maximum temperature was 38.5ºC in March,2021 and the minimum temperature was 19.5ºC in January and February ,2021
3.	Relative Humidity	Maximum relative humidity recorded was 100% in July and September 2020 and minimum relative humidity was 52.% on February ,2021
4.	Precipitation	Annual rainfall was 2645.5 mm and the maximum monthly rainfall was 635.1 mm in August 2020 and minimum monthly rainfall 1.8 mm in February 2021
5.	Wind-Direction	The main wind directions observed were from South East and North East directions.
6.	Wind Speed	Maximum daily mean wind speed was 6.97 km/hr in December, 2020 and minimum daily mean wind speed was 0.1 km/hr in July, 2020.
7.	Evaporation	Maximum Evaporation was 7.1 mm in February 2021 and minimum of 0.1 mm in September and December 2020.
8.	Sunshine Recorder	The maximum duration of bright sunshine was 10.40 Hours in November , 2020
9.	Global Radiation	Maximum Global Radiation was 1156.4 watts/m^2 in March 2021

Appendix – III

List of tests conducted in the CM laboratory

Report No	Details of Client	Description of Sample	Description of tests
CM 001 /20-21	Southern Railway, Deputy Chief Engineer, Ernakulam.	Tests on Aggregates	Impact test
			Abrasion test
			Water absorption
CM 002 /20-21	Southern Railway, Deputy Chief Engineer, Ernakulam.	Tests on Aggregates	Impact test
			Abrasion test
			Water absorption
CM 003 /20-21	Thrissur District Labour Contract Co-Op Society Ltd. No. 1389	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 004 /20-21	WAPCOS Ltd, (Nissy Enterprises)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 005 /20-21	WAPCOS Ltd, (Nissy Enterprises)	Tests on Solid Blocks	Water Absorption
			Compressive strength of Solid Blocks
CM 006 /20-21	WAPCOS Ltd, (Nissy Enterprises)	Tests on Solid Blocks	Water Absorption
			Compressive strength of Solid Blocks
CM 007 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 008 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 009 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 010 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 011 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 012 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers &	Tests on Concrete Cubes	Compressive strength of Concrete Cubes

	Contractors)		
CM 013 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 014 /20-21	JWR Section, IDRB Aliyar	Tests on Steel	Unit weight
			yield Strength
			Ultimate Strength
			Elongation
CM 015 /20-21	JWR Section, IDRB Aliyar	Mix Design	Sieve analysis
			Specific gravity
			Loose density
			Cement test
			Mix Trials
CM 016 /20-21	Thrissur District Labour Contract Co-Op Society Ltd. No. 1389	Tests on steel bars	Unit weight
			yield Strength
			Ultimate Strength
			Elongation
			Bend & Rebend Test
CM 017 /20-21	Magtech Engineers & Constructions	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 018 /20-21	WAPCOS LTD, (Nissy Enterprises)- Nandikkkara Site	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 019 /20-21	JWR Section, IDRB Aliyar	Tests on Steel	Unit weight, yield strength, ultimate strength, percentage elongation, & Bend and rebend tests
CM 020 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 021/20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 022 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 023 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests

CM 024 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 025 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 026 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 027 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 028 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 029 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 030 /20-21	Saji Antony , Heavenly City Garden, Pattikkad	Tests on clay bricks	Water Absorption
			compressive strength
CM 031 /20-21	WAPCOS Ltd, (Nissy Enterprises)	Tests on Solid Blocks	Water Absorption
			compressive strength
CM 032 /20-21	WAPCOS Ltd, (Nissy Enterprises)	Tests on Solid Blocks	Water Absorption
			compressive strength
CM 033 /20-21	WAPCOS Ltd, (Nissy Enterprises)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 034 /20-21	Assistant Engineer, MI Kinnamkulam	FIELD - PILE ECHO TEST	FIELD - PILE ECHO TEST
CM 035 /20-21	Magtech Engineers & Constructions	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 036 /20-21	WAPCOS Ltd, (Nissy Enterprises)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 037 /20-21	WAPCOS Ltd, (Nissy Enterprises)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 038 /20-21	WAPCOS Ltd, (Nissy Enterprises)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 039 /20-21	Executive Secretary & Project Manager, Nirmithikendra Thrissur	Tests On Steel Bars	Unit weight
			yield Strength
			Ultimate Strength
			Elongation

CM 040 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 041 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 042 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 043 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 044 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 045 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 046 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 047 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 048 /20-21	Assistant Engineer, Bhavani Basin Section II, Agali	Tests on rock core samples	strength of CORE samples-rock
CM 049 /20-21	Jayaprakash K., Mannath (H), Vazhukkumpara, Chuvannumannu P.O	Tests on clay bricks	Water Absorption compressive strength
CM 050 /20-21	WAPCOS Ltd, (Nissy Enterprises)	Tests on Solid Blocks	Water Absorption Compressive strength of Solid Blocks
CM 051 /20-21	WAPCOS Ltd, (Nissy Enterprises)	Tests on Solid Blocks	Water Absorption Compressive strength of Solid Blocks
CM 052 /20-21	WAPCOS Ltd, (Nissy Enterprises)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 053 /20-21	WAPCOS Ltd, (Nissy Enterprises)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 054 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 055 /20-21	Deputy Amnager, Civil, FACT-RCF Building Products Ltd, Kochi	Tests on Concrete Cubes	Compressive strength of Concrete Cubes

CM 056 /20-21	Ceecon Ready Mix Concrete Pvt Ltd	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 057 /20-21	Executive Secretary & Project Manager, Nirmithikendra Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 058 /20-21	Executive Secretary & Project Manager, Nirmithikendra Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 059 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 060 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 061 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 062 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 063 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 064 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 065 /20-21	Thrissur Express Ltd, (Kmc Kl)	Tests on Steel	Unit weight, yield strength, ultimate strength, percentage elongation, & Bend and rebend tests
CM 066 /20-21	Capital Pavings, Shornur	Tests ON Paver Blocks	Abrasion tests of paving blocks
CM 067 /20-21	Ceecon Ready Mix Concrete Pvt Ltd	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 068 /20-21	Assistant Engineer, PWD Special Building Section, Thrissur	MIX DESIGN	Sieve analysis
			Specific gravity
			Loose density
			Cement test
			Mix Trials
CM 069 /20-21	Assistant Engineer, PWD Special Building Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 070 /20-21	Capital Pavings, Shornur	Tests ON Paver Blocks	Abrasion tests of paving blocks
CM 071 /20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on Concrete Cubes	Compressive strength of Concrete Cubes

	(Fins Engineers & Contractors)		
CM 072 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 073 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 074 /20-21	Asst Exe. Engineer, KVASU, Mannuthy	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 075 /20-21	Capital Pavings, Shornur	Tests ON Paver Blocks	Compressive strength
CM 076 /20-21	Executive Secretary & Project Manager, Nirmithikendra Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 077 /20-21	Assistant Engineer, PWD Building Section,	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 078 /20-21	Asst. Exe. Engineer, KSEB LTD	Tests on 11KV hardware fittings	Break load test
CM 079A/20-21	Chelakkara Granites	Tests on Coarse & Fine Aggregates	**M SAND- Type I**
			Sieve Analysis of fine aggregates
			Specific gravity
			Bulk Density
			Water Absorption
CM 079B/20-21			**M SAND- Type II**
			Sieve Analysis of fine aggregates
			Specific gravity
			Bulk Density
			Water Absorption
CM 079C/20-21			**Coarse Aggregates - 20mm**
			Sieve Analysis
			Specific gravity
			Bulk Density
			Water Absorption
			Aggregate Crushing value
			Aggregate Impact value
			Flakiness/Elongation index
			Los Angeles Abrasion Test

CM 079D/20-21			**Coarse Aggregates - 12.5mm**
			Sieve Analysis of Coarse aggregates
			Specific gravity
			Bulk Density
			Water Absorption
			Aggregate Crushing value
			Aggregate Impact value
			Flakiness/Elongation index
			Los Angeles Abrasion Test
CM 079E/20-21			**Coarse Aggregates - 6.3mm**
			Specific gravity
			Bulk Density
			Water Absorption
			Los Angeles Abrasion Test
CM 080 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 081 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 082 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 083 /20-21	Assistant Engineer, Irrigation Section, Enamakkal	MIX DESIGN	Sieve analysis
			Specific gravity
			Loose density
			Cement test
			Mix Trials
CM 084 /20-21	Assistant Engineer, Kerala Water Authority, Chembukav	TESTS ON STEEL BARS	Unit weight
			yield Strength
			Ultimate Strength
			Elongation
			Bend & Rebend test
CM 085 /20-21	Executive Secretary & Project Manager, Nirmithikendra Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 086 /20-21	Executive Secretary & Project Manager, Nirmithikendra Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 087 /20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on Concrete Cubes	Compressive strength of Concrete Cubes

	(Fins Engineers & Contractors)		
CM 088 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 089 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 090 /20-21	Assistant Engineer, PWD Building Section, Kodungalloor	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 091 /20-21	Assistant Engineer, PWD Building Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 092 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 093 /20-21	Deputy Manager, Civil, FACT-RCF Building Products Ltd, Kochi	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 094 /20-21	Executive Secretary & Project Manager, Nirmithi-Kendra Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 095 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 096 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 097 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 098 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 099 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests

CM 100 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 101 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 102 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 103 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 104 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 105 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 106 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Tests on Cement	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 107 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Test On Fly Ash Bricks	Effective length and width of Bricks
CM 108 /20-21			Compressive strength of bricks of all kind
CM 109 /20-21			Water Absorption for bricks/tiles
CM 110 /20-21			Efflorescence test
CM 111 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Test On Tiles	Water Absorption for tiles
			Wet transverse strength of cement concrete flooring tiles
			Resistance to wear for flooring tiles
CM 112 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Test On tiles	Water Absorption for tiles
			Wet transverse strength of cement concrete flooring tiles
			Resistance to wear for

			flooring tiles
CM 113 /20-21	Assistant Engineer, CPWD, Trichur, Central Sub Division	Test On Granites	Water Absorption test
CM 114 /20-21			
CM 115 /20-21			Specific gravity
CM 116 /20-21	Assistant Engineer, PWD Building Section, Irinjalakuda	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 117 /20-21	Executive Secretary & Project Manager, NIRMITHI KENDRA THRISSUR	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 118 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 119 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Fine Aggregates	Sieve Analysis of fine aggregates
			Bulking of sand
			Bulk Density
CM 120 /20-21	Executive Secretary & Project Manager, Nirmithi Kendra Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 121 /20-21	Executive Secretary & Project Manager, Nirmithi Kendra Thrissur	Tests on STEEL BARS	Compressive strength of Concrete Cubes
CM 122 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 123 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 124 /20-21	Assistant Engineer, PWD Building Section	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 125 /20-21	Assistant Engineer, Kerala Water Authority, Section Ii	MIX DESIGN	Sieve analysis
			Specific gravity
			Loose density
			Cement test
			Mix Trials -M25
CM 126 /20-21			Mix Trials -M30
CM 127 /20-21	Kvasu (Silpi Builders)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 128 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers &	Tests on Concrete Cubes	Compressive strength of Concrete Cubes

	Contractors)		
CM 129 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 130 /20-21	Assistant Engineer, PWD Building Section, Irinjalakuda	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 131 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 132 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 133 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 134 /20-21	Assistant Engineer, Irrigation Quality Control Section, Thrissur	Tests on Concrete Cubes	Compressive strength of Concrete Cubes
CM 135 /20-21	Asst. Exe. Engineer, KSEB LTD	Tests on stay wire	Break load test
CM 136 /20-21	Asst Engineer, PWD Building Section, Mg Kavu, TSR	Tests on Solid Blocks	Water Absorption
			Compressive Strength
CM 137 /20-21	Asst Engineer, PWD Building Section, Mg Kavu, TSR	Mix Design	Sieve analysis
			Specific gravity
			Loose density
			Cement test
			Mix Trials -M25
CM 138 /20-21	Asst Engineer, PWD Building Section, MG Kavu, TSR	CEMENT Test	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 139 /20-21	Asst Engineer, PWD Building Section, Mg Kavu, TSR	Test On Steel Bars	Unit weight
			yield Strength
			Ultimate Strength
			Elongation
			Bend & Rebend test
CM 140 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Test On Concrete Cubes	Compressive strength of Concrete Cubes
CM 141 /20-21	Shibu, C Two Infrastructure, Thrissur	Test On Concrete Cubes	Compressive strength of Concrete Cubes
CM 142 /20-21	Executive Secretary &	Test On Concrete	Compressive strength of

	Project Manager, NIRMITHI KENDRA THRISSUR	Cubes	Concrete Cubes
CM 143 /20-21	Executive Secretary & Project Manager, NIRMITHI KENDRA THRISSUR	Test On Concrete Cubes	Compressive strength of Concrete Cubes
CM 144 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Test On Concrete Cubes	Compressive strength of Concrete Cubes
CM 145 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Test On Concrete Cubes	Compressive strength of Concrete Cubes
CM 146 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Test On Concrete Cubes	Compressive strength of Concrete Cubes
CM 147 /20-21	Assistant Engineer, QC Section, Idukki, Muttam	Steel Test	Unit weight
			yield Strength
			Ultimate Strength
			Elongation
			Bend & Rebend test
CM 148 /20-21	Assistant Engineer, PWD Building Section, Irinjalakuda	Test On Concrete Cubes	Compressive strength of Concrete Cubes
CM 149 /20-21	Asst. Exe. Engineer, KSEB LTD	Stay Wire Test	Break load test
CM 150 /20-21	The Project Engineer-6, KIIDC, (M/S TBAS Constructions)	MIX DESIGN	Sieve analysis
			Specific gravity
			Loose density
			Cement test
			Mix Trials -M15-RAMCO
CM 151 /20-21	The Project Engineer-6, KIIDC, (M/S TBAS Constructions)		Mix Trials -M20- zuari
CM 152 /20-21			Mix Trials -M20- ramco
CM 153 /20-21			Mix Trials -M25- zuari
CM 154 /20-21			Mix Trials -M25- ramco
CM 155 /20-21			Mix Trials -M30-RAMCO
CM 156 /20-21	The Project Engineer-6, KIIDC, (M/S TBAS Constructions)	CEMENT Test	Fineness
			Consistency
			Setting times
			Compressive strength tests
CM 157 /20-21			Fineness
			Consistency
			Setting times

			Compressive strength tests
CM 158 /20-21	The Project Engineer-6, KIIDC, (M/S TBAS Constructions)	Fine Aggregates	Sp. Gravity, Sieve Analysis, W/A
CM 159 /20-21		Coarse aggregates	Sp. Gravity, Sieve Analysis, W/A, Impact value, crushing
CM 160 /20-21		Coarse aggregates	Sp. Gravity, Sieve Analysis, W/A, Impact value, crushing
CM 161 /20-21	Executive Secretary & Project Manager, Nirmithi kendra Thrissur	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 162 /20-21	Assistant Engineer, PWD Building Section, Thrissur	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 163 /20-21	Pradeep Vatanappally	test on interlock tiles	Compressive strength test of Paving Blocks
CM 164 /20-21	Executive Secretary & Project Manager, Nirmithikendra Thrissur	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 165 /20-21	Assistant Engineer, PWD Building Section, Irinjalakuda	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 166 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Compressive strength of Concrete Cubes	Compressive strength test of concrete cubes
CM 167 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Compressive strength of Concrete Cubes	Compressive strength test of concrete cubes
CM 168 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Compressive strength of Concrete Cubes	Compressive strength test of concrete cubes
CM 169 /20-21	Assistant Engineer, PWD Building Section, Chavakkad	Steel test	Unit weight
			yield Strength
			Ultimate Strength
			Elongation
			Bend & Rebend test
CM 170 /20-21	Assistant Engineer, PWD Building Section, Chavakkad	MIX DESIGN	Sieve analysis
			Specific gravity
			Loose density
			Cement test
			Mix Trials
CM 171 /20-21	Assistant Engineer, PWD	Coarse aggregates	Sp. Gravity, Sieve Analysis,

	Building Section, Chavakkad		W/A, Impact value, crushing
CM 172 /20-21	Assistant Engineer, PWD Building Section, Chavakkad	Fine Aggregates	Sp. Gravity, Sieve Analysis, W/A
CM 173 /20-21	Assistant Engineer, PWD Building Section, Chavakkad	Cement Test	Consistency, Setting Time, Strength
CM 174 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Compressive strength of Concrete Cubes	Compressive strength test of concrete cubes
CM 175 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Compressive strength of Concrete Cubes	Compressive strength test of concrete cubes
CM 176 /20-21	Assistant Engineer, KSHB, TSR Division, Ayyanthole	Diameter& Weight	Diameter& Weight
CM 177 /20-21	Assistant Engineer, KSHB, TSR Division, Ayyanthole	Dimensions & Weight	Diameter& Weight
CM 178 /20-21	Assistant Engineer, PWD Building Section, Thrissur	Compressive strength of Concrete Cubes	Compressive strength test of concrete cubes
CM 179 /20-21	AEE, PYIP Sub Div., Mattanur	Mix Design M25	Sieve analysis
			Specific gravity & Water Absorption
			Loose density
			Cement test
			Mix Trials
CM 180 /20-21	Project Engineer, KIIDC Ltd, Tvm	MIx Design M15	Sieve analysis
			Specific gravity & Water Absorption
			Loose density
			Cement test
			Mix Trials
CM 181 /20-21	Project Engineer, KIIDC Ltd, Tvm	MIx Design M15	Sieve analysis
			Specific gravity & W/A
			Loose density
			Cement test
			Mix Trials
CM 182/20-21	Project Engineer, KIIDC Ltd, Tvm	MIx Design M20	Sieve analysis
			Specific gravity & W/A
			Loose density
			Cement test

			Mix Trials
CM 183/20-21	Project Engineer, KIIDC Ltd, Tvm	MIx Design M20	Sieve analysis
			Specific gravity & W/A
			Loose density
			Cement test
			Mix Trials
CM 184/20-21	Project Engineer, KIIDC Ltd, Tvm	MIx Design M25	Sieve analysis
			Specific gravity & W/A
			Loose density
			Cement test
			Mix Trials
CM 185/20-21	Project Engineer, KIIDC Ltd, Tvm	MIx Design M25	Sieve analysis
			Specific gravity & W/A
			Loose density
			Cement test
			Mix Trials
CM 186/20-21	Project Engineer, KIIDC Ltd, Tvm	MIx Design M30	Sieve analysis
			Specific gravity & W/A
			Loose density
			Cement test
			Mix Trials
CM 187/20-21	Project Engineer, KIIDC Ltd, Tvm	MIx Design M30	Sieve analysis
			Specific gravity & W/A
			Loose density
			Cement test
			Mix Trials
CM 188 /20-21	AE, PWD Buildings Section, Irinjalakuda	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 189 /20-21	Executive Secretary & Project Manager, Nirmithi kendra Thrissur	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 190 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 191 /20-21	AE, PWD Buildings Section, Irinjalakuda	MIX DESIGN	Sieve analysis
			Specific gravity & Water Absorption
			Loose density
			Cement test
			Mix Trials
CM 192 /20-21	AE, PWD Buildings Section, Irinjalakuda	Coarse aggregates	Aggregate Impact Value
CM 193 /20-21	AE, PWD Buildings Section, Irinjalakuda	Coarse aggregates	Aggregate Impact Value
CM 194 /20-21	AE, PWD Buildings	Fine Aggregates	Sieve analysis

	Section, Irinjalakuda		
CM 195 /20-21	AE, PWD Buildings Section, Irinjalakuda	Steel test	Unit weight, Yield strength, Ultimate Strength , Elongation
CM 196 /20-21	AE, PWD Buildings Section, Irinjalakuda	Solid Blocks	Compressive strength
CM 197 /20-21	AE, PWD Buildings Section, Irinjalakuda	Cement test	Fineness, Consistency, Setting Time, Compressive strength
CM 198 /20-21	AE, PWD Buildings Section, Irinjalakuda	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 199 /20-21	AE, PWD Buildings Section, Kodungallur	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 200 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 201 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 202 /20-21	Senior Manager-Projects, Vishraam Builders	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 203 /20-21	Senior Manager-Projects, Vishraam Builders & Developers	Tests on Steel	Unit weight, Yield strength, Ultimate Strength , Elongation & Bend-Rebend test
CM 204 /20-21	Senior Manager-Projects, Vishraam Builders & Developers	Cement test	Fineness
			Consistency
			Setting Times
			Compressive strength
CM 205 /20-21	Managing Director, El Roi Constructions	Test on Steel	Unit weight, Yield strength, Ultimate Strength & Elongation
CM 206 /20-21	TBAS Constructions, Aluva, Ernakulam	Test on Steel	Unit weight, Yield strength, Ultimate Strength & Elongation
CM 207 /20-21	Executive Secretary & Project Manager, Nirmithikendra Thrissur	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 208 /20-21	Senior Consultant, Kitco Ltd	Cement test	Fineness
			Consistency
			Setting Times
			Compressive strength
CM 209 /20-21		Coarse aggregates	Sieve analysis
			Flakiness Index

			Water Absorption
			Aggregate Impact Value
CM 210 /20-21		Fine Aggregates	Sieve analysis
			Specific Gravity
			Bulking of Sand
CM 211 /20-21	AE, Kwa, Public Health Section	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 212 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 213 /20-21	AEE, KSEB Ltd	GI Wire test	Tension test
CM 214 /20-21	Team Leader, WAPCOS Ltd, (Nissy Enterprises)	Tests on Solid Blocks	Compressive strength test of Solid Blocks
CM 215 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 216 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 217 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Cement	Fineness
			Consistency
			Setting Times
			Compressive strength
CM 218 /20-21	AE, PWD Buildings Section, Kodungallur	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 219 /20-21	AE, PWD Buildings Section, Kunnamkulam	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 220 /20-21	AE, PWD Buildings Section, Irinjalakuda	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 221 /20-21	AE, PWD Buildings Section, Kunnamkulam	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 222 /20-21	Team Leader, WAPCOS Ltd, (Shree Shylam Enterprises)	Tests on Solid Blocks	Water Absorption
			Compressive strength of Solid Blocks
CM 223 /20-21	Team Leader, WAPCOS Ltd, (Shree Shylam Enterprises)	Tests on Cement	Fineness
			Consistency
			Setting Times
			Compressive strength
CM 224 /20-21	Team Leader, WAPCOS Ltd, (Shree Shylam Enterprises)	Tests on Cement	Fineness
			Consistency
			Setting Times
			Compressive strength
CM 225 /20-21	Team Leader, WAPCOS	Tests on Cement	Fineness

	Ltd, (Shree Shylam Enterprises)		Consistency
			Setting Times
			Compressive strength
CM 226 /20-21	Team Leader, WAPCOS Ltd, (Shree Shylam Enterprises)	Tests on Cement	Fineness
			Consistency
			Setting Times
			Compressive strength
CM 227 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 228 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 229 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 230 /20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 231/20-21	Sabareesh Marketing	Test on paving blocks	Compressive strength of Paving Tiles
CM 232/20-21	Executive Secretary & Project Manager, Nirmithikendra Thrissur	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 233/20-21	Executive Secretary & Project Manager, Nirmithikendra Thrissur	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 234/20-21	WAPCOS LTD, (Shree Shylam Contractors-Nissy Enterprises)	Fine Aggregates	Sieve Analysis, Bulk Density & Bulking Of Sand
CM 235/20-21	WAPCOS LTD, (Shree Shylam Contractors-Nissy Enterprises)		Sieve Analysis, Bulk Density & Bulking Of Sand
CM 236/20-21	WAPCOS LTD, (Shree Shylam Contractors-Nissy Enterprises)		Sieve Analysis, Bulk Density & Bulking Of Sand
CM 237/20-21	WAPCOS LTD, (Shree Shylam Contractors-Nissy Enterprises)		Sieve Analysis, Bulk Density & Bulking Of Sand
CM 238/20-21	P.P. Paul, Ponmanissery (H). Chengaloor	PAVING BLOCK	Compressive strength test
CM 239/20-21	Managing PARTNER,	20 mm	Bulk Density

	ST. BASIL GRANITES	AGGREGATES	Sieve Analysis of Coarse aggregates
			Specific gravity
			Water Absorption
			Aggregate Impact value
			Aggregate Crushing value
			Los Angeles Abrasion Test
CM 240/20-21		12 mm AGGREGATES	Bulk Density
			Sieve Analysis of Coarse aggregates
			Specific gravity
			Water Absorption
			Aggregate Impact value
			Aggregate Crushing value
			Los Angeles Abrasion Test
CM 241/20-21		M SAND	Bulk Density
			Sieve Analysis of fine aggregates
			Specific gravity
			Water Absorption
CM 242/20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 243/20-21	SSE, Railway	MIX DESIGN	Sieve analysis
			Specific gravity & Water Absorption
			Loose density
			Cement test
			Mix Trials
CM 244/20-21		20 mm Aggregates	Aggregate Crushing value
CM 245/20-21		MSAND	Sieve Analysis, Bulk Density & Bulking Of Sand
CM 246/20-21		CEMENT OPC 43	Consistency, Setting Time, Strength
CM 247/20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 248/20-21	TDLC Kannara	Test On Tiles	Water Absorption
			Wet transverse strength
			Resistance to wear
CM 249/20-21	AE, PWD Buildings Section, Kunnamkulam	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 250/20-21	AE, PWD Buildings Section, Kunnamkulam	Tests on Concrete Cubes	Compressive strength test of concrete cubes

CM 251/20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 252/20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 253/20-21	Assistant Engineer, LSGD, Mattathur Gp	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 254/20-21	Assistant Engineer, LSGD, Mattathur Gp	Tests ON Paver Blocks	Compressive strength test of paver blocks
CM 255/20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 256/20-21	AE, PWD Buildings Section, Kunnamkulam	Tests on Concrete Cubes	Compressive strength test of concrete cubes
CM 257/20-21	Project Engineer, KIIDC Ltd, Tvm	Tests on Aggregates	Flakiness Index, Elongation index, Crushing value, Gradation
CM 258/20-21	Project Engineer, KIIDC Ltd, Tvm	Tests on cement	Consistency, Fineness, Setting Time, Compressive Strength
CM 259/20-21	Project Engineer, KIIDC Ltd, Tvm	Tests on Solid Blocks	Compressive Strength, Water Absorption
CM 260/20-21	Magtech Engineers & Constructions	Tests on Concrete Cubes	Compressive Strength
CM 261/20-21	AE, PWD Buildings Section, Kodungallur	Tests on Concrete Cubes	Compressive Strength
CM 262/20-21	AE, PWD Buildings Section, Kodungallur	Tests on Concrete Cubes	Compressive Strength
CM 263/20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive Strength
CM 264/20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive Strength
CM 265/20-21	AE, PWD Buildings Section, Kunnamkulam	Tests on Concrete Cubes	Compressive Strength
CM 266/20-21	AE, PWD Buildings Section, Kunnamkulam	Tests on Concrete Cubes	Compressive Strength
CM 267/20-21	TBAS Constructions, Aluva, Ernakulam	Mix Design	Fineness Of Cement, Consistency, Setting Time, Compressive Strength,

			Gradation, Specific Gravity, Water Absorption, Loose Density, Mix Trials
CM 268/20-21	TBAS Constructions, Aluva, Ernakulam	Mix Design	Fineness Of Cement, Consistency, Setting Time, Compressive Strength, Gradation, Specific Gravity, Water Absorption, Loose Density, Mix Trials
CM 269/20-21	Kitco Ltd, Kochi	Tests on Cement	Fineness, Consistency, Setting Time, Compressive strength
CM 270/20-21	Assistant Engineer, Public Health Section, Kwa, Peechi	Tests on Concrete Cubes	Compressive strength
CM 272/20-21	AE, PWD Buildings Section, Kodungallur	Tests on Concrete Cubes	Compressive strength
CM 273/20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength
CM 274/20-21	Team Leader, Central Zone, WAPCOS Ltd, (Fins Engineers & Contractors)	Tests on Concrete Cubes	Compressive strength
CM 275/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on Concrete Cubes	Compressive strength
CM 276/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on Solid Blocks	Compressive Strength, Water Absorption
CM 277/20-21	Project Manager, Thrissur Expressway Ltd	Tests on steel	Unit weight, Yield strength, Ultimate Strength & Elongation
CM 278/20-21	Project Manager, Thrissur Expressway Ltd	Tests on steel	Unit weight, Yield strength, Ultimate Strength & Elongation
CM 279/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on Concrete Cubes	Compressive strength
CM 280/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on Concrete Cubes	Compressive strength
CM 281/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on Concrete Cubes	Compressive strength
CM 282/20-21	Sri. Sunil Menon	Tests on Solid Blocks	Compressive strength
CM 283/20-21	Magtech Engineers & Constructions (Bpcl)	Tests on Concrete Cubes	Compressive strength
CM 284/20-21	Senior Consultant, Kitco Ltd	Tests on Concrete Cubes	Compressive strength

CM 285/20-21	Senior Consultant, Kitco Ltd	Tests on Concrete Cubes	Compressive strength
CM 286/20-21	Senior Consultant, Kitco Ltd	Tests on steel	Unit weight, Yield strength, Ultimate Strength & Elongation
CM 287/20-21	AE, PWD Buildings Section, Kodungallur	Tests on Concrete Cubes	Compressive strength
CM 288/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on Concrete Cubes	Compressive strength
CM 289/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on Concrete Cubes	Compressive strength
CM 290/20-21	AE, PWD Buildings Section, Kunnamkulam	Tests on Concrete Cubes	Compressive strength
CM 291/20-21	AE, PWD Buildings Section, Kunnamkulam	Tests on Concrete Cubes	Compressive strength
CM 292/20-21	Project Engineer, KIIDC Ltd, Tvm	MiX DESIGN	Sieve analysis
			Specific gravity & W/A
			Loose density
			Cement test
			Mix Trials
CM 293/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on Concrete Cubes	Compressive strength
CM 294/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on Solid Blocks	Compressive strength
			Dimension
			Density
			Water absorption
CM 295/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 296/20-21	Thrissur Expressway Ltd, (Kmc Kl)	Tests on Steel	Unit weight, Yield strength, Ultimate Strength & Elongation, Bend Rebend
CM 297/20-21	Thrissur Expressway Ltd, (Kmc Kl)	Tests on Steel	Unit weight, Yield strength, Ultimate Strength & Elongation, Bend Rebend
CM 298/20-21	Thrissur Expressway Ltd, (Kmc Kl)	Tests on Steel	Unit weight, Yield strength, Ultimate Strength & Elongation, Bend Rebend
CM 299/20-21	Thrissur Expressway Ltd, (Kmc Kl)	Tests on Steel	Compressive strength
CM 300/20-21	Thrissur Expressway Ltd, (Kmc Kl)	Tests on Steel	Unit weight, Yield strength, Ultimate Strength & Elongation, Bend Rebend
CM 301/20-21	Thrissur Expressway Ltd, (Kmc Kl)	Tests on Steel	Unit weight, Yield strength, Ultimate Strength & Elongation, Bend Rebend
CM 302/20-21	Thrissur Expressway Ltd,	Tests on Steel	Unit weight, Yield strength,

	(Kmc Kl)		Ultimate Strength & Elongation, Bend Rebend
CM 303/20-21	Thrissur Expressway Ltd, (Kmc Kl)	Tests on Steel	Unit weight, Yield strength, Ultimate Strength & Elongation, Bend Rebend
CM 304/20-21	Project Engineer, KIIDC Ltd, Tvm	Mix Design M35	
CM 305/20-21	AE, PWD Buildings Section, Kunnamkulam	Tests on cubes	Compressive strength
CM 306/20-21	AE, PWD Buildings Section, Kodungallur	Tests on cubes	Compressive strength
CM 307/20-21	AE, PWD Buildings Section, Kodungallur	Tests on cubes	Compressive strength
CM 308/20-21	Jithin Sreekumar	Tests on cubes	Compressive strength
CM 309/20-21	T.M. Vasudevan	Test of Silica Manganese aggregates	Specific Gravity
			Water Absorption
			Aggregate Impact value
			Los Angeles Abrasion value
CM 310/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 311/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 312/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 313/20-21	AE, PWD Buildings Section, Kunnamkulam	Tests on cubes	Compressive strength
CM 314/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 315/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 316/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 317/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 318/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 319/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 320/20-21	TDLCCS	Tests on Paver Blocks	Compressive strength
CM 321/20-21	AE, PWD Buildings Section, Irinjalakuda	Tests on cubes	Compressive strength
CM 322/20-21	Assistant Engineer, Public Health Section, Kwa, Peechi	Tests on cubes	Compressive strength
CM 323/20-21	AE, PWD Buildings	Tests on cubes	Compressive strength

	Section, Irinjalakuda		
CM 324/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 325/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 326/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 327/20-21	Executive Engineer, Chamaravattom Project Division, Eswaramangalam	Tests on Steel	Tensile test, Dimension
CM 328/20-21	Assistant Engineer, MI Section, Cherpu	Tests on Steel	Unit weight, Yield strength, Ultimate Strength & Elongation, Bend Rebend
CM 329/20-21	Assistant Engineer, MI Section, Kunnamkulam	Tests on cubes	Compressive strength
CM 330/20-21	Team Leader, Central Zone, WAPCOS Ltd,	Tests on cubes	Compressive strength
CM 331/20-21	AE, PWD Buildings Section, Kunnamkulam	Tests on cubes	Compressive strength
CM 332/20-21	AE, LSGD, Chalakkudy Block Panchayath	Tests on cubes	Compressive strength
CM 333/20-21	AE, PWD Buildings Section, Kodungallur	Tests on cubes	Compressive strength
CM 334/20-21	Sri. Rabish	Tests on chequered tile	Wet transverse strength
CM 335/20-21	KSEB Ltd, A.E.E, Transgrid T C Subdivision Chalakudy	Test on aggregates	Sieve Analysis of C A Flakiness Index
CM 336/20-21	A.E.E, Transgrid T C Subdivision Chalakudy	Test on aggregates	Sieve Analysis of C A Flakiness Index
CM 337/20-21	A.E.E, Transgrid T C Subdivision Chalakudy	Test on aggregates	Sieve Analysis of C A Flakiness Index
CM 338/20-21	AE, PWD Buildings Section, Irinjalakuda	Test on Cubes	Compressive strength
CM 339/20-21	AE, PWD Buildings Section, Kodungallur	Test on Cubes	Compressive strength
CM 340/20-21	AE, PWD Buildings Section, Irinjalakuda	Test on Cubes	Compressive strength
CM 341/20-21	Team Leader, Central Zone, WAPCOS Ltd, Gvhss Nandikkara	Test on Paver blocks	Compressive strength Diamension
CM 342/20-21	AE, PWD Buildings Section, Kunnamkulam	Test on Cubes	Compressive strength
CM 343/20-21	Team Leader, Central Zone, WAPCOS LTD,	Test on Cubes	Compressive strength

	M/S Fins Engineers		
CM 344/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers	Test on Cubes	Compressive strength
CM 345/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers	Test on Cubes	Compressive strength
CM 346/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers	Test on Cubes	Compressive strength
CM 347/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers	Test on Cubes	Compressive strength
CM 348/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers	Test on Cubes	Compressive strength
CM 349/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers	Test on Cubes	Compressive strength
CM 350/20-21	Assistant Engineer, MI Section, Chalakudy	Test on Steel	Yield strength, tensile Strength & Elongation, Bend Rebend
CM 351/20-21	Assistant Engineer, MI Section, Chalakudy	Test on Steel	Yield strength, tensile Strength & Elongation, Bend Rebend
CM 352/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers	Test on Cubes	Compressive strength
CM 353/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers	Test on Cubes	Compressive strength
CM 354/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers	Test on Cubes	Compressive strength
CM 355/20-21	Project Engineer, KITCO Ltd M/S South Indian Construction	Unit Weight	Weight per unit meter length
CM 356/20-21	Project Engineer, KITCO Ltd M/S South Indian Construction	Test on aggregates	Sieve Analysis Bulk density Water Absorption Specific Gravity Impact Value Crushing Value Bulking of Sand
CM 357/20-21	AE, PWD Buildings Section, Kunnamkulam	Test on Cubes	Compressive strength
CM 358/20-21	A.E.E, Transgrid T C Subdivision Chalakudy	Test on M Sand, Cement &	Gradation of Coarse Aggregates,

		aggregates	Flakiness index, Sieve Analysis, Fineness by sieving, Consistency test Setting time (Initial & Final) Compressive strength
CM 359/20-21	A.E.E, Transgrid T C Subdivision Chalakudy	Test on M Sand, Cement & aggregates	Gradation of Coarse Aggregates, Flakiness index, Sieve Analysis, Fineness by sieving, Consistency test Setting time (Initial & Final) Compressive strength
CM 360/20-21	A.E.E, Transgrid T C Subdivision Chalakudy	Test on M Sand, Cement & aggregates	Gradation of Coarse Aggregates, Flakiness index, Sieve Analysis, Fineness by sieving,
CM 361/20-21	AE, PWD Buildings Section, Kodungallur	Test on Cubes	Compressive strength
CM 362/20-21	Viswas K. V, Kuppayil House, Mudikkod	Test on Paver blocks	Compressive strength
CM 363/20-21	Registrar, KFRI, Peechi	Test on Cement Concrete Paver blocks	Compressive strength
CM 364/20-21	AE, PWD Buildings Section, Kodungallur	Test on Cubes	Compressive strength
CM 365/20-21	AE, Pwd Buildings Section, Chalakudy M/S AP Constructions	Test on Solid blocks & Steels	Compressive strength, Tension test on steel up to 25mm dia
CM 366/20-21	AE, PWD Buildings Section, Kunnamkulam	Test on Cubes	Compressive strength
CM 367/20-21	K. Sivan, Karyattu (H), Marottichal(Po) Thrissur	Test on A Aerated Concrete blocks	Compressive strength
CM 368/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers & Contrctors Pvt Ltd	Test on Cubes	Compressive strength
CM 369/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers & Contrctors Pvt Ltd	Test on Cubes	Compressive strength
CM 370/20-21	Team Leader, Central	Test on Cubes	Compressive strength

	Zone, WAPCOS LTD, M/S Fins Engineers & Contrctors Pvt Ltd		
CM 371/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers & Contrctors Pvt Ltd	Test on Cubes	Compressive strength
CM 372/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers & Contrctors Pvt Ltd	Test on Cubes	Compressive strength
CM 373/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers & Contractors Pvt Ltd	Test on Cubes	Compressive strength
CM 374/20-21	Team Leader, Central Zone, WAPCOS LTD, M/S Fins Engineers & Contrctors Pvt Ltd	Test on Cubes	Compressive strength
CM 375/20-21	AE, PWD Buildings Section, Irinjalakuda	Test on Cubes	Compressive strength
CM 376/20-21 to CM 378/20-21	AE , Peechi Project Section, Mannamangalam	Test on Steel & Mix design	Tension test , Mix Design including material test
CM 379/20-21	Team Leader, Central Zone, Wapcos Ltd, M/S Fins Engineers & Contrctors Pvt Ltd	Test on Cubes	Compressive strength
CM 380/20-21	AE, PWD Buildings Section, Kodungallur	Test on Cubes	Compressive strength
CM 1001/20-21	AE, CIP Head works Section, Cheerakkuzhy	Inspection for NDT	Inspection for NDT

Appendix – IV

List of tests conducted in the SM Laboratory

Soil samples analysis for undisturbed and disturbed samples were tested for the following works:-

1. Soil Investigation – SDRF – Desilting of Wadakkanchery River in WadakkancheryMuncipality
2. Preliminary Soil Investigation Works at Dam Area of Attappady Irrigation Project (AIP)
3. Soil Investigation – Investigation for the rectification of existing regulators at Enamakkal and Idiyanchira, Thrissur District – Enamakkal Regulator
4. Soil Test for the Construction of Banana and Honey Park at Kannara Farm, Thrissur District
5. Detailed Silt study or Sediment Analysis of River water-Investigation of Urumi-III SHE Scheme (2.40MW).
6. Soil Investigation – Investigation for the rectification of existing regulators at Enamakkal and Idiyanchira, Thrissur District- Idiyanchira Regulator
7. Soil Test for the Construction of Banana and Honey Park at Kannara Farm, Thrissur District.
8. Hydrographic Survey of Poringalkuthu HEP (KSEB) using Integrated Bathymetric System & Sub Bottom Profiler- Testing of Soil Samples
9. Soil Investigation – Extension of Moolathara Right bank canal from Korayar to Varattayar.
10. Sedimentation Study of Pothundy Reservoir using IBS & Sub Bottom Profiler- Testing of Soil Samples
11. Sedimentation Study of Meenakara Reservoir using IBS & Sub Bottom Profiler- Testing of Soil Samples

12. KRP – DRIP Phase II – Soil test for reviewing the stability analysis of existing earth dam at Karapuzha.
13. Sedimentation Study of Malankara Reservoir using IBS & Sub Bottom Profiler- Testing of Soil Samples
14. Construction of I M Vijayan Indoor Stadium and Sports Complex at Laloor, Thrissur – Testing of Soil Samples
15. Soil Investigation for Projects in Irrigation Department – For retaining wall & approach road of proposed regulator at Munayam
16. Soil Investigation for the proposed RCB at Kainurchira, Nadathara GP, Thrissur District
17. Soil Investigation works of KunnampidariEri
18. Soil Investigation works of KambalatharaEri
19. Soil test for the Samples collected from Kaloor, Cochin for new project site
20. Soil Investigation - KIP Main Canal Earth Slippage at Chainage 17000m
21. Testing of Soil Samples – Rehabilitation work for ThrithalaVelliamkallu RCB
22. Soil Investigation works of VenkalakayamEri
23. Sedimentation Study of Pazhassi Reservoir using IBS & Sub Bottom Profiler – Testing of Soil Samples.
24. Testing of Soil Samples – Sand Budgeting in Chaliyar River
25. Sedimentation Study of Karapuzha Reservoir using IBS & Sub Bottom Profiler – Testing of Soil Samples
26. Testing of Soil samples - Landslide studies conducted in Plamoola area of Wayanad District.
27. Construction of I M Vijayan Indoor Stadium and Sports Complex at Laloor, Thrissur – Testing of Soil.
28. Soil Investigation works – Development of Fish Seed Hatchery at Bhoothathankettu.

Appendix – V

Times and Places of observation

Serial No.	Month	Date of observation
1.	April	22/04/2020
2.	May	22/05/2020
3.	June	20/06/2020
4.	July	20/07/2020
5.	August	18/08/2020
6.	September	17/09/2020
7.	October	16/10/2020
8.	November	14/11/2020
9.	December	14/12/2020
10.	January	1301/2021
11.	February	11/02/2021
12.	March	13/03/2021

Appendix-VI

Details of Simultaneous Observations

Sl.No.	Name of Station	Time and CP Nos				
		9.00 AM	10.00 AM	11.00 AM	11.45 AM	12.30 AM
1.	Vettukkad	0112	0114	0116	0114	0112
2.	Anjengo	0223	0228	0233	0228	0223
3.	Eravipuram	0324	0327	0329	0327	0324
4.	Thottappally	0597	0600	0602	0600	0597
5.	Alapuzha	0704	0707	0710	0707	0704
6.	Thanki	0935	0930	0926	0930	0935
7.	Kannamali	1047	1037	1025	1037	1047
8.	Kuzhuppilly	1140	1147	1149	1147	1140
9.	Perinjanam	1269	1274	1279	1274	1269
10.	Nattika	1323	1330	1333	1330	1323
11.	Blangad	1418	1421	1428	1421	1418
12.	Vakkad	1595	1599	1605	1599	1595
13.	Calicut	1830	1826	1821	1826	1830
14.	Melody	2013	2009	2004	2009	2013
15.	Thalassey	Behind Bishop's House (New CP 2188)	Old CP1067(40m north of new CP2176)	Old CP1075(100m north of new CP2176)	Old CP1067(40m north of new CP2176	Behind Bishop's House (New CP 2188)
16.	Kanhangad	2608	2603	2598	2603	2608
17.	Kasargod	2730	2725	2720	2725	2730
18.	Kannuvatheertha (Old CP)	103	111	121	111	103