DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT OF PROPOSED IRRIGATION PROJECT BY CONSTRUCTION OF BARRAGE WITH HEAD SLUICES

SECTOR 1(C) - RIVER VALLEY/IRRIGATION PROJECTS
CATEGORY – B1

TERMS OF REFERENCE

Lr.No.SEIAA-TN/F.No.9677/Violation/ToR-1400/2022 dated 23.03.2023

LOCATION OF BARRAGE

Across the River Coleroon at RD 74/3 Mile

Village – Adhanur and Kumaramangalam

District – Cuddalore and Mayiladuthurai

State – Tamil Nadu

PROPOSED COMMAND AREAS

Total Command Areas – 9159 Ha

Cuddalore District – 6601 Ha

Mayiladuthurai District – 2558 Ha

PROJECT PROPONENT

THE EXECUTIVE ENGINEER

Water Resource Department,
Special Project Division,
Kumbakonam – 612001.

EIA CONSULTANT

AADHI BOOMI MINING & ENVIRO TECH (P) LTD
(QCI/NABET Accredited EIA Organization)

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The Executive Engineer
Water Resource Department,
Special Project Division,
Kumbakonam – 612001**.**

To **Date:**

1. **The District Environmental Engineer,**
   Tamilnadu Pollution Control Board,
   Plot No A-3, SIPCOT Industrial Complex,
   Kudikadu, Cuddalore - 607 005.

2. **The District Environmental Engineer,**
   Tamil Nadu Pollution Control Board,
   District Collectorate, Master Plan Complex,
   Nagapattinam – 611001.

Sub: Submission of **Draft Environmental Impact Assessment (EIA) Report** as per EIA Notification, 2006 dated 14.09.2006 and amendments for the proposed Irrigation Project (under violation) by construction of Barrage with head sluices across the River Coleroon at RD 74/3 mile in Adhanur-Kumaramangalam Villages of Cuddalore and Mayiladuthurai Districts covering 9159 hectares of cultivable command area – reg.

Ref:

1. Earlier online EC proposal No: SIA/TN/RIV/406095/2022 dated 18.11.2022
2. Minutes of 358th SEAC Meeting dated 24.02.2023
3. Minutes of 604th SEIAA meeting dated 23.03.2023
4. TOR Lr.No.SEIAA-TN/F.No.9677/Violation/ToR-1400/2022 dated 23.03.2023

Dear Sir,

With reference to the above mentioned subject, we herewith submit the hard copy of **Draft Environmental Impact Assessment Report** as per the Terms of Reference vide Lr.No.SEIAA-TN/F.No.9677/Violation/ToR-1400/2022 dated 23.03.2023 with a Demand Draft of Rs_____ (_____) in favor of DEE, TNPCB, Cuddalore and Nagapattinam for your kind perusal.

Hence, we kindly request you to process our application for Public Hearing as per EIA Notification, 2006 for obtaining Environment Clearance from SEIAA/SEAC, Tamil Nadu as early as possible.

Yours faithfully,

The Executive Engineer
Water Resource Department,
Special Project Division,
Kumbakonam – 612001.
(Project Proponent)

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The Executive Engineer
Water Resource Department,
Special Project Division,
Kumbakonam – 612001.

Undertaking by Project Proponent

I, **The Executive Engineer**, Water Resource Department, Special Project Division, Kumbakonam – 612001 hereby give this undertaking to the effect that the conditions laid down in Terms of Reference vide Lr.No.SEIAA-TN/F.No.9677/Violation/ToR-1400/2022 dated 23.03.2023 for our proposed Irrigation Project (under violation) by construction of Barrage with head sluices across the River Coleroon at RD 74/3 mile in Adhanur-Kumaramangalam Villages of Cuddalore and Mayiladuthurai Districts covering 9159 hectares of cultivable command area, have been compiled with, and the data submitted and the information presented in this report are true to the best of my knowledge.

Signature and seal of the Project Proponent

Place : Salem
Date :

GST : 33AAOC0944L1ZJ

AADHI BOOMI MINING AND ENVIRO TECH (P) Ltd.

(NABET/QCI Accredited Organisation – 'A' Category)
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Call: 0427-2444297, +91 9842729655, +91 9443290855
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Declaration by the Head of the accredited consultant organization/authorized person

I, **Mr. Suriyakumar**, Managing Director of Aadhi Boomi Mining & Enviro Tech (P) Ltd, hereby confirm that the Draft EIA Report has been prepared as per the conditions laid down in Terms of Reference vide Lr.No.SEIAA-TN/F.No.9677/Violation/ToR-1400/2022 dated 23.03.2023 for conducting Public Hearing and obtaining Environment Clearance from SEIAA/SEAC, Tamil Nadu for the proposed Irrigation Project by construction of Barrage with head sluices across the River Coleroon at RD 74/3 mile in Adhanur- Kumaramangalam Villages of Cuddalore and Mayiladuthurai Districts, Tamil Nadu.

I, hereby confirm that the mentioned experts in NABET Annexure VII prepared the Draft EIA report of **The Executive Engineer**, WRD, SPD, Kumbakonam. I also confirm that I, the EIA Coordinator (EC) have gone through the report, and shall be fully accountable for any mis-leading information mentioned in this statement. It is certified that no unethical practices, plagiarism involved in carrying out the work and external data/text has not been used without proper acknowledgement while preparing this EIA report.

Name : **Mr. S. SURIYAKUMAR**

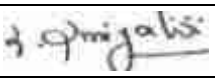
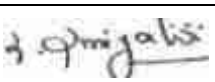
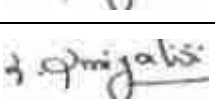
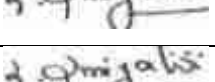
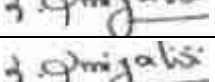
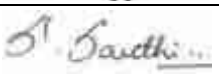
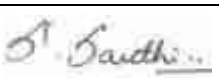
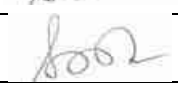
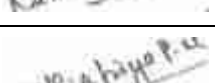
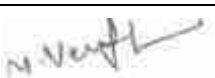
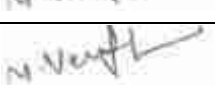
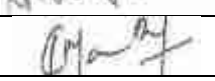
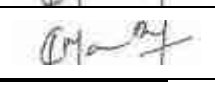
Signature :

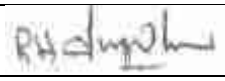
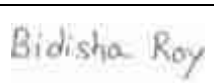
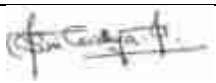
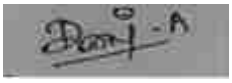
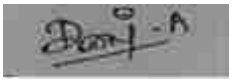
Designation : **Managing Director**

Name of the EIA Consultant Organization: **Aadhi Boomi Mining & Enviro Tech Private Limited.**

QCI/NABET Accredited Consultant, Certificate No: **NABET/EIA/2124/RA 0228**.

DECLARATION OF EXPERTS - NABET ANNEXURE – VII

S.No	Name of the Expert	Category	Functional Areas	Signature
In-House Experts				
1.	Mr.S.Suriyakumar	A	EIA Co-ordinator	
		A	Solid and Hazardous Waste SHW*- HW* only	
		A	Risk Assessment and Hazard Management (RH)	
		A	Land Use (LU)	
		A	Soil Conservation (SC)	
2.	Mrs. S. Santhi	B	Land Use (LU)	
		B	Socio Economics (SE)	
3.	Mr.K.Thirumeni	B	EIA Co-ordinator - Building and Construction	
		B	EIA Co-ordinator - Highways	
		B	Land use (LU)	
4.	R.R Prakash Babu	B	Air Pollution, Monitoring, Prevention and Control (AP)	
		B	Noise and Vibration (NV)	
5.	Dr. Nithia Priya P.M	B	Air Pollution, Monitoring, Prevention and Control (AP)	
		B	Water Pollution Monitoring, Prevention and Control (WP)	
6.	Mr. M. Venkatesh Prabhu	B	Meteorology, Air Quality Modelling & Prediction (AQ)	
		B	Noise and Vibration (NV)	
7.	Mr. K. Manuraj	B	Geology (GEO)	
			Hydrogeology (HG)	

8.	V. Sudha	B	Ecology and Biodiversity	
Empanelled Experts				
9.	Dr. Nallathambi Varadarajan	A	Geology (Geo)	
		A	Hydrology, ground water and water conservation (HG)	
10.	Bidisha Roy	B	Meteorology, Air Quality Modelling & Prediction (AQ)	
Team Member Involved in Report Preparation				
11.	Mrs. S. Sri Vidhya	Team Member	Water Pollution Monitoring, Prevention and Control (WP) under FAE - Dr. Nithia Priya P.M	
			Meteorology, Air Quality Modelling & Prediction (AQ) under FAE - Mr. M. Venkatesh Prabhu	
12.	Mr. S. Sagath Srikrishnan	Team Member	Solid hazardous Waste (SHW) under FAE Mr. Suriyakumar. S	
			Water Pollution Monitoring, Prevention and Control (WP) under FAE - Dr. Nithia Priya P.M	
13.	Mrs. A. Nagadevi	Team Member	Water Pollution Monitoring, Prevention and Control (WP) under FAE - Dr. Nithia Priya P.M	
			Ecology and Biodiversity (EB) under FAE – V. Sudha	
14.	Mr. A. Jagadeesh Kumar	Team Member	Noise and vibration under FAE - Mr. M. Venkatesh Prabhu	
			Meteorology, Air Quality Modelling & Prediction (AQ) under FAE - Mr. M. Venkatesh Prabhu	

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LIST OF ABBREVIATIONS AND ACRONYMS

EIA	Environmental Impact Assessment
EMP	Environment Management Plan
EMC	Environment Management Cell
MOEF & CC	Ministry of Environment Forest and Climate Change
WRD	Water Resources Department
TOR	Terms of Reference
EC	Environment Clearance
SEAC	State Expert Appraisal Committee
SEIAA	State Environmental Impact Assessment Authority
TNPCB	Tamil Nadu Pollution Control Board
NABET	National Accreditation Board for Education and Training
NABL	National Accreditation Board for Testing and Calibration Laboratories
CPCB	Central Pollution Control Board
DGM	Department of Geology& Mining
PWD	Public Works Department
NOC	No Objection Certificate
NH	National Highway
SH	State Highway
KM	Kilo Meter
HA	Hectare
DGPS	Differential Global Positioning System
AAQ	Ambient Air Quality
AQI	Air Quality Index
GLC	Ground Level Concentration
SPM	Suspended Particulate Matter
DB	Decibel
LEQ	Equivalent Noise Level
SEIS	Seismograph
KLD	Kilo Litre Per -Day
HSE	Health Safety And Environment
PH	Public Hearing
R & R	Rehabilitation & Resettlement
CSR	Corporate Social Responsibility
EMC	Environmental Management Cell
GOVT	Government of Tamil Nadu

WQI	Water Quality Index
CCA	Cultivable Command Area
TMC	Thousand Million Cubic feet
IMD	India Meteorological Department
MSL	Mean sea Level
BMTPC	Building Materials and Technology Promotion Council
CTE	Consent to Establish
CTO	Consent to Operate
PM	Particulate Matter
VES	Vertical Electrical Sounding
EC	Electrical conductivity
CER	Corporate Environmental Responsibility
CPHEEO	Central Public health and Environment Engineering Organization
Mcft	Million Cubic Feet
NIHL	Noise Induced Hearing Loss
HEC – RAS	Hydrologic Engineering Centers River Analysis System
NGO	Non-Government Organization
CWC	Central Water Commission
DDMA	District Disaster Management Authority
CAT	Catchment Area Treatment
SYI	Silt Yield Index
TWAD	Tamil Nadu Water Supply And Drainage Board
BIS	Bureau of Indian Standards
SDO	The Sub Divisional Officer
NMR	Nominal Muster Roll
NAAQS	National Ambient Air Quality Standards

Specific TOR by SEAC

S.No	ToR	Compliance
1.	The pp shall furnish 30 Years Coleroon river flow data.	The thirty years of Coleroon river flow data is attached as annexure II. Refer Page No 407 in EIA Report.
2.	The pp shall furnish drainage pattern around 10 km of the project site & the Cultural Command Area along with details of wells, infiltration area, surface water sources with capacity, Ground water level etc for a period of 10 Years.	The drainage pattern around 10km radius of the project site and in command area is shown in Fig No 3.64 and 3.65. Refer Page No 214 and 215 in Chapter 3 of EIA report. There is no major surface water body such as lake and ponds within command areas. Veeranam Lake is located 6.3 km away from proposed barrage in north direction. The details of well and water level in the study are mentioned in chapter 3. Refer Page No 117 to 121.
3.	Details and current status of Land acquisition for Govt. and Private lands with Survey No. & Village	The details of land acquisition Survey No. & Village is given in Chapter 4. Refer Page No 252 and 253.
4.	Details on the operating, expired, abandoned quarries located within 5 km radially around the proposed construction of barrage.	There are no quarries located within 5km radius of the proposed barrage.
5.	Details on the seismicity of the region where the construction is carried out.	The seismicity of the region of project site is shown in Fig No 2.3 in Page No.16 of Chapter 2. The project falls under Zone-II, Low damage risk zone as per BMTPC, Vulnerability atlas Seismic zone of India IS: 1893-2002
6.	Details of impact on pulse & paddy production before & after proposed construction of barrage.	The detailed study of impact on pulse and paddy is mentioned in Chapter 4. Refer Page No 258 to 277.

7.	Details of drinking water sources downside of barrage and the implications of barrage on them.	The Kumaramanglam water intake is located is located 140m away from the proposed barrage in downstream side. The dam breach analysis of proposed barrage is given detail in Chapter 7. Refer Clause 7.5 in Page No. 292
8.	Detailed residual moisture impact study.	The residual moisture impact is mentioned in Chapter 4. Refer Clause 4.1.2 in Page No 231.
9.	Details & Impact study on the proposed desilting & Dredging activity associated with proposed construction of barrage.	The details of desilting activity are given in Chapter 2. Refer Clause 2.12 in Page No 27. The impact of desiliting and its mitigation measures are mentioned in Chapter 4. Refer Clause 4.4.1 and 4.4.1.1 in Page No 238 and 239.
10.	Details on Disaster Management pertaining to proposed barrage.	The detailed disaster management plan is given in Chapter 7. Refer Page No Page No 288 to 307.

Terms of Reference by SEIAA

S.No	ToR	Compliance
1.	Details of impact on migratory fish movement and habitat of wild life near the sedimentation area.	There are no wildlife sanctuaries within 10km radius of the proposed barrage. The impact on migratory fish movement is mentioned in Clause 4.4.3 of Chapter 4. Refer Page No 244.
2.	Impact of changes due to sedimentation and the effect on water quality due to interferences.	The slope of the sub water shed in the upstream side of the proposed barrage is ranged between 0 and 4.7% which is gentle. The possibility of sedimentation in the barrage except through river water is negligible. The sedimentation of the sand will reduce capacity of water storage area. The sand will be desilted based on periodical survey of silt deposition in storage area.
3.	Possible acoustic and noise pollution and their impact on river fauna.	The impact of noise pollution on river fauna is mentioned in Chapter 4. Refer Table No 4.6 in Page No 249.
4.	Impact due to reduced capacity of stored dissolved oxygen.	The construction of barrage is almost completed. During the construction work, the part of river water was diverted within the river. So there was no depletion of stored dissolved oxygen.
5.	New technologies to overcome hazard on riverine system.	The dam breach analysis and management plan is mentioned in Chapter 7. Refer Page No 292 to 307. It is planned to strengthening the both side of river bank on upstream and downstream of proposed barrage. Refer (j) of Clause 2.5 in Chapter 2. Page No 24. The earth for strengthening will be sourced from Ponneri Tank in Ariyalur District. Refer Table No2.7 in Page No 25 of Chapter 2.

Standard Terms of Reference

S.No	ToR	Compliance
1.	**Scope of EIA Study:** The ElA Report should identify the relevant environmental concerns and focus on potential impacts that may change due to the construction of proposed project. Based on the baseline data collected for three (3) seasons (Pre-monsoon, Monsoon and Winter seasons), the status of the existing environment in the area and capacity to bear the impact on this should be analysed. Based on this analysis, the mitigation measures for minimizing the impact shall be suggested in the EIA/EMP study.	The base line data collected for three seasons such as Pre-monsoon, Monsoon and Winter seasons is given in Chapter 3. Refer Page No 38-157. The impact of construction and operation of proposed barrage on various environments such as air, water, noise and soil and its mitigation measures are discussed in Chapter 4. Refer Page No 228 to 277.
2.	**Details or the Project and Site:** **General introduction about the proposed project.** Details of Project and site giving L-Sections of all U/S and D/S Projects with all relevant maps and figures. Connect such information as to establish the total length of interference of Natural River and the committed unrestricted release from the site of Dam/Barrage into the main river. A map of boundary of the project site giving details of protected areas in the vicinity of 25 km of project location. Location details on a map of the project area with contours indicating main project features. The project layout shall be superimposed on a	Coleroon River originates from Upper anicut and its traverses a distance about 165 km and confluences with Bay of Bengal at Palayarai of Nagapattinam District. The proposed barrage is designed for the discharge of 4,55,726 Cusecs which is based on the maximum discharge of Coleroon River (4,00,000 Cusecs) in the year 1961. The construction work of barrage is completed by 9%. There are no protected areas located within 25km radius of proposed barrage. Karaivetti Bird Sanctuary – 57 km-SW The location of barrage, channels

	contour map of ground elevation showing main project features (viz. location of dam, Head works, main canal, branch canals. quarrying etc.) shall be depicted in a scaled map. Layout details and map of the project along with contours with project components clearly marked with proper scale maps of at least 1 :50,000 scale and printed at least on A3 scale for clarity. Existence of National Park, Sanctuary, Biosphere Reserve etc. in the study area, if any, should be detailed and presented on a map with distinct distances from the project components. Drainage pattern and map of the river catchment up to the proposed project site. Delineation of critically degraded areas in the directly draining catchment on the basis of Silt Yield Index as per the methodology of Soil and Land use Survey of India. **Soil characteristics and map of the project area.** Geological and Seismo-tectonic details and maps of the area surrounding the proposed project site showing location of dam site and canal sites. Remote Sensing studies, interpretation of satellite imagery, topographic sheets along with ground verification shall be	superimposed on the contour map is given in Fig No 1.1 in Page No 5 of Chapter 1. The drainage pattern of area of 25km radius around proposed barrage is shown in Fig No 3.64 in Page No 214 of Chapter 3. The nearest catchment map of the proposed barrage is shown in Fig No 7.10 in Page No 316 of Chapter 7. Based on the Silt Yield Index Method, the priority for treatment of catchment area is very low as the slope of the catchment area is less than 5%. The details of geology and geomorphology of the study area around 25km radius of project site and in command areas including map is given Chapter 3. Refer Page No 216 to 221. The project site falls under Zone-II, Low damage risk zone as per

	used to develop the land use/land cover pattern of the study using overlaying mapping techniques viz. Geographic Information System (GIS), False Color Composite (FCC) generated from satellite data of project area. Land details including forests, private and other land. Demarcation of snow fed and rain fed areas for a realistic estimate of the water availability.	BMTPC, Vulnerability atlas Seismic zone of India IS: 1893-2002. Refer Fig No 2.3 in Page No 16 of Chapter 2. The land use details of the study area around 25km radius of project and in command areas are given details in Chapter 3. Refer Page No 206 to 212.
3.	**Description of Environment and Baseline Data:** To know the present status of environment in the area, baseline data with respect to environmental components air, water, noise, soil, land and biology & biodiversity (flora & fauna), wildlife, socioeconomic status etc. should be collected within 10 km radius of the main components of the project/site i.e. dam site and power house site. The air quality and noise are to be monitored at such locations which are environmentally & ecologically more sensitive in the study area. The baseline studies should be collected for 1 season (Preferably Monsoon season). Flora-Fauna in the catchment and command area should be documented. The study area should comprise of the following: Catchment area up to the dam/barrage site. Submergence Area. Project area or the direct impact area	The base line study has been conducted for air, water, noise, soil, land and biology & biodiversity environment for three seasons (June 1st, 2022 to May 31st, 2023). The study area is 10km radius proposed barrage site and in the command areas of both Cuddalore and Mayiladuthurai District. Refer Page No 38 to 186 in Chapter 3. The socio economic status of the study area is mentioned in Clause 3.12 in Page No 187.

	should comprise of area within 10 km radius of the main project components like dam, canals etc. Downstream upto 10 km from the tip of the reservoir.	
4.	**Details of the Methodology:** The methodology followed for collection of base line data along with details of number of samples and their locations in the map should be included. Study area should be demarcated properly on the appropriate scale map. Sampling sites should be depicted on map for each parameter with proper legends. For Forest Classification, Champion and Seth (1968) methodology should be followed.	The monitoring of ambient air and noise level, sampling of soil was carried out 9 locations which includes project site and its buffer zone and command areas. Likewise ground water sampling was done at 33 locations and surface water sampling was done 7 locations. The geo-referenced map showing location of air and noise monitoring and location of water and soil sampling is given in Fig No 3.4 in Page No 44 of Chapter 3
5.	**Methodology for Collection of Biodiversity Data:** The number of sampling locations should be adequate to get a reasonable idea of the diversity and other attributes of flora and fauna. The guiding principles should be the size of the study area (larger area should have larger number of sampling locations) and inherent diversity at the location, as known from secondary sources (e.g. eastern Himalayan and low altitude sites should have a larger number of sampling locations owing to higher diversity). The entire area should be divided in	The study on biodiversity was carried out as per guideline in this Terms of Reference. The study was conducted both around the 10km radius of proposed barrage and in the command areas. The details of floral and faunal diversity in the study areas are mentioned in Chapter 3. Refer Page No 164 to 186.

	grids of 5km X 5km preferably on a GIS domain. There after 25% of the grids should be randomly selected for sampling of which half should be in the directly affected area (grids including project components such as reservoir, dam, powerhouse, tunnel, canal etc.) and the remaining in the rest of the area (areas of influence in 10 km radius form project components). At such chosen location, the size and number of sampling units (e.g. quadrates in case of flora/transects in case of fauna) must be decided by species area curves and the details of the same (graphs and cumulative number of species in a tabulated form) should be provided in the EIA report. Some of the grids on the edges may not be completely overlapping with the study area boundaries. However these should be counted and considered for selecting 25% of the grids. The number of grids to be surveyed may come out as a decimal number (i.e. it has an integral and a fractional part) which should be rounded to the next whole number, The conventional sampling is likely to miss the presence of rare, endangered and threatened (r.e.t.) species since they often occur in low densities and in case of faunal species are usually secretive in behaviour. Reaching the conclusion about the absence of such species in the study area based on such methodology is misleading. It is very important to document the status of such species owing to their high	

	conservation value. Hence likely presence of such species should be ascertained from secondary sources by a proper literature survey for the said area including referring to field guides which are now available for many taxonomic groups in India. Even literature from studies/surveys in the larger landscapes which include the study area for the concerned project must be referred to, since most species from adjoining catchments is likely to be present in the catchments in question. In fact such literature form the entire state can be referred to. Once a listing of possible r.e.t. species form the said area is developed, species specific methodologies should be adopted to ascertain their presence in the study area which would be far more conclusive as compared to the conventional sampling. if the need be, modem methods like camera trapping can be resorted to, particularly for areas in the eastern Himalayas and for secretive/nocturnal species. A detailed listing of the literature referred to, for developing lists of r.e.t. species should be provided in the EIA reports. The R.E.T. species referred to in this point should include species listed in Schedule I and Il of Wildlife (Protection) Act, I912 and those listed in the red data books (BSI, ZSI and IUCN).	
6.	**Components of the EIA Study:** Various aspects to be studied and provided in the EIA/EMP report are as follows:	

	A. Physical and Chemical Environment	
	Geological & Geophysical Aspects and Seismo- Tectonics: Physical geography, Topography, Regional Geological aspects and structure of the Catchment.	The geology, geomorphology and topography of the project site and its buffer zone and in command area are given detail in Chapter 3. Refer Page No 206 to 227.
	Tectonics, seismicity and history of past earthquakes in the area. A site specific study of the earthquake parameters will be done. The results of the site specific earthquake design shall be sent for approval of the NCSDP (National Committee of Seismic Design Parameters, Central water Commission, New Delhi for large dams.	The project site falls under Zone-II, Low damage risk zone as per BMTPC, Vulnerability atlas Seismic zone of India IS: 1893-2002. Moreover the low head diversion dam is small having storage capacity of 0.334 TMC.
	Landslide zone or area prone to landslide existing in the study area should be examined. Presence of important economic mineral deposit, if any.	The project site is not subjected to area prone to landslide. The slope of the area is less 5%.
	Justification for location & execution of the project in relation to structural components (dam/ barrage height).	The justification for selecting the location of the project site is mentioned in Chapter 5. Refer Page No 278 to 280.
	Impact of project on geological environment Meteorology, Air and Noise:	
	Meteorology (viz. Temperature, Relative humidity, wind speed/ direction etc.) to be collected from nearest IMD station.	The meteorology of the project site collected from IMD is mentioned in Chapter 3. Refer Page No 41 to 43.
	Ambient Air Quality with parameters viz. Suspended Particulate Matter (SPM), Respirable Suspended	The ambient air quality and noise level was monitored at 9 locations for three seasons. The analyses of

	Particulate Matter (RSPM) i.e. suspended particulate materials< 10 microns, Sulphur dioxide (S02) and Oxides of Nitrogen (NOX) in the study area at 5-6 Locations. Existing Noise Levels and traffic density in the study area at S-6 Locations. **Soil Characteristics:** Soil classification, physical parameters (viz., texture, Porosity, Bulk Density and water holding capacity) and chemical parameters (viz. pH, electrical conductivity, magnesium, calcium, total alkalinity, chlorides, sodium, potassium, organic carbon, available potassium, available phosphorus, SAR. nitrogen and salinity, etc.) at @ one sample/ha of command area. **Remote Sensing and GIS Studies:** Generation of thematic maps viz, slope map, drainage map, soil map, land use and land cover map, etc. Based on these, thematic maps, an: erosion intensity map should be prepared. New configuration map to be given in the EIA Report. **Water Quality** History of the ground water table fluctuation in the study area. Water Quality for both surface water and ground water for [i] Physical	various parameters of air quality are given in Chapter 3. Refer Page No Page No 45 to 60. The location and noise level of study area are mentioned in Page No 61 to 69 in Chapter 3. The soil sampling was carried out at 9 locations including command areas and their analyses are given Chapter 3. Refer Page No 149 to 159 The slope map, drainage map, soil map, land use and land cover map for the proposed project has been prepared and incorporated in Chapter 3. Refer Page No 206 to 227. Based on the above said map, the erosion intensity map was prepared which is given Chapter 7. Refer No 7.10 in Page No 316. The ground water table in the area is mentioned in Clause 3.9.5 of Page No 117 of Chapter 3.

	parameters (pH, Temperature. Electrical Conductivity, TSS); [ii] Chemical parameters (Alkalinity, Hardness, BOD, COD, No_3, Po_4, Cl, So_4, Na, K, Ca, Mg, Silica, Oil & grease, phenolic compounds, residual sodium carbonate); [iii] Bacteriological parameter (MPN, Total coliform); and [iv] Heavy Metals (Pb, As, Hg, Cd, Cr-6, Total Cr, Cu, Zn, Fe) a minimum 10 Locations, however, the sampling numbers should be increased depending on the command area.	The ground water sample water was collected 33 locations and surface water sample was collected at 7 locations. The analysis of ground water and surface water is mentioned in Chapter 3. Refer Page No 69 to 109.
	Delineation of sub and micro watersheds, their locations and extent based on the Soil and Land Use Survey of India (SLUSOI), Department of Agriculture, Government of India. Erosion levels in each micro-watershed and prioritization of micro-watershed through Silt Yield Index (SYI) method of SLUSOI.	The erosion level of micro water shed in upstream of proposed barrage was studied based on Silt Yield Index (SYI) method of SLUSOI and its details are mentioned Clause of 7.9 of Chapter 7. Refer Page No 310 to 323.
	B. Water Environment & Hydrology:	
	Hydro-Meteorology of the project viz. precipitation (snowfall, rainfall), temperature, relative humidity, etc. Hydro-meteorological studies in the catchment area should be established along-with real time telemetry and data acquisition system for inflows monitoring.	The Hydro-Meteorology of the project area is mentioned in Chapter 3. Refer Page No 41 to 43.
	Run off, discharge, water availability for the project, sedimentation rate, etc. Basin Characteristics.	The water availability for the proposed project is given detail in Chapter 4. Refer Clause 4.14.8 in Page No 275. Environmental flow release will be 20% of the average of the 4 lean months and 30% of Monsoon flow during monsoon season.
	Catastrophic events like cloud bursts	

	and flash floods, if any, should be documented. For estimation of Sedimentation Rate, direct sampling of river flow is to be done during the EIA study. The study should be conducted for minimum one year. Actual silt flow rate to be expressed in ha-m km^{-2} $year^{-1}$. Set-up a G&D monitoring station and a few rain gauge; stations in the catchment area for collecting data during the investigation. Flow series, 10 daily with 90%, 75% and 50% dependable years discharges. Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge. A site specific study on minimum environment flow should be carried out. **C. Biological Environment:** **Flora** Characterization of forest types (as per Champion and Seth method) in the study area and extent of each forest type as per the Forest Working Plan. General vegetation profile and floral diversity covering all groups of flora	The detailed study on Geo-hydro geological Status of the Study Area is covered in Chapter 3. Refer Page No 109 to 148. There is no Reserve Forest or Protected Forest, Wild Life Sanctuaries located within 10km radius of proposed project. Only Pichavaram R.F Extension is

	including Bryophytes, Pteridophytes, Lichens and Orchids. A species wise list may be provided.	located within command area of Cuddalore District.
	Assessement of plant species with respect to dominance, density, frequency, abundance, diversity index, similarity index, importance value index [IVI], Shannon Weiner lndex etc. of the species to be provided. Methodology used for calculating various diversity indices along with details of locations of quadrats, size of quadrats etc. to be reported within the study area in different ecosystems.	The study on ecology and biodiversity was carried out as per guidelines given in the TOR. The floral diversity of the study area is mentioned in Chapter 3. Refer Page No 164 to 174
	Existence of National Park, Sanctuary, Biosphere Reserve etc in the study area if any, should be detailed.	
	Economically important species like medicinal plants, timber, fuel wood etc. Details of endemic species found in the project area.	
	Flora under RET categories should be documented using International Union for the Conservation of Nature and Natural Resources (IUCN) criteria and Botanical Survey of India's Red Data list along with economic significance. Species diversity curve for RET species should be given.	
	Fauna:	
	Fauna study and inventorisation should be carried out for all groups of animals including reptiles and nocturnal animals in the study area. Their present status along with Schedule of the	The details of faunal diversity are mentioned in Page no 175 to 186 of Chapter 3. The catchment area treatment plan

	species. Information (authenticated) on Avi-fauna and wild life in the study area. Status of avifauna their resident/migatory/ passage migrants etc. Documentation of butterflies, if any, found in the area. Details of endemic species found in the project area. RET species- voucher specimens should be collected along with GPS readings to facilitate rehabilitation. RET faunal species to be classified as per IUCN Red Data list and as per different schedule of Indian Wildlife (Protection) Act, 1972. Existence of barriers and corridors if any for wild animals, compensatory afforestation to compensate the green belt area that will be removed, if any, as part of the proposed project development and loss of biodiversity. For categorization of sub-catchments into various erosion classes and for the consequent CAT plan, the entire catchment (Indian Portion) is to be considered and not only the directly the draining catchment. **D. Aquatic Ecology:** Documentation of aquatic fauna like macro-invertebrates, zooplankton, phytoplankton, benthos etc., Fish and fisheries their migration and breeding grounds.	is given in Clause 7.9 of Chapter 7. Refer Page No 310 to 323 The study on Aquatic Ecology is covered in Chapter 3. Refer Page No 164 to 186

	Fish diversity, composition and maximum length & weight of the measured populations to be studied for estimation of environmental flow. Conservation status aquatic fauna.	
	E. Irrigation and Cropping Pattern	
	Copping pattern and Horticultural practices in the study area.	The detailed study on cropping pattern in command areas of Cuddalore and Mayiladuthurai District and water balance chart are given in Chapter 4. Refer Page No 258 to 277.
	Collection of primary data on agricultural activity, crop and their productivity and irrigation facilities component.	
	Component of pressurized/drip irrigation and micro irrigation. Details of Conjunctive use of water for irrigation.	
	F. Socio-Economic:	
	Collection of Baseline data on human settlements, health status of the community and existing infrastructure facilities for social welfare including sources of livelihood, job opportunities and safety and security of workers and surrounding population.	The socio economic study has been conducted around 10km radius of project site and in culturable command areas. The data was collected from both by conducting primary survey and from secondary data.
	Collection of information with respect to social awareness about the developmental activity in the area and social welfare measures existing and proposed by project proponent.	The details on populations, household, literacy, number of labours and facilities available in the villages of study area are given detailed in Chapter 3. Refer Page no 187 to 205
	Collection of information on sensitive habitat of historical, cultural and religious and ecological importance.	
	The Socio-economic survey/profile	

	within 10 Km of the study area for Demographic profile; Economic Structure; Development Profile; Agricultural Practices; Infrastructure, education facilities; health and sanitation facilities; available communication network etc. Documentation of Demographic. Ethnographic. Economic structure and development profile of the area. Information on Agricultural practices. Cultural and aesthetic sites, Infrastructure facilities etc Information on the dependence of the local people on minor forest produce and their cattle grazing rights in the forest land. List of all the Project Affected Families with their names, education, land holdings, other properties. Occupation, source of income, land and other properties to be acquired, etc. In addition to Socio-economic aspects of the study area, a separate chapter on socio-cultural aspects based upon study on Ethnography of the area should be provided.	
7.	**Impact Prediction and Mitigation Measures:** The adverse impact due to the proposed project should be assessed and effective mitigation steps to abate these impacts should be described.	

	Air Environment Changes in ambient and ground level concentrations due to total emissions from point, line and area sources. Effect on soils, material, vegetation and human health: Impact of emissions from DG sets used for power during the construction, if any, on air environment. Pollution due to fuel combustions in equipments & vehicles Fugitive emissions from various sources. Impact on micro climate.	The impact on air environment due to proposed project during construction phase and operational phase are mentioned in Clause 4.1 in Chapter 4. Refer Page No 228 to 232.
	Water Environment : Changes in surface & ground water quality. Steps to develop pisci-culture and recreational facilities. Changes in hydraulic regime and down stream flow. Water pollution due to disposal of sewage. Water pollution from labour colony/camps and washing equipment.	The impact on water environment (Ground water and surface water) due to proposed project during construction phase and operational phase are mentioned in Clause 4.4 in Chapter 4. Refer Page No 238 to 245.
	Land Environment: Adverse impact on land stability, catchment of soil erosion, reservoir sedimentation and spring flow (if any) [a] due to considerable road construction/widening activity [b] interference of reservoir with the inflowing streams [c] blasting for excavation of canals and some other	The channels are already available to discharge water from proposed barrage for irrigation purposes. As the geology of the project site sedimentary formation blasting is not required. The impact on land environment is

	structures Changes in land use/land cover and drainage pattern. Immigration of labour population. Quarrying operation and muck disposal. Changes in land quality including effects of waste disposal River bank and their stability Impact due to submergence. **Biological Environment:** Impact on forests, flora, fauna including wildlife, migratory avi-fauna, rare and endangered species, medicinal plants etc. Pressure on existing natural resources Deforestation and disturbance to wildlife, habitat fragmentation and wild animal's migratory corridors Compensatory afforestation-Identification of suitable native tree species for compensatory afforestation & green belt. Impact on fish migration and habitat degradation due to decreased flow of water Impact on breeding and nesting grounds of animals and fish **Socio-economic Aspects** Impact on local community including demographic profile. Impact on socio-economic status.	mentioned in Clause 4.11 of Chapter 4. Refer Page No 255. The impacts of waste generation are mentioned in Clause 4.6 and 4.7 in Chapter 4. Refer Page No 246 to 248. The impact on Biological Environment is given Chapter 4. Refer Clause 4.9 (Page No 249 to 251). The proposed green belt development is given in Chapter 4. Refer Clause 4.9.2 in Page No 252 The impact on Socio economic is given detail in Chapter 4. Refer Clause 4.10 in page No 252 to 254.

	Impact on economic status. Impact on human health due to water / vector borne disease. Impact on increases traffic. **Impact on Holy Places and Tourism.** Impacts of blasting activity during project construction which generally destabilize the land mass and lead to landslides, damage to properties and drying up of natural springs and cause noise pollution, will be studied. Proper record shall be maintained of the base line information in the post project period. Positive as well as negative impacts likely to be accrued due to the project are to be listed.	The blasting during construction activity is not required in this project as the geological formation of the area is sedimentary.
8.	**Environment Impact Analysis:** Environmental Impact Analysis due to the project on the above mentioned components should be earned out for construction and operation phases using qualitative or quantitative methods.	Environmental Impact Analysis due to the proposed project during construction and operational phase is given detailed. Refer Page No 228 to 277
9.	**Environment Management Plan (EMP):** Environmental Management Plan aimed at minimizing the negative impacts of the project should be given in detail. The mitigation measures are to be presented for all the likely adverse impacts on the environment. The following suggestive mitigating plans should be included: Catchment Area Treatment (CAT) Plan should be prepared micro-watershed	The effective Environmental Management Plan is mentioned in Chapter 10. Refer Page No 330 to 337. The Catchment Area Treatment (CAT) Plan has be prepared for the

	wise. Identification of area for treatment based upon Remote Sensing & GIS methodology and Silt Yield Index (SYI) method of SLUSOI coupled with ground survey. Areas/watersheds falling under 'very severe' and 'severe' erosion categories are required to be treated. Both biological and engineering measures should be proposed in consultation with State Forest Department. Year-wise schedule of work and monetary allocation should be provided. CAT plan is to be completed prior to reservoir impoundment. Mitigations measures to check shifting cultivation in the catchment area with provision for alternative and better agricultural practices should be included. Command Area Development (CAD) Plan giving details of implementation schedule with a sample CAD plan.	proposed project based upon Remote Sensing & GIS methodology and Silt Yield Index (SYI) method of SLUSOI coupled with ground survey. Refer Clause 7.9 in Chapter 7 (Page No 310 to 323). The channel facility is already available in command areas connecting proposed barrage for the irrigation purposes. The basic Command Area Development (CAD) Plan is given in Clause 7.8 of Chapter 7. (Page No 307 to 310)
	Compensatory Afforestation in lieu of the forest land required for the project needs to be proposed. Choice of plants should be made in consultation with State Forest Department including native and RET species, if any.	There is Reserve Forest or Protected Forest located within 10km radius of proposed project.
	Biodiversity and Wild Life Conservation & Management Plan for conservation and preservation of endemic, rare and endangered species of flora and fauna to be prepared in consultation with State Forest Department.	No endemic, rare and endangered species of flora and fauna found within study area of proposed project.
	Resettlement and Rehabilitation (R&R)	The Resettlement and Rehabilitation

	Plan need to be prepared with due consultation with Project Affected Families (PAFs). The provision of the d R&R plan should be according to the National Resettlement and Rehabilitation Policy (NRRP-2007) as well as State Resettlement and Rehabilitation Policy. Detailed budgetary estimates are to be provided. Resettlements sites should be identified.	(R&R) Plan for the proposed project is mentioned in Chapter 7. Refer Clause 7.7 in Page No 307.
	Plan for Green Belt Development along the periphery of reservoir, colonies, approach road, canals etc. to be prepared in consultation with the State Forest Department. Local plant species suitable for greenbelt development should be selected.	The green belt development plan is mentioned in Chapter 4. Refer Table No 4.7 in Page No 252
	Reservoir Rim Treatment Plan for stabilization of land slide/land slip zones if any, around the reservoir periphery to be prepared. Suitable engineering and biological measures for treatment of the identified slip zones to be provided with physical and financial schedule.	The slope of the 10km radius of study area is less than 5%. The land slide/land slip is not possible in the surroundings. Hence Reservoir Rim Treatment Plan is not required.
	Plan for Land Restoration and Landscaping of project sites.	
	Fisheries Conservation & Management Plan-Fish fauna inhabiting the affected stretch of river, a specific fisheries management plan should be prepared for river and reservoir. Muck Disposal Plan- suitable sites for dumping of excavated material should be identified in consultation with the State Pollution	The construction work of proposed barrage is completed by 90%. The excavated sand during the foundation work was dumped over the deepest bed level of the Coleroon River. The excavated silt and clay was

	Control Board and Forest Department. All Muck disposal sites should be minimum 30 m away from the HFL of river. Plan for rehabilitation of muck disposal sites should also be given. The L- section/ cross section of muck disposal sites and approach roads to be given. Financial out lay for this may be given separately.	dumped along the river bank for the strengthening of river bank. The ecological damage assessment was carried out and remediation plans are mention in Chapter 13.
	Plan for Restoration of quarry sites and landscaping of colony areas, working areas, roads, etc.	
	Study of Design Earthquake Parameters: A site specific study of earthquake parameters should be done. The results of the site specific earth quake design parameters should be approval by National Committee of Seismic Design Parameters. Central Water Commission (NCSDP), New Delhi.	The dam breach analysis was carried out using HEC- RAS Software (Hydrologic Engineering Centers River Analysis System)
	Dam Break Analysis and Disaster Management Plan: The outputs of Dam Break Model should be illustrated with appropriate graphs and maps clearly bringing out the impact of Dam break scenario. Provision for early warning systems should be provided.	The details of The dam breach analysis and its management plan are given detail in Chapter 7. Refer Clause No 7.5 in Page No 292 to 307
	Water and Air Quality & Noise Management Plans to be implemented during construction and post-construction periods.	The environmental management plan and its implementation are mentioned in Chapter 10. Refer Page No 330 to 337.
	Mitigating measures for impacts due to Blasting on the structures in the vicinity.	The blasting will not be carried out in the proposed project as the geology of the project site is sedimentary formation.

	Ground Water Management Plan.	
	Public Health Delivery Plan including the provisions for drinking water facility for the local community.	There are more than five water intakes located within water storage area of proposed barrage. The proposed barrage will supply sanitary drinking water to existing villages.
	Labour Management Plan for their Health and Safety.	
	Sanitation and Solid Waste Management Plan for domestic waste from colonies and labor camps etc.	Solid waste management plan for labor camps is given in Chapter 4. Refer Clause 4.6 in Page No 246 to 248.
	Local Area Development Plan to be formulated in consultation with the Revenue Officials and Village Panchayats. Local skill development schemes should be given. Details of various activities to be undertaken along with its financial out lay should be provided.	Local area development and local skill development in consultation with the Revenue Officials and Village Panchayats will be carried under CER activity. Refer Table No 8.2 in Page No 326 of Chapter 8.
	Environmental safeguards during construction activities including Road Construction.	Environmental safeguards during construction activities are give in Chapter 4.
	Energy Conservation Measures.	
	Environmental Monitoring Programme with physical & financial details covering all the aspects of EMP. A summary of cost estimate for all the plans, cost for implementing all Environmental Management Plans including the cost for implementing environmental monitoring programme should be given. Provision for an Environmental Management Cell should be made.	The capital cost and recurring cost for the environmental management plan is mentioned in Chapter 10. Refer Table 10.1 and 10.2 in Page No 336 and 337 respectively. The details on Environmental Management Cell are mentioned in Clause 10.3 in Page No 334 of Chapter 10.
	In the EMP, also include a sample CAD	The north rajan and south rajan channels already exist to distributing

	plan for a distributary outlet command. Such a plan is to show the alignment of irrigation and drainage channels. The components of the OFD works to be undertaken may be clearly mentioned along with a time schedule for their completion vis-a-vis the progress of irrigation development.	irrigation water from the proposed barrage to command areas. So the CAD plan is not required for this project

Check-list

Name of the project: Construction of Barrage with head sluices across the River Coleroon at RD 74/3 mile in

Project location: Adhanur-Kumaramangalam Villages of Cuddalore and Mayiladuthurai Districts

Stage at which the project execution stands: Construction Phase

Part-A: Applicable for Pre-construction:

S.No	Description	Remarks
1.	Have the constructions of STP, Solid Waste Management facility, E-waste management facility, DG sets, etc., been made in the earmarked area only?	Yes
2.	Have statutory clearances and approvals been obtained? a) Chief Controller of Explosives, b) Fire and Rescue Services Department, c) Civil Aviation Department, d) Forest Conservation Act, 1980 and Wild Life (Protection) Act. I 972. e) State/ Central Ground Water Authority, f) Coastal Regulatory Zone Authority, Bio-Diversity Act, 2002, Wetland Authority Act & Rules, other statutory and other authorities as applicable to the project been obtained by project proponent from the concerned competent authorities?	No, the construction of proposed barrage has been started without obtaining EC from SEIAA, Chennai. So the project falls under violation category as per EIA Notification 2006. Now, the PP has been issued TOR under violation to carry out EIA studies for obtaining EC from SEIAA. No other statutory clearances are required for the proposed project.
3.	Have trees been cut? If yes, has the compensation plantation been done, in the ratio of 1: 10?	No, the project has been carried out within water body (River Coleroon). So no trees were cut due to construction activity.
4.	Have the Plastic wastes been segregated and disposed as per the provisions of Plastic Waste (Management & Handling) Rules 2016?	Yes, the Plastic wastes was segregated and disposed as per the provisions of Plastic

		Waste (Management & Handling) Rules 2016
5.	Has a separate environmental management cell formed with suitable qualified personnel?	No. It is proposed to form separate environmental management cell to implement environmental management plan effectively.

Part-B-Pre construction phase:

1.	Has the approval of the competent authority been obtained for structural safety of the buildings during earthquake, adequacy of fire fighting equipments, etc as per National building code including protection measures from lightning etc before commencement of the work?	Yes, structural safety of the barrage was approved by competent authority
2.	Have all required sanitary and hygienic measures for the workers were in place before starting construction activities and the same have been maintained throughout the construction phase?	Yes, the sanitary facility for the labors was made along the river bank on both sides
3.	Are the designs of buildings in conformity with the Seismic Zone Classifications?	Yes, designs of barrage is conformity with the Seismic Zone Classifications
4.	Has the construction of the structures been undertaken as per the plans approved by the concerned local authorities/local administration?	Yes
5.	Has any construction activity of any kind been taken up in the OSR area?	Not applicable
6.	Has the Consent of the local body concerned been obtained for using the treated sewage in the OSR area for gardening purpose?	Not applicable
7.	Are the height and coverage of the constructions in accordance with the existing FSI/FAR norms as per Coastal Regulation Zone Notification, 2011?	Not applicable
8.	Is the basement of the building above the maximum	Not applicable

	flood level documented by the Water Resource Department, PWD, Government of Tamil Nadu in consultation with the CMDA?	
9.	Are the pipelines marked with different colors with the following details? i. Location of STP, compost system, underground sewer line. ii. Pipe Line conveying the treated effluent for green belt development. iii. Pipe Line conveying the treated effluent for toilet flushing iv. Water supply pipeline v. Gas supply pipe line, if proposed vi. Telephone cable vii. Power cable viii. Strom water drains, and ix. Rain water harvesting system.	It is project of construction of barrage. Septic tank was constructed along the banks to treat the latrine wastes during construction phase. Pipelines of Water supply, Power cable and Strom water drains are marked with different colors.
10.	Has a First Aid Room been provided in the project site during the entire construction and operation phases of the project?	Yes
11.	Has the structural design of the proposed building been vetted by premier academic institutions like Anna University, IIT Madras, etc?	NA
12.	Is there any threat to the biodiversity due to the proposed development?	No, the construction activity has been carried out without causing any threat to biodiversity.
13.	Has the present land use surrounding the project site got disturbed at any point of time?	No
14.	Has the existing land use been altered due to the project and is it in consistent with the surroundings?	The land use of river water body will remain river; only the part of water will be stored and diverted for irrigation purposes.
15.	Has the green belt area been planted with indigenous native trees, in adequate numbers and areas?	The process of plantation along the river bank is under process.
16.	Have the natural vegetation listed particularly the	No, the trees were not cut

	tress, been removed during the construction phase? Was there disturbance to the aquatic eco-system within and outside the area?	due to any construction activities in this project. No, this project did not disturb the aquatic eco-system within and outside the area
17.	Did the construction activities of the site adhere to all environmental and ecological standards and safeguards?	Yes
18.	Have the rain water harvesting system (storage + recharge pits) been designed as per the Rain water harvesting and conservation manual of CPWD?	The project itself is proposed for storage of river water to irrigate the command areas.
19.	Has the land earmarked for OSR been identified, earmarked in coordination with CMDA adjacent to the entry or exit and it has been fenced?	Not applicable
20.	Does storm water generated within the premises find access to any water bodies directly/ indirectly?	Yes
21.	Are proper Fire fighting plan and disaster management plan in place?	Yes
22.	Does the building spoil the green views and aesthetics of surroundings and does it provide enough clean air space?	The proposed project improves the agricultural activity in the surrounding thereby aesthetic view of villages will be improved.
23.	Are the DG Sets and STP located away from the boundary of the project site to ensure minimal disturbance to the neighbours?	Yes

Part-C -Construction phase;

24.	Have all the labourers engaged for construction been screened for health and adequately treated before and during their employment on the work at the site?	No, labors will be undergone medical examination. The cost allocated for this is mentioned in Chapter 13.
25.	Were Personnel working in dusty areas given protective respiratory devices and provided with adequate training and information on safety and	No, the cost allocated for providing PPE to working people is mentioned in

	health aspects? Have Occupational health surveillance program of the workers been undertaken periodically to observe any contradictions due to exposure to dust?	Chapter 10. The medical check for workers will be carried six months once. The cost for periodical medical checkup is mentioned in Chapter 4.
26.	Have Periodical medical examination of the workers engaged in the project been carried out and records maintained?	No. It will be done regularly in future when the work is carried out after getting EC from SEIAA.
27.	Water Supply: i) If water requirement during construction phase was met from ground water source, then approval of the PWD Department of water resources is necessary. Was it obtained? ii) Was provision made for the housing labor within the site with all necessary infrastructures and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care. creche etc? iii) Was adequate drinking water and sanitary facilities provided for construction workers at the site? Was the treatment and disposal of waste water through dispersion trench after treatment through-septic tank? The MSW generated disposed through Local Body? iv) Was water demand during construction reduced by use of pre-mixed concrete, curing agents and other best practices prevalent? v) Are the fixtures for showers, toilet flushing and drinking water of flow type by adopting the use of aerators I pressure reducing devises / sensor based control?	The water requirement for construction purposes is sourced from WRD's bore well. Yes, all the facilities required for labors has been made along the river banks. Yes, adequate drinking water and sanitary facilities provided for construction workers at the site. The latrine Waste has been treated through septic tank and disposed properly. Yes Yes
28.	Solid Waste Management: i) Was the solid waste in the form of excavated	No it is used for

	earth excluding the top soil generated from the project activity scientifically utilized for construction of approach road and peripherals roads?	strengthening of bunds
29.	Top Soil Management: i) Was the top soil excavated during construction activities stored for use in horticulture/ landscape development within the project site?	The mineral rich soil excavated is proposed to use for green belt development
30.	Did disposal of construction debris during construction phase affect the neighboring communities and was it disposed off only in approved sites, with the approval of Competent Authority with necessary precautions for general safety and health aspects of the people? Was the construction and demolition waste managed as per Construction & Demolition Waste Management Rules, 2016?	The construction and demolition waste has been managed as per Construction & Demolition Waste Management Rules, 2016
31.	Did Construction spoils, including bituminous materials and other hazardous materials, watercourses? Were the dump sites for such materials secured so that they should not leach into the adjacent land/ lake/ stream etc?	No, Construction work did not spoils any watercourses
32.	Diesel Generator sets: i) For the diesel generator used during construction phase, was the air and noise emission in conformity to the standards prescribed in the Rules under the Environment (Protection) Act, 1986, and the Rules framed thereon? ii) Was the diesel required for operating stand by DG sets stored in underground tanks fulfilling the safety norms? Was clearance from Chief Controller of Explosives was taken? iii) Are the acoustic enclosures installed at all noise generating equipments such as DG sets, air conditioning systems, cooling water tower, etc?	Yes Not applicable Yes
33.	Air & Noise Pollution Control: i) Were vehicles hired for bringing construction	Yes, all the tippers used

	materials to the site in good condition and conformed to air and noise emission standards, prescribed by TNPCB/CPCB? Were the vehicles operated only during non-peak hours? ii) Ambient air and noise levels should conform to residential standards prescribed by the TNPCB, both during day and night. Was the Incremental pollution loads on the ambient air and noise quality closely monitored during the construction phase? Was any pollution abatement measures implemented? iii) Traffic congestion near the entry and exit points from the roads adjoining the proposed project site shall be avoided. Is parking fully internalized and no public space utilized? Is Parking plan as per CMDA norms? iv) Do the buildings have adequate distance between them to allow free movement of fresh air and passage of natural light, air and ventilation?	during construction work were in good condition. The air and noise emission from tippers complied with TNPCB/CPCB prescribed standards. Ambient air and noise levels were complied residential standards prescribed by the TNPCB, both during day and night. The vehicles were parked on the river banks NA
34.	Building material: i) Were Fly-ash blocks used as building material in the construction as per the provision of Fly ash Notification of September, 1999 and amended as on 27th August, 2003 and Notification No. S.O. 2807 (E) dated: 03.11.2009? ii) Was Ready-mix concrete used in building construction and necessary cube-tests conducted to ascertain their quality? iii) Is the use of glass reduced up to 40% to reduce the electricity consumption and load on air conditioning?	NA Yes, cube-tests were conducted to ascertain the quality of Ready-mix concrete used in barrage construction. NA
35.	Storm Water Drainage: Is Storm water management around the site and on site established by following the guidelines laid down	Yes

	by the storm water manual?	
36.	Are the following Energy Conservation Measures been implemented? i) Roof should meet prescriptive requirement as per Energy Conservation Building Code by using appropriate thermal insulation material, to fulfill the requirement. ii) Opaque wall should meet prescribed requirement as per Energy Conservation Building Code which is mandatory for all air conditioned spaces by use of appropriate thermal insulation material to fulfill the requirement. iii) All norms of Energy Conservation Building Code (ECBC) and National Building Code, 2005 as energy conservation have to be adopted Solar lights shall be provided for illumination of common areas. iv) Application of solar energy should be incorporated for illumination of common areas, lighting for gardens and street lighting. A hybrids system or fully solar system for a portion of the apartments shall be provided. v) A report on the energy conservation measures conforming to energy conservation norms prescribed by the Bureau of Energy Efficiency shall be prepared incorporating details about building materials & technology; R & U factors etc and submitted to the SEIAA in three month's time. vi) Energy conservation measures like installation of CFLs/TFLs for lighting the areas outside the building should be integral part of the project design and should be in place before project commissioning.	Not applicable Not applicable It is project of barrage construction. Solar light may not work at sometimes. The light powered by electric current are suggested to use in and around the barrage. Not applicable Agreed, CFLs/TFLs will be used for lighting in and around the barrage
37.	Fire Safety: i) Are adequate fire protection equipments and rescue arrangements in place as per the prescribed standards?	Yes

	ii) Is proper and free approach road for fire-fighting vehicles upto the buildings and for rescue operations in the event of emergency in place?	Yes
38.	Green Belt Development: i) Has the Project Proponent planted tree species with large potential for carbon capture in the proposed green belt area based on the recommendation of the Forest department well before the project is completed?	The green belt development plan is mentioned in Chapter 4 of EIA report.
39.	Sewage Treatment Plant: i) Is the Sewage Treatment Plant (STP) installed certified by an independent expert / reputed Academic institution for its adequacy?	Not applicable
40.	Rain Water Harvesting: i) Is roof rain water collected from the covered roof of the buildings, etc harvested so as to ensure the maximum beneficiation of rain water harvesting by constructing adequate sumps so that 100% of the harvested water is reused? ii) Is Rain water harvesting for surface run-off implemented as per plan? Before recharging the surface run off, is pre-treatment planned with screens, settlers etc done to remove suspended matter, oil and grease, etc? Is adequate number of bore wells/ percolation pits/ as provided? iii) Is the roof rain water collected and stored in the sumps proposed to be treated before water is put to any beneficial us	Not applicable Not applicable Not applicable
41.	Building Safety: i) Is lightning arrester properly designed and installed at top of the building and \there ever is necessary?	Yes lightning arrester properly designed and installed at barrage.

CHAPTER – 1 INTRODUCTION

1.1 PURPOSE OF THE REPORT

The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonam – 612001 (Government of Tamil Nadu) has proposed to construct Barrage with 84 vents across the River Coleroon at RD 74/3 mile in Adhanur and Kumaramangalam Villages to irrigate the cultivable command area of 9159 Ha in Cuddalore and Mayiladuthurai Districts but the construction work of Barrage across the River Coleroon has been already initiated by the project proponent.

As the cultivable command area of 9159 Ha is less than 10,000 Ha, the proposed project has been applied under Category B2 in PARIVESH portal vide SIA/TN/RIV/406095/2022 dated 18.11.2022 to obtain environment clearance from SEAC/SEIAA for the proposed irrigation project.

The project proposal was placed in 358th SEAC Meeting held on 24.02.2023. During the SEAC meeting, committee observed that the project activity was started without prior environmental clearance and the project/activity is covered under Category "B1". Therefore, the Terms of Reference under violation has been issued by SEAC/SEIAA vide Letter no. SEIAA-TN/F.No.9677/Violation/ToR-1400/2022 dated 23.03.2023 to carry out Environmental Impact Assessment Studies including Ecological Damage Assessment, Remediation Plan, Natural and Community Resource Augmentation Plan along with public hearing as per MoEF&CC, O.M dated 12.11.2020.

1.2. IDENTIFICATION OF PROJECT AND PROJECT PROPONENT

1.2.1. IDENTIFICATION OF PROJECT

Coleroon River originates from Upper Anicut and its traverses a distance about 165 km and confluences with Bay of Bengal at Palayarai of Nagapattinam District. It primarily serves as a flood carrier of Cauvery River, carries the surplus water discharged from Mettur Dam. Surplus water from tributaries of Cauvery, in between Upper Anicut and Grand Anicut and also the flood water from Kudamuriti through Cauvery and other drainage through Kuvalai drain on the upstream side of Grand Anicut. The Lower Anicut was constructed across River Coleroon in the year 1836 at RD 67/2-3 mile (108.210 Km).

The flood water that occur in River Cauvery are being diverted through River Coleroon and these water, after meeting the needs of Lower Anicut drain into sea as waste, since no irrigation structures are in existence at the downstream of Lower

Anicut. To store these flood water, the **Executive Engineer, Water Resource Department, Special Project Division** planned to construct Barrage with 84 vents (Low Head Diversion Dam) across the River Coleroon at RD 74/3 mile, 12km downstream of Lower Anicut between Adhanur and Kumaramangalam Villages to irrigate the cultivable command area of 9159 Ha in Cuddalore and Mayiladuthurai Districts. The capacity of the Barrage is 0.334 TMC or 9.457 Million Cum or KLD. The water stored in the barrage will be discharged through the North and South Rajan Channels to irrigate command area of 9159 Ha which is unable to irrigate by Lower Anaicut Barrage.

By implementing this scheme, the water stored in the Lower Anicut can be sufficiently diverted to the Veeranam tank through the Vadavar channel to cater the needs of the drinking water supply to Chennai city.

1.2.2. IDENTIFICATION OF PROJECT PROPONENT

The proponent of the project is The Executive Engineer, Special Project Division, Water Resource Department (Government of Tamil Nadu), Kumbakonam – 612001.

1.3. BRIEF DESCRIPTION OF THE PROJECT

1.3.1. Nature of the Project

The project of construction of barrage across the River Coleroon for irrigation purposes comes under River Valley Sector – 1C and Category B1 as per EIA Notification 2006 and its amendments. The proposed project has been planned to irrigate 9159 Ha of cultivable command area which covers 53 villages in Cuddalore District and 35 villages in Mayiladuthurai District. From the District Diagnostic Report Cuddalore, it is found that production of Paddy crops in 6601Ha of CCA in Cuddalore district is dramatically reduced due to insufficient irrigation water. The proposed project will massively increase the paddy production which will overcome the hunger and starvation across India.

1.3.2 Size of the Project

The capacity of the proposed barrage is 0.334 TMC which covers nearly 310 Ha of river bed area in upstream side. There are 84 numbers of vents planned in this barrage in which 12 vents are scour vents. The height of shutters placed in 72 vents is 3.05m and the height of shutters placed in scour vent is 3.55m. The maximum discharge planned through the barrage vent is 385481 Cusecs and discharge planned through scour vent is 70245 Cusecs. The total discharge of barrage is designed as 4,55,726 Cusecs which is based on the maximum discharge of Coleroon

River(4,00,000 Cusecs) in the year 1961. The command areas proposed to be stabilized by the proposed project is 9159 Ha.

The head sluices has been planned to construct for north and south rajan channel to discharge stored water for irrigation purposes in proposed command area. The cost estimated for the proposed barrage is **Rs. 465.43 Crores.**

1.3.3. Access to the Project site

The project site is easily accessible from Kattumannarkoil in Cuddalore District. By travelling from Kattumannarkoil via road adjacent to Periyakulam(Pond), Omampuliyur village is arrived at the distance of 8km in South side. From the Omampuliyur village, travel further by taking right, the Adhanur village is reached at the distance of 3.5km. From the Adhanur village, the project site is reached at the distance of 350m in south side.

The area is represented by Survey of India Toposheet No. **58 M/12.** The location map is given in fig no 1.1. The Latitude and Longitude of the proposed site at left bank is 11˚11′45″N and 79˚32′04″E and at right bank is 11˚11′14″N and 79˚32′29″E respectively.

1.3.4 Importance and Benefits of the Project

Agriculture, with its allied sectors, is the largest source of livelihood in Tamil Nadu. More than two third of rural households in the State still depend primarily on agriculture for their sustenance, with 93 percent of farmers being small and marginal. The welfare and wellbeing of the State's population mainly depends either directly or indirectly on fortunes of agriculture.

As per Directorate of Economics and Statistics, Department of Agriculture and Farmers Welfare, the agricultural production (food grains) of Tamil Nadu was reported at 12.050 Ton mn in 2022. This records an increase from the previous number of 10.820 Ton mn for 2021. Tamil Nadu data is updated yearly, averaging 7.600 Ton mn from Mar 1981 to 2022, with 42 observations. The data reached an all-time high of 12.050 Ton mn in 2022 and a record low of 4.140 Ton mn in 2017.

To further improve the agricultural activity and its production for the welfare of farmers and people in Tamil Nadu, Government of Tamil Nadu is taking all out efforts to construct barrage across the perennial and non perennial rivers.

The construction of barrage provides employment for more than 300 people during its construction phase and for 10 people during its operational phase. Depending on

this project, indirect employment has been generated by keeping hotels, mechanic shed, petty shops in the villages around the proposed barrage. The storage of water in the barrage and supply of water will improve agricultural activity around the proposed barrage and in command areas of 9159 Ha. The proposed barrage will support in improvement of agricultural production rate from 12.050 Ton mn.

1.3.5 Supply and Demand Details

The demand in agricultural products in Tamil Nadu is getting increased due to lack of sufficient irrigation facility, increased population and conversion of agricultural land in to residential plots, industrial area. If the agricultural activity is not carried out for some years due to insufficient water, the agricultural lands are converted to plots by the farmers. This will leads to shortage of food in Tamil Nadu in future. To overcome such issues, to improve the agriculture, the irrigation systems have to be developed in Tamil Nadu especially in Delta regions. The statistics of agricultural production should be noted every year to plan the construction of barrages, check dams etc. The proposed project will be helpful to maintain the demand and supply of agricultural products in Tamil Nadu.

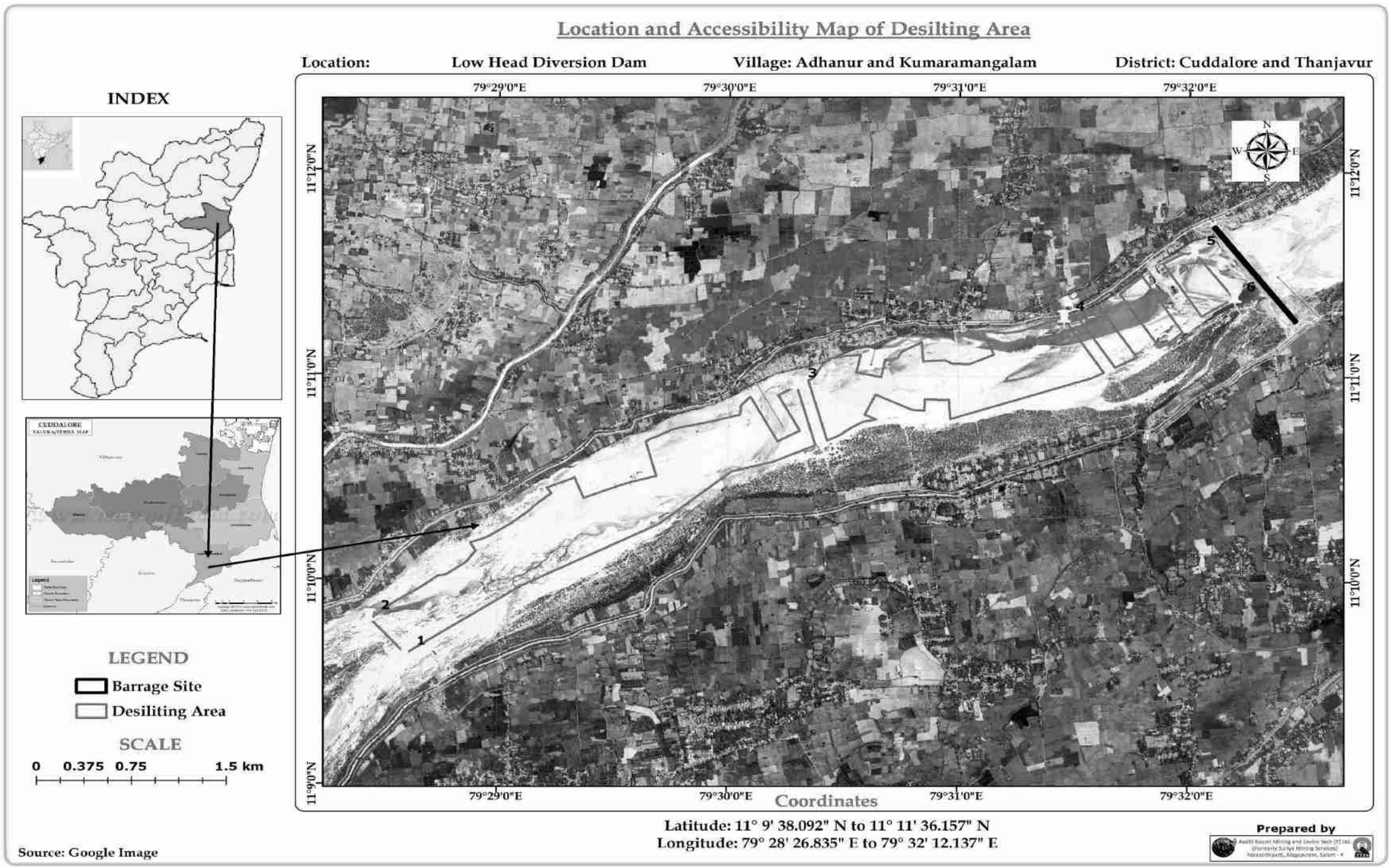
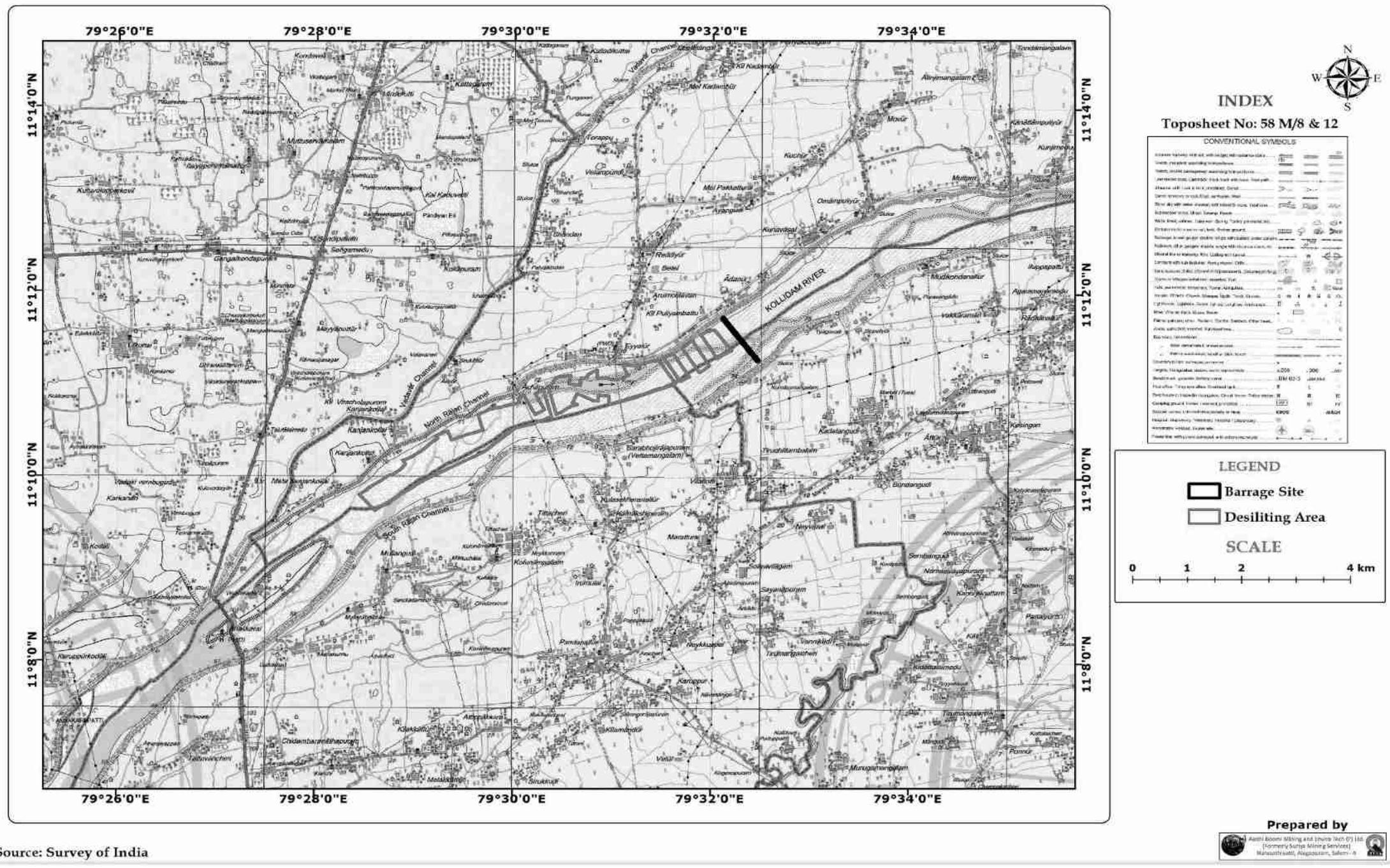


Fig.No:1.1 Showing Location and route map of proposed project site

Toposheet showing Location of Desilting Area



Source: Survey of India

Prepared by

Fig 1.2: Toposheet showing Location of the barrage around 25km radius

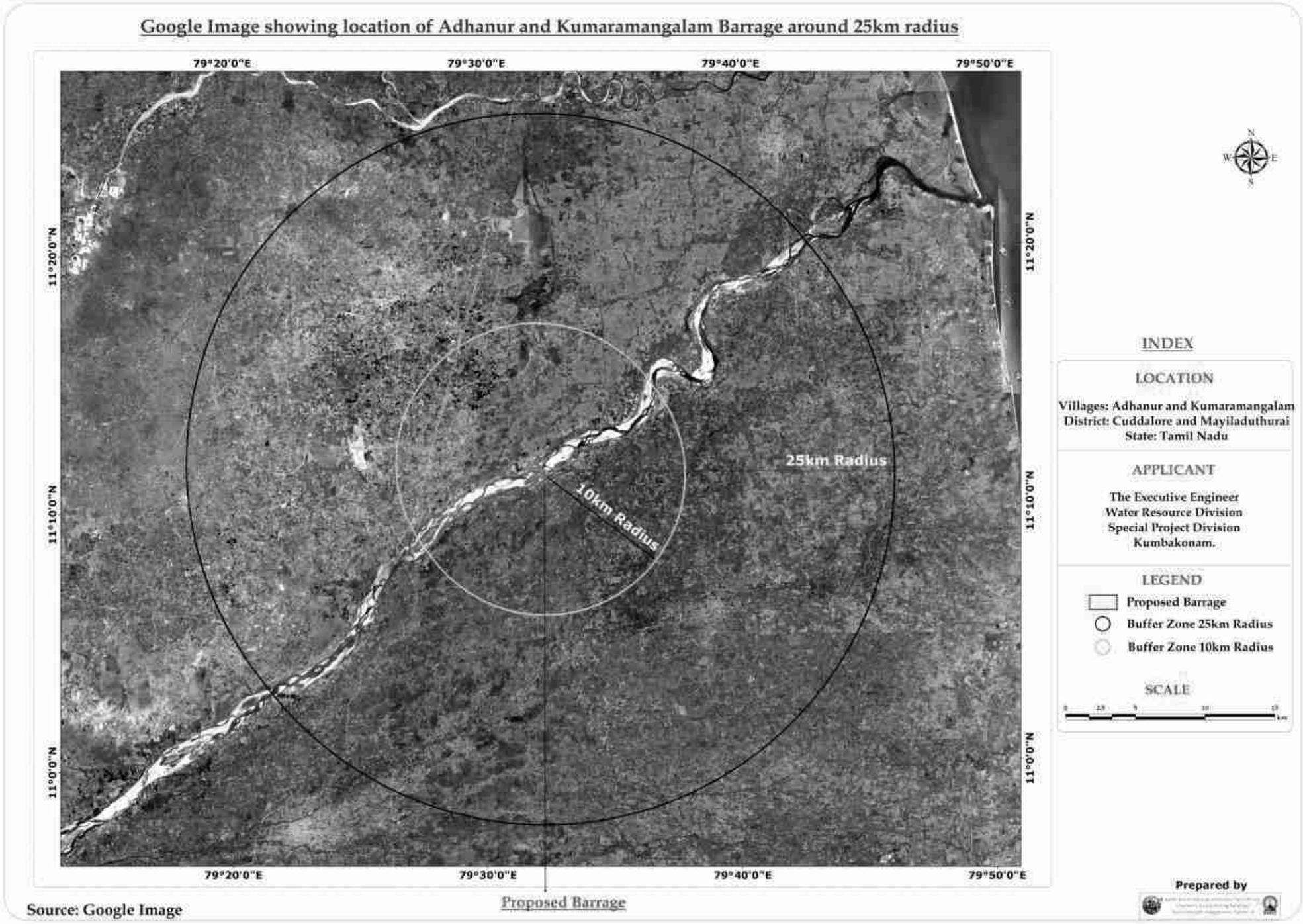


Fig 1.3: Google Earth Image showing 10km and 25km radius around proposed barrage

1.4. SCOPE OF THE PROJECT

The proposal for Environment Clearance of proposed barrage of **The Executive Engineer,** WRD, Special Project Division, requires Environmental Impact Assessment (EIA) study to be carried out as per Generic Terms of Reference specified by the SEAC/SEIAA. During the 358th SEAC meeting, committee observed that the project activity was started without prior environmental clearance and the project/activity is covered under Category "B1". This is primarily to ascertain the potential impacts of the construction and operation of barrage on environmental components, prediction and evaluation of environmental impacts including Ecological Damage Assessment, Remediation Plan, Natural Resource Augmentation and Community Resource Augmentation to delineate Environment Management Plan.

The EIA/EMP report also includes an independent chapter prepared by an Accredited Consultant. The collection and analysis of air, water and soil sample required for preparation of EIA report data will be done by an Environmental Laboratory duly notified under the Environment (Protection) Act, 1986, accredited by NABET/NABL.

The scope of the study includes a detailed characterization of the environment in an area of 10 km radius from the proposed project site and in command areas. The EIA covers one year baseline environmental data, as per the standard generic model given by the MoEFCC, New Delhi.

In order to assess the likely impacts arising out of this project on the surrounding environment and evaluating the quantum of likely negative impacts, if any, from the proposed industrial activity, the proponent has selected Aadhi Boomi Mining and Enviro Tech Pvt. Ltd., Salem as their EIA consultant for this project. ABM prepared an Environmental Impact Assessment (EIA) report and made an effective Environment management Plan (EMP) for various environmental components likely to be affected.

The scope covers all the conditions along with the specific and additional TOR prescribed by SEAC/SEIAA, Tamil Nadu vide Letter no. SEIAA-TN/F.No.9677/Violation/ToR-1400/2022 dated 23.03.2023.

1.5 METHODOLOGY OF EIA STUDY

The EIA study includes detailed baseline data generation and characterization of existing status of environment in an area of 10km radius with the project as its centre and in command areas for various environmental components viz. air, noise, water(surface water and ground water), land(soil quality and land use), biological and

socio-economic components and other parameters of interest. The envisaged scope of EIA is as follows:

- To assess the present status of air, biota, water, land, biological and socio-economic components of environment within 10km radius of study area from the project site and in command areas.
- To identify and quantify the significant positive and negative impacts due to various proposed construction activities in various components of the environment through identification and prediction of impacts.
- To identify the impact and description of the impact with quantitative and qualitative data
- To prepare a detailed Environment Management Plan for implementation of mitigate measures
- To suggest a monitoring program to evaluate the effectiveness of mitigate measures
- Post-project environmental quality monitoring program to be followed
- To prepare a capital and running cost estimates for Environmental Management Plan (EMP).
- To enumerate the aspects of violation study and Ecological Damage Assessment & Remediation Plan.

The baseline monitoring study has been carried out during the June 1st 2022 to May 31st 2023 for various environmental components so as to assess the anticipated impact on the environment and suggest suitable mitigation measures for likely adverse impacts due to the project. Environmental attributes, source and frequency of monitoring are outlined in Table – 1.3.

Table: 1.1 Environment Attributes

S. No	Attributes	Parameters	Source and Frequency
1	Meteorology	Temperature, relative humidity, cloud cover, Wind Speed, Wind Direction, Rain fall,	Secondary sources of IMD station, Cuddalore. Hourly recorded data for the period of one year.

2	Ambient Air Quality	PM_{10}, $PM_{2.5}$, SO_2, NO_x	8 hour samples twice in a week for three seasons at 9 locations.
3	Water Quality	Physical, Chemical and Biological parameters covering 28/30 Parameters	Grab sampling at 7 locations of surface water body and 33 locations of ground water source thrice during one year study period.
4	Noise levels	Noise levels in dB(A) for day time and night time	At 9 locations data monitored once in a month for one year for 24 hours during EIA study.
5	Soil Characteristics	Physical and Chemical, nutrients level and micro-biological characteristics	Thrice at 9 locations during one year study period.
6	Land use	Existing land use for different categories	Based on recent times satellite imageries, Survey of India's OSM and ground validation
7	Biodiversity a) Aquatic b) Terrestrial	Existing terrestrial flora and fauna within 10Km radius	Field observation and utilization of Secondary data.
8	Socio–Economic aspects	Socio–economic and demographic characteristics, worker characteristics	Based on collection of primary data through questionnaire analyses and utilization of Secondary data from census records (2001 –2011), statistical hand books, topo sheets, health records and relevant official records.
9	Risk assessment and Disaster Management Plan	Identify areas where disaster can occur by construction and operation of barrage and release of toxic substances if any	Based on the findings of risk associated with operation of barrage, vehicle movements, stacking of raw materials, etc..,

The impacts of the project activities on environmental components can be quantified through EIA Studies within the impact zone of the project activities. The results of EIA Studies form the basis for the preparation of a viable EMP for mitigation of the adverse impacts.

CHAPTER – 2: PROJECT DESCRIPTION

2.1. Need for the project

The Lower Anicut was constructed across River Coleroon in the year 1836 at RD 67/2-3 mile (108.210 Km). The Lower Anicut supplies the irrigation water to stabilize command areas in Ariyalur, Cuddalore, Thanjavur and Mayiladuthurai Districts. Also it diverts water to Veeranam Eri for the drinking water supply to Chennai city. During monsoon season, the Lower Anicut unable to supply sufficient irrigation water to command areas in Cuddalore and Mayiladuthurai Districts adjacent to coastal areas due to less water pressure. In summer season, the water stored in Lower Anicut needs to supply water to Veeranam Eri and also to irrigation purposes but there is lack of water supply to drinking and irrigation purposes due to storage capacity of Lower Anicut Barrage. To overcome the above issues, the Proponent, Water Resource Department, Special Project Division, Kumbakonam District has proposed to construct barrage with head sluices across the River Coleroon (12 km downstream of Lower Anicut) at RD 74/3 Mile between Adhanur Village, kattumannarkoil Taluk, Cuddalore District and Kumaramangalam Village, Mayiladuthurai Taluk & District to irrigate Cultural Command Area of 9159 Ha (< 10,000 Ha).

2.2 Location of the project:

The project site is represented by Survey of India Topo sheet No. 58 M/12. The Latitude and Longitude of the proposed site at left bank is 11˚11′45″N and 79˚32′04″E and at right bank is 11˚11′14″N and 79˚32′29″E respectively. The area is accessible from Lower Anaicut to reach the Adhanur Barrage by 12km along the mud road on South Rajan canal side.

2.3 Cultivable command areas

The proposed cultivable command area is 9159 Ha in which 6601 Ha is in Cuddalore District covering 53 villages and 2558 Ha in Mayiladuthurai District covering 35 villlages. The distance between the proposed barrage and command area in Cuddalore district is 27km whereas the distance between the proposed barrage and command area in Mayiladuthurai district is about 41km. The command area in both districts is shown in Fig No.2.1.

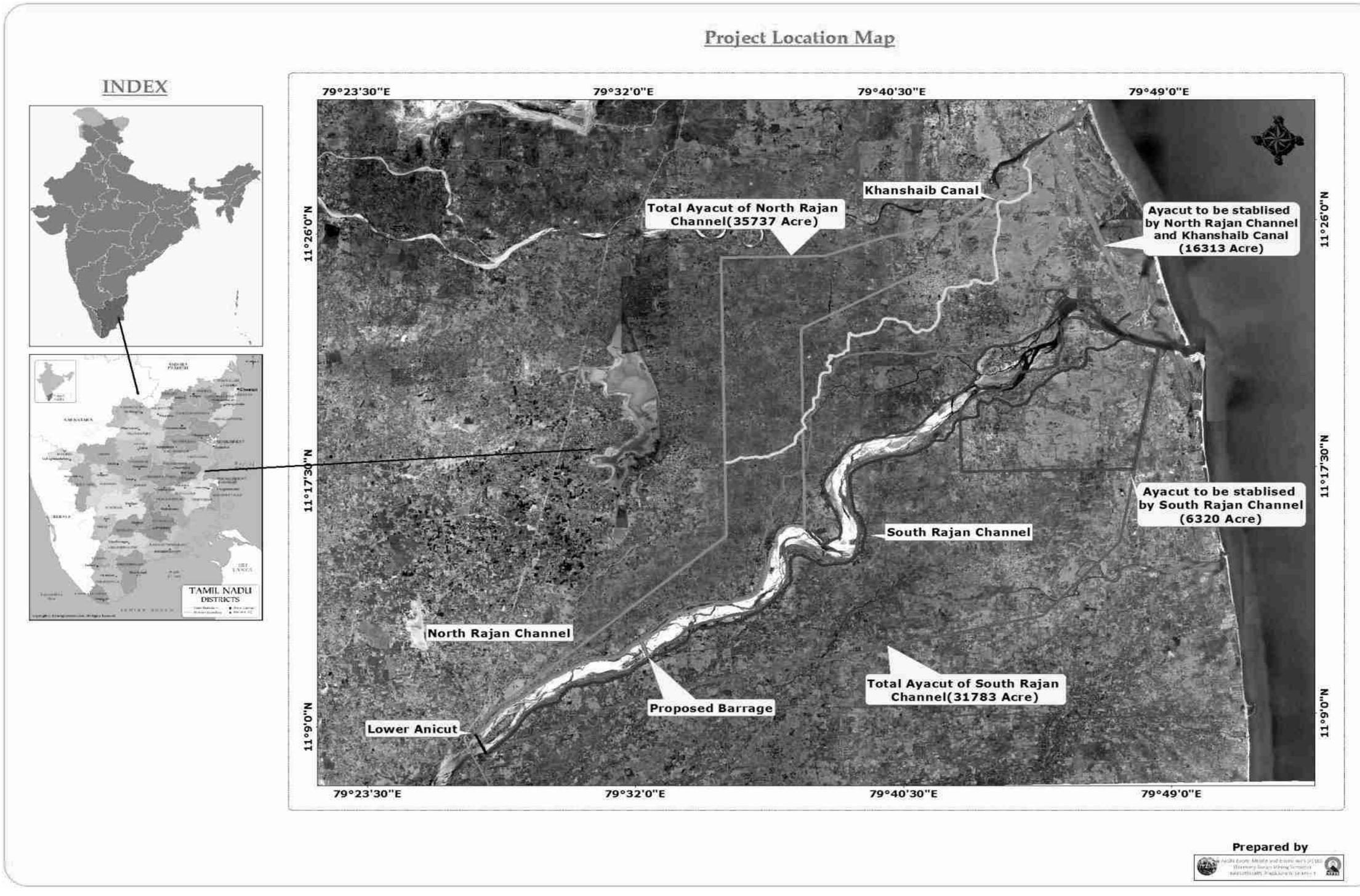


Fig No 2.1 Proposed command areas in Cuddalore and Mayiladuthurai Districts

Table 2.1.: Environmental Settings

<table>
<tr><th colspan="2">Project Details</th></tr>
<tr><td>Project Proponent</td><td>The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonam District</td></tr>
<tr><td>Site Location</td><td>Between Adhanur village of Kattumannarkoil Taluk of Cuddalore District in left bank of the Coleroon River and Kumaramangalam (hamlet) of Thiruchitrambalam village of Mayiladuthurai district in right bank of the Coleroon River.</td></tr>
<tr><td>Geographical Co-ordinates</td><td>Left bank - 11˚11’45”N and 79˚32’04”E
Right bank - 11˚11’14”N and 79˚32’29”E</td></tr>
<tr><td>Toposheet No.</td><td>58M/12</td></tr>
<tr><td>Elevation of river bed level</td><td>+9.5m above MSL</td></tr>
<tr><th colspan="2">Accessibility</th></tr>
<tr><td>Nearest Village</td><td>Adhanur – 100m – N
Kumaramangalam – 240m - S</td></tr>
<tr><td>Nearest Settlement</td><td>
<table>
<tr><th>Name of Village</th><th>Direction</th><th>Distance from project site (Approx.)</th><th>Population</th></tr>
<tr><td>Adhanur</td><td>N</td><td>0.11</td><td>927</td></tr>
<tr><td>Kizhpuliyampattu</td><td>W</td><td>1</td><td>773</td></tr>
<tr><td>Tiruchitrambalam</td><td>S</td><td>1.5</td><td>6371</td></tr>
<tr><td>Sarabojiraja puram</td><td>SW</td><td>0.38</td><td>4782</td></tr>
</table>
</td></tr>
<tr><td>Nearest Town</td><td>Kattumannarkoil - 9Km - N</td></tr>
<tr><td>Nearest Roadway</td><td>NH 81- connecting Coimbatore to Chidambaram 6.2km - N
SH 150-Connecting Kattrupattacheri to Vaitheshwaran kovil – 2.6km – S
MDR – Arulmozhidevan village to Ramadevinallur – 1.6km - NW
Village road – Eyyalur to Adhanur – 60m N
River bank road adjacent to project site</td></tr>
<tr><td>Nearest Railway station</td><td>Mayiladuthurai Railway Station-14.0Km-SE</td></tr>
<tr><td>Nearest Airport</td><td>Trichy International Airport-100km-SW</td></tr>
<tr><th colspan="2">Environmental Sensitiveness</th></tr>
<tr><td>Interstate Boundary</td><td>There is no interstate boundary within 15km radius. Tamil Nadu – Andhra Pradesh Interstate boundary is located 197 km away from</td></tr>
</table>

	lease area in North west direction.
Coastal Zone	Bay of Bengal is located 34.0 km away from lease area in E direction.
Reserve Forest	There is no Reserve forest and Protected forest located within 10km radius of project site. Periyavalayam R.F – 13.6 km - NW Vethiyarvettu R.F – 14.0km – NW Karuppurkodai R.F(within river bed) – 13.7km – SW Koovathur R.F – 19.0km – NW Melur Devanur R.F - 21.3km – NW Sooriyamanal R.F – 22km – NW Siluvaicheri R.F – 24.5km – NW Within Command areas: Pichavaram R.F Extension
Wildlife sanctuary	Nil within 25km radius. The Proposed project site does not attract the Wildlife (Protection) Act, 1972. Karaivetti Bird Sanctuary – 57 km-SW
Water bodies	The site itself is a Water body (Coleroon River). Veeranam Lake-6.3 km-N
Defense Installations	Nil within 10km radius
Critically Polluted area	Nil within 10km radius
Desilting around 500m radius	Nil within 500 m radius
Seismic zone	Zone-II, Low damage risk zone as per BMTPC, Vulnerability atlas Seismic zone of India IS: 1893-2002

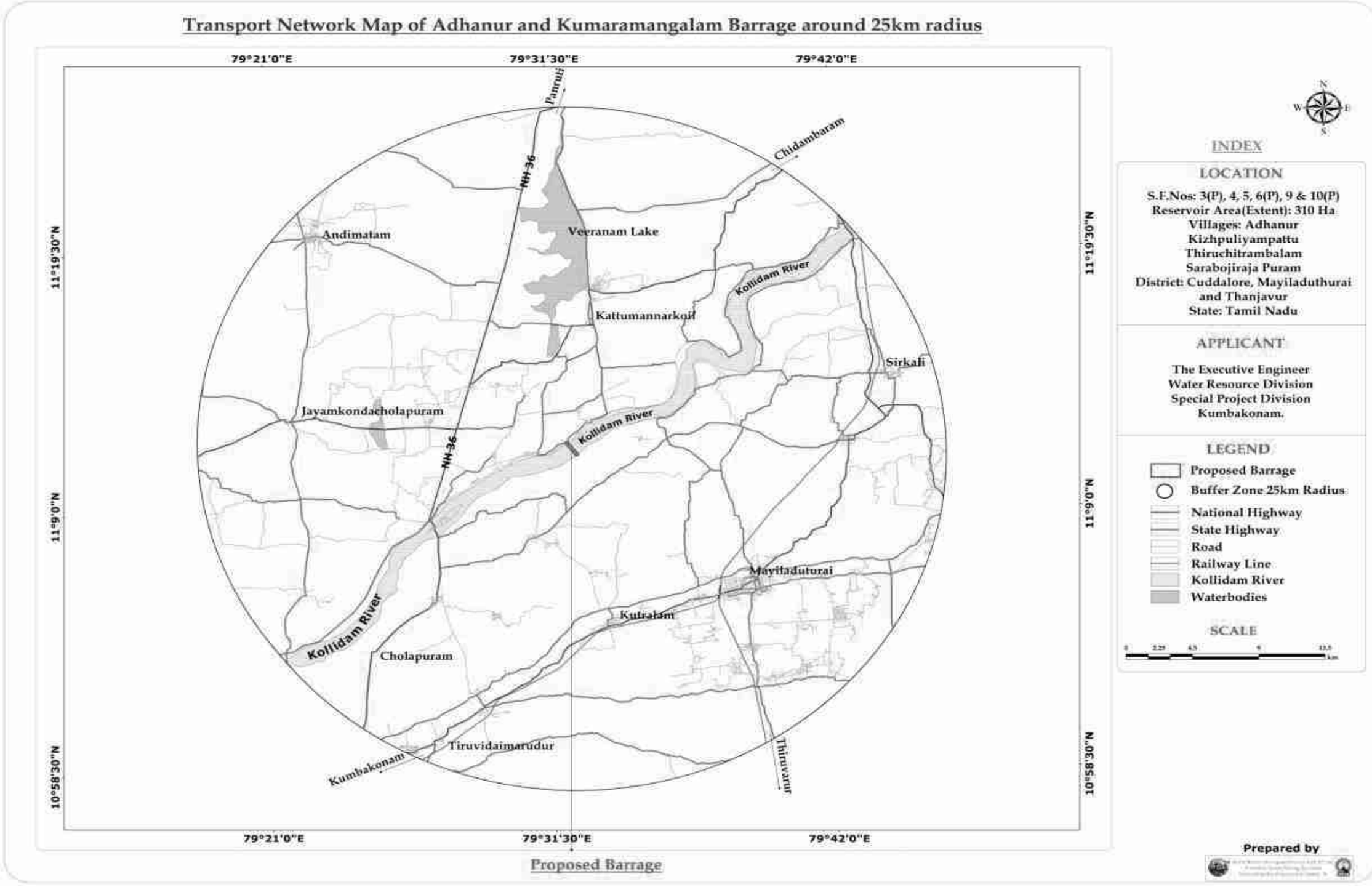


Fig No 2.2: Google Earth Image showing Transport Network of 25 km radius around proposed barrage

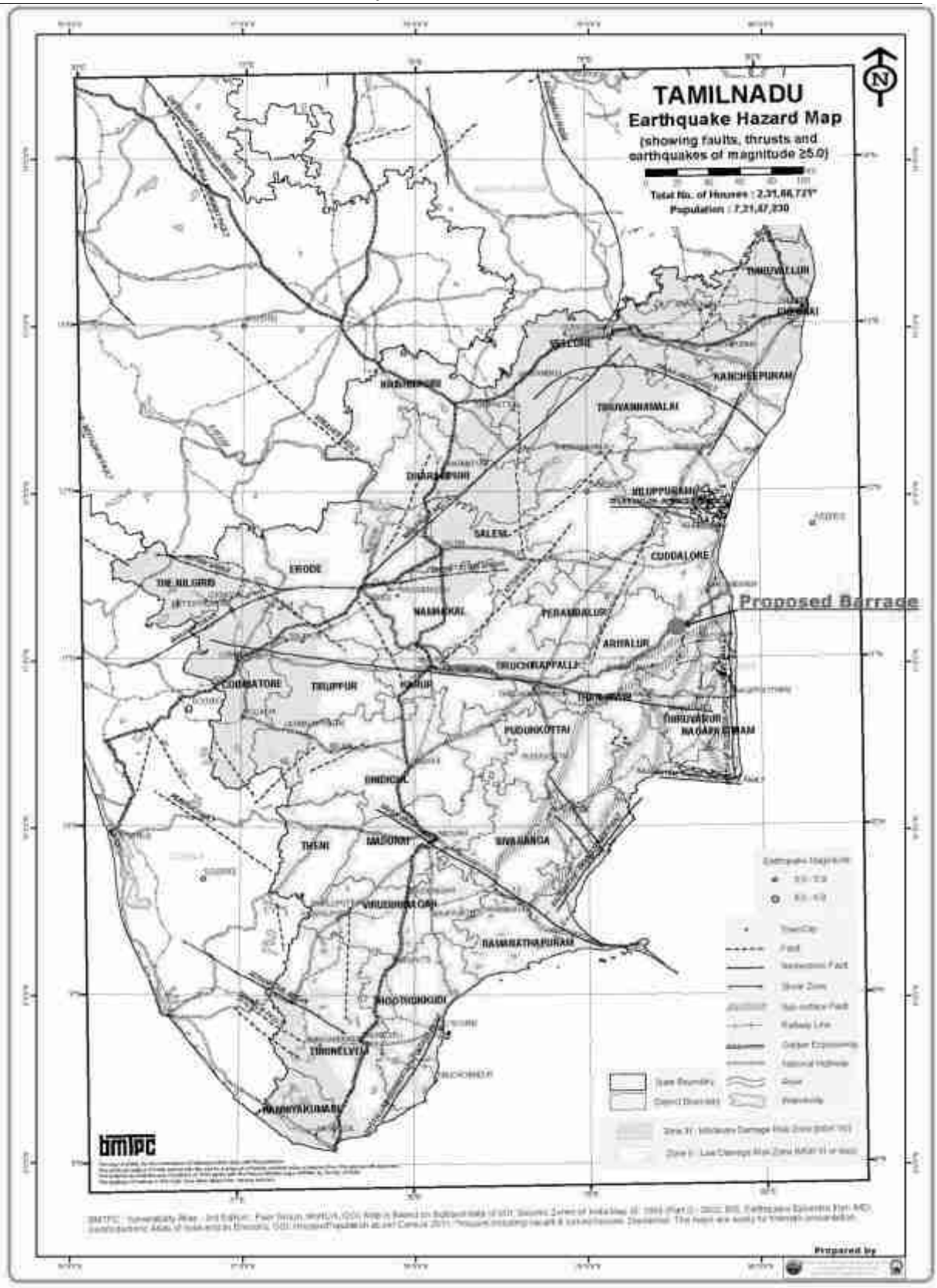


Fig No: 2.3 Earthquake Hazard Map

The project site falls under Zone-II, Moderate damage risk zone as per BMTPC, Vulnerability atlas Seismic zone of India IS: 1893-2002

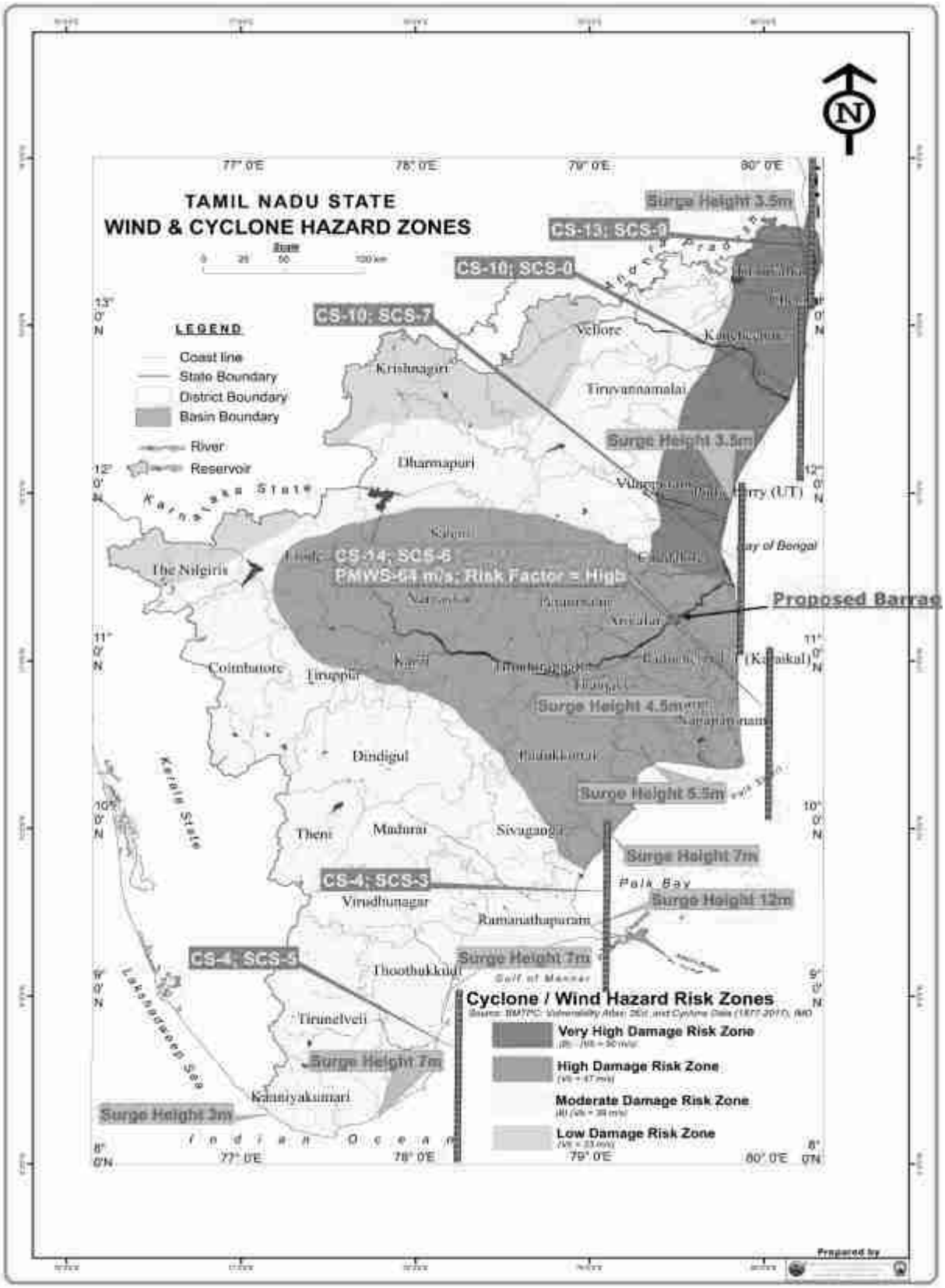


Fig No: 2.4 Winds and Cyclone Hazard Map

The project site falls under High Damage Risk Zone-B (V_b = 47 m/s).

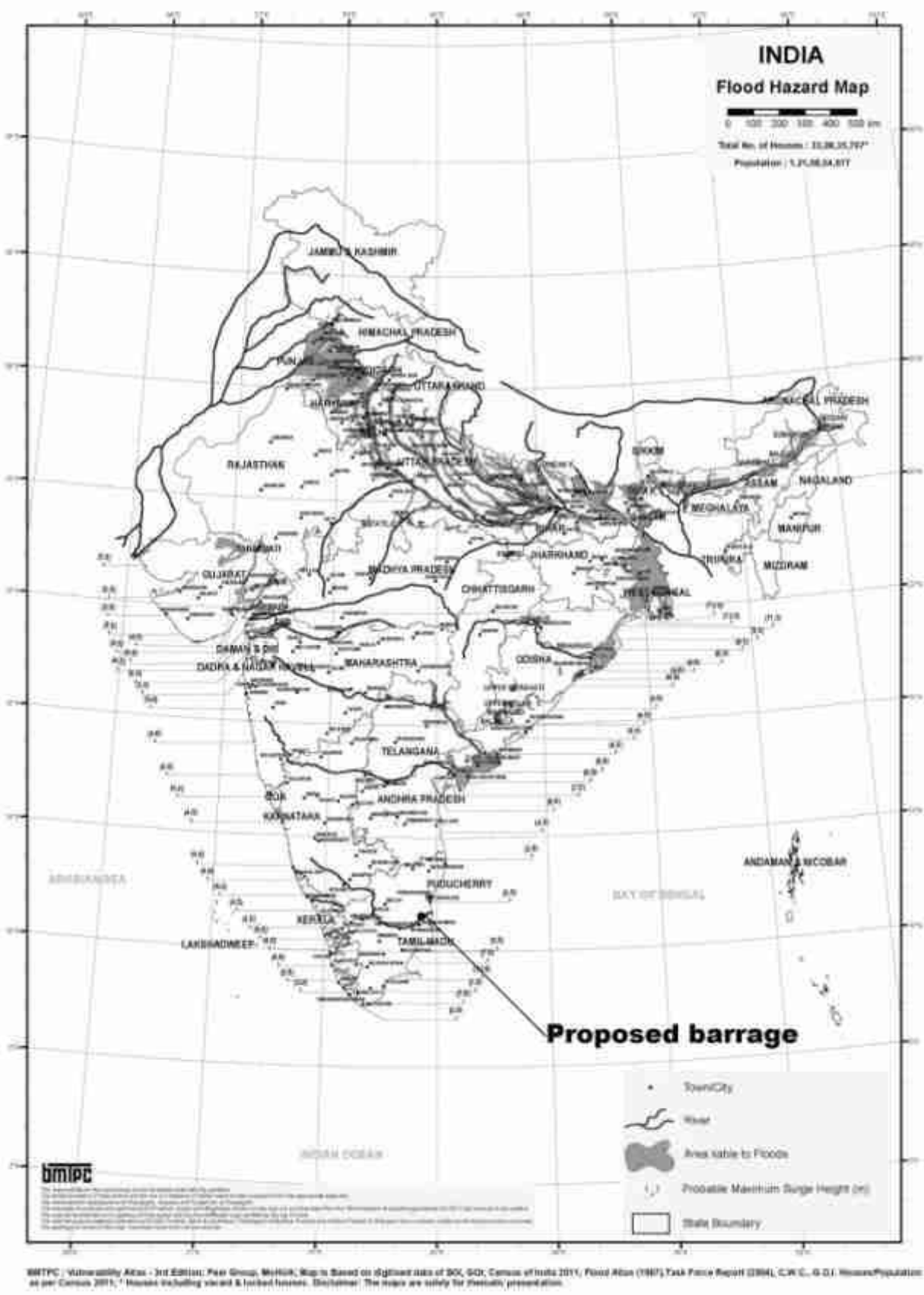


Fig No: 2.5 Flood Hazard Map

2.4 Salient features of the proposed project

Table No 2.2 Salient features of proposed project

S.No	Features		Remarks
1.	Proposed crest level		+10.000m
2.	Proposed shutter height		3.05m
3.	Proposed scour vent shutter		3.55m
4.	Proposed sill for North Rajan channel additional head sluice		+11.300m
5.	Proposed sill for South Rajan channel additional head sluice		+11.000m
6.	Bed width of the Coleroon @ the axis of Proposed Regulator site		1200m
7.	Deepest bed level of the Coleroon River		+8.440
8.	Highest bed level of the Coleroon River		+11.710
9.	Existing top bund level	Left	+17.430
		Right	+17.475
10.	Existing bed level of North Rajan		+10.185
11.	Existing top bund level of North Rajan	Left	+13.820
		Right	+17.350
12.	Existing bed level of South Rajan		+10.950m
13.	Existing top bund level of South Rajan	Left	+17.475
		Right	+14.275
14.	Theoretical bed level of North Rajan near proposed barrage site		+11.185m
15.	Theoretical bed level of South Rajan near proposed barrage site		+11.010m
16.	Proposed storage capacity		0.334 TMC
17.	Sill level of Kondappan Cauvery drainage inlet regulator		+8.505m

2.5 Details of barrage and other structures proposed to be constructed:

a) Barrage

The barrage has been designed for a design discharge of 4, 55,726 cusecs. The barrage is designed with raft foundation. The depth of upstream and downstream cut off wall is 5.0m and 9.0m respectively with open excavation. The Barrage consists of

- Surplus Regulator
- Scour Vent.
- Upstream Protection works
- Downstream Protection works
- Barrage Shutters
- Operating Platform

Table No 2.3 Hydraulic particulars of proposed barrage

S.No	Features	Remarks
General		
1.	Maximum flood discharge	4,55,726 Cusecs or 12,905 Cumecs
2.	Front maximum water level	+15.300m
3.	Rear water level	+14.900m
4.	Total No. of vents	84
5.	Top of shutters	+13.050m
6.	Upstream floor level	+9.500m
7.	Downstream bed level	+9.500m
8.	Top of operating platform	+20.400m
Barrage		
1.	Sill level	10.000m
2.	Number of vents	72
3.	Size of vents	10.60 x 5.30m
4.	Thickness of pier	2.00m
5.	Discharge through barrage	3,85,481 cusecs or 10915.5 cumecs
6.	Stilling basin level	+8.500m
Scour vent		
1.	Sill level	+9.500m
2.	Number of vents	12
3.	Size of vents	10.60 x 5.80m
4.	Thickness of pier	2.00m
5.	Discharge through barrage	70245 cusecs or 1989.11 cumecs
6.	Stilling basin level	+8.500m

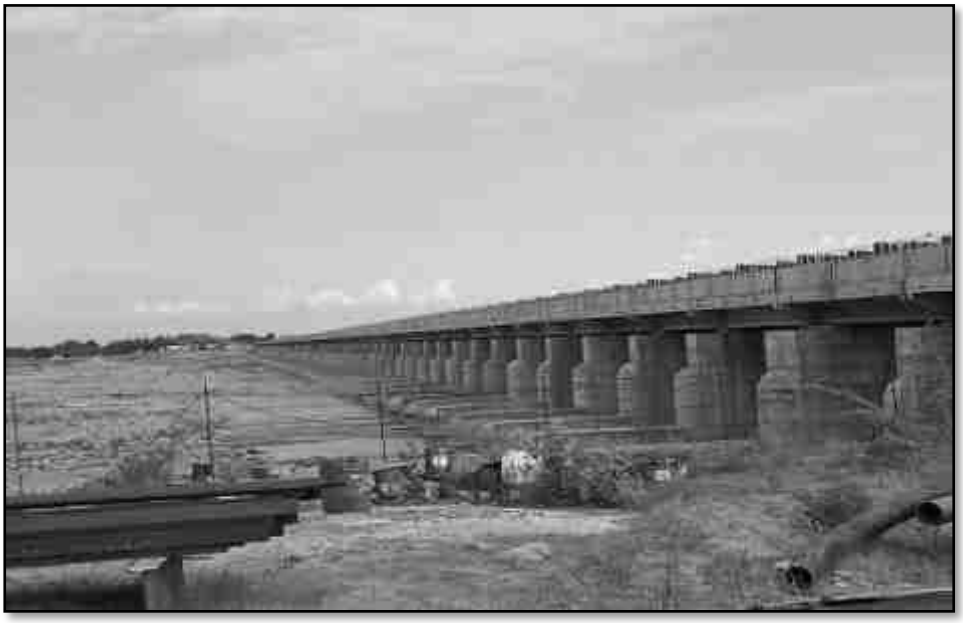


Fig No 2.6 General view of the Barrage

b) Two lane bridges over the barrage

A two lane bridge has been proposed to be constructed along with the barrage for the purpose of inspection and to connect the villages on both banks of river the Coleroon. The width of the bridge including carriage way and both sides foot path is 12m and the total length of the bridge is 1064.40m with 84 Nos. of span.

c) Head sluice for North Rajan Channel

A quantity of 745 Cusecs of water has been proposed to be discharged from this barrage into North Rajan channel towards the stabilization of the existing ayacuts. For this purpose a head sluice has been proposed at the left flank of the barrage in the left bank of Coleroon.

Table No 2.4 Hydraulic particulars of North Rajan channel head sluice:

S.No	Features	Remarks
1.	Maximum flood discharge	21.10 cumecs or 745 cusecs
2.	Sill level	+11.300m
3.	Number of vents	5
4.	Size of vents	2.30m x 1.75m
5.	Up stream bed level	+9.500m
6.	Downstream bed level	+10.000m
7.	Pier thickness	1.00m
8.	Top of shutter	+13.200m
9.	Bottom level of breast wall	+13.050m
10.	Top pier including bed blocks	+17.130m
11.	Road level	+17.750m
12.	Front maximum flood level	+15.450m
13.	Rear water level	+12.900m
14.	Stilling basin level	+9.700m
15.	Stilling basin length	7.00m
16.	Total floor length	27.00m

d) Head sluice for South Rajan Channel

A quantity of 640 Cusecs of water has been proposed to be discharged from this barrage into South Rajan channel towards the stabilization of the existing ayacuts. For this purpose a head sluice has been proposed at the right flank of the barrage in the right bank of Coleroon.

Table No 2.5 Hydraulic particulars of South Rajan channel head sluice:

S.No	Features	Remarks
1.	Maximum flood discharge	18.12 cumecs or 640 cusecs
2.	Sill level	+11.000m
3.	Number of vents	3
4.	Size of vents	2.50m x 1.80m
5.	Up stream bed level	+9.500m
6.	Downstream bed level	+11.000m
7.	Pier thickness	1.20m
8.	Top of shutter	+12.950m
9.	Bottom level of breast wall	+13.050m
10.	Top pier including bed blocks	+17.130m

Fig No 2.7 Head sluice of north rajan channel

Fig No 2.8 Head sluice of south rajan channel

e) Formation of Channel for Narimudukku Drain

The Narimudukku drain is the only drain which infalls into Coleroon river at L.S 117.87 km through Narimudukku regulator. Since the barrage is proposed the drain water has to be diverted and taken to the downstream of proposed barrage which is done by forming the new drain in already existing South Rajan Channel section with a carrying capacity of 2500 cusecs. It runs parallel to South rajan canal upto a distance of 1700m. It crosses South Rajan through Syphon Acqueduct at 1800m and runs further 200m to infall into coleroon through Kondappan Cauvery Infall Regulator.

Fig No 2.9 Diversion of Narimudukku Drain into existing south rajan channel by constructing baffle wall at the centre of channel

f) Two Lane Bridge over North Rajan Channel

A two lane bridge has been proposed to be constructed across the North Rajan Channel to connect the villages in left bank of River the Coleroon. The overall width of the road is 15.775m and the width of the carriageway is 12.00m.

g) Two Lane Bridge over South Rajan and Narimudukku Drain

A two lane bridge is proposed to be constructed across Narimudukku drain and South Rajan Canal at the diversion location of Narimudukku Drain to connect the villages in right banks of River the Coleroon.

h) Syphon Aqueduct

A Syphon aqueduct is proposed at L.S 1.80 km from starting point of Narimudukku Drain across the South Rajan Channel for a designed discharge of about 2500 Cusecs. The Syphon Aqueduct is designed for 4 Nos of vent having size of 3.05x2.40m.

i) Reconstruction of Kondappan Cauvery infall Regulator

It is proposed to construct a new Regulator at the point where the Kondappan Cauvery Regulator exists to drain a total discharge of about 3500 cusecs from Narimudukku Drain and Kondappan Cauvery Drain into Coleroon River. The Regulator design consists of 9 vent way of size of 2.70m x 2.00m.

j) Standardization of bund

The maximum height of storage at the proposed site is 3.05m. The sill level of barrage is fixed as +10.000m. The storage level is fixed at +13.050m and the maximum water level is+15.300m. The top bund level is fixed as +17.500 m including free board. It is proposed to strengthen the bund in the left and right bank of The Coleroon River for a length of 11.600 Km in the upstream side right bund and for a length of 500m in the downstream side from the proposed barrage.

2.6 Details of the project benefited Channels:

Table No 2.6 Benefited channels

North Branch	1. Vadavar 2. Kanjankollai 3. North Rajan Channel 4. Khanshaib canal
South Branch	1. South Rajan Channel 2. Kumukkimanniar 3. Melaraman
Island	1. Vinayagan Theru Voikkal

The main canal length of North Rajan channel is about 45,000m and South Rajan channel is about 53,500m. The length of distributaries of North Rajan channel is about 2,00,350m, South Rajan channel is about 2,19,840m and Khansahib canal is about 1,26,000m.

2.7 Raw Materials and its Source (During Construction Phase)

Table No 2.7 Raw materials and its source

S.No	Raw materials	Source	Distance in km from project site
1.	Sand	Approved sand desilting Muttam village in Cuddalore District	8km
2	Broken jelly, IRC jelly and stone dust	Thoramanaglam village in Perambalur District	86km
3	Jeddy stone, Rough stone and Bond stone	Elavanasurkottai village in Kallakurichi District	110km
4	Earth for standarization of bund	Ponneri Tank in Ariyalur District	25km
5.	Gravel	Palayamkottai village in Cuddalore District	35km
6.	Bricks	Vallampadugai village in Cuddalore District	40km
7.	Tiles	Srimushnam village in Cuddalore District	30km
8.	Limestone	Keerapalayam vllage in Cuddalore District	35km

2.8 Manpower Requirement

The total manpower requirement during construction phase is about 300 people whereas the total manpower requirement during the operational phase is estimated to be around 30 persons.

2.9 Water Requirement

During the construction phase, the 300 numbers of workers are engaged for the construction of barrage. The details of water requirement for the workers and construction activity are given below.

Average requirement of water per labor per day in construction industry = 30 liters
Total water requirement of water for workers = 30*300
= 6 KLD
Total requirement water for construction work = 6 KLD
Total water requirement during construction phase = 12 KLD

Source: Proponent's Bore well

The waste water from the washing taps and drinking water fountains will be used to develop green belt development within the premises. Domestic sewage will be

biologically (naturally) treated in temporarily built Septic Tank of adequate size and properly disposed periodically.

2.10 Proposed schedule for approval and implementation

The proposed activity will be commenced only after obtaining Environment Clearance from SEAC/SEIAA, Tamil Nadu and CTE/CTO from TNPCB and other necessary clearance from concerned departments.

2.11 Amenities for proposed barrage

2.11.1 Health and Sanitation

Semi permanent latrines & urinals have been constructed at convenient places for use of labors during constructional phase. To ensure optimum hygienic conditions in the project site, proper drainage network will be provided to avoid water logging.

2.11.2 First Aid facility

First Aid facility will be set up in project site during construction and operation phase as per IS 13115 : 1991 and The Health and Safety (First Aid) Regulations 1981. The qualified first aid personnel should be appointed or nominated to attend emergency first aid treatment.

2.11.3 Precautionary safety measures to the Labourers

Safety provisions like helmet, goggles, safety shoes and ropes etc have to be provided.

2.11.4 Engineering Office

During construction phase, the temporary engineering office was constructed along the both side of river banks to meet the frequent inspection of construction activities by the WRD Engineers.

For the inspection of barrage during operational phase, permanent engineering office and other staff rooms will be constructed near to the barrage.

2.11.5 Additional rooms/sheds during construction phase.

The staff rooms, security room on both entrance of barrage, labor shed with toilet facilities, power room were constructed by using temporary portable container along the river banks.

2.12 Desilting of storage area of proposed barrage

Desilting is the removal of fine silt and sediment that has collected in a river in order to restore its natural capacity, without widening or deepening of the river. Desiltation works have the potential to improve the hydraulic performance of a river.

Drone aerial surveying with DGPS ground control points followed by digital Photogrammetry has been done to estimate the sand reserves in the reservoir area. The area of desilting in the storage area is 383.3 Ha covering three Districts – Cuddalore (341.46 Ha), Mayiladuthurai (1.3 Ha) and Thanjavur (40.54 Ha). The desilting plan for desilting has been prepared separately for above three districts and submitted to Department of Geology and Mining for approval of desilting plan.

The geological resources of shoal between lower Anicut and proposed barrage (820.77.70 Ha) is estimated about 93,85,525m^3. The total mineable reserve (341.46 Ha – storage area) is estimated as 85,75,310m^3. The Latitude and Longitude of the desiliting area ranges from 11°10'29.97"N to 11°11'37.87"N and from 79°30'28.44"E to 79°32'26.10"E respectively.

Table No 2.8 Co-ordinates of Desilting lease Boundary Pillars

P.No	Latitude	Longitude
1	11°10'29.97"N	79°30'38.39"E
2	11°10'42.84"N	79°30'28.44"E
3	11°10'54.24"N	79°30'57.29"E
4	11°11'10.78"N	79°30'52.43"E
5	11°11'37.87"N	79°32'6.72"E
6	11°11'13.30"N	79°32'26.10"E

2.13 Location of the desilting area in three districts

2.13.1 Cuddalore District

The area of 341.46Ha proposed to be desilting is located in S. F. No. 63/(P), 44/(P), 99(P), 119(P) and 260(P) of Kizhpuliyampattu, Eyyalur, Achalpuram, Sirukattur and Kanjankollai Villages, Kattumannarkoil taluk, Cuddalore district. The area is represented by Geological Survey of India Toposheet No 58M/12. The latitude of the area ranges from 11°10'29.97"N to 11°11'37.87"N and longitude of area from 79° 30'28.44"E to 79°32'26.10"E.

Table No 2.9 Geo Coordinates of lease applied area - Cuddalore District

P.No	Latitude	Longitude	Northing	Easting
1	11°10'29.97"N	79°30'38.39"E	1235997.00	337183.00
2	11°10'42.84"N	79°30'28.44"E	1236135.00	337079.00
3	11°10'54.24"N	79°30'57.29"E	1236481.00	337956.00
4	11°11'10.78"N	79°30'52.43"E	1236990.00	337811.0
5	11°11'37.87"N	79°32'6.72"E	1237811.00	340069.00
6	11°11'13.30"N	79°32'26.10"E	1237519.13	340293.12

2.13.2 Mayiladuthurai District

The area of 1.3Ha proposed to be desilting is located in S.F No. 10(P) of Thiruchitrambalam Village, Mayiladuthurai Taluk and District. The area is represented by Geological Survey of India Toposheet No 58M/12. The latitude of the area ranges from 11°10'47.15"N to 11°11'28.41"N and longitude of area from 79°31'39.29"E to 79°32'26.10"E.

Table No 2.10 Geo Coordinates of lease applied area - Mayiladuthurai District

P.No	Latitude	Longitude	Northing	Easting
1	11°10'47.15"N	79°31'39.29"E	339229.02	1236256.73
2	11°11'2.61"N	79°31'37.56"E	339178.9	1236731.98
3	11°11'28.41"N	79°32'14.19"E	340294.03	1237519.13
4	11°11'13.30"N	79°32'26.10"E	340653.03	1237053.1

2.13.3 Thanjavur District

The area of 40.54Ha proposed to be desilting is located in S.F No. 9 of Sarabojirajapuram Village, Thiruvidaimaruthur Taluk, Thanjavur District. The area is represented by Geological Survey of India Toposheet No 58M/12. The latitude of the area ranges from 11°10'29.97"N to 11°11'2.61"N and longitude of area from 79° 30'31.95"E and 79°31'39.29"E.

Table No 2.11 Geo Coordinates of lease applied area – Thanjavur District

P.No	Latitude	Longitude	Northing	Easting
1	11°10'29.97"N	79°30'38.39"E	1235738.00	337379.00
2	11°10'38.41"N	79°30'31.95"E	1235998.56	337184.88
3	11°11'2.61"N	79°31'37.56"E	1236732.02	339178.77
4	11°10'47.15"N	79°31'39.29"E	1236256.83	339229.05

Fig No 2.10 General view of the desiliting lease applied area

2.14 Geology of Study area around 25km of project site

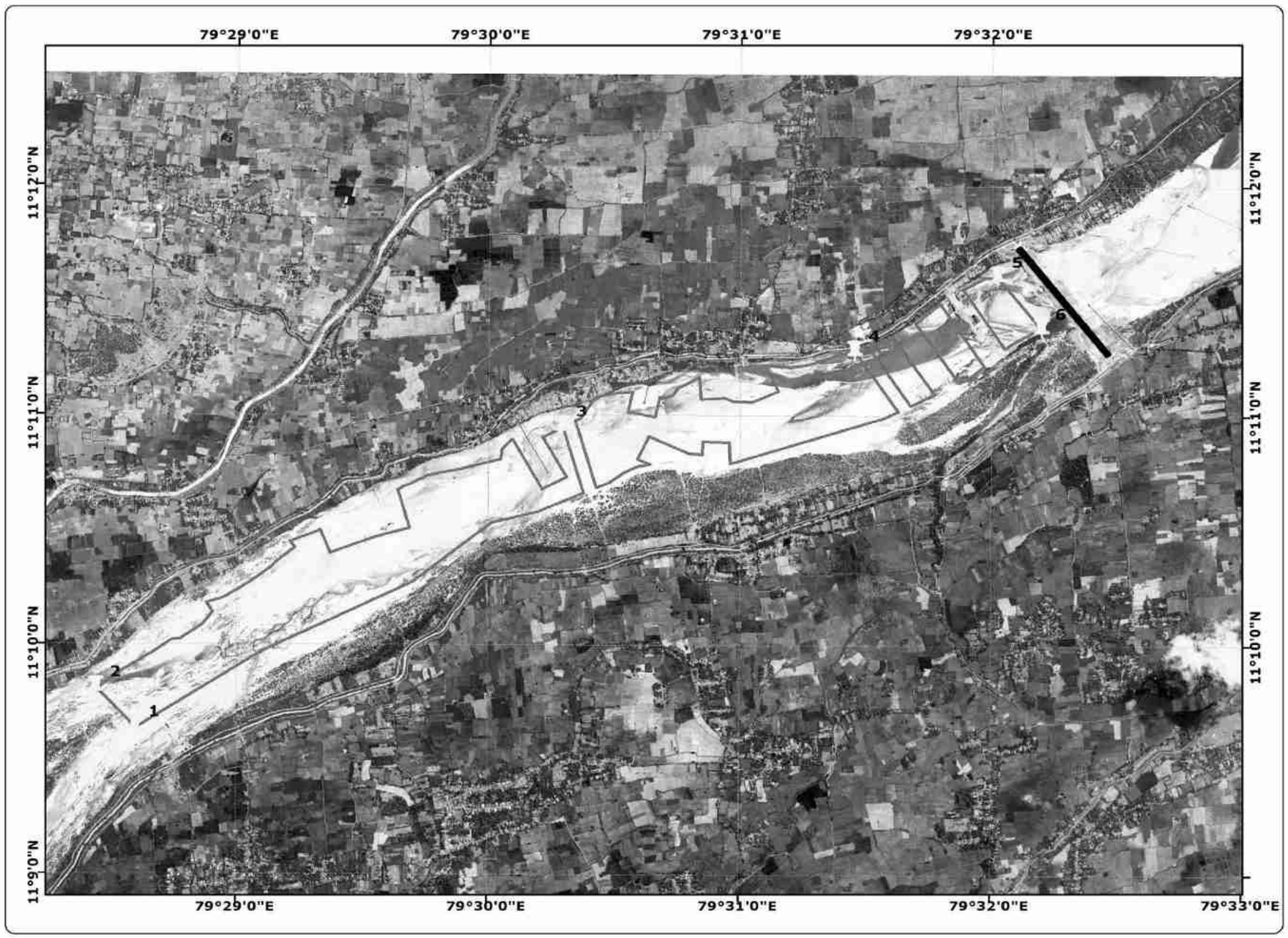
The geology of the study area is following:

1. Fluvio Marine
2. Fluvial
3. Sandstone stone with clay

2.15 General Geology of the applied Area:

The proposed site for desilting is situated in Coleroon River, upstream of proposed barrage, which contains fine sand with little soil mixing and waste debris. This sand was formed by the continuous mechanical action of river erosion of weathered particles transported and deposited when the gravity loses. The elevation of the proposed site is 8.44-11.710m above MSL. The major constituent of the sand is quartz, Feldspar with clay.

Google Image showing Desilting Area with Coordinates



Source: Google Image

Coordinates of Pillars

P.No	Latitude	Longitude
1	11° 9' 38.092" N	79° 28' 36.214" E
2	11° 9' 48.423" N	79° 28' 26.835" E
3	11° 10' 56.911" N	79° 30' 17.928" E
4	11° 11' 16.787" N	79° 31' 27.639" E
5	11° 11' 36.157" N	79° 32' 1.696" E
6	11° 11' 22.667" N	79° 32' 12.137" E

INDEX

LOCATION

Extent: 341.46 Ha Out of 382.0 Ha
S.F.Nos: 1(P),2(P),3(P),4(P),5(P)
Villages: Kizhpuliyampattu, Eyyalur, Achalpuram, Sirukattur
Taluk: Kattumannarkoil
District: Cuddalore

APPLICANT

The Executive Engineer
Water Resources Department
Special Project Division
Kumbakonam-612001.

LEGEND

Barrage Site
Desiliting Area

SCALE

0 0.5 1 2 km

Prepared by

Fig No 2.11 Google image showing desiliting lease boundary in three districts and Coordinates of the Lease Area

Table 2.12: Desilting Details

Cuddalore District	
Particulars	**Details**
Method of Desilting	Mechanized method by using Hydraulic excavators and tippers combination
Area of Desilting	341.46.0 Ha out of 382.0 Ha
Mineable reserves	85,75,310m^3
River bed level	+9.500m above MSL
Sill level	+10.00m above MSL
Depth of Desilting	0.5m below sill level upto scour vent or river bed level
Proposed Bench Height & Width	0.5m below the sill level including shoal above the sill level for storage of water. No benches shall be formed; it is only deepening and desilting.
Shoal height	+3.825m
Period of Lease	1 year
Blasting	No blasting shall be practiced

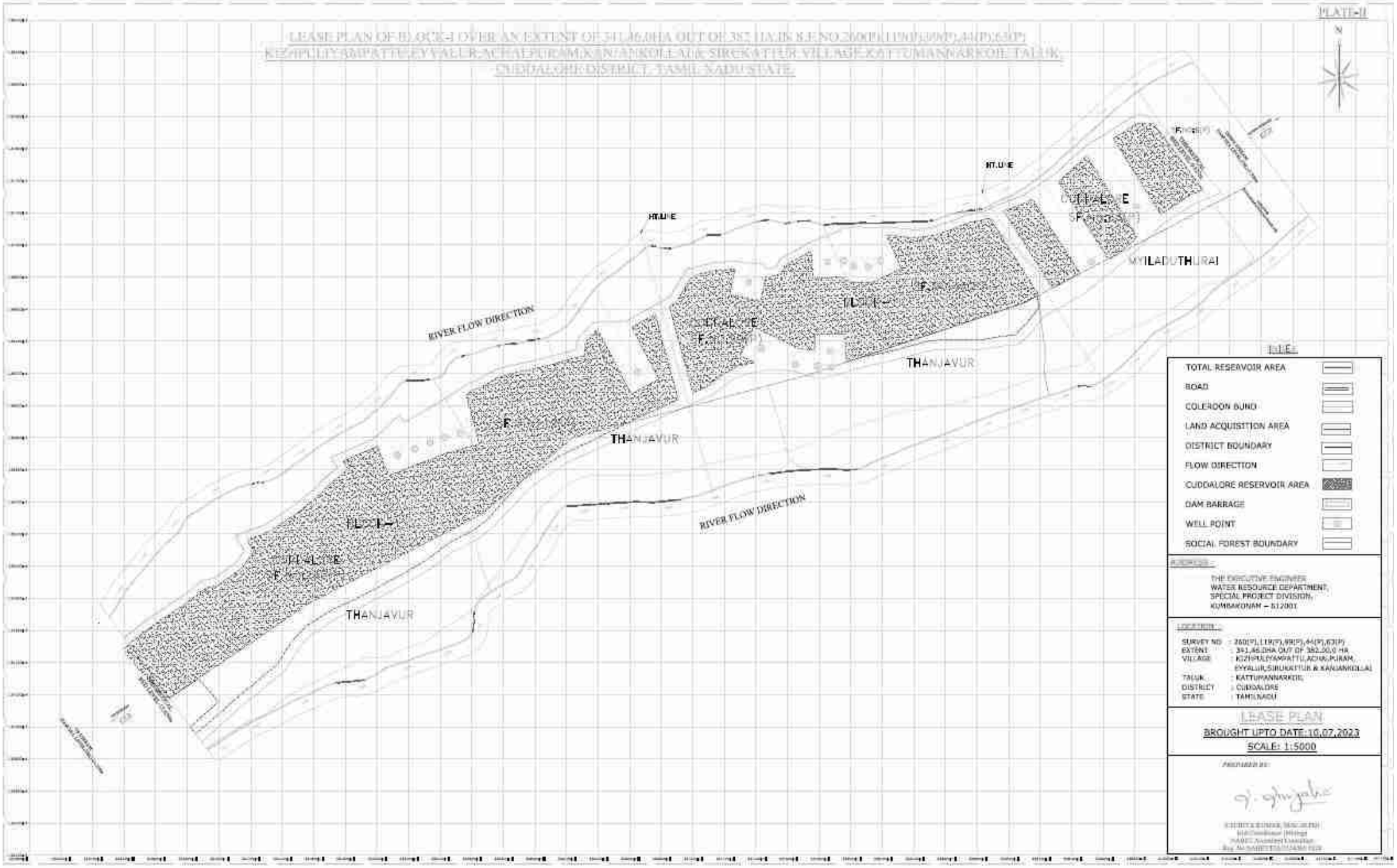


Fig No 2.12 Lease Plan of desilting area in Cuddalore District

2.16 Employment Potential for Desilting

Management and supervisory personal

For the purpose of Mines safety under the provisions of MMR, 1961 under the Mines Act, 1952 the workers are employed more than 10, it is preferred to have a qualified Mate to keep all the production workers directly under his control and supervision.

A mines clerk will be appointed to keep the registers and record of the mine and make necessary entries for the persons employed in the mines.

Table No 2.13 Employment potential for Desilting in each district (Cuddalore and Thanjavur)

Supervisory & Skilled Persons			
S.No	**Designation**		**Nos**
1	WRD/MMD Assistant Engineer		1
2	Technical Assistant		1
3	Permit Slip clerk		3
		Total	**5**
Unskilled			
S.No	**Designation**		**Nos**
4	Traffic Regulator	Entrance	2
		Exit	2
		Desilting Site	3
5	Loading Workers		21
6	Office Helper		1
7	Spotter		6
8	Watchman(Two Shift)		4
Total			**39**
Grand Total			**44**

2.17 Water Requirement for Desiliting

Table No 2.14: Water Requirements for Desiliting in Cuddalore district

Drinking	0.5 KLD
Domestic	2.5 KLD
Dust suppression	3.0 KLD
Green Belt	2.0 KLD
Total	**8.0 KLD**
Source	Drinking - Mineral water supply Domestic, Dust suppression and Greenbelt – WRD's Bore Well

2.18 Welfare Measures for Desiliting

a) Drinking Water:

Whole some drinking water shall be provided as per the Mines Rules, 1955. Quantity for Drinking and utilities is 3.0 KLD. Dust suppression and Green belt of water is 5.0KLD. Total 8.0 KLD water required per Day. The drinking water is obtained from Mineral water suppliers in the nearby areas.

b) Sanitary facilities:

Surface latrines and urinals shall be constructed at convenient places for use of labors as per the provisions of Rule (33) of the Mines Rules, 1955 separately for males and female. The scale of latrine shall be one for every 50 employees for the purpose of calculating the number of latrines. Washing facilities shall also be arranged as per the Rule (36) of the Mines Rules, 1955.

c) First Aid facility :

Being a small mine First Aid station as per provisions under Rule (44) of the Mines Rules 1955 will be provided with facilities as prescribed in third schedule. Qualified First Aid personnel should be appointed or nominated to attend emergency first aid treatment.

d) Labour Health:

Periodic medical examination has to be arranged for occupational health once in a year in addition to attending medical treatment of occupational injuries under the Rule 45 (A) of MR, 1955.

e) Precautionary safety measures to the Labourers

Safety provisions like helmet, goggles, safety shoes etc have to be provided as per the circulars and amendments made for Mine labours under the guidance of DGMS.

f) Child Labour Employment:

As per the Mines Act, 1952, no child labour below 18 years of old shall be engaged for any work in the desilting.

2.19 Project cost / investment (Lakhs) including desilting

Land Cost	:	Nil
Construction of Barrage	:	Rs 46543
land acquisition cost	:	Rs 3125
Surveying cost	:	Rs 24
Total	**:**	**Rs 49692 Lakhs or 496.92 Crores**

CHAPTER – 3: DESCRIPTION OF THE ENVIRONMENT

3.1 GENERAL

Collection of baseline environmental data of the project influenced area helps to predict the magnitude of impacts that are likely to be caused due to proposed activity of project. It also helps to identify critical environmental attributes required to be monitored during and after the proposed improvements. The baseline status of the project on environment is described section wise for better understanding of the broad spectrum conditions. The baseline environment quality represents the background environment scenario of various environment components such as Land, Water, Air, Noise, Biological and Socio-economic status of the study area. Field monitoring studies to evaluate the base line status of the project site were carried out covering June 2022 – May 2023 (Monsoon, Pre Monsoon and Post Monsoon seaons) with CPCB guidelines. Environmental data has been collected with reference to proposed barrage:

- Water
- Air
- Noise
- Biological
- Socio-economic status
- Land

3.2 STUDY AREA

Exploitation of resources causes Environmental and ecological instability, severe land degradation besides biological physical and socio-economic imbalance. The impact of the industrial activities can be quantified through Environmental Impact Assessment Studies within the impact zone. The findings of EIA studies help in preparation of the environmental management plan for mitigating the adverse impacts. For the purpose of studying the baseline status of the environment, core zone and buffer zone are considered for Impact Assessment.

The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonam – 612001 (Government of Tamil Nadu) has proposed to construct Barrage with 84 vents across the River Coleroon at RD 74/3 mile in Adhanur and Kumaramangalam Villages to irrigate the cultivable command area of 9159 Ha in Cuddalore and Mayiladuthurai Districts. The Latitude and Longitude of the proposed site at left bank is 11˚11‘45”N and 79˚32‘04”E and at right bank is 11˚11‘14”N and 79˚32‘29”E respectively. The buffer zone comprises a 10 km from around the core

area. This section contains a description of the existing baseline environmental status of the area surrounding the core zone. The data collected has been used to define the environmental scenario of the area, against which the potential impacts of the project has been assessed.

3.3 STUDY PERIOD

Collection of base line data is an integral part of the preparation of environmental impact assessment reports. The scope of the study includes preparation of Environmental Impact Assessment study with detailed characterization of various environmental components such as air, noise, water, land, biological and socio economic and other impacts like hydro-geological disturbances of the area around 10 km radius of barrage located at Adhanur and Kumaramangalam Villages of Cuddalore and Mayiladuthurai Districts. The scope covers all the conditions outlined in the TOR prescribed by SEAC/SEIAA Tamil Nadu for this project vides Letter No. SEIAA-TN/F.No.9677/Violation/ToR-1400/2022 dated 23.03.2023. EIA study was conducted during the period of June 2022 – May 2023 to assess the Impact of this project to the environment and society for a period of one year covering three seasons.

3.4. BASELINE ENVIRONMENT

3.4.1. Scope of Baseline Data Collection

The scope of baseline data collection with respect to project activity covers the following environmental components.

- **Site Meteorology:** Collection of micro meteorological data on wind speed, Wind direction, temperature, relative humidity and solar radiation on hourly basis continuously during the study period.
- **Ambient Air Quality:** Collection of AAQ data at nine locations for PM_{10}, $PM_{2.5}$, SO_2 and NO_X and other parameters.
- **Noise Environment:** Collection of noise levels at nine locations on hourly basis to compute the day equivalent and nigh equivalent**.**
- **Water Environment:** Collection of water samples from Ground water (thirty three) and surface water sources (seven locations) in and around project site within 10 km radius and in the cultivable command area for assessment of the existing physico-chemical and bacteriological quality.

- **Land Environment:**
  - **Soil quality:** Collection of soil samples from nine locations within 10 km radius of site and in CCA for analysis of the Physico-chemical characteristics.
  - **Land use and land cover:** Assessment of land use and land cover pattern of the study area through Remote sensing Technique.
  - **Hydrology:** Collection of information on surface water bodies is to assess the interference with project activities.
  - **Hydro Geology:** Collection of information on ground water status (Quality, quantity and ground water table) is to assess impact on subsurface water bodies.

- **Ecology and Biodiversity:** Collection of primary data to understand baseline ecological status, important floristic and faunal elements, sensitive habitat and rare species; from field observation; collection of data from local village about importance and status of plants and animals. Compare the data so generated with authentic past records to understand changes with respect to proposed project; Identification of sensitive locations or Protected as per Wildlife Conservation and Protection Act, 1972.

- **Socio-economic Environment:** Collection of details of the project affected persons does draw Rehabilitation & Resettlement. Collection of socio-economic status of various villages and amenities exists within an area of 10 km around the project area.

3.5 METEOROLOGY

Meteorology is the important characteristics in assessing the diffusion pattern of air pollutants released into atmosphere. Meteorological characteristic plays a vital role in assessing possible environment impacts and in preparing environmental management plan. Since meteorological factors show wide fluctuations with time, meaningful interpretation can be drawn from long-term reliable data. Such source of data is India Meteorological Department (IMD), which maintains a network of meteorological stations at important locations. The nearest IMD station is located at Chidambaram, Cuddalore district.

3.5.1 Regional Meteorology

3.5.1.1 Cuddalore District

The District has a hot tropical climate. The summer season, which is very oppressive, is from March to May. The southwest monsoon, which follows, lasts till September. October to December constitutes North East monsoon season. January to February is the comparatively cooler period. The highest and lowest temperatures recorded are in June (37.7º C), and January (20.4º C) respectively. The relative humidity recorded in Cuddalore District is about 65 to 85%. Highest humidity percentage is observed during the North East monsoon period i.e., from October to December. Wind velocity is moderate showing its maximum during May and lowest in November. Normally this area receives about an annual rainfall of 1304.6 mm.

Cuddalore District has been classified as a multi-hazard prone district. Since the District has a long coastline, therefore the District is vulnerable to the cyclonic depressions and the resultant rains which causing floods. Cyclones and flood have wreaked havoc in the district several times in the past few centuries. Cyclone ―Nisha" in 2008 and the cyclone ―Thane― in December, 2011 caused heavy damage to this district in many respect. Cuddalore District experienced worst impacts of Tsunami during the year 2004.

3.5.1.2 Mayiladuthurai District (Previously within Nagapattinam District)

The average maximum temperature of the district as a whole is about 32^0 C and the average minimum temperature is 24.6^0 C. Dust storm, whirl winds and dusty winds blow from various quarters towards the end of May. The Southwest winds sets in during April, it is the strongest in June and continues till September. Northeast monsoon starts during the month of October and blow till January. Cyclonic storm with varying wind velocity affects the district once in 3 or 4 years during the months of November and December. The storms affect the plantation crop. During Southwest monsoon the air is calm and undisturbed. The Northeast monsoon which starts in October and ends in December contributes about 60% of the total annual rainfall.

3.5.2 Meteorological Data Recorded At IMD Station, Cuddalore District

The meteorological parameters were recorded on hourly basis during the study period for parameters like rainfall, wind speed, wind direction and temperature. In the present study, in the month of June 2022 to May, 2023 meteorological data has

been taken to find the dispersion of pollutant concentration. Wind-rose diagram for the study period is shown given below in Fig No. 3.1, 3.2 and 3.3.

Table No 3.1: Summary of the Meteorological data for the study period

S. No	Month	Temperature (°C)		Rainfall (mm)	Humidity%	Avg. wind speed (mps)
		Max	Min			
1	June, 2022	37	26	42.2	67	1.1
2	July, 2022	36	25	65.0	68	1.1
3	Aug, 2022	35	25	99.9	74	0.8
4	Sep, 2022	35	25	110.2	76	0.8
5	Oct, 2022	33	24	298.9	80	0.6
6	Nov, 2022	31	23	363.2	84	0.8
7	Dec, 2022	30	22	131.5	82	0.8
8	Jan, 2023	30	21	23.5	77	0.8
9	Feb, 2023	31	21	1.5	76	0.8
10	Mar, 2023	33	23	19.3	76	0.8
11	Apr, 2023	35	26	12.8	76	0.8
12	May, 2023	38	26	36.0	72	1.1

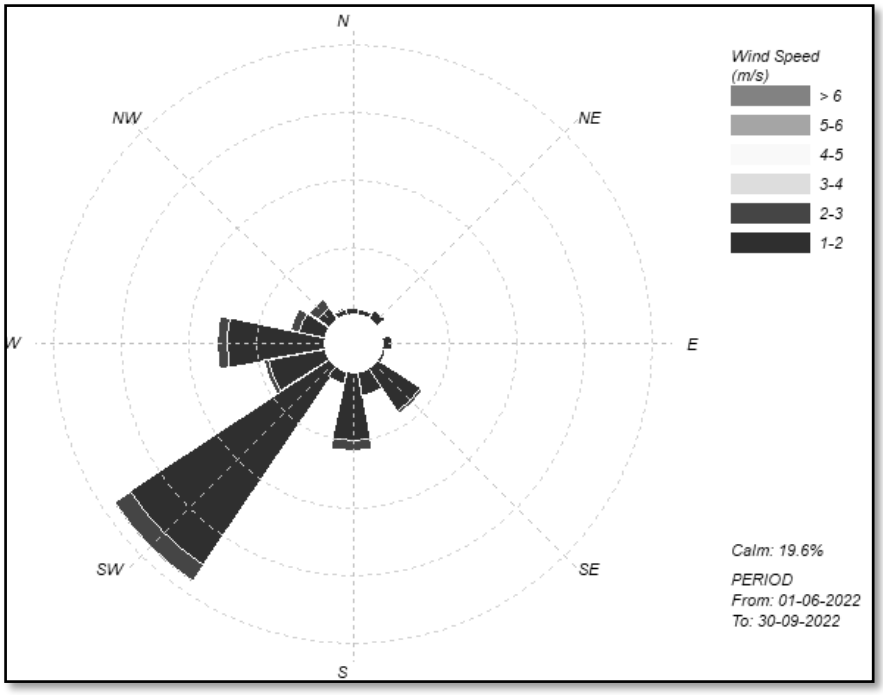


Fig No 3.1: Wind rose Pattern for the study period (Monsoon Season)

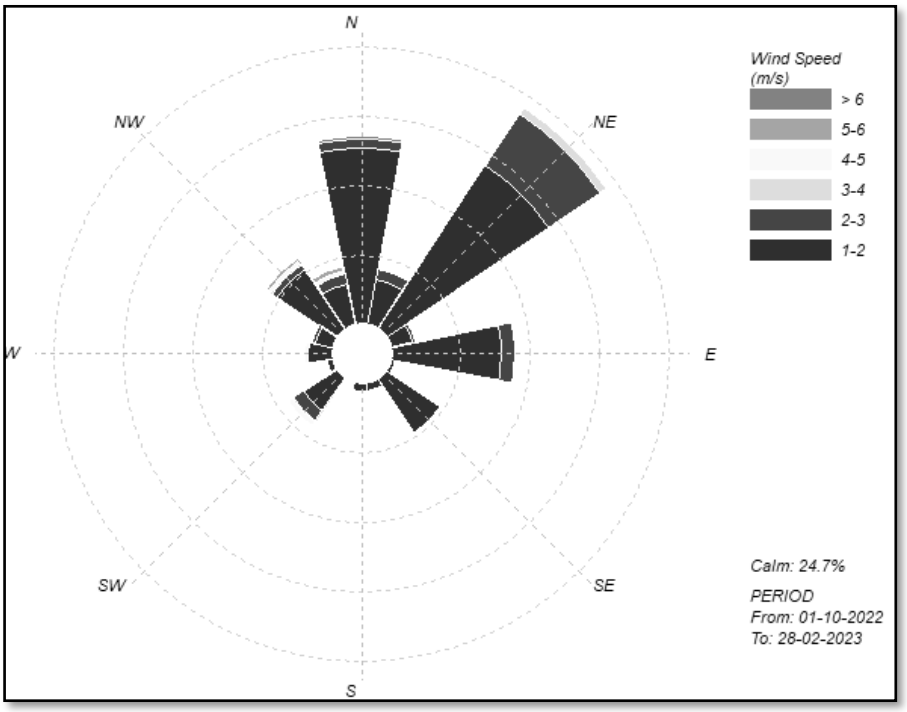


Fig No 3.2: Wind rose Pattern for the study period (Post Monsoon Season)

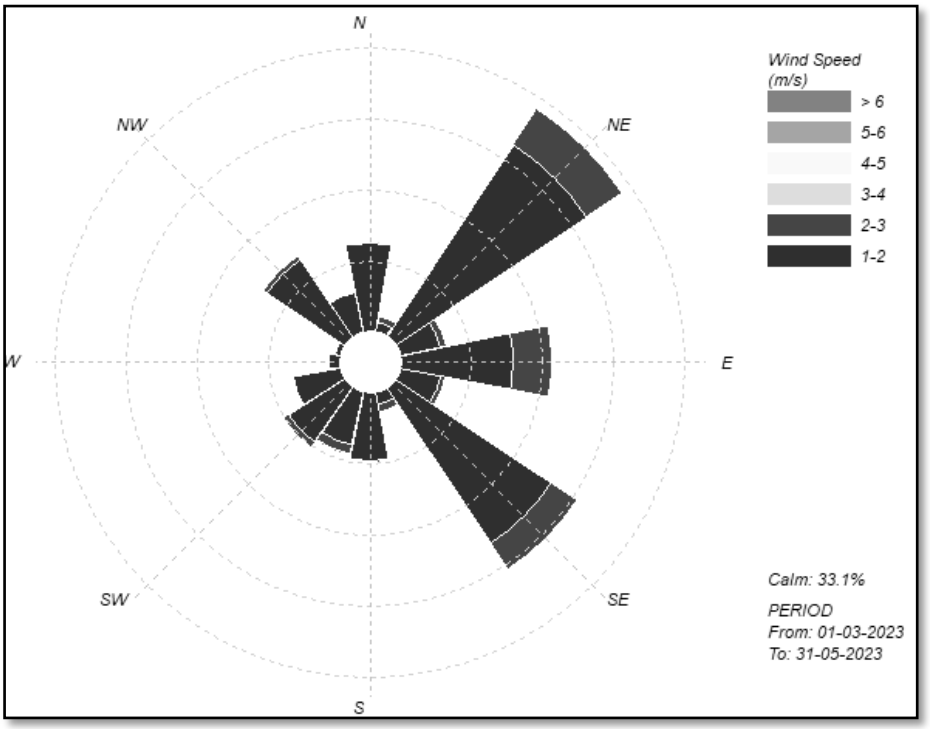


Fig No 3.3: Wind rose Pattern for the study period (Pre Monsoon Season)

(Link : https://mausam.imd.gov.in/chennai)

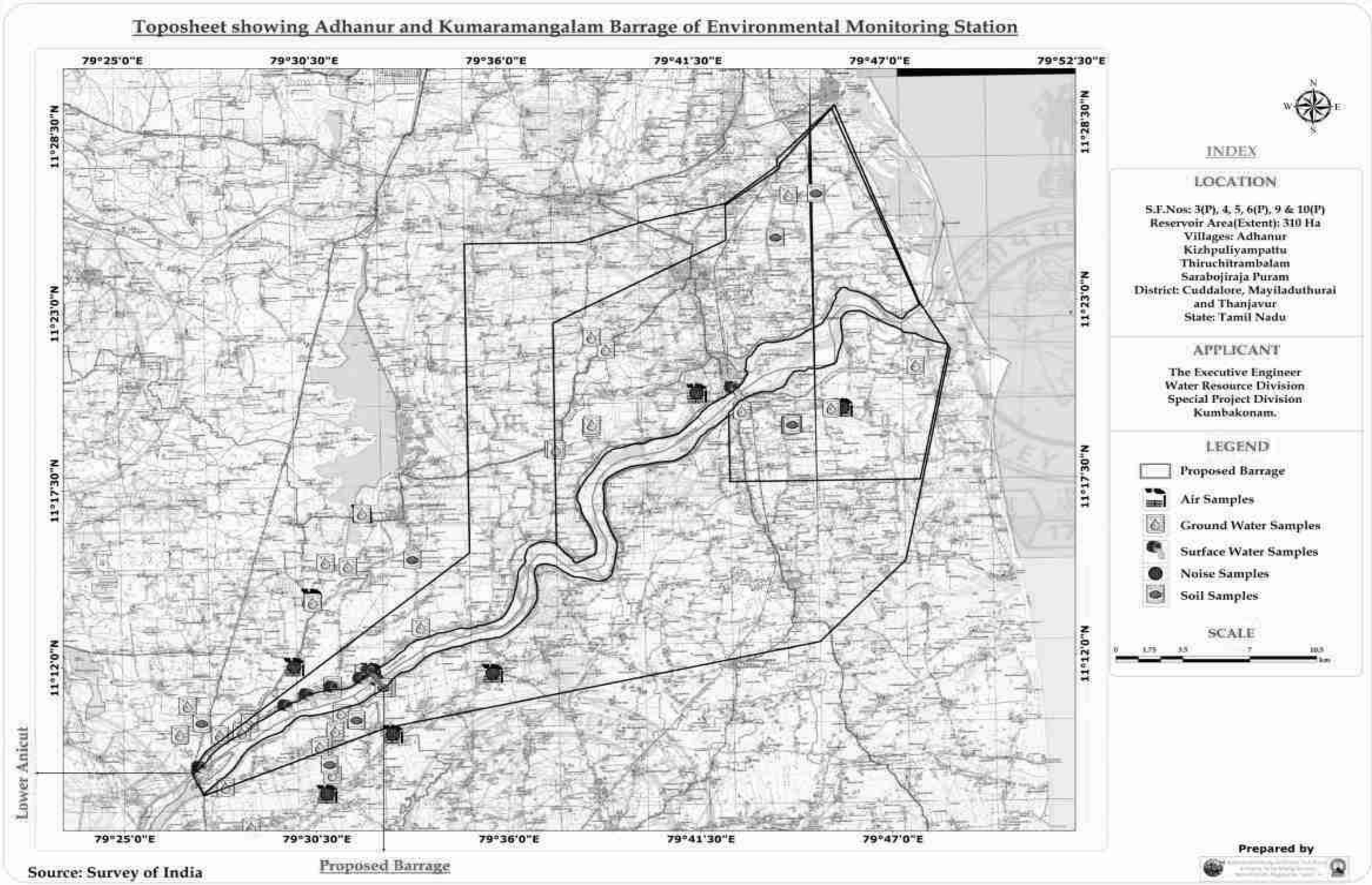


Fig No 3.4 Geo-Referenced Toposheet showing Environmental Monitoring Stations in 10km radius of proposed barrage and in command areas

3.6 AIR ENVIRONMENT

To find the existing air quality of the study area, the baseline study was carried out. This will be useful for assessing the standards of the ambient air quality of the proposed project during the construction and operation phase.

3.6.1 Ambient Air Monitoring

3.6.1.1 Selection of sampling location

To assess the ambient air quality, monitoring was carried out on monthly basis in the surrounding areas of the project site. The monitoring stations was established at upwind, downwind and crosswind direction as per the guidelines of CPCB. The site location and height was selected in such a way to avoid the capture of re-suspended road dust and fugitive domestic emission. Air quality survey has been conducted at nine locations over a period of 3 seasons – Monsoon, Post Monsoon and Pre Monsoon i.e June 2022 to September 2022, October 2022 to February 2023 and March 2023 to May 2023. The ambient air quality monitoring stations are given in Table No 3.2

Table No 3.2 Ambient Air Quality Monitoring Stations

Sampling Code	Location	Latitude	Longitude	Distance (km)	Direction
AAQ 1	Project site	11°11'44.91"N	79°32'6.81"E	--	--
AAQ 2	Nattarmangalam	11°16'40.18"N	79°31'55.67"E	9.1	N
AAQ 3	Periyapogene	11°14'4.54"N	79°30'27.20"E	5.2	NW
AAQ 4	Palavaykandan	11°11'56.40"N	79°29'55.27"E	3.9	NW
AAQ 5	Pandanallur	11° 7'58.75"N	79°30'48.41"E	6.7	SW
AAQ 6	Thiruchitrambalam	11° 9'48.69"N	79°32'43.03"E	2.7	S
AAQ 7	Manalmedu	11°11'39.27"N	79°35'36.29"E	5.7	E
AAQ 8	Achalpuram	11°19'45.48"N	79°45'45.25"E	In CCA	-
AAQ 9	Kodipallam	11°20'16.31"N	79°41'35.33"E	In CCA	-

3.6.1.2 Parameters and Monitoring Methodology

Ambient air quality monitoring was conducted over 12 months i.e. from June 2022 to May 2023 at a frequency of twice a week at each station adopting a 24-hours schedule. The sampling equipment was placed at a height of 3 to 3.5 meters above ground level

at each monitoring station, thus negating the effects of wind blow ground dust. Ambient Air quality monitoring was conducted in respect of the following parameters: PM_{10} & $PM_{2.5}$, Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2) and other pollutants such as Ozone, Ammonia, BAP, Benzene and metals such as lead, Arsenic and Nickel.

Fig A. Core Zone

Fig B. Nattarmangalam Village

Fig C. Periyapogene Village

Fig D. Palavaykandan Village

Fig E. Pandanallur Village

Fig F. Thiruchitrambalam Village

Fig G. Manalmedu Village

Fig H. Kodipallam Village in CCA (Cuddalore)

Fig I. Achalpuram village in CCA (Cuddalor)

Fig No 3.5: Air Sampling at nine stations

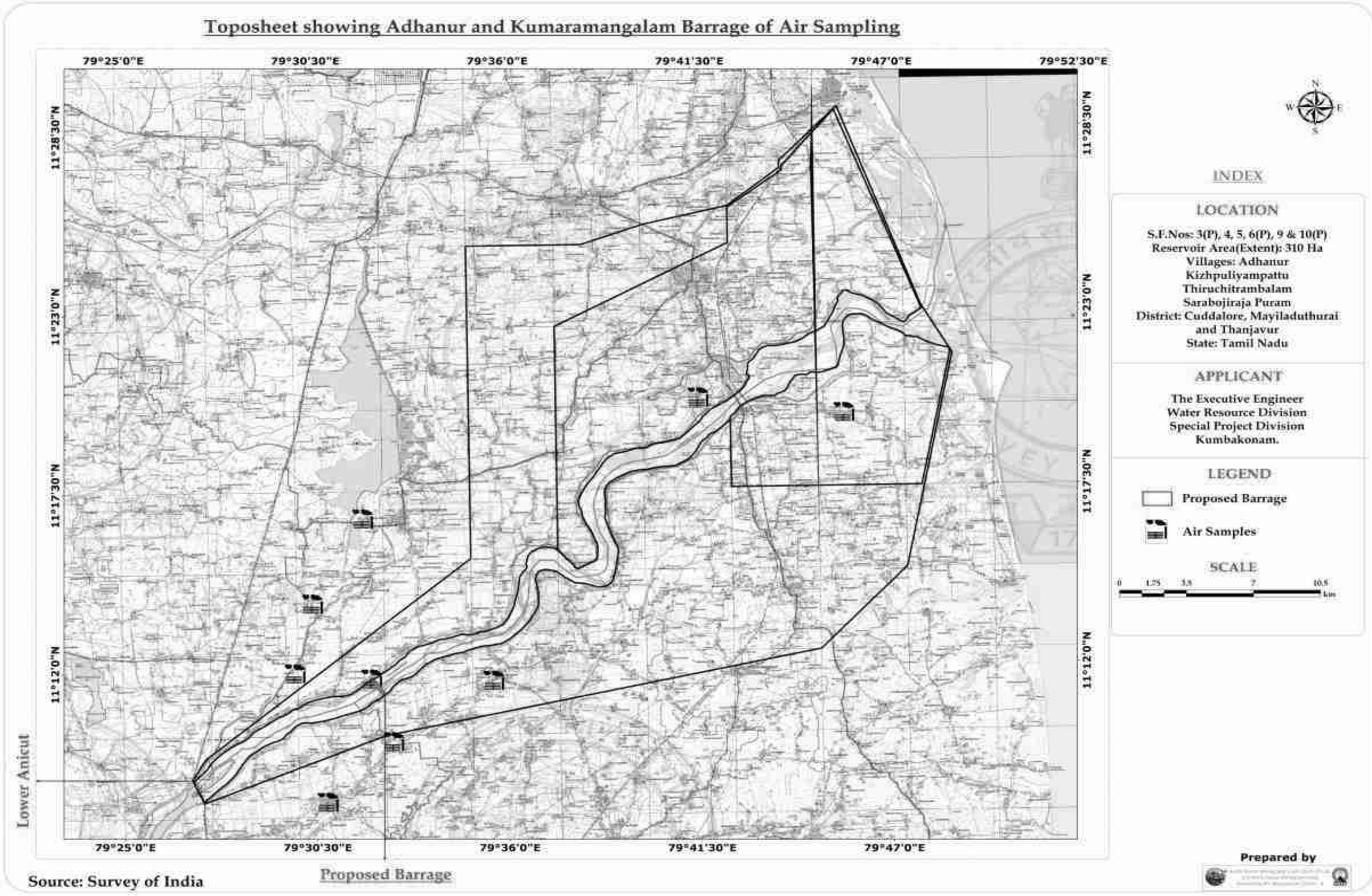


Fig No 3.6: Georeferenced Toposheet showing air sampling location in 10km radius around barrage and in command area

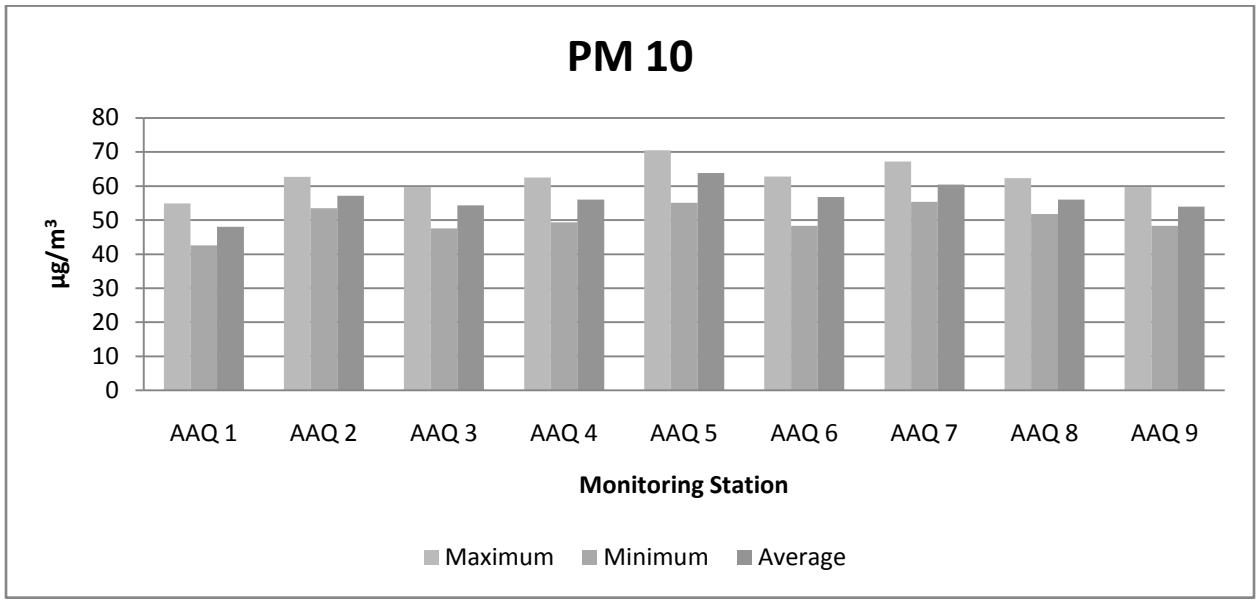
3.6.2 Monitoring Result

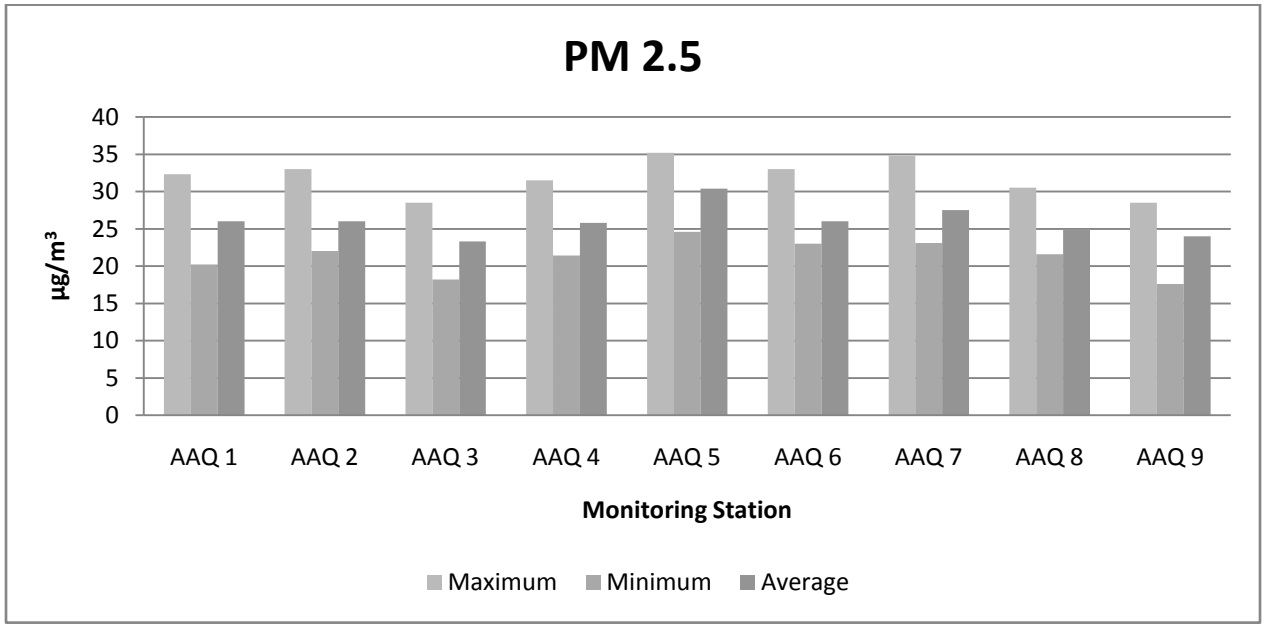
Statistical Analysis of Ambient Air Quality in the study area for the three monitoring period are shown parameter wise in Table No 3.3, 3.4 and 3.5.

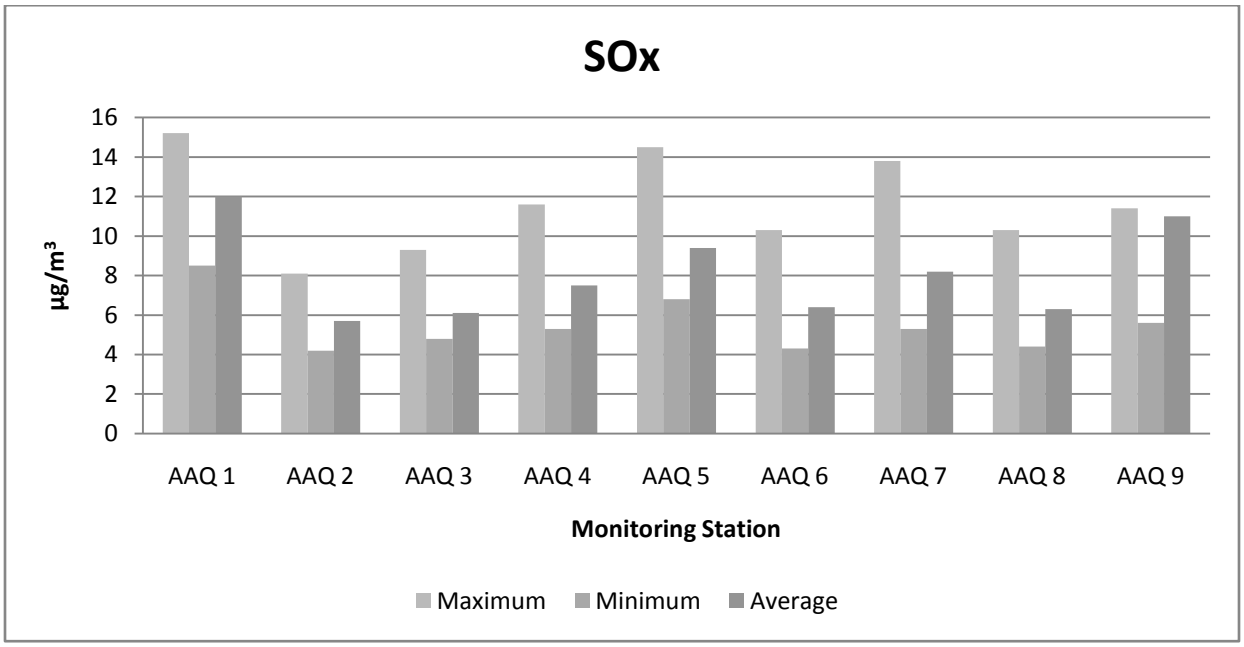
Table No 3.3 Summary of Ambient Air Quality Results (Monsoon Season – 1st June 2022 to 30th September 2022)

Code	Locations	Parameters	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	SO_2 (µg/m³)	NO_2 (µg/m)
AAQ 1	Project site	Maximum	54.9	32.3	15.2	21.6
		Minimum	42.6	20.5	8.5	14.5
		Average	48.0	26.0	12	17
		98%	54.3	31.7	15.0	20.5
AAQ 2	Nattarmangalam	Maximum	62.7	33	8.1	11.2
		Minimum	53.5	22	4.2	6.3
		Average	57.2	26	5.7	8.6
		98%	62.2	32.0	7.9	11.1
AAQ 3	Periyapogene	Maximum	59.7	28.5	9.3	15.2
		Minimum	47.6	18.2	4.8	6.5
		Average	54.3	23.3	6.1	10.2
		98%	58.7	28.5	8.4	14.9
AAQ 4	Palavaykandan	Maximum	62.5	31.5	11.6	16.4
		Minimum	49.4	21.4	5.3	8.3
		Average	56.0	25.8	7.5	12.8
		98%	62.4	30.8	10.6	16.2
AAQ 5	Pandanallur	Maximum	70.5	35.2	14.5	21.9
		Minimum	55.1	24.6	6.8	12.4
		Average	63.8	30.4	9.4	17
		98%	70.4	35.1	14.3	21.2
AAQ 6	Thiruchitrambalam	Maximum	62.8	33	10.3	14.4
		Minimum	48.3	23	4.3	7.1
		Average	56.8	26.0	6.4	10.9
		98%	62.5	32.5	9.7	14.2
AAQ 7	Manalmedu	Maximum	67.2	34.8	13.8	22.8
		Minimum	55.4	23.1	5.3	13.5
		Average	60.4	27.5	8.2	17.1
		98%	67.0	34.4	12.2	22.4

AAQ 8	**Kodipallam Village in CCA(Cuddalore)**	Maximum	62.3	30.5	10.3	13.2
		Minimum	51.8	21.6	4.4	7.5
		Average	56.0	25.0	6.3	9.5
		98%	61.8	30.0	9.7	13.0
AAQ 9	**Achalpuram Village in CCA (Cuddalore)**	Maximum	59.7	28.5	11.4	14.5
		Minimum	48.3	17.6	5.6	7.5
		Average	54.0	24.0	7.5	10.6
		98%	59.3	28.3	11.0	14.1
NAAQS			**100**	**60**	**80**	**80**







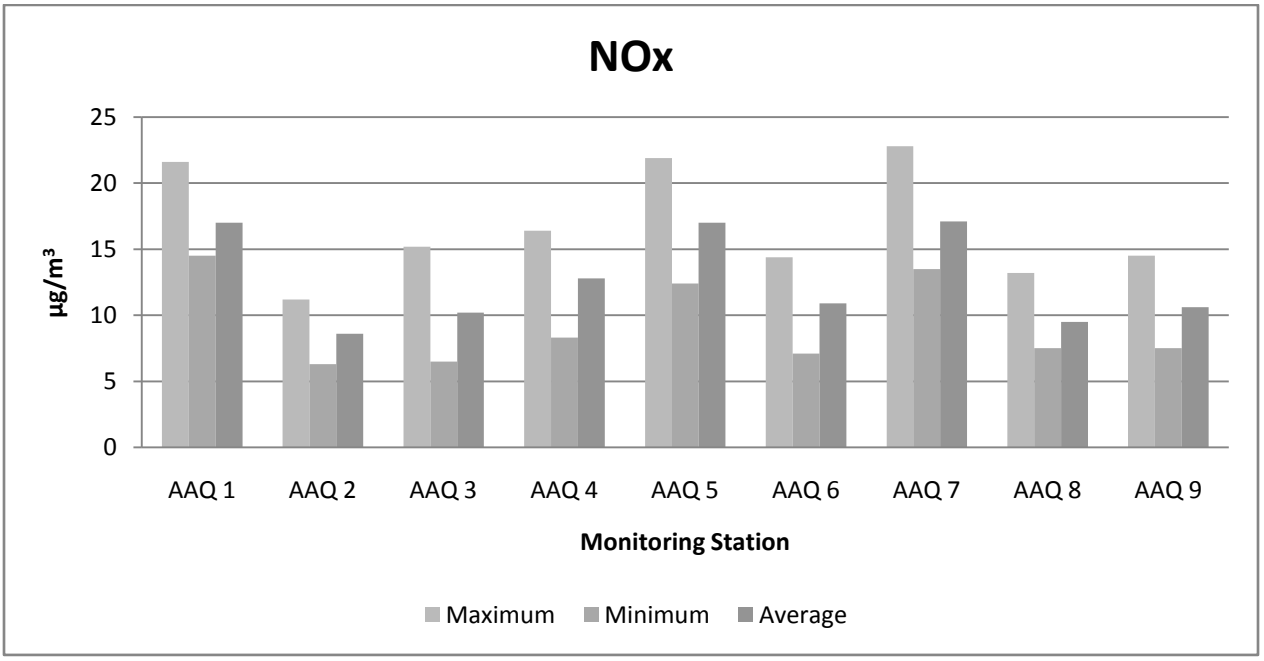


Fig No 3.7: Variation in Concentration of air pollutants during monsoon season

3.6.3 Observation (Monsoon Season)

(i) Particulate Matter (PM_{10})

The average $PM_{1.0}$ level at nine stations was varied from 48µg/m^3 to 63.8µg/m^3 for the monitoring period 1st June, 2022 to 30th September, 2022. The maximum concentration was recorded at Pandanallur village of 70.5µg/m^3 and the minimum concentration was recorded at Project site of 42.6µg/m^3.

(ii) Particulate Matter ($PM_{2.5}$)

The average $PM_{2.5}$ level at nine stations was varied from 23.3µg/m^3 to 30.4µg/m^3 for the monitoring period 1st June, 2022 to 30th September, 2022. The maximum concentration was recorded at Pandanallur village of 35.2µg/m^3 and the minimum concentration was recorded at Achalpuram village of 17.6µg/m^3.

(iii) Sulphur Dioxide (SO_2)

The average SO_2 level at eight stations was varied from 5.7µg/m^3 to 12µg/m^3 for the monitoring period 1st June, 2022 to 30th September, 2022. The maximum concentration was recorded at Project site of 15.2µg/m^3 and the minimum concentration was recorded at Nattarmangalam village of 4.2µg/m^3.

(iv) Nitrogen Dioxide (NO_2)

The average NO_2 level at eight stations was varied from 8.6µg/m^3 to 17.1µg/m^3 for the monitoring period 1st June, 2022 to 30th September, 2022. The maximum concentration was recorded at Manalmedu village of 22.8µg/m^3 and the minimum concentration was recorded at Nattarmangalam village of 6.3µg/m^3.

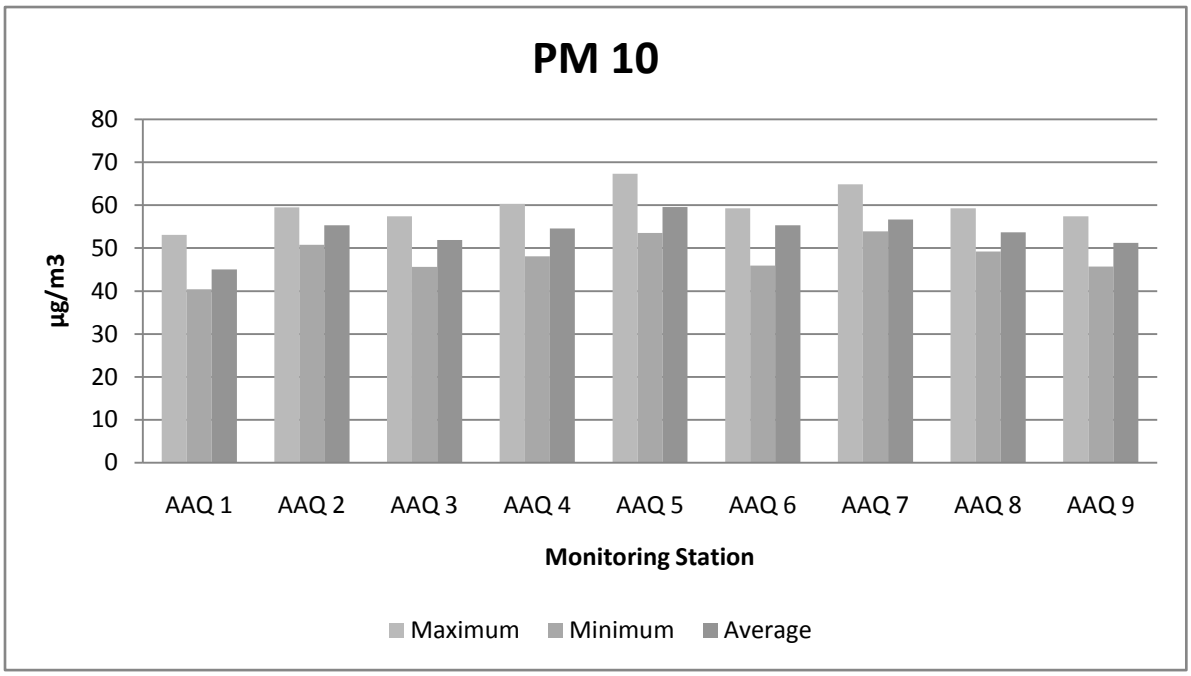
The concentration levels of the above pollutants were observed to be well within the limits of NAAQS prescribed by CPCB [Standard for PM2.5 is 60 µg/m^3, PM10 is 100 µg/m^3, SO_2 is 80 µg/m^3 and NO_2 is 80 µg/m^3] in all the samples.

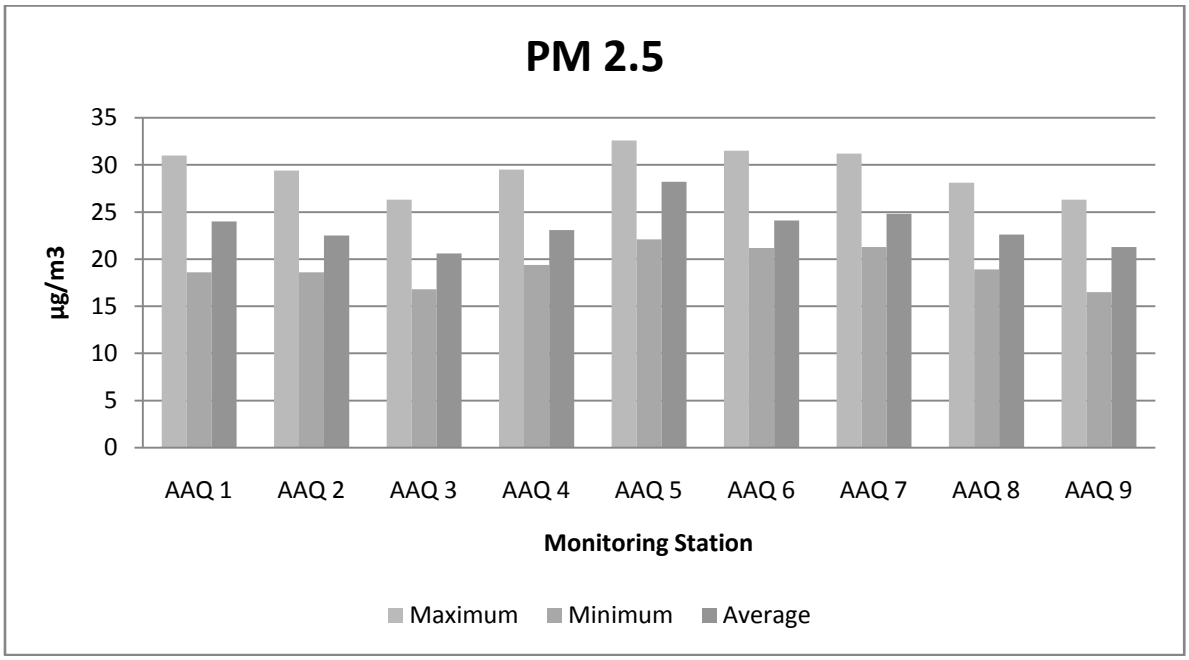
Table No 3.4 Summary of Ambient Air Quality Results

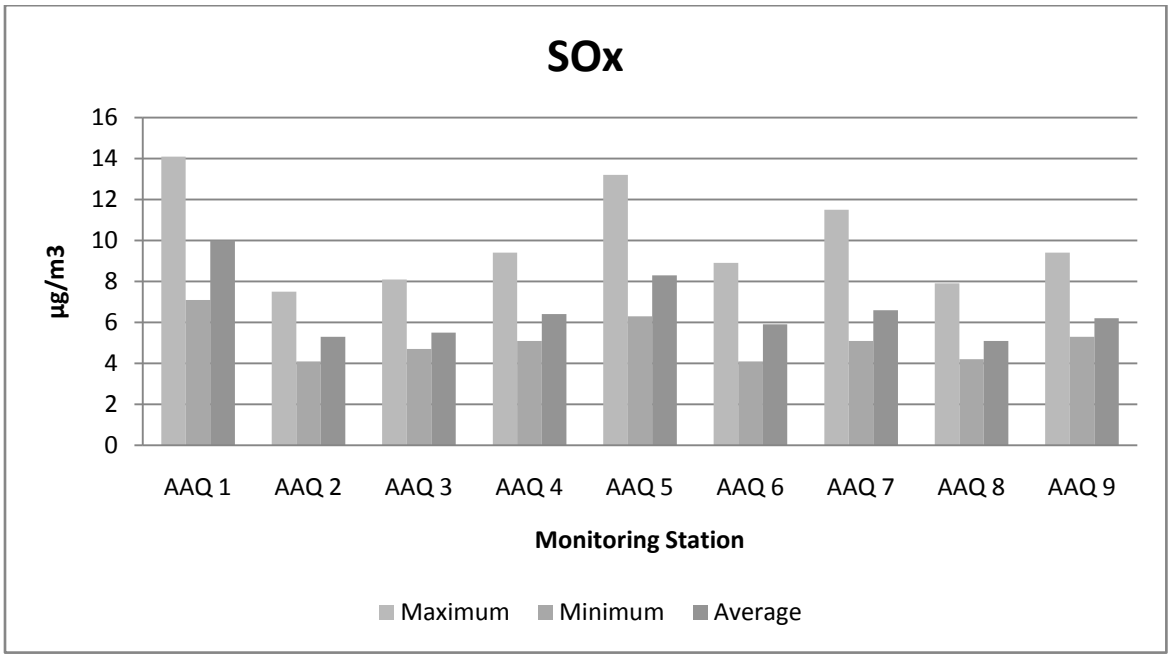
(Post Monsoon Season – 1st October 2022 to 28th February 2023)

Code	Locations	Parameters	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m$)
AAQ 1	**Project site**	Maximum	53.1	31.0	14.1	19.6
		Minimum	40.4	18.6	7.1	12.9
		Average	**45.0**	**24.0**	**10.0**	**15.0**
		98%	52.0	30.38	13.8	19.2
AAQ 2	**Nattarmangalam**	Maximum	59.5	29.4	7.5	9.8
		Minimum	50.8	18.6	4.1	5.9
		Average	**55.3**	**22.5**	**5.3**	**7.8**
		98%	58.3	28.8	7.35	9.6
AAQ 3	**Periyapogene**	Maximum	57.4	26.3	8.1	13.6
		Minimum	45.6	16.8	4.7	6.3
		Average	51.9	20.6	5.5	9.4
		98%	56.2	25.7	7.9	13.3
AAQ 4	**Palavaykandan**	Maximum	60.3	29.5	9.4	14.2
		Minimum	48.1	19.4	5.1	8.1
		Average	**54.6**	**23.1**	**6.4**	**11.2**
		98%	59.0	28.9	9.2	13.9
AAQ 5	**Pandanallur**	Maximum	67.3	32.6	13.2	18.5
		Minimum	53.5	22.1	6.3	11.2
		Average	**59.6**	**28.2**	**8.3**	**15.4**
		98%	65.9	31.9	12.9	18.1
AAQ 6	**Thiruchitrambalam**	Maximum	59.3	31.5	8.9	12.6
		Minimum	45.9	21.2	4.1	6.8
		Average	**55.3**	**24.1**	**5.9**	**9.1**
		98%	58.1	30.8	8.7	12.3
AAQ 7	**Manalmedu**	Maximum	64.9	31.2	11.5	19.8
		Minimum	53.9	21.3	5.1	11.6
		Average	**56.7**	**24.8**	**6.6**	**14.8**
		98%	63.6	30.5	11.2	19.4
AAQ 8	**Kodipallam Village in CCA(Cuddalore)**	Maximum	59.3	28.1	7.9	11.9
		Minimum	49.2	18.9	4.2	7.1
		Average	**23.7**	**22.6**	**5.1**	**7.2**
		98%	58.1	27.5	7.7	11.6

AAQ 9	**Achalpuram Village in CCA (Cuddalore)**	Maximum	57.4	26.3	9.4	12.5
		Minimum	45.7	16.5	5.3	7.2
		Average	**51.2**	**21.3**	**6.2**	**7.9**
		98%	56.2	25.7	9.2	12.2
NAAQS			**100**	**60**	**80**	**80**







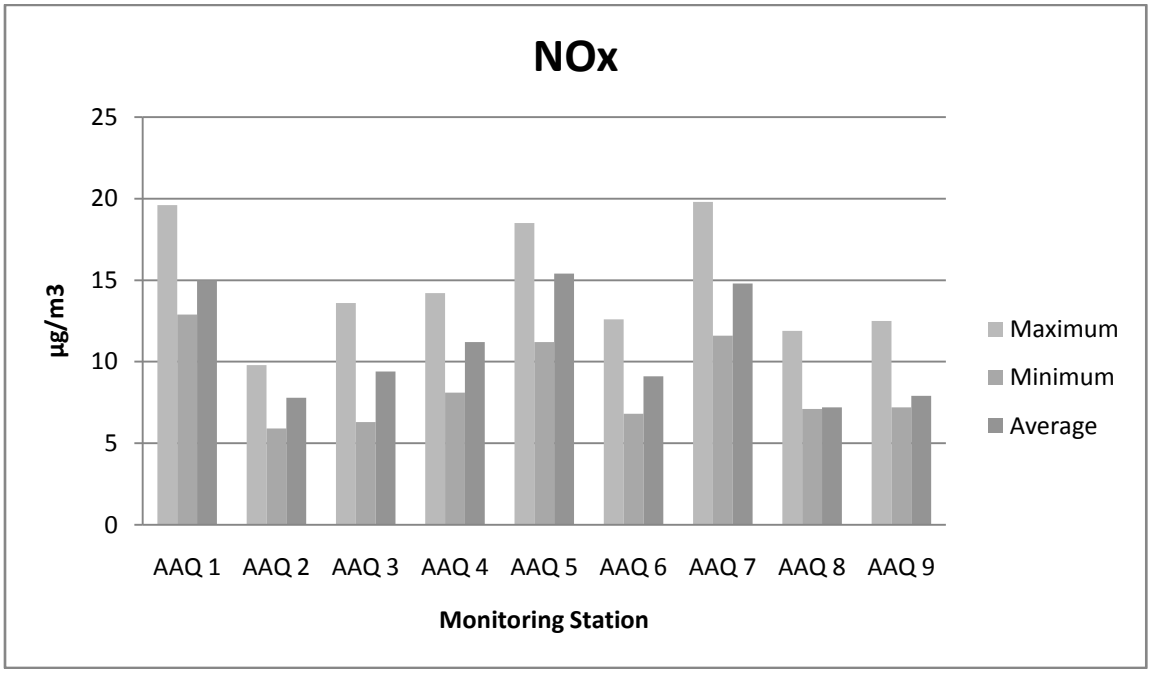


Fig No 3.8: Variation in Concentration of air pollutants during Post Monsoon Season

3.6.4 Observation (Post Monsoon Season)

(i) Particulate Matter (PM_{10})

The average $PM_{1.0}$ level at nine stations was varied from 45.0µg/m^3 to 59.6µg/m^3 for the monitoring period 1st October, 2022 to 28th February, 2023. The maximum concentration was recorded at Pandanallur village of 67.3µg/m^3 and the minimum concentration was recorded at Project site of 40.4µg/m^3.

(ii) Particulate Matter ($PM_{2.5}$)

The average $PM_{2.5}$ level at nine stations was varied from 20.6µg/m^3 to 28.2µg/m^3 for the monitoring period 1st October, 2022 to 28th February, 2023. The maximum concentration was recorded at Pandanallur village of 32.6µg/m^3 and the minimum concentration was recorded at Achalpuram village of 16.5µg/m^3.

(iii) Sulphur Dioxide (SO_2)

The average SO_2 level at nine stations was varied from 5.1µg/m^3 to 10µg/m^3 for the monitoring period 1st October, 2022 to 28th February, 2023. The maximum concentration was recorded at Project site of 14.1µg/m^3 and the minimum concentration was recorded at Nattarmangalam and Thiruchitrambalam village of 4.1µg/m^3.

(iv) Nitrogen Dioxide (NO_2)

The average NO_2 level at nine stations was varied from 7.2µg/m^3 to 15.4µg/m^3 for the monitoring period 1st October, 2022 to 28th February, 2023. The maximum concentration was recorded at Manalmedu village of 19.8µg/m^3 and the minimum concentration was recorded at Nattarmangalam village of 5.9µg/m^3.

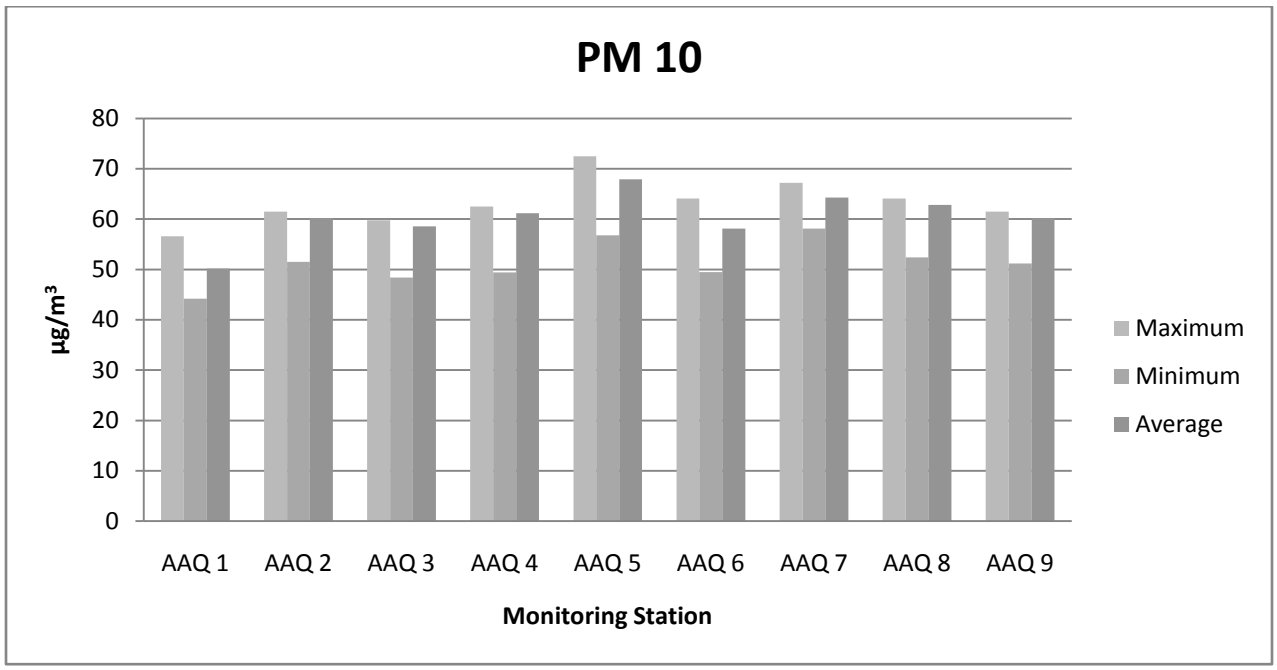
The concentration levels of the above pollutants were observed to be well within the limits of NAAQS prescribed by CPCB [Standard for PM2.5 is 60 µg/m^3, PM10 is 100 µg/m^3, SO_2 is 80 µg/m^3 and NO_2 is 80 µg/m^3] in all the samples.

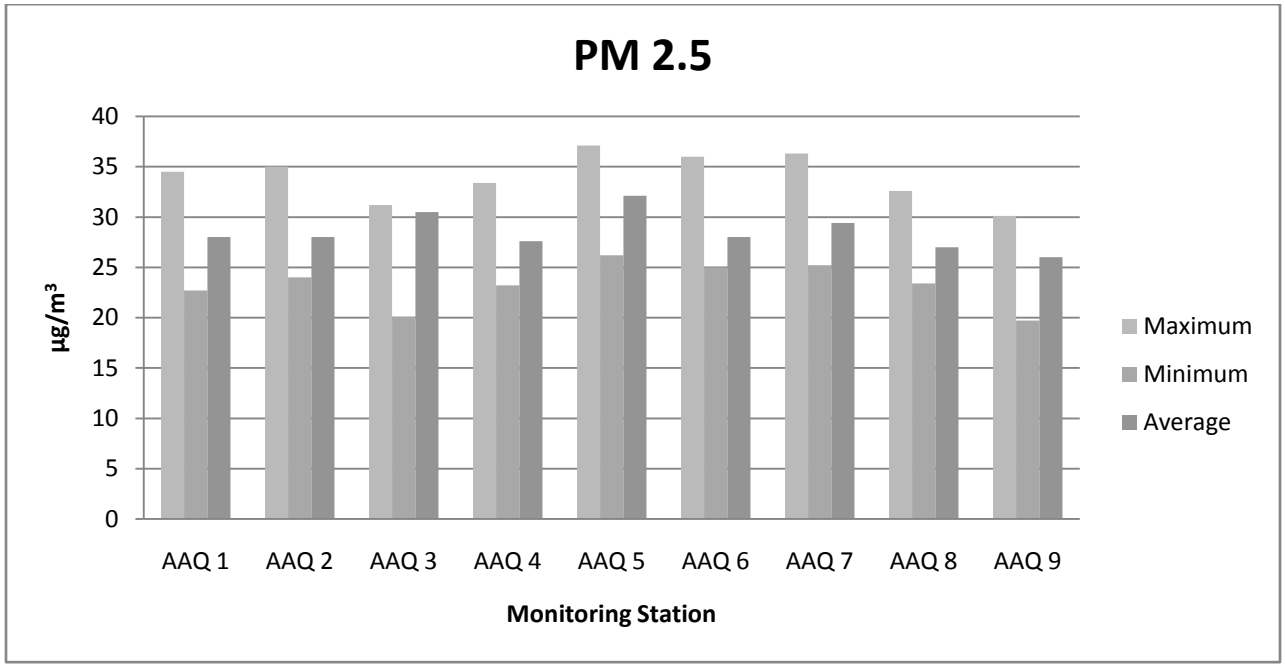
Table No 3.5 Summary of Ambient Air Quality Results

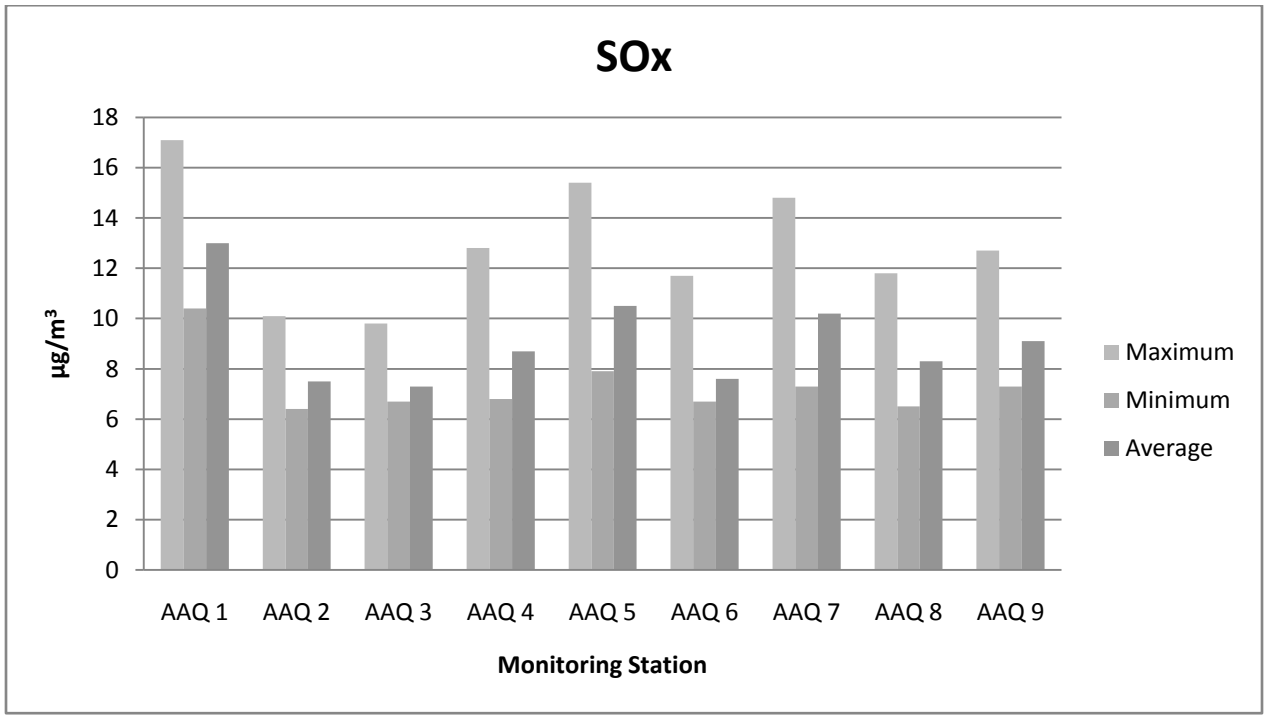
(Pre Monsoon Season – 1st March 2023 to 31st May 2023)

Code	Locations	Parameters	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m$)
AAQ 1	**Project site**	Maximum	56.6	34.5	17.1	22.3
		Minimum	44.2	22.7	10.4	16.2
		Average	50.2	28.0	13	19
		98%	55.4	33.8	16.7	21.8
AAQ 2	**Nattarmangalam**	Maximum	61.5	35	10.1	12.2
		Minimum	51.5	24	6.4	8.1
		Average	60.2	28	7.5	10.2
		98%	62.2	34.3	9.8	11.9
AAQ 3	**Periyapogene**	Maximum	59.8	31.2	9.8	17.4
		Minimum	48.4	20.1	6.7	8.3
		Average	58.6	30.5	7.3	12.0
		98%	58.7	28.5	9.6	17.0
AAQ 4	**Palavaykandan**	Maximum	62.5	33.4	12.8	18.2
		Minimum	49.4	23.2	6.8	10.3
		Average	61.2	27.6	8.7	14.5
		98%	62.4	32.7	12.5	17.8
AAQ 5	**Pandanallur**	Maximum	72.5	37.1	15.4	22.9
		Minimum	56.8	26.2	7.9	14.3
		Average	67.9	32.1	10.5	19
		98%	71.0	36.3	15.0	22.4
AAQ 6	**Thiruchitrambalam**	Maximum	64.1	36	11.7	16.3
		Minimum	49.5	25	6.7	9.1
		Average	58.1	28.0	7.6	12.5
		98%	62.8	35.2	11.4	15.9
AAQ 7	**Manalmedu**	Maximum	67.2	36.3	14.8	24.7
		Minimum	58.1	25.2	7.3	15.4
		Average	64.3	29.4	10.2	19.1
		98%	66.0	35.5	14.5	24.2
AAQ 8	**Kodipallam Village in CCA(Cuddalore)**	Maximum	64.1	32.6	11.8	15.2
		Minimum	52.4	23.4	6.5	9.5
		Average	62.8	27.0	8.3	14.8

		98%	61.8	32.0	11.5	13.0
AAQ 9	**Achalpuram Village in CCA (Cuddalore)**	Maximum	61.5	30.1	12.7	16.5
		Minimum	51.2	19.7	7.3	9.6
		Average	60.2	26.0	9.1	12.4
		98%	59.3	29.4	12.4	16.1
NAAQS			**100**	**60**	**80**	**80**







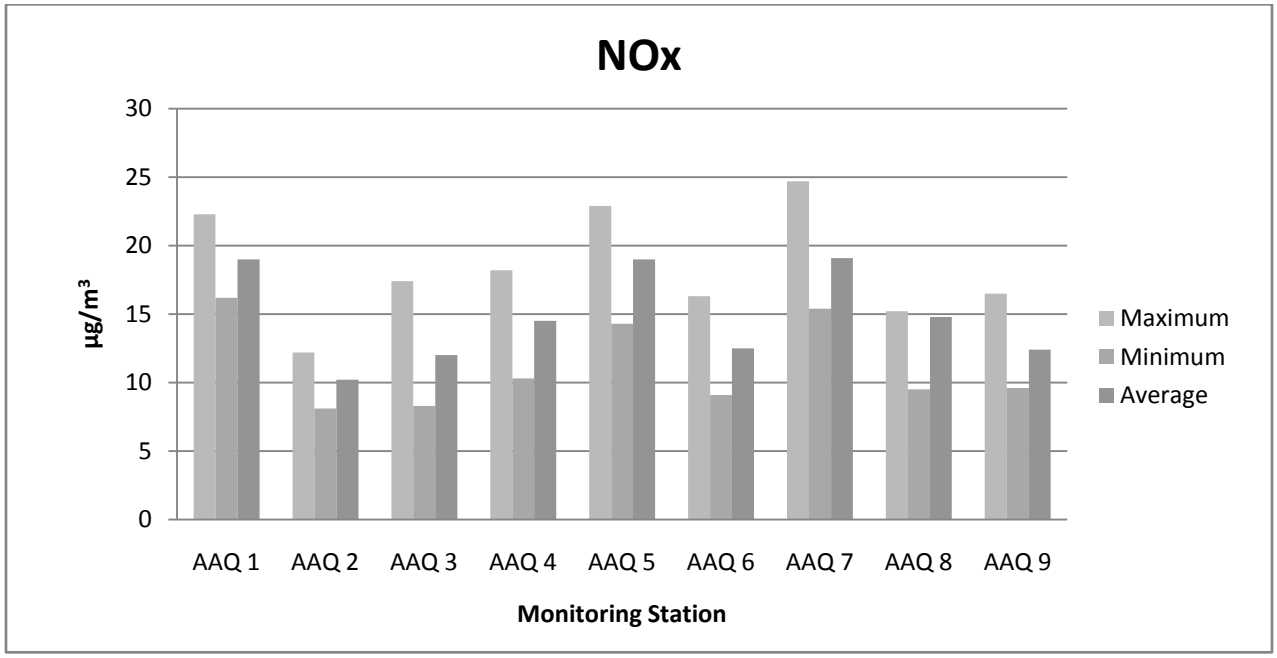


Fig No 3.9: Variation in Concentration of air pollutants during Pre Monsoon Season

3.6.5 Observation – (Pre Monsoon Season)

(i) Particulate Matter (PM_{10})

The average PM_{10} level at nine stations was varied from 50.2µg/m^3 to 67.9µg/m^3 for the monitoring period 1st March, 2023 to 31st May, 2023. The maximum concentration was recorded at Pandanallur village of 72.5µg/m^3 and the minimum concentration was recorded at Project site of 44.2µg/m^3.

(ii) Particulate Matter ($PM_{2.5}$)

The average $PM_{2.5}$ level at nine stations was varied from 26.0µg/m^3 to 31.2µg/m^3 for the monitoring period 1st March, 2023 to 31st May, 2023. The maximum concentration was recorded at Pandanallur village of 37.1µg/m^3 and the minimum concentration was recorded at Achalpuram village of 19.7µg/m^3.

(iii) Sulphur Dioxide (SO_2)

The average SO_2 level at nine stations was varied from 7.3µg/m^3 to 13µg/m^3 for the monitoring period 1st March, 2023 to 31st May, 2023. The maximum concentration was recorded at Project site of 17.1µg/m^3 and the minimum concentration was recorded at Nattarmangalam village of 6.4µg/m^3.

(iv) Nitrogen Dioxide (NO_2)

The average NO_2 level at nine stations was varied from 12.0µg/m^3 to 19.1µg/m^3 for the monitoring period 1st March, 2023 to 31st May, 2023. The maximum concentration was recorded at Manalmedu village of 24.7µg/m^3 and the minimum concentration was recorded at Nattarmangalam village of 8.1µg/m^3.

The concentration levels of the above pollutants were observed to be well within the limits of NAAQS prescribed by CPCB [Standard for PM2.5 is 60 µg/m^3, PM10 is 100 µg/m^3, SO_2 is 80 µg/m^3 and NO_2 is 80 µg/m^3] in all the samples.

3.7 NOISE ENVIRONMENT

A preliminary reconnaissance was undertaken for identification and evaluation of the present noise status on the general population. Therefore, noise level measurement was carried out at each ambient air quality station and also at site. The objectives of Noise environment studies are:

- To assess the ambient noise level in the study area.
- To characterize the noise pollution area.
- To predict the temporal changes in the ambient noise level of the area.

The baseline noise levels were taken to assess the impact of noise on the workers in the project site and on the nearby settlements due to machineries, movements of vehicles etc. Nine locations were identified based on the activities in the study area in dB (A) scale. Georeferenced Top map showing location of noise sampling is given in the Fig No.3.11. The Noise recording stations are shown below in Table No. 3.6 and Fig No. 3.10.

Table No 3.6 Noise Monitoring Stations

Sl. No	Location	Station code	Distance (km)	Direction
1	Project site (Centre)	N1	--	--
	Left Bank of River	N2	0.08	NW
	Right Bank of River	N3	0.08	SE
2	Nattarmangalam	N4	9.1	N
3	Periyapogene	N5	5.2	NW
4	Palavaykandan	N6	3.9	NW
5	Pandanallur	N7	6.7	SW
6	Thiruchitrambalam	N8	2.7	S
7	Manalmedu	N9	5.7	E
8	Kodipallam Village in CCA (Cuddalore)	N10	In CCA	-
9	Achalpuram Village in CCA (Cuddalore)	N11	In CCA	-

3.7.1. Method of Monitoring

Sound Pressure Level (SPL) was measured at nine locations; one reading per hour was taken for 24 hours. The day time noise levels were monitored during 6 am to 10 pm and night time levels during 10 pm to 6 am at all the monitoring locations within the study area. Noise monitoring location of core zone and buffer zone are given in the Fig No. 3.10.

Fig a: Noise Monitoring at Core Zone

Fig b. Noise Monitoring at Nattarmangalam

Fig c. Noise Monitoring at Periyapogene

Fig d. Noise Monitoring at Pandanallur

Fig e. Noise Monitoring at Thiruchitrambalam

Fig f. Noise Monitoring at Achalpuram

Fig g. Noise Monitoring at Kodipallam

Fig No 3.10: Noise Sampling at Core Zone and Buffer Zone

For each location, day and night time Leq values have then been computed from the hourly Leq values such that comparison could be made with the national ambient noise standards.

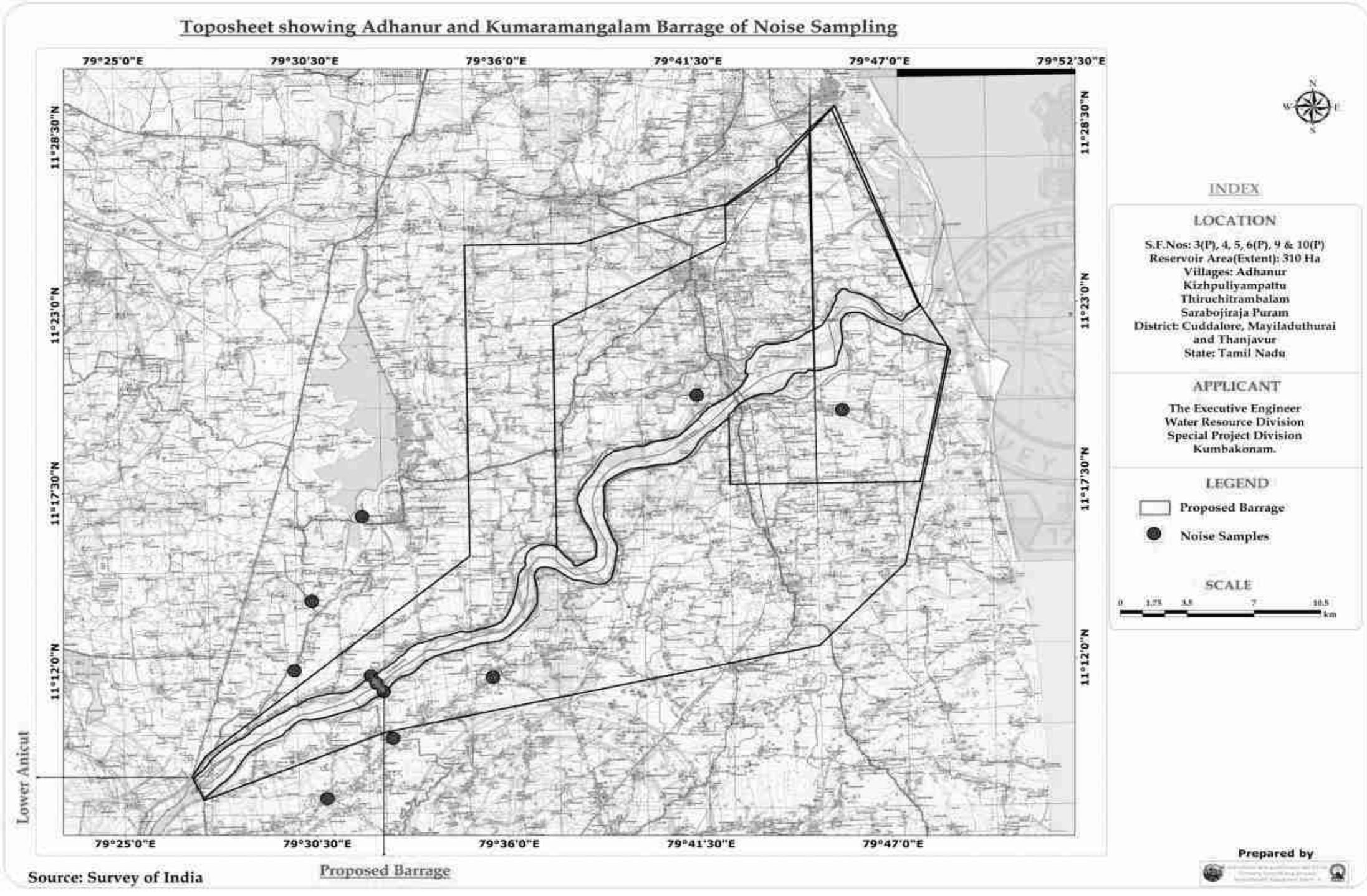


Fig No 3.11: Georeferenced Toposheet showing Noise sampling locations in 10km radius around barrage and in command area

Table No 3.7 Summary of Ambient Noise Level
(Monsoon Season – 1st June 2022 to 30th September 2022)

Sample code	Location	Decibel dB (A)		TNPCB Standards
		Day Time	Night Time	
N1	Project site (Centre)	42.5	39.8	Industrial – 75 dB(A) Residential – 55 dB(A)
	Left Bank of River	41.8	38.2	
	Right Bank of River	43.5	41.3	
N2	Nattarmangalam	47.5	42.6	
N3	Periyapogene	43.4	37.9	
N4	Palavaykandan	45.1	42.6	
N5	Pandanallur	44.8	38.4	
N6	Thiruchitrambalam	46.5	41.9	
N7	Manalmedu	48.1	43.5	
N8	Kodipallam Village in CCA (Cuddalore)	41.2	37.3	
N9	Achalpuram Village in CCA (Cuddalore)	37.4	36.1	

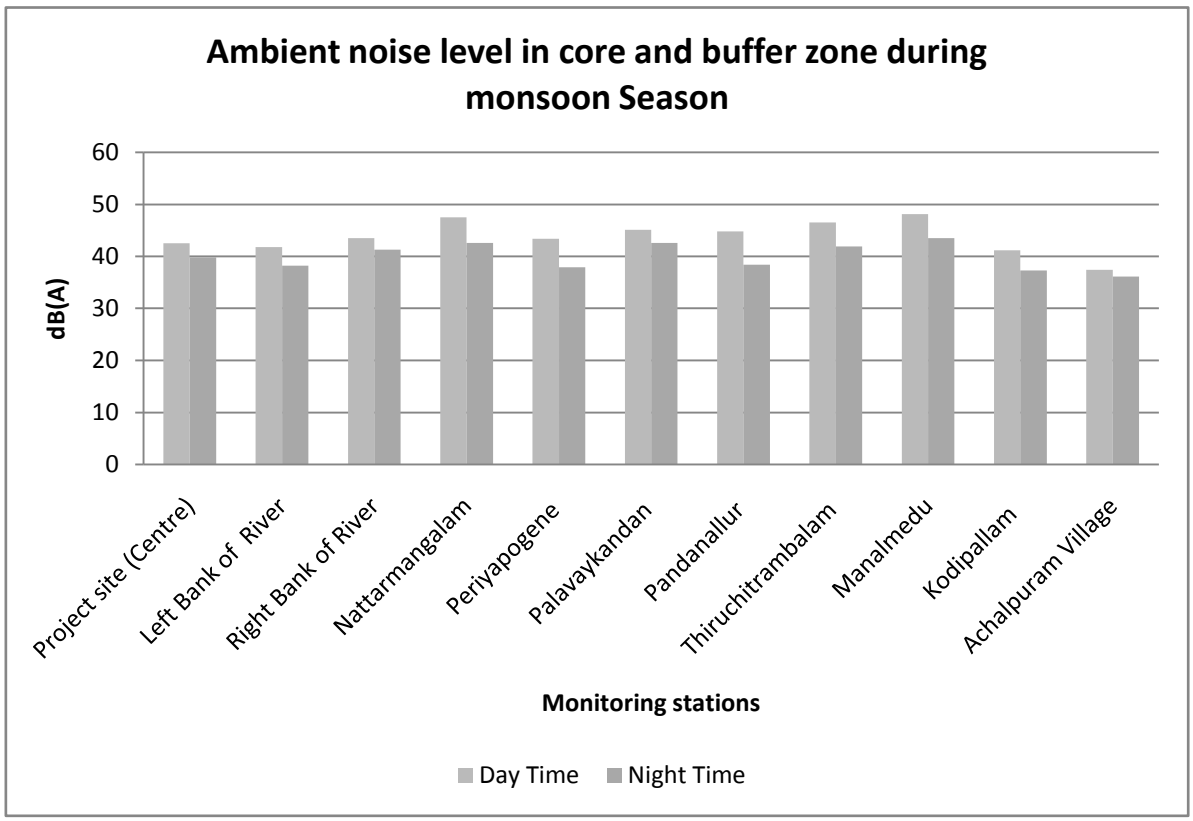


Fig No 3.12: Ambient Baseline Noise Level during Monsoon Season

3.7.2 Interpretation – Monsoon Season

Day Time Noise Levels: The day time noise levels at core zone were observed between the range 41.8 dB(A) and 43.5 dB(A) being well within the Industrial area prescribed limit of 75 dB (A) whereas the noise levels at all locations of buffer zone were observed between the range of 37.4 dB(A) and 48.1 dB(A) being well within the Residential area prescribed limit of 55 dB (A) as per CPCB Standard.

Night Time Noise Levels: The night time noise levels at core zone were observed between the range 38.2 dB(A) and 41.3 dB(A) being well within the Industrial area prescribed limit of 70 dB (A) whereas the noise levels at all locations of buffer zone were observed between the range of 36.1 dB(A) and 42.6 dB(A) being well within the Residential area prescribed limit of 45 dB (A) as per CPCB Standard.

Table No 3.8 Summary of Ambient Noise Level
(Post Monsoon Season – 1st October 2022 to 28th February 2023)

Sample code	Location	Decibel dB (A)		TNPCB Standards
		Day Time	Night Time	
N1	Project site (Centre)	41.3	38.4	Industrial – 75 dB(A) Residential – 55 dB(A)
	Left Bank of River	40.6	37.3	
	Right Bank of River	41.7	40.5	
N2	Nattarmangalam	44.2	42.2	
N3	Periyapogene	42.4	39.6	
N4	Palavaykandan	44.9	42.9	
N5	Pandanallur	42.7	39.6	
N6	Thiruchitrambalam	43.9	42.4	
N7	Manalmedu	46.2	40.9	
N8	Kodipallam Village in CCA (Cuddalore)	41.5	39.6	
N9	Achalpuram Village in CCA (Cuddalore)	39.5	38.4	

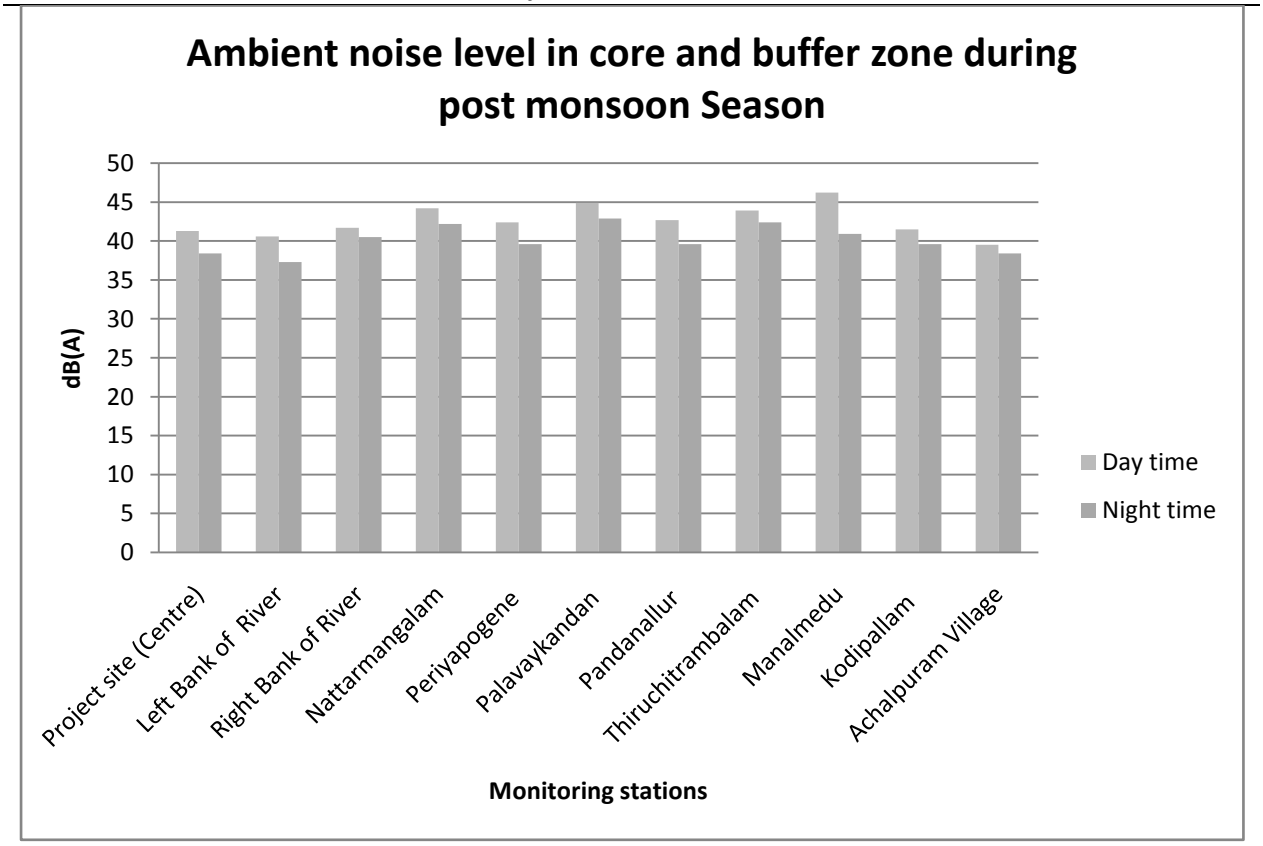


Fig No 3.13: Ambient Baseline Noise Level during Post Monsoon Season

3.7.3 Interpretation – Post Monsoon Season

Day Time Noise Levels: The day time noise levels at core zone were observed between the range 40.6 dB(A) and 41.7 dB(A) being well within the Industrial area prescribed limit of 75 dB (A) whereas the noise levels at all locations of buffer zone were observed between the range of 39.5 dB(A) and 46.2 dB(A) being well within the Residential area prescribed limit of 55 dB (A) as per CPCB Standard.

Night Time Noise Levels: The night time noise levels at core zone were observed between the range 37.3 dB(A) and 40.5 dB(A) being well within the Industrial area prescribed limit of 70 dB (A) whereas the noise levels at all locations of buffer zone were observed between the range of 38.4 dB(A) and 42.9 dB(A) being well within the Residential area prescribed limit of 45 dB (A) as per CPCB Standard.

Table No 3.9 Summary of Ambient Noise Level

(Pre-monsoon period - 1st March, 2023 to 31st May, 2023)

Sample code	Location	Decibel dB (A)		TNPCB Standards
		Day Time	Night Time	
N1	Project site (Centre)	44.7	41.6	Industrial – 75 dB(A) Residential – 55 dB(A)
	Left Bank of River	42.7	40.4	
	Right Bank of River	45.3	42.6	
N2	Nattarmangalam	49.3	39.2	
N3	Periyapogene	45.2	38.1	
N4	Palavaykandan	47.1	43.7	
N5	Pandanallur	46.5	39.6	
N6	Thiruchitrambalam	48.6	42.8	
N7	Manalmedu	50.1	43.5	
N8	Kodipallam Village in CCA(Cuddalore)	43.7	39.3	
N9	Achalpuram Village in CCA(Cuddalore)	39.6	35.4	

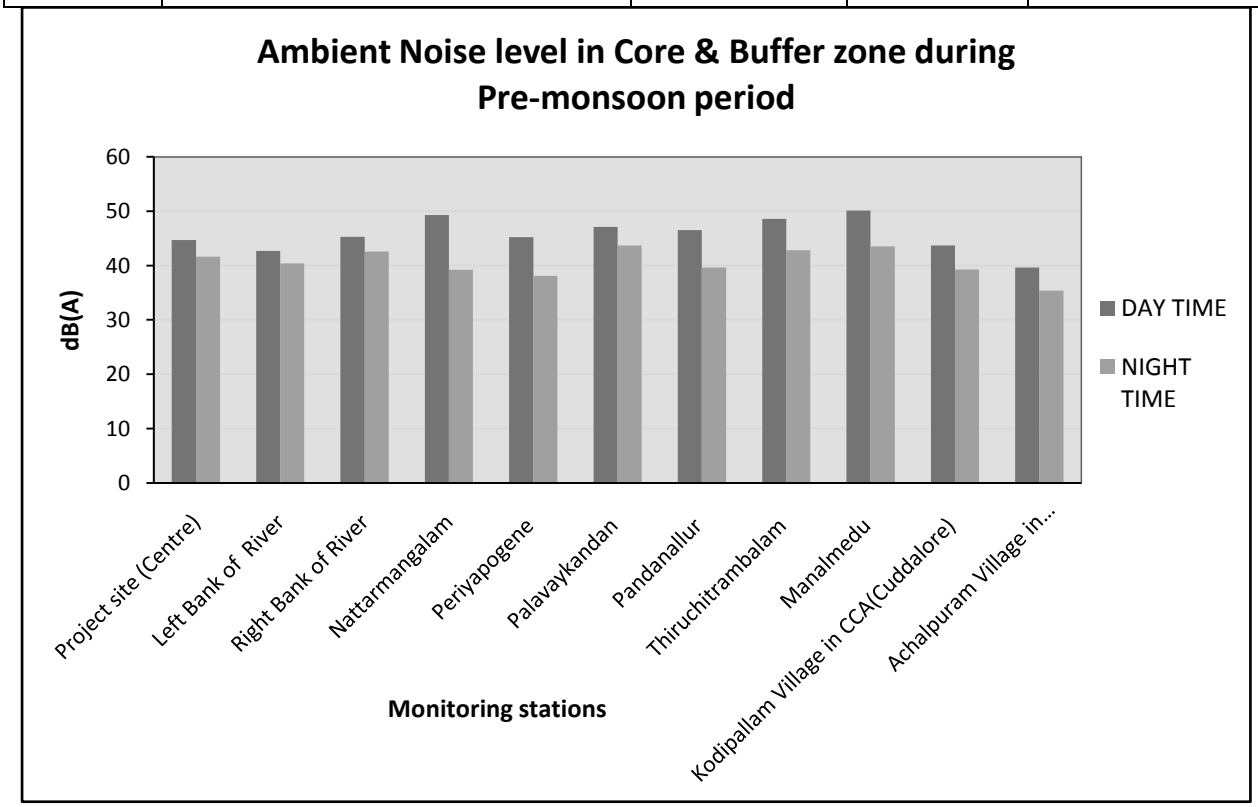


Fig No 3.14 Ambient Baseline Noise Level during Pre Monsoon Season

3.7.4 Interpretation – Pre monsoon season

Day Time Noise Levels: The day time noise levels at core zone were observed between the range 42.7 dB(A) and 45.3 dB(A) being well within the Industrial area prescribed limit of 75 dB (A) whereas the noise levels at all locations of buffer zone were observed between the range of 39.6 dB(A) and 50.1 dB(A) being well within the Residential area prescribed limit of 55 dB (A) as per CPCB Standard.

Night Time Noise Levels: The night time noise levels at core zone were observed between the range 40.4 dB(A) and 42.6 dB(A) being well within the Industrial area prescribed limit of 70 dB (A) whereas the noise levels at all locations of buffer zone were observed between the range of 35.4 dB(A) and 43.7 dB(A) being well within the Residential area prescribed limit of 45 dB (A) as per CPCB Standard.

3.8 WATER ENVIRONMENT

Reconnaissance survey was undertaken and monitoring locations were selected based on:

- Identification and Location of major surface and ground water sources
- Location of the project site
- Water samples were collected and analysed for physical, chemical and biological parameters characteristics as per IS

Thirty three Ground water samples and seven surface water samples were collected from different locations of the study area and in cultivable command area. Samples for chemical analysis were collected in polyethylene bottles. Samples for bacteriological analysis were collected in sterilized glass bottles. Selected physico-chemical and bacteriological parameters have been analyzed for projecting the existing water quality (baseline values) status of ground and surface water in the study area. Photographs of Core and Buffer Zone water sampling locations are given in the Fig No. 3.15 and 3.16. Details of water sampling locations are present in Table No. 3.10 & 3.11. In addition, water quality details are given in the Table No. 3.12, 3.12.1, 3.12.2, 3.13, 3.14, 3.14.1, 3.14.2, 3.15, 3.16, 3.16.1, 3.16.2 and 3.17. The following image of Georeferenced Topomap showing locations of water samples are given in the Fig No.3.17.

Table No 3.10 Ground Water Sampling Locations

Sampling code	Location	Latitude	Longitude	Distance (km)	Direction
WQ 1	Core zone (Adhanur)	11°11'42.0"N	79°31'55.4" E	0.34	W
WQ 2	Eyyalur	11°11'20.8"N	79°31'00.9" E	2.0	W
WQ 3	Kanjankollai-I	11°10'12.2"N	79°28'37.4" E	6.9	WSW
WQ 4	Kanjankollai-II	11°9'55.5"N	79°28'23.5" E	7.2	WSW
WQ 5	Kulothunganallur	11°9'51.10"N	79°27'46.19" E	8.6	WSW
WQ 6	Vembukudi	11°9'52.97"N	79°26'37.48" E	10.0	WSW
WQ 7	Vanathirayankuppam	11°10'46.2"N	79°26'51.3" E	9.6	W
WQ 8	Periyapogene	11°13'55.8"N	79°30'29.4" E	5.0	NW
WQ 9	Kandamangalam	11°15'02.2"N	79°31'30.9" E	6.2	N
WQ 10	Veerananthapuram	11°15'9.31"N	79°30'52.50" E	6.3	N
WQ 11	Omampuliyur	11°13'06.9"N	79°33'34.5" E	4.0	NE
WQ 12	Kumaramangalam (Core Zone)	11°11'14.99"N	79°32'33.97" E	0.17	SE
WQ 13	Nattarmangalam	11°16'40.33"N	79°31'56.53"E	9.0	N
WQ 14	Thiruchitrambalam	11°10'15.8"N	79°31'40.2" E	2.4	SW
WQ 15	Vettamangalam	11°10'28.9"N	79°31'15.4" E	2.6	SW
WQ 16	Kulasekaranallur	11°09'55.6"N	79°31'04.5" E	3.5	SW
WQ 17	Kamachipuram	11°09'28.6"N	79°30'44.1" E	4.5	SW
WQ 18	Kallaiyopur	11°09'26.7"N	79°30'37.8" E	4.7	SW
WQ 19	Ozhugacheri	11°08'13.9"N	79°27'54.3" E	10	SW
WQ 20	Kuruchi	11°06'58.4"N	79°28'37.4" E	10	SW

WQ 21	Irumoolai	11°08′34.2″N	79°30′58.2″ E	5.6	SW
WQ 22	Kumaratchi in CCA (Cuddalore)	11°18' 35.770" N	79°37' 28.369" E	-	-
WQ 23	Kumaratchi in CCA (Cuddalore)	11°18' 33.768" N	79°37' 31.776" E	-	-
WQ 24	Keezhakarai in CCA (Cuddalore)	11°19'14.68"N	79°38'32.84"E	-	-
WQ 25	Keezhakarai in CCA (Cuddalore)	11°19' 19.790" N	79°38' 34.584" E	-	-
WQ 26	Sevayam in CCA (Cuddalore)	11°21' 39.600" N	79°39' 0.700" E	-	-
WQ 27	Esanai in CCA (Cuddalore)	11°22' 3.391" N	79°38' 36.483" E	-	-
WQ 28	Edapalayam in CCA (Cuddalore)	11°26' 22.517" N	79°44' 19.431" E	-	-
WQ 29	Nallanayagipuram in CCA	11°19' 15.591" N	79°44' 20.057" E	-	-
WQ 30	Nallanayagipuram in CCA (Mayiladuthurai)	11°19' 13.908" N	79°44' 14.754" E	-	-
WQ 31	Achalpuram in CCA (Cuddalore)	11°19' 44.388" N	79°45' 26.888" E	-	-
WQ 32	Kollidam in CCA (Mayiladuthurai)	11°19' 41.776" N	79°42' 52.900" E	-	-
WQ 33	Vattathankarai in CCA (Mayiladuthurai)	11°21' 1.958" N	79°47' 52.900" E	-	-

Table No 3.11 Surface Water Sampling Locations

Sampling code	Location	Latitude	Longitude	Distance (km) from new barrage	Direction
WQ1	Adhanur	11°11'41.05"N	79°32'4.47" E	0.1	Upstream
WQ2	Keelpuliyampattu	11°11'27.92"N	79°31'50.40" E	0.68	Upstream
WQ3	Achalpuram	11°10'59.2"N	79°30'17.4" E	3.5	Upstream
WQ4	Sirukattur	11°10'39.22"N	79°29'40.61"E	4.9	Upstream
WQ5	Anaikarai	11° 8'46.31"N	79°27'10.73"E	10.4	Upstream
WQ6	Eyyalur	11°11'12.54"N	79°31'0.91"E	2.2	Upstream
WQ7	In CCA	11°20' 19.90" N	79°42' 37.70" E	-	NE






Fig No 3.15 Collection of ground water sample in study area of 10km radius around proposed barrage






(A) Collection of Ground water sample in CCA of Cuddalore district

(B) Collection of Ground water sample in CCA of Mayiladuthurai district

(C) Collection of Surface water sample in Kollidam River

Fig No 3.16 Photos showing Ground water sampling in CCA & Surface water Sampling

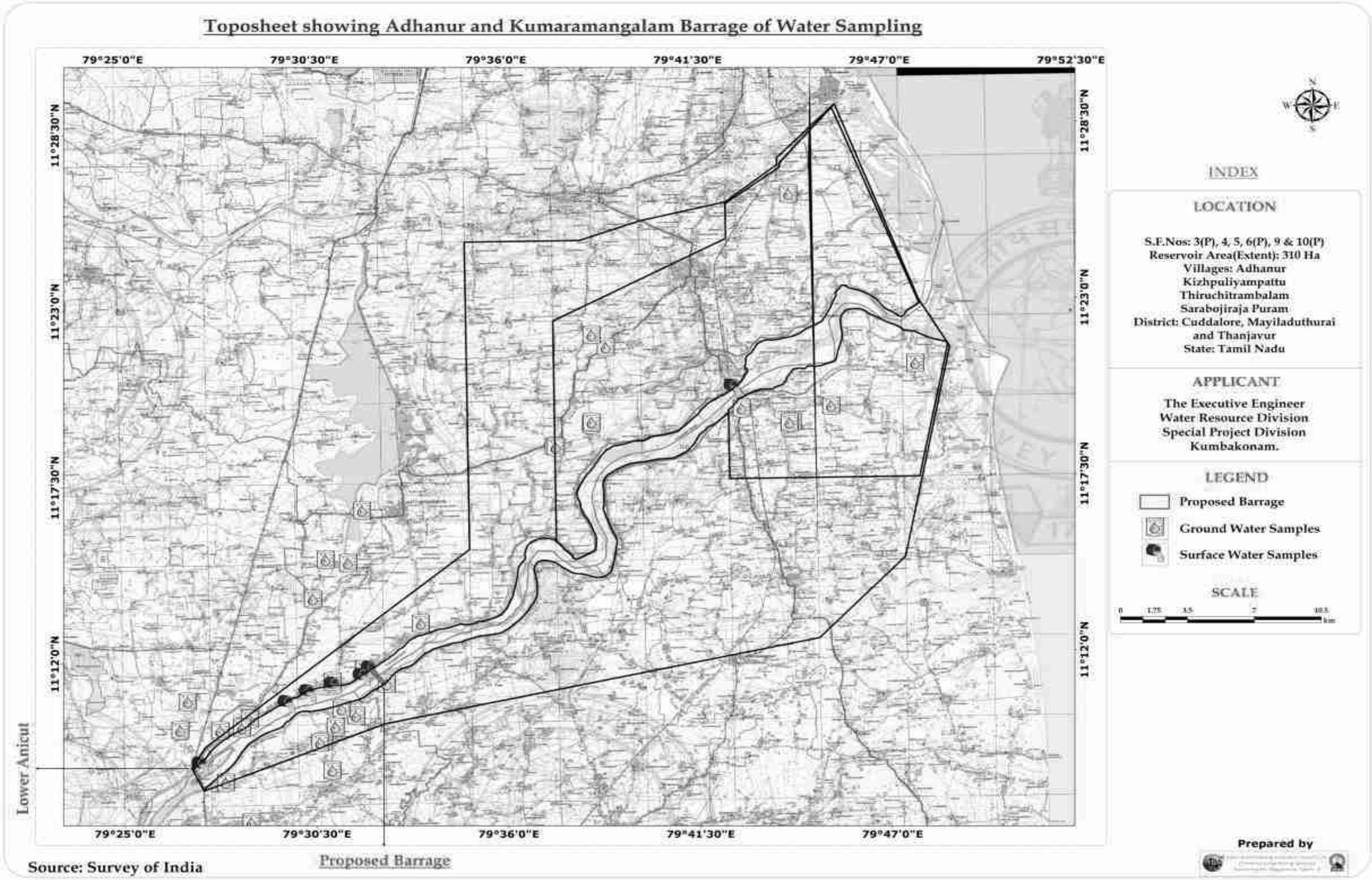


Fig No 3.17: Georeferenced Toposheet showing water sampling location in 10km radius around barrage and in command area

Table No: 3.12 Summary of Ground water Quality Results (1 to 10) (Monsoon Season)

Parameters	Units	As Per IS 10500:2018		IS Methods	Core zone (Adhanur)	Eyyalur	Kanjankollai-I	Kanjankollai-II	Kulothunga nallur	Vembukudi	Vanathirayan kuppam	Periyapogene	Kandamanga lam	Veerananthapuram
		Requirement (Acceptable limit)	Permissible limit in the absence of alternate source											
pH value at 25°C	-	6.5 – 8.5	No relaxation	IS 3025:P.11:2022	7.66	7.35	7.80	7.60	7.72	7.03	7.20	7.13	7.17	7.43
Electrical conductivity at 25°C	Micromhos/ cm	-	-	IS 3025:P.14:2013	759	695	540	534	620	540	428	455	724	717
Turbidity	NTU	1	5	IS 3025:P.10:2023	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)
Temperature	^{0}C	-	-	IS 3025:P.09:1984:R.2017	25.6	25.5	25.5	25.5	25	25.2	25.3	25.4	25.3	25.3
Taste	-	Agreeable	Agreeable	IS 3025:P.07:2017	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Color	HU	5	15	IS 3025:P.04:2021	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Odour	-	Agreeable	Agreeable	IS 3025:P.05:2018	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Total Suspended Solids	mg/l	-	-	IS 3025:P.17:2022	2	2	2	2	2	2	1	1	2	2
Total Dissolved Solids	mg/l	500	2000	IS 3025:P.16:2023	460	440	352	348	370	350	282	300	490	450
Total Solids	mg/l	-	-	IS 3025:P.15:1984:R.2017	462	442	354	350	372	352	283	301	492	452
Total Hardness as $CaCO_3$	mg/l	200	600	IS 3025:P.21:2009:R.2019	133	222	168	155	209	244	133	191	364	377
Calcium as Ca	mg/l	75	200	IS 3025:P.40:1991:R.2019	45	78	56	48	56	64	43	64	113	111
Calcium Hardness	mg/l	-	-	IS 3025:P.40:1991:R.2019	124	218	155	133	134	178	120	178	315	306
Magnesium Hardness	mg/l	-	-	IS 3025:P.46:1994:R.2019	9	4	13	22	23	66	13	13	49	71
Magnesium as Mg	mg/l	30	100	IS 3025:P.46:1994:R.2023	2	1	3	5	13	16	3	3	11	17
Chlorides as Cl	mg/l	250	1000	IS 3025:P.32:1988:R.2019	76	190	152	78	154	166	72	165	230	226
Acidity as $CaCO_3$	mg/l	-	-	IS 3025:P.22:1986:R.2019	-	-	-	-	-	-	-	-	-	-

Total Alkalinity as $CaCO_3$	mg/l	200	600	IS 3025:P.23:2023	150	150	80	80	100	80	50	50	150	150
Carbonate	mg/l	-	-	IS 3025:P.51:2023	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)
Bicarbonate	mg/l	-	-	IS 3025:P.51:2023	150	150	80	80	100	80	50	50	150	150
Sulfates as SO_4	mg/l	200	400	IS 3025:P.24:1986:R.2019	9	8	6	6	7	6	4	5	8	8
Total Iron as Fe	mg/l	0.3	0.3	IS 3025:P.53:2003:R.2019	0.06	0.06	0.05	0.05	0.06	0.05	0.04	0.04	0.06	0.06
Hexavalent Chromium as Cr^{+6}	mg/l	-	-	IS 3025:P.52:2003:R.2019	0.004	0.005	0.003	0.003	0.004	0.003	BDL (DL:0.001)	BDL (DL:0.001)	0.004	0.003
Sodium as Na	mg/l	-	-	IS 3025:P.45:2019	54	42	22	16	38	22	9	10	48	43
Potassium as K	mg/l	-	-	IS 3025:P.45:.2019	12	7	4	4	5	4	3	3	8	7
Dissolved Oxygen as DO	mg/l	-	-	IS 3025:P.38:1989:R.2019	6.6	6.8	7.0	6.9	6.8	6.8	6.7	6.6	6.6	6.6
Chemical Oxygen Demand as COD	mg/l	-	-	IS 3025:P.51:2023	8	8	4	4	4	4	4	4	8	8
Biological Oxygen Demand as BOD	mg/l	-	-	IS 3025:P.44:2023	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nitrite as NO2	mg/l	-	-	IS 3025 P.34:2019	BDL (DL:0.001)	0.004	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	0.002	0.003
Nitrate as NO3	mg/l	-	-	IS 3025 P.34:2019	1	0.08	0.06	0.06	0.07	0.06	0.03	0.03	1	1
Oil & Grease	mg/l	-	-	IS 3025 P.39:2021	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

Table No: 3.12.1 Summary of Ground water Quality Results (11 to 22) (Monsoon Season)

Parameters	Units	As Per IS 10500:2018		IS Methods	Omampuliyur	Kumaraman galam (Core Zone)	Nattarman galam	Thiruchitram balam	Vettaman galam	Kulasekara nallur	Kamachi puram	Kallaiyopur	Ozhugacheri	Kuruchi	Irumoolai	Kumaratchi in CCA (Cuddalore)
		Requirement (Acceptable limit)	Permissible limit in the absence of alternate source													
pH value at 25°C	-	6.5 – 8.5	No relaxation	IS 3025:P.11:2022	7.43	7.76	7.24	7.87	7.94	7.50	7.77	7.81	7.56	8.13	7.84	7.06
Electrical conductivity at 25°C	Micromhos/ cm	-	-	IS 3025:P.14:2013	682	559	734	636	671	1137	1042	1253	660	462	699	2290
Turbidity	NTU	1	5	IS 3025:P.10:2023	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)
Temperature	^{0}C	-	-	IS 3025:P.09:1984:R.2017	25.2	25.6	25.6	25.6	25.7	25.8	25.9	25.1	25.3	25.5	25.1	25
Taste	-	Agreeable	Agreeable	IS 3025:P.07:2017	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Color	HU	5	15	IS 3025:P.04:2021	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Odour	-	Agreeable	Agreeable	IS 3025:P.05:2018	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Total Suspended Solids	mg/l	-	-	IS 3025:P.17:2022	2	2	2	2	2	2	2	2	2	1	2	12
Total Dissolved Solids	mg/l	500	2000	IS 3025:P.16:2023	420	354	464	400	430	698	632	750	388	294	436	1346
Total Solids	mg/l	-	-	IS 3025:P.15:1984:R.2017	422	356	466	402	432	700	634	752	390	295	438	1358
Total Hardness as $CaCO_3$	mg/l	200	600	IS 3025:P.21:2009:R.2019	249	164	266	244	253	182	244	293	266	138	289	343
Calcium as Ca	mg/l	75	200	IS 3025:P.40:1991:R.2019	80	48	88	75	78	51	61	64	83	39	78	76
Calcium Hardness	mg/l	-	-	IS 3025:P.40:1991:R.2019	222	133	244	208	217	142	169	178	230	107	218	190
Magnesium Hardness	mg/l	-	-	IS 3025:P.46:1994:R.2019	27	31	22	36	36	40	75	115	36	31	71	153
Magnesium as Mg	mg/l	30	100	IS 3025:P.46:1994:R.2023	7	8	5	9	9	10	18	28	9	8	17	37
Chlorides as Cl	mg/l	250	1000	IS 3025:P.32:1988:R.2019	192	78	198	182	180	82	148	165	200	150	140	343

Acidity as $CaCO_3$	mg/l	-	-	IS 3025:P.22:1986:R.2019	-	-	-	-	-	-	-	-	-	-	-	-
Total Alkalinity as $CaCO_3$	mg/l	200	600	IS 3025:P.23:2023	100	80	150	100	100	200	200	220	100	50	100	600
Carbonate	mg/l	-	-	IS 3025:P.51:2023	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)
Bicarbonate	mg/l	-	-	IS 3025:P.51:2023	100	80	150	100	100	200	200	200	100	50	100	600
Sulfates as SO_4	mg/l	200	400	IS 3025:P.24:1986:R.2019	8	6	9	8	8	16	12	21	6	4	7	37
Total Iron as Fe	mg/l	0.3	0.3	IS 3025:P.53:2003:R.2019	0.05	0.05	0.07	0.06	0.06	0.08	0.08	0.08	0.06	0.03	0.07	2.1
Hexavalent Chromium as Cr^{+6}	mg/l	-	-	IS 3025:P.52:2003:R.2019	0.005	0.007	0.006	0.005	0.004	0.007	0.007	0.007	0.003	BDL (DL:0.001)	0.004	0.03
Sodium as Na	mg/l	-	-	IS 3025:P.45:2019	41	23	49	38	40	85	68	101	40	10	42	315
Potassium as K	mg/l	-	-	IS 3025:P.45:.2019	7	4	8	7	7	30	22	42	7	3	7	135
Dissolved Oxygen as DO	mg/l	-	-	IS 3025:P.38:1989:R.2019	7.5	8.2	7.6	7.4	6.7	5.8	5.9	5.5	6.2	7.2	6.6	6
Chemical Oxygen Demand as COD	mg/l	-	-	IS 3025:P.51:2023	8	4	8	4	8	14	14	16	8	4	8	24
Biological Oxygen Demand as BOD	mg/l	-	-	IS 3025:P.44:2023	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nitrite as NO2	mg/l	-	-	IS 3025 P.34:2019	0.003	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	0.003	0.004	0.005	0.005	BDL (DL:0.001)	BDL (DL:0.001)	0.002	1.392
Nitrate as NO3	mg/l	-	-	IS 3025 P.34:2019	1	0.09	0.09	0.08	0.09	0.08	2	2	0.08	0.03	0.06	3.4
Oil & Grease	mg/l	-	-	IS 3025 P.39:2021	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

Table No: 3.12.2 Summary of Ground water Quality Results (23 to 33) (Monsoon Season)

Parameters	Units	As Per IS 10500:2018		IS Methods	Kumaratchi in CCA (Cuddalore)	Keezhakarai in CCA (Cuddalore))	Keezhakarai in CCA (Cuddalore))	Sevayam in CCA (Cuddalore)	Esanai in CCA (Cuddalore)	Edapalayam in CCA (Cuddalore)	Nallanayagipuram in CCA (Mayiladuthurai)	Nallanayagipuram in CCA (Mayiladuthurai)	Achalpuram in CCA (Cuddalore)	Kollidam in CCA (Mayiladuthurai)	Vattathangarai in CCA (Mayiladuthurai)
		Requirement (Acceptable limit)	Permissible limit in the absence of alternate source												
pH value at 25°C	-	6.5 – 8.5	No relaxation	IS 3025:P.11:2022	8.31	7.78	7.24	7.32	7.10	7.24	7.40	6.74	7.14	7.0	6.90
Electrical conductivity at 25°C	Micromhos/ cm	-	-	IS 3025:P.14:2013	1984	1105	1340	804	763	5094	3740	2890	403	703	1353
Turbidity	NTU	1	5	IS 3025:P.10:2023	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)
Temperature	^{0}C	-	-	IS 3025:P.09:1984:R.2017	25	25	25	25	25	25	25	25	25	25	25
Taste	-	Agreeable	Agreeable	IS 3025:P.07:2017	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Color	HU	5	15	IS 3025:P.04:2021	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Odour	-	Agreeable	Agreeable	IS 3025:P.05:2018	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Total Suspended Solids	mg/l	-	-	IS 3025:P.17:2022	6	4	4	2	2	18	16	14	1	1	4
Total Dissolved Solids	mg/l	500	2000	IS 3025:P.16:2023	1055	530	690	454	430	3006	2208	1676	250	390	850
Total Solids	mg/l	-	-	IS 3025:P.15:1984:R.2017	1061	534	694	456	432	302	2224	1690	251	391	854
Total Hardness as $CaCO_3$	mg/l	200	600	IS 3025:P.21:2009:R.2019	286	57	343	190	171	857	446	571	114	190	274
Calcium as Ca	mg/l	75	200	IS 3025:P.40:1991:R.2019	73	15	92	61	53	211	84	104	31	40	84
Calcium Hardness	mg/l	-	-	IS 3025:P.40:1991:R.2019	183	38	228	152	133	526	209	259	76	99	209
Magnesium Hardness	mg/l	-	-	IS 3025:P.46:1994:R.2019	103	19	115	38	38	331	237	312	38	91	65
Magnesium as Mg	mg/l	30	100	IS 3025:P.46:1994:R.2023	25	5	28	9	9	80	58	76	9	22	16
Chlorides as Cl	mg/l	250	1000	IS 3025:P.32:1988:R.2019	181	110	227	95	76	973	477	439	19	81	191

Acidity as $CaCO_3$	mg/l	-	-	IS 3025:P.22:1986:R.2019	-	-	-	-	-	-	-	-	-	-	-
Total Alkalinity as $CaCO_3$	mg/l	200	600	IS 3025:P.23:2023	440	296	280	240	288	440	400	280	120	240	240
Carbonate	mg/l	-	-	IS 3025:P.51:2023	80	32	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)
Bicarbonate	mg/l	-	-	IS 3025:P.51:2023	360	264	280	240	288	440	400	280	120	240	240
Sulfates as SO_4	mg/l	200	400	IS 3025:P.24:1986:R.2019	27	24	25	10	9	67	33	48	4	8	26
Total Iron as Fe	mg/l	0.3	0.3	IS 3025:P.53:2003:R.2019	0.08	0.08	0.09	0.07	0.06	3	2.4	1.706	0.04	0.05	0.08
Hexavalent Chromium as Cr^{+6}	mg/l	-	-	IS 3025:P.52:2003:R.2019	0.01	0.006	0.007	0.006	0.004	0.02	0.01	0.01	0.006	0.07	0.04
Sodium as Na	mg/l	-	-	IS 3025:P.45:2019	310	86	76	61	54	230	280	67	83	86	120
Potassium as K	mg/l	-	-	IS 3025:P.45:.2019	135	6	14	9	12	56	95	12	19	21	57
Dissolved Oxygen as DO	mg/l	-	-	IS 3025:P.38:1989:R.2019	6.4	6.2	6.4	6.8	6.6	5.6	5.9	5.9	7.2	6.8	6.1
Chemical Oxygen Demand as COD	mg/l	-	-	IS 3025:P.51:2023	20	18	22	10	8	36	24	24	8	14	20
Biological Oxygen Demand as BOD	mg/l	-	-	IS 3025:P.44:2023	<2	<2	<2	<2	<2	2.3	2.1	<2	<2	<2	<2
Nitrite as NO2	mg/l	-	-	IS 3025 P.34:2019	0.03	0.05	0.02	0.0149	BDL (DL:0.001)	0.08	0.008	0.03	0.0559	0.0041	0.01
Nitrate as NO3	mg/l	-	-	IS 3025 P.34:2019	0.3	0.201	0.325	0.3	1	4.8	0.3	0.1	0.1	0.08	0.290
Oil & Grease	mg/l	-	-	IS 3025 P.39:2021	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

Table No: 3.13 Summary of Surface water Quality Results (Monsoon Season)

Parameters	Units	As Per IS 10500:2018		IS Methods	Adhanur	Keelpuliyampattu	Achalpuram	Sirukattur	Anaikarai	Eyyalur	In CCA
		Requirement (Acceptable limit)	Permissible limit in the absence of alternate source								
pH value at 25°C	-	6.5 – 8.5	No relaxation	IS 3025:P.11:2022	7.14	7.56	7.36	7.58	7.65	8.01	8.13
Electrical Conductivity at 25°C	Micromhos/ cm	-	-	IS 3025:P.14:2013	576	612	1342	686	496	569	588
Turbidity	NTU	1	5	IS 3025:P.10:2023	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)
Temperature	^{0}C	-	-	IS 3025:P.09:1984:R.2017	25.3	25.6	25.7	25.8	25.5	25	25
Taste	-	Agreeable	Agreeable	IS 3025:P.07:2017	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Color	HU	5	15	IS 3025:P.04:2021	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Odour	-	Agreeable	Agreeable	IS 3025:P.05:2018	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Total Suspended Solids	mg/l	-	-	IS 3025:P.17:2022	2	2	2	2	1	1	1
Total Dissolved Solids	mg/l	500	2000	IS 3025:P.16:2023	360	384	796	422	296	314	320
Total Solids	mg/l	-	-	IS 3025:P.15:1984:R.2017	362	386	798	424	297	315	321
Total Hardness as $CaCO_3$	mg/l	200	600	IS 3025:P.21:2009:R.2019	184	198	249	232	133	95	99
Calcium as Ca	mg/l	75	200	IS 3025:P.40:1991:R.2019	55	68	76	66	46	32	31
Calcium Hardness	mg/l	-	-	IS 3025:P.40:1991:R.2019	151	186	209	182	129	80	76
Magnesium Hardness	mg/l	-	-	IS 3025:P.46:1994:R.2019	33	12	40	50	4	15	23
Magnesium as Mg	mg/l	30	100	IS 3025:P.46:1994:R.2023	8	3	10	12	1	4	6

Chlorides as Cl	mg/l	250	1000	IS 3025:P.32:1988:R.2019	152	165	190	210	82	67	69
Acidity as $CaCO_3$	mg/l	-	-	IS 3025:P.22:1986:R.2019	-	-	-	-	-	-	-
Total Alkalinity as $CaCO_3$	mg/l	200	600	IS 3025:P.23:2023	80	50	80	100	50	160	248
Carbonate	mg/l	-	-	IS 3025:P.51:2023	BDL(DL:1)	BDL(DL:1)	BDL(DL:1)	BDL(DL:1)	BDL(DL:1)	BDL(DL:1)	24
Bicarbonate	mg/l	-	-	IS 3025:P.51:2023	80	50	80	100	50	160	224
Sulfates as SO_4	mg/l	200	400	IS 3025:P.24:1986:R.2019	7	5	26	10	4	5	6
Total Iron as Fe	mg/l	0.3	0.3	IS 3025:P.53:2003:R.2019	0.06	0.05	0.08	0.08	BDL (DL:0.01)	0.06	0.06
Hexavalent Chromium as Cr^{+6}	mg/l	-	-	IS 3025:P.52:2003:R.2019	0.003	0.003	0.004	0.004	BDL (DL:0.001)	0.002	0.003
Sodium as Na	mg/l	-	-	IS 3025:P.45:2019	16	35	120	46	9	26	29
Potassium as K	mg/l	-	-	IS 3025:P.45:.2019	5	4	44	8	2	8	9
Dissolved Oxygen as DO	mg/l	-	-	IS 3025:P.38:1989:R.2019	6.8	6.8	5.2	7.6	6.8	7.2	7.1
Chemical Oxygen Demand as COD	mg/l	-	-	IS 3025:P.51:2023	4	4	16	8	4	8	8
Biological Oxygen Demand as BOD	mg/l	-	-	IS 3025:P.44:2023	<2	<2	<2	<2	<2	<2	<2
Nitrite as NO2	mg/l	-	-	IS 3025 P.34:2019	BDL (DL:0.001)	BDL (DL:0.001)	0.005	0.003	BDL (DL:0.001)	0.007	0.008
Nitrate as NO3	mg/l	-	-	IS 3025 P.34:2019	0.07	0.04	2	1	0.02	0.1120	
Oil & Grease	mg/l	-	-	IS 3025 P.39:2021	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

3.8.1. Observations on Ground Water Quality - Monsoon season

Ground Water Quality results were compared with Acceptable limits for Drinking Water as per the Standard IS 10500:2012. 31 parameters has been analysed including the Chromium (Cr^{+6}), Acidity, Alkalinity etc.

- pH of ground water samples in the study area around 10km radius of proposed barrage were ranged from 7.03 – 8.13 which is found within the prescribed limits. pH of water samples from cultivable command area were ranged from 7.06 to 8.31 which is also found within the limits.

- Total Iron from all the water samples in the study area of 10km radius was found within the acceptable range. In the cultivable command area, ground water samples from 12 stations were collected for analysis. From the result, it is found that the Total Iron in the water sample from Kumaratchi, Edapalayam and Nallanayagipuram were 2.1mg/l, 3.0mg/l and 2.4mg/l which are beyond the acceptable limits of 0.3mg/l.

- In the study area of 10km radius, the Total Dissolved Solids in all the water sample except from Kulasekaranallur, Kamchipuram and Kallaiyopur were found within the acceptable limits of 500 mg/L as per CPCB norms whereas the TDS from the above three villages were found between 632 to 750 mg/l which is beyond 500mg/lit. Among 12 locations in CCA, the TDS in water sample from the four locations such as Achalpuram, Kollidam, Esanai and Shevayam were found within the acceptable limits. The TDS from other locations are higher than 500mg/lit, the reason behind is the CCA are located near to coastal boundary.

- In the study area of 10km radius around proposed barrage, Total Hardness of water sample varied between 133-377 mg/l and the maximum value of 377mg/l was recorded at Veerananthapuram and the minimum value of 133mg/lit was recorded at both Vanathirayanpuram and in Adhanur (Core zone) villages. However the maximum value was found within the permissible limits of 600mg/l. In the cultivable command area, Total Hardness of water sample varied between 57-857 mg/l and the maximum value recorded at Edapalayam village.

- Calcium and Magnesium was found to be within the permissible limits of 200mg/l and 100mg/l respectively in all the locations of study area and in CCA.

- In the study area of 10km radius, Total Alkalinity from all the water samples except in Kallaiyopur village was found within acceptable limits of 200mg/l whereas in Kallaiyopur village, it is 220mg/l. In the cultivable command area, Total alkalinity in all the location except in Achalpuram Village exceeds acceptable limits of 200mg/l whereas in Achalpuram village it is 120mg/l.

- Chloride from all the water samples in study area around barrage was ranged from 72 to 230mg/l which was within prescribed limit of 250mg/l. In CCA, chloride from all the water samples was ranged from 19 to 973mg/l. The maximum value of 973mg/l was recorded in Edapalayam village which located very close to sea shore.

- Both in study area of 10km radius and in cultivable command area, Sulphate in water samples was ranged from 4 to 67mg/l which is well within the acceptable limits of 200mg/l.

- Hexavalent Chromium (Cr^{+6}) from all the water samples were analysed and found to be in the range of 0 to 0.07 mg/l.

Prolonged consumption of water containing high TH causes Cardio vascular problems, diabetes, skin diseases, rashes, reproductive failure and renal failure. For the excellent quality of drinking, the water must be treated with reverse osmosis process to overcome above mentioned such impacts on human body. Boiling of water will remove the microorganisms effectively from all waters in the above said villages and core zone making the water aseptically fit for drinking purposes.

3.8.2. Observations on Surface Water Quality – Monsoon Season

Surface Water Quality results were compared with Acceptable limits for Drinking Water as per the Standard IS 10500:2012. Same 31 parameters has been analysed including the Chromium (Cr^{+6}), Acidity, Alkalinity etc as ground water quality.

- pH of Coleroon River water between Lower Anicut and proposed barrage was ranged from 7.14 to 8.01 which is found within the prescribed limits and one water sample was taken at downstream of proposed barrage near bridge at Kollidam. The pH of that sample was recorded as 8.13.

- Total Iron from all the surface water samples was found in the range 0.05 and 0.08 which is within the acceptable limit of 0.3.

- TDS from all the water sample was ranged from 296 -796 mg/l. The TDS in water sample from Achalpuram village only exceeds the acceptable limit of 500mg/l. The Achalpuram village is located at middle of Lower Anicut and proposed barrage.

- The total hardness from the seven water samples was ranged from 99-249mg/l. The total hardness in Achalpuram village and in Sirukattur village was recorded as 249mg/l and 232mg/l which exceed the acceptable limits of 200mg/l.

- Calcium and Magnesium was found to be within the permissible limits of 200mg/l and 100mg/l respectively in all the locations.

- The total alkalinity in the Coleroon River water sample between Lower Anicut and proposed barrage was ranged from 50 to 160mg/l. The total alkalinity in river water sample in CCA was recorded as 248mg/l which exceeds the acceptable limit of 200mg/l.

- Chloride from all the water samples was ranged from 67 to 210mg/l which was within prescribed limit of 250mg/l. At the same time sulphate in all water sample was within the acceptable of 200 mg/l.

- Hexavalent Chromium (Cr^{+6}) from all the water samples were analysed and found to be in the range of 0 to 0.004 mg/l.

The quality of Coleroon River water is good which can be consumed without any prior water treatment. Boiling of water is must in surface water consumption to remove the microorganisms which can transmit diseases such as diarrhea, cholera, dysentery, typhoid and polio.

Table No: 3.14 Summary of Ground water Quality Results (1 to 10) (Post Monsoon Season)

Parameters	Units	As Per IS 10500:2018		IS Methods	Core zone (Adhanur)	Eyyalur	Kanjankollai-I	Kanjankollai-II	Kulothunga nallur	Vembukudi	Vanathirayan kuppam	Periyapogene	Kandamanga lam	Veerananthapuram
		Requirement (Acceptable limit)	Permissible limit in the absence of alternate source											
pH value at 25°C	-	6.5 – 8.5	No relaxation	IS 3025:P.11:2022	7.26	7.13	7.62	7.38	7.41	7.08	7.16	7.03	7.11	7.31
Electrical conductivity at 25°C	Micromhos/ cm	-	-	IS 3025:P.14:2013	752	684	527	519	605	536	412	428	690	701
Turbidity	NTU	1	5	IS 3025:P.10:2023	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)
Temperature	^{0}C	-	-	IS 3025:P.09:1984:R.2017	28.6	28.6	28.4	28.4	27.3	28.1	28.0	27.6	28.3	27.6
Taste	-	Agreeable	Agreeable	IS 3025:P.07:2017	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Color	HU	5	15	IS 3025:P.04:2021	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Odour	-	Agreeable	Agreeable	IS 3025:P.05:2018	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Total Suspended Solids	mg/l	-	-	IS 3025:P.17:2022	2	2	1	1	2	1	2	1	1	2
Total Dissolved Solids	mg/l	500	2000	IS 3025:P.16:2023	412	429	328	315	351	337	262	289	458	421
Total Solids	mg/l	-	-	IS 3025:P.15:1984:R.2017	414	431	329	316	353	338	264	290	459	422
Total Hardness as $CaCO_3$	mg/l	200	600	IS 3025:P.21:2009:R.2019	125	208	149	151	198	237	124	175	354	342
Calcium as Ca	mg/l	75	200	IS 3025:P.40:1991:R.2019	47	83	58	45	60	68	41	59	118	127
Calcium Hardness	mg/l	-	-	IS 3025:P.40:1991:R.2019	113	199	142	124	126	180	114	172	290	293
Magnesium Hardness	mg/l	-	-	IS 3025:P.46:1994:R.2019	12	9	7	27	72	57	10	3	64	49
Magnesium as Mg	mg/l	30	100	IS 3025:P.46:1994:R.2023	3	1	4	4	17	21	1	2	15	19
Chlorides as Cl	mg/l	250	1000	IS 3025:P.32:1988:R.2019	81	210	173	95	164	154	77	148	213	216
Acidity as $CaCO_3$	mg/l	-	-	IS 3025:P.22:1986:R.2019	-	-	-	-	-	-	-	-	-	-

Total Alkalinity as $CaCO_3$	mg/l	200	600	IS 3025:P.23:2023	145	153	65	65	87	68	42	42	67	67
Carbonate	mg/l	-	-	IS 3025:P.51:2023	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)
Bicarbonate	mg/l	-	-	IS 3025:P.51:2023	145	153	65	65	87	68	42	42	67	67
Sulfates as SO_4	mg/l	200	400	IS 3025:P.24:1986:R.2019	7	6	5	6	6	5	6	5	6	7
Total Iron as Fe	mg/l	0.3	0.3	IS 3025:P.53:2003:R.2019	0.06	0.06	0.05	0.05	0.06	0.05	0.04	0.04	0.06	0.06
Hexavalent Chromium as Cr^{+6}	mg/l	-	-	IS 3025:P.52:2003:R.2019	0.004	0.005	0.003	0.003	0.004	0.003	BDL (DL:0.001)	BDL (DL:0.001)	0.004	0.003
Sodium as Na	mg/l	-	-	IS 3025:P.45:2019	62	58	34	25	42	28	17	16	63	65
Potassium as K	mg/l	-	-	IS 3025:P.45:.2019	16	21	9	9	12	12	8	8	15	21
Dissolved Oxygen as DO	mg/l	-	-	IS 3025:P.38:1989:R.2019	7.2	7.3	7.5	8.2	8.2	8.2	8.5	7.2	7.3	7.7
Chemical Oxygen Demand as COD	mg/l	-	-	IS 3025:P.51:2023	10	10	6	6	6	6	6	6	10	10
Biological Oxygen Demand as BOD	mg/l	-	-	IS 3025:P.44:2023	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nitrite as NO2	mg/l	-	-	IS 3025 P.34:2019	BDL (DL:0.001)	0.004	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	0.002	0.003
Nitrate as NO3	mg/l	-	-	IS 3025 P.34:2019	1	0.07	0.05	0.07	0.09	0.12	0.15	0.08	1	1
Oil & Grease	mg/l	-	-	IS 3025 P.39:2021	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

Table No: 3.14.1 Summary of Ground water Quality Results (11 to 22) (Post Monsoon Season)

Parameters	Units	As Per IS 10500:2018		IS Methods	Omampuliyur	Kumaraman galam (Core Zone)	Nattarman galam	Thiruchitram balam	Vettaman galam	Kulasekara nallur	Kamachi puram	Kallaiyopur	Ozhugacheri	Kuruchi	Irumoolai	Kumaratchi in CCA (Cuddalore)
		Requirement (Acceptable limit)	Permissible limit in the absence of alternate source													
pH value at 25°C	-	6.5 – 8.5	No relaxation	IS 3025:P.11:2022	7.12	7.54	7.05	7.51	7.63	7.42	7.65	7.72	7.51	7.95	7.55	7.02
Electrical conductivity at 25°C	Micromhos/ cm	-	-	IS 3025:P.14:2013	621	536	714	607	629	1084	1021	1197	654	438	673	1914
Turbidity	NTU	1	5	IS 3025:P.10:2023	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)
Temperature	^{0}C	-	-	IS 3025:P.09:1984:R.2017	28.3	27.7	27.7	25.6	25.4	27.2	27.2	25.1	25.8	26.4	26.9	27.0
Taste	-	Agreeable	Agreeable	IS 3025:P.07:2017	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Color	HU	5	15	IS 3025:P.04:2021	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Odour	-	Agreeable	Agreeable	IS 3025:P.05:2018	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Total Suspended Solids	mg/l	-	-	IS 3025:P.17:2022	2	2	2	2	2	2	2	2	2	1	2	10
Total Dissolved Solids	mg/l	500	2000	IS 3025:P.16:2023	410	338	441	386	398	654	611	726	354	267	419	1195
Total Solids	mg/l	-	-	IS 3025:P.15:1984:R.2017	412	340	443	388	400	656	613	728	356	268	421	1205
Total Hardness as $CaCO_3$	mg/l	200	600	IS 3025:P.21:2009:R.2019	232	157	258	212	235	267	215	274	255	131	278	319
Calcium as Ca	mg/l	75	200	IS 3025:P.40:1991:R.2019	74	39	72	69	62	42	54	51	73	31	65	68
Calcium Hardness	mg/l	-	-	IS 3025:P.40:1991:R.2019	210	127	228	193	204	132	148	159	215	95	194	163
Magnesium Hardness	mg/l	-	-	IS 3025:P.46:1994:R.2019	222	30	30	19	31	135	67	115	40	36	84	156
Magnesium as Mg	mg/l	30	100	IS 3025:P.46:1994:R.2023	6	7	4	8	8	8	16	25	7	6	14	32
Chlorides as Cl	mg/l	250	1000	IS 3025:P.32:1988:R.2019	201	84	205	194	192	87	155	174	215	163	155	354
Acidity as $CaCO_3$	mg/l	-	-	IS 3025:P.22:1986:R.2019	-	-	-	-	-	-	-	-	-	-	-	-

Total Alkalinity as $CaCO_3$	mg/l	200	600	IS 3025:P.23:2023	90	85	145	110	110	235	235	215	95	65	112	620
Carbonate	mg/l	-	-	IS 3025:P.51:2023	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)
Bicarbonate	mg/l	-	-	IS 3025:P.51:2023	90	85	145	110	110	235	235	215	95	65	112	620
Sulfates as SO_4	mg/l	200	400	IS 3025:P.24:1986:R.2019	10	7	11	9	7	18	14	23	5	7	11	26
Total Iron as Fe	mg/l	0.3	0.3	IS 3025:P.53:2003:R.2019	0.05	0.05	0.07	0.06	0.06	0.08	0.08	0.08	0.06	0.03	0.07	2.1
Hexavalent Chromium as Cr^{+6}	mg/l	-	-	IS 3025:P.52:2003:R.2019	0.005	0.007	0.006	0.005	0.004	0.007	0.007	0.007	0.003	BDL (DL:0.001)	0.004	0.03
Sodium as Na	mg/l	-	-	IS 3025:P.45:2019	54	32	55	47	51	92	75	112	57	17	53	326
Potassium as K	mg/l	-	-	IS 3025:P.45:.2019	12	11	15	18	18	45	28	59	9	11	16	156
Dissolved Oxygen as DO	mg/l	-	-	IS 3025:P.38:1989:R.2019	10.5	10.2	12.6	11.2	10.5	8.5	6.5	8.2	8.3	8.9	7.4	6.9
Chemical Oxygen Demand as COD	mg/l	-	-	IS 3025:P.51:2023	11	6	10	6	10	16	16	18	11	5	12	28
Biological Oxygen Demand as BOD	mg/l	-	-	IS 3025:P.44:2023	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nitrite as NO2	mg/l	-	-	IS 3025 P.34:2019	0.003	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	0.003	0.004	0.005	0.005	BDL (DL:0.001)	BDL (DL:0.001)	0.002	1.392
Nitrate as NO3	mg/l	-	-	IS 3025 P.34:2019	1	0.15	1	0.16	0.21	0.33	5	5	0.34	0.84	1	5.5
Oil & Grease	mg/l	-	-	IS 3025 P.39:2021	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

Table No: 3.14.2 Summary of Ground water Quality Results (23 to 33) (Post Monsoon Season)

Parameters	Units	As Per IS 10500:2018		IS Methods	Kumaratchi in CCA (Cuddalore)	Keezhakarai in CCA (Cuddalore))	Keezhakarai in CCA (Cuddalore))	Sevayam in CCA (Cuddalore)	Esanai in CCA (Cuddalore)	Edapalayam in CCA (Cuddalore)	Nallanayagipuram in CCA (Mayiladuthurai)	Nallanayagipuram in CCA (Mayiladuthurai)	Achalpuram in CCA (Cuddalore)	Kollidam in CCA (Mayiladuthurai)	Vattathangarai in CCA (Mayiladuthurai)
		Requirement (Acceptable limit)	Permissible limit in the absence of alternate source												
pH value at 25°C	-	6.5 – 8.5	No relaxation	IS 3025:P.11:2022	8.12	7.25	7.13	7.18	7.08	7.15	7.25	6.55	7.12	7.01	6.96
Electrical conductivity at 25°C	Micromhos/ cm	-	-	IS 3025:P.14:2013	1857	985	1283	755	712	4522	2688	2745	395	685	1239
Turbidity	NTU	1	5	IS 3025:P.10:2023	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)
Temperature	^{0}C	-	-	IS 3025:P.09:1984:R.2017	25	25	25	25	25	25	25	25	25	25	25
Taste	-	Agreeable	Agreeable	IS 3025:P.07:2017	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Color	HU	5	15	IS 3025:P.04:2021	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Odour	-	Agreeable	Agreeable	IS 3025:P.05:2018	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Total Suspended Solids	mg/l	-	-	IS 3025:P.17:2022	6	3	3	2	2	9	12	8	2	2	3
Total Dissolved Solids	mg/l	500	2000	IS 3025:P.16:2023	996	496	628	435	417	2950	2110	1596	236	365	834
Total Solids	mg/l	-	-	IS 3025:P.15:1984:R.2017	1004	501	634	438	420	2968	2127	1612	238	367	839
Total Hardness as $CaCO_3$	mg/l	200	600	IS 3025:P.21:2009:R.2019	258	45	331	185	154	864	418	549	105	174	252
Calcium as Ca	mg/l	75	200	IS 3025:P.40:1991:R.2019	70	11	85	54	46	198	74	91	25	38	74
Calcium Hardness	mg/l	-	-	IS 3025:P.40:1991:R.2019	175	32	215	144	125	510	198	241	55	86	183
Magnesium Hardness	mg/l	-	-	IS 3025:P.46:1994:R.2019	83	13	116	41	29	354	220	308	50	88	69
Magnesium as Mg	mg/l	30	100	IS 3025:P.46:1994:R.2023	22	4	24	7	7	72	54	73	7	18	14
Chlorides as Cl	mg/l	250	1000	IS 3025:P.32:1988:R.2019	185	121	234	105	82	1052	521	456	26	95	205

Acidity as $CaCO_3$	mg/l	-	-	IS 3025:P.22:1986:R.2019	-	-	-	-	-	-	-	-	-	-	-
Total Alkalinity as $CaCO_3$	mg/l	200	600	IS 3025:P.23:2023	422	263	274	232	258	426	380	262	113	238	235
Carbonate	mg/l	-	-	IS 3025:P.51:2023	65	25	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)
Bicarbonate	mg/l	-	-	IS 3025:P.51:2023	357	238	274	232	258	426	380	262	113	238	235
Sulfates as SO_4	mg/l	200	400	IS 3025:P.24:1986:R.2019	32	27	28	15	17	62	32	44	8	12	31
Total Iron as Fe	mg/l	0.3	0.3	IS 3025:P.53:2003:R.2019	0.08	0.08	0.09	0.07	0.06	3	2.4	1.706	0.04	0.05	0.08
Hexavalent Chromium as Cr^{+6}	mg/l	-	-	IS 3025:P.52:2003:R.2019	0.01	0.006	0.007	0.006	0.004	0.02	0.01	0.01	0.006	0.07	0.04
Sodium as Na	mg/l	-	-	IS 3025:P.45:2019	315	93	85	93	64	248	293	72	88	90	135
Potassium as K	mg/l	-	-	IS 3025:P.45:.2019	142	8	16	15	18	62	105	18	25	30	62
Dissolved Oxygen as DO	mg/l	-	-	IS 3025:P.38:1989:R.2019	6.6	8.2	8.5	9.3	10.6	6.1	6.5	8.5	9.2	7.5	6.5
Chemical Oxygen Demand as COD	mg/l	-	-	IS 3025:P.51:2023	25	27	26	15	13	42	29	28	13	15	23
Biological Oxygen Demand as BOD	mg/l	-	-	IS 3025:P.44:2023	<2	<2	<2	<2	<2	2.3	2.1	<2	<2	<2	<2
Nitrite as NO2	mg/l	-	-	IS 3025 P.34:2019	0.03	0.05	0.02	0.0149	BDL (DL:0.001)	0.08	0.008	0.03	0.0559	0.0041	0.01
Nitrate as NO3	mg/l	-	-	IS 3025 P.34:2019	0.3	0.501	0.421	0.5	2	5.5	0.5	0.5	0.6	0.12	0.46
Oil & Grease	mg/l	-	-	IS 3025 P.39:2021	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

Table No: 3.15 Summary of Surface water Quality Results (Post Monsoon Season)

Parameters	Units	As Per IS 10500:2018		IS Methods	Adhanur	Keelpuliyampattu	Achalpuram	Sirukattur	Anaikarai	Eyyalur	In CCA
		Requirement (Acceptable limit)	Permissible limit in the absence of alternate source								
pH value at 25°C	-	6.5 – 8.5	No relaxation	IS 3025:P.11:2022	7.25	7.7	7.45	7.63	7.68	8.21	8.33
Electrical Conductivity at 25°C	Micromhos/ cm	-	-	IS 3025:P.14:2013	580	620	732	680	498	580	595
Turbidity	NTU	1	5	IS 3025:P.10:2023	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)
Temperature	^{0}C	-	-	IS 3025:P.09:1984:R.2017	25.3	25.6	25.7	25.8	25.5	25	25
Taste	-	Agreeable	Agreeable	IS 3025:P.07:2017	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Color	HU	5	15	IS 3025:P.04:2021	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Odour	-	Agreeable	Agreeable	IS 3025:P.05:2018	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Total Suspended Solids	mg/l	-	-	IS 3025:P.17:2022	1	1	2	2	2	2	1
Total Dissolved Solids	mg/l	500	2000	IS 3025:P.16:2023	365	395	456	462	328	341	338
Total Solids	mg/l	-	-	IS 3025:P.15:1984:R.2017	366	396	458	464	330	343	339
Total Hardness as $CaCO_3$	mg/l	200	600	IS 3025:P.21:2009:R.2019	191	205	254	238	138	105	118
Calcium as Ca	mg/l	75	200	IS 3025:P.40:1991:R.2019	62	75	86	91	55	41	38
Calcium Hardness	mg/l	-	-	IS 3025:P.40:1991:R.2019	158	192	214	196	134	95	88
Magnesium Hardness	mg/l	-	-	IS 3025:P.46:1994:R.2019	33	13	40	42	4	10	30
Magnesium as Mg	mg/l	30	100	IS 3025:P.46:1994:R.2023	10	5	15	17	3	12	18
Chlorides as Cl	mg/l	250	1000	IS 3025:P.32:1988:R.2019	162	166	195	223	87	72	85

Acidity as $CaCO_3$	mg/l	-	-	IS 3025:P.22:1986:R.2019	-	-	-	-	-	-	-
Total Alkalinity as $CaCO_3$	mg/l	200	600	IS 3025:P.23:2023	75	42	77	91	43	148	229
Carbonate	mg/l	-	-	IS 3025:P.51:2023	BDL(DL:1)	BDL(DL:1)	BDL(DL:1)	BDL(DL:1)	BDL(DL:1)	BDL(DL:1)	32
Bicarbonate	mg/l	-	-	IS 3025:P.51:2023	75	42	77	91	43	148	197
Sulfates as SO_4	mg/l	200	400	IS 3025:P.24:1986:R.2019	9	8	28	15	9	13	15
Total Iron as Fe	mg/l	0.3	0.3	IS 3025:P.53:2003:R.2019	0.06	0.05	0.08	0.08	BDL (DL:0.01)	0.06	0.06
Hexavalent Chromium as Cr^{+6}	mg/l	-	-	IS 3025:P.52:2003:R.2019	0.003	0.003	0.004	0.004	BDL (DL:0.001)	0.002	0.003
Sodium as Na	mg/l	-	-	IS 3025:P.45:2019	21	44	138	55	18	45	48
Potassium as K	mg/l	-	-	IS 3025:P.45:.2019	8	9	52	15	9	16	21
Dissolved Oxygen as DO	mg/l	-	-	IS 3025:P.38:1989:R.2019	9.8	12.3	8.5	9.6	8.4	7.7	8.3
Chemical Oxygen Demand as COD	mg/l	-	-	IS 3025:P.51:2023	5	6	18	13	8	13	18
Biological Oxygen Demand as BOD	mg/l	-	-	IS 3025:P.44:2023	<2	<2	<2	<2	<2	<2	<2
Nitrite as NO2	mg/l	-	-	IS 3025 P.34:2019	BDL (DL:0.001)	BDL (DL:0.001)	0.005	0.003	BDL (DL:0.001)	0.007	0.008
Nitrate as NO3	mg/l	-	-	IS 3025 P.34:2019	0.12	0.23	3.2	1.5	0.56	0.83	0.53
Oil & Grease	mg/l	-	-	IS 3025 P.39:2021	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

3.8.3. Observations on Ground Water Quality - Post monsoon season

Ground Water Quality results were compared with Acceptable limits for Drinking Water as per the Standard IS 10500:2012. 31 parameters has been analysed including the Chromium (Cr^{+6}), Acidity, Alkalinity etc.

- pH of ground water samples in the study area around 10km radius of proposed barrage were ranged from 7.03 – 7.95 which is found within the prescribed limits. pH of water samples from cultivable command area were ranged from 6.55 to 8.12 which is also found within the limits.

- Total Iron from all the water samples in the study area of 10km radius was found within the acceptable range. In the cultivable command area, ground water samples from 12 stations were collected for analysis. From the result, it is found that the Total Iron in the water sample from Kumaratchi, Edapalayam and Nallanayagipuram were 2.1mg/l, 3.0mg/l and 2.4mg/l which are beyond the acceptable limits of 0.3mg/l.

- In the study area of 10km radius, the Total Dissolved Solids in all the water sample except from Kulasekaranallur, Kamchipuram and Kallaiyopur were found within the acceptable limits of 500 mg/L as per CPCB norms whereas the TDS from the above three villages were found between 611 to 726 mg/l which is beyond 500mg/lit. Among 12 locations in CCA, the TDS in water sample from the five locations such as Keezhakarai, Achalpuram, Kollidam, Esanai and Shevayam were found within the acceptable limits. The TDS from other locations are higher than 500mg/lit, the reason behind is the CCA are located near to coastal boundary.

- In the study area of 10km radius around proposed barrage, Total Hardness of water sample varied between 124-354 mg/l and the maximum value of 377mg/l was recorded at Kandamangalam and the minimum value of 124mg/lit was recorded at Vanathirayanpuram. However the maximum value was found within the permissible limits of 600mg/l. In the cultivable command area, Total Hardness of water sample varied between 45-864 mg/l and the maximum value recorded at Edapalayam village.

- Calcium and Magnesium was found to be within the permissible limits of 200mg/l and 100mg/l respectively in all the locations of study area and in CCA.

- In the study area of 10km radius, Total Alkalinity from all the water samples except in Kulasekaranallur, kamachipuram and Kallaiyopur village was found within acceptable limits of 200mg/l whereas in Kulasekaranallur, kamachipuram and Kallaiyopur village, it is 235mg/l, 235mg/l, 215mg/l respectively. In the cultivable command area, Total alkalinity in all the location except in Achalpuram Village exceeds acceptable limits of 200mg/l whereas in Achalpuram village it is 113mg/l.

- Chloride from all the water samples in study area around barrage was ranged from 77 to 216mg/l which was within prescribed limit of 250mg/l. In CCA, chloride from all the water samples was ranged from 26 to 1052mg/l. The maximum value of 1052mg/l was recorded in Edapalayam village which located very close to sea shore.

- Both in study area of 10km radius and in cultivable command area, Sulphate in water samples was ranged from 4 to 62mg/l which is well within the acceptable limits of 200mg/l.

- Hexavalent Chromium (Cr^{+6}) from all the water samples were analysed and found to be in the range of 0 to 0.07 mg/l.

Prolonged consumption of water containing high TH causes Cardio vascular problems, diabetes, skin diseases, rashes, reproductive failure and renal failure. For the excellent quality of drinking, the water must be treated with reverse osmosis process to overcome above mentioned such impacts on human body. Boiling of water will remove the microorganisms effectively from all waters in the above said villages and core zone making the water aseptically fit for drinking purposes.

3.8.4. Observations on Surface Water Quality - Post monsoon season

Surface Water Quality results were compared with Acceptable limits for Drinking Water as per the Standard IS 10500:2012. Same 32 parameters has been analysed including the Chromium (Cr^{+6}), Acidity, Alkalinity etc as ground water quality.

- pH of Coleroon River water between Lower Anicut and proposed barrage was ranged from 7.25 to 8.21 which is found within the prescribed limits and one water sample was taken at downstream of proposed barrage near bridge at Kollidam. The pH of that sample was recorded as 8.33.

- Total Iron from all the surface water samples was found in the range 0.05 and 0.08 which is within the acceptable limit of 0.3.

- TDS from the entire water sample was ranged from 328-462 mg/l which is within the acceptable limits of 500mg/l.

- The total hardness from the seven water samples was ranged from 105-254mg/l. The total hardness in Achalpuram village and in Sirukattur village was recorded as 254mg/l and 238mg/l which exceed the acceptable limits of 200mg/l.

- Calcium and Magnesium was found to be within the permissible limits of 200mg/l and 100mg/l respectively in all the locations.

- The total alkalinity in the Coleroon River water sample between Lower Anicut and proposed barrage was ranged from 42 to 148mg/l. The total alkalinity in river water sample in CCA was recorded as 229mg/l which exceeds the acceptable limit of 200mg/l.

- Chloride from all the water samples was ranged from 72 to 223mg/l which was within prescribed limit of 250mg/l. At the same time sulphate in all water sample was within the acceptable of 200 mg/l.

- Hexavalent Chromium (Cr^{+6}) from all the water samples were analysed and found to be in the range of 0 to 0.004 mg/l.

The quality of Coleroon River water is good during post monsoon season which can be consumed without any prior water treatment. Boiling of water is must in surface water consumption to remove the microorganisms which can transmit diseases such as diarrhea, cholera, dysentery, typhoid and polio.

Table No: 3.16 Summary of Ground water Quality Results (1 to 10) (Pre monsoon season)

Parameters	Units	As Per IS 10500:2018		IS Methods	Core zone (Adhanur)	Eyyalur	Kanjankollai-I	Kanjankollai-II	Kulothunga nallur	Vembukudi	Vanathirayan kuppam	Periyapogene	Kandamanga lam	Veerananthapuram
		Requirement (Acceptable limit)	Permissible limit in the absence of alternate source											
pH value at 25°C	-	6.5 – 8.5	No relaxation	IS 3025:P.11:2022	7.85	7.51	7.83	7.74	7.78	7.24	7.23	7.19	7.24	7.59
Electrical conductivity at 25°C	Micromhos/ cm	-	-	IS 3025:P.14:2013	784	712	558	538	634	557	452	489	735	741
Turbidity	NTU	1	5	IS 3025:P.10:2023	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)
Temperature	^{0}C	-	-	IS 3025:P.09:1984:R.2017	29	29	29	30	30	29	30	30	29	30
Taste	-	Agreeable	Agreeable	IS 3025:P.07:2017	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Color	HU	5	15	IS 3025:P.04:2021	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Odour	-	Agreeable	Agreeable	IS 3025:P.05:2018	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Total Suspended Solids	mg/l	-	-	IS 3025:P.17:2022	1	2	1	1	2	2	2	2	1	2
Total Dissolved Solids	mg/l	500	2000	IS 3025:P.16:2023	487	463	386	368	395	387	301	334	497	472
Total Solids	mg/l	-	-	IS 3025:P.15:1984:R.2017	488	465	387	369	397	389	303	336	498	474
Total Hardness as $CaCO_3$	mg/l	200	600	IS 3025:P.21:2009:R.2019	154	246	189	164	228	267	154	198	383	395
Calcium as Ca	mg/l	75	200	IS 3025:P.40:1991:R.2019	51	84	62	56	63	84	55	71	118	129
Calcium Hardness	mg/l	-	-	IS 3025:P.40:1991:R.2019	132	236	162	158	161	195	148	186	339	328
Magnesium Hardness	mg/l	-	-	IS 3025:P.46:1994:R.2019	22	10	27	6	67	72	6	12	44	67
Magnesium as Mg	mg/l	30	100	IS 3025:P.46:1994:R.2023	3	2	6	10	15	21	5	8	15	21
Chlorides as Cl	mg/l	250	1000	IS 3025:P.32:1988:R.2019	72	188	145	71	148	156	65	140	212	205
Acidity as $CaCO_3$	mg/l	-	-	IS 3025:P.22:1986:R.2019	-	-	-	-	-	-	-	-	-	-

Total Alkalinity as $CaCO_3$	mg/l	200	600	IS 3025:P.23:2023	155	162	95	98	112	96	65	72	163	181
Carbonate	mg/l	-	-	IS 3025:P.51:2023	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)
Bicarbonate	mg/l	-	-	IS 3025:P.51:2023	155	162	95	98	112	96	65	72	163	181
Sulfates as SO_4	mg/l	200	400	IS 3025:P.24:1986:R.2019	12	15	11	13	18	12	10	14	18	19
Total Iron as Fe	mg/l	0.3	0.3	IS 3025:P.53:2003:R.2019	0.06	0.06	0.05	0.05	0.06	0.05	0.04	0.04	0.06	0.06
Hexavalent Chromium as Cr^{+6}	mg/l	-	-	IS 3025:P.52:2003:R.2019	0.004	0.005	0.003	0.003	0.004	0.003	BDL (DL:0.001)	BDL (DL:0.001)	0.004	0.003
Sodium as Na	mg/l	-	-	IS 3025:P.45:2019	48	38	18	15	32	17	7	8	42	37
Potassium as K	mg/l	-	-	IS 3025:P.45:.2019	9	6	4	4	3	2	2	2	6	5
Dissolved Oxygen as DO	mg/l	-	-	IS 3025:P.38:1989:R.2019	5.2	5.8	6.5	6.1	6.3	5.5	5.9	5.8	6.1	6.2
Chemical Oxygen Demand as COD	mg/l	-	-	IS 3025:P.51:2023	7	7	3	3	3	3	3	3	6	6
Biological Oxygen Demand as BOD	mg/l	-	-	IS 3025:P.44:2023	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nitrite as NO2	mg/l	-	-	IS 3025 P.34:2019	BDL (DL:0.001)	0.004	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	0.002	0.003
Nitrate as NO3	mg/l	-	-	IS 3025 P.34:2019	1	0.02	0.03	0.03	0.05	0.04	0.01	0.01	0.05	0.05
Oil & Grease	mg/l	-	-	IS 3025 P.39:2021	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

Table No: 3.16.1 Summary of Ground water Quality Results (11 to 22) (Pre monsoon season)

Parameters	Units	As Per IS 10500:2018		IS Methods	Omampuliyur	Kumaraman galam (Core Zone)	Nattarman galam	Thiruchitram balam	Vettaman galam	Kulasekara nallur	Kamachi puram	Kallaiyopur	Ozhugacheri	Kuruchi	Irumoolai	Kumaratchi in CCA (Cuddalore)
		Requirement (Acceptable limit)	Permissible limit in the absence of alternate source													
pH value at 25°C	-	6.5 – 8.5	No relaxation	IS 3025:P.11:2022	7.52	7.82	7.36	7.89	7.96	7.63	7.85	7.93	7.61	8.21	7.93	7.27
Electrical conductivity at 25°C	Micromhos/ cm	-	-	IS 3025:P.14:2013	712	590	756	690	720	1250	1097	1356	720	536	735	2350
Turbidity	NTU	1	5	IS 3025:P.10:2023	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)
Temperature	^{0}C	-	-	IS 3025:P.09:1984:R.2017	29	29	29	30	30	29	30	30	29	30	29	29
Taste	-	Agreeable	Agreeable	IS 3025:P.07:2017	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Color	HU	5	15	IS 3025:P.04:2021	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Odour	-	Agreeable	Agreeable	IS 3025:P.05:2018	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Total Suspended Solids	mg/l	-	-	IS 3025:P.17:2022	1	1	2	2	2	1	2	1	1	2	1	2
Total Dissolved Solids	mg/l	500	2000	IS 3025:P.16:2023	453	385	495	428	463	720	640	796	415	328	465	1480
Total Solids	mg/l	-	-	IS 3025:P.15:1984:R.2017	454	386	497	430	465	721	642	797	416	330	466	1482
Total Hardness as $CaCO_3$	mg/l	200	600	IS 3025:P.21:2009:R.2019	255	182	273	256	267	192	254	312	296	154	306	358
Calcium as Ca	mg/l	75	200	IS 3025:P.40:1991:R.2019	85	52	96	95	102	68	94	86	88	45	87	105
Calcium Hardness	mg/l	-	-	IS 3025:P.40:1991:R.2019	236	145	254	235	241	162	185	196	241	127	239	212
Magnesium Hardness	mg/l	-	-	IS 3025:P.46:1994:R.2019	19	37	19	21	26	30	69	116	55	27	67	146
Magnesium as Mg	mg/l	30	100	IS 3025:P.46:1994:R.2023	10	12	15	17	17	16	23	35	15	14	28	52
Chlorides as Cl	mg/l	250	1000	IS 3025:P.32:1988:R.2019	185	65	190	175	172	65	124	147	186	138	129	327
Acidity as $CaCO_3$	mg/l	-	-	IS 3025:P.22:1986:R.2019	-	-	-	-	-	-	-	-	-	-	-	-

Total Alkalinity as $CaCO_3$	mg/l	200	600	IS 3025:P.23:2023	112	96	167	112	125	236	244	256	134	72	135	612
Carbonate	mg/l	-	-	IS 3025:P.51:2023	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)
Bicarbonate	mg/l	-	-	IS 3025:P.51:2023	112	96	167	112	125	236	244	256	134	72	135	612
Sulfates as SO_4	mg/l	200	400	IS 3025:P.24:1986:R.2019	10	12	15	14	14	25	21	32	10	10	10	45
Total Iron as Fe	mg/l	0.3	0.3	IS 3025:P.53:2003:R.2019	0.05	0.05	0.07	0.06	0.06	0.08	0.08	0.08	0.06	0.03	0.07	2.1
Hexavalent Chromium as Cr^{+6}	mg/l	-	-	IS 3025:P.52:2003:R.2019	0.005	0.007	0.006	0.005	0.004	0.007	0.007	0.007	0.003	BDL (DL:0.001)	0.004	0.03
Sodium as Na	mg/l	-	-	IS 3025:P.45:2019	35	18	36	31	28	63	59	95	31	8	38	302
Potassium as K	mg/l	-	-	IS 3025:P.45:.2019	6	3	7	6	6	25	18	32	6	2	6	112
Dissolved Oxygen as DO	mg/l	-	-	IS 3025:P.38:1989:R.2019	6.8	7.5	6.9	6.6	5.2	5.4	5.8	5.2	5.5	6.7	6.1	5.3
Chemical Oxygen Demand as COD	mg/l	-	-	IS 3025:P.51:2023	7	3	7	3	7	8	8	9	7	4	7	21
Biological Oxygen Demand as BOD	mg/l	-	-	IS 3025:P.44:2023	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Nitrite as NO2	mg/l	-	-	IS 3025 P.34:2019	0.003	BDL (DL:0.001)	BDL (DL:0.001)	BDL (DL:0.001)	0.003	0.004	0.005	0.005	BDL (DL:0.001)	BDL (DL:0.001)	0.002	1.392
Nitrate as NO3	mg/l	-	-	IS 3025 P.34:2019	0.5	0.05	0.05	0.04	0.05	0.04	1.5	1.5	0.06	0.01	0.03	2.1
Oil & Grease	mg/l	-	-	IS 3025 P.39:2021	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

Table No: 3.16.2 Summary of Ground water Quality Results (23 to 33) (Pre monsoon season)

Parameters	Units	As Per IS 10500:2018		IS Methods	Kumaratchi in CCA (Cuddalore)	Keezhakarai in CCA (Cuddalore))	Keezhakarai in CCA (Cuddalore))	Sevayam in CCA (Cuddalore)	Esanai in CCA (Cuddalore)	Edapalayam in CCA (Cuddalore)	Nallanayagipuram in CCA (Mayiladuthurai)	Nallanayagipuram in CCA (Mayiladuthurai)	Achalpuram in CCA (Cuddalore)	Kollidam in CCA (Mayiladuthurai)	Vattathangarai in CCA (Mayiladuthurai)
		Requirement (Acceptable limit)	Permissible limit in the absence of alternate source												
pH value at 25°C	-	6.5 – 8.5	No relaxation	IS 3025:P.11:2022	8.5	7.82	7.36	7.45	7.25	7.45	7.63	7.2	7.29	7.36	7.06
Electrical conductivity at 25°C	Micromhos/ cm	-	-	IS 3025:P.14:2013	2156	1374	1380	956	832	5124	3865	2954	415	756	1421
Turbidity	NTU	1	5	IS 3025:P.10:2023	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)
Temperature	^{0}C	-	-	IS 3025:P.09:1984:R.2017	29	29	29	30	30	29	30	30	29	30	29
Taste	-	Agreeable	Agreeable	IS 3025:P.07:2017	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Color	HU	5	15	IS 3025:P.04:2021	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Odour	-	Agreeable	Agreeable	IS 3025:P.05:2018	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Total Suspended Solids	mg/l	-	-	IS 3025:P.17:2022	2	2	3	2	2	14	12	8	2	2	1
Total Dissolved Solids	mg/l	500	2000	IS 3025:P.16:2023	1183	612	754	493	457	3158	2265	1758	312	432	987
Total Solids	mg/l	-	-	IS 3025:P.15:1984:R.2017	1185	614	757	495	459	3172	2277	1766	314	434	988
Total Hardness as $CaCO_3$	mg/l	200	600	IS 3025:P.21:2009:R.2019	295	82	356	213	185	935	475	596	153	215	293
Calcium as Ca	mg/l	75	200	IS 3025:P.40:1991:R.2019	85	23	108	75	84	225	96	115	38	54	96
Calcium Hardness	mg/l	-	-	IS 3025:P.40:1991:R.2019	183	38	228	152	133	526	209	259	76	99	209
Magnesium Hardness	mg/l	-	-	IS 3025:P.46:1994:R.2019	112	44	128	61	52	409	266	337	77	116	84
Magnesium as Mg	mg/l	30	100	IS 3025:P.46:1994:R.2023	32	12	32	15	15	95	63	85	15	32	25
Chlorides as Cl	mg/l	250	1000	IS 3025:P.32:1988:R.2019	165	95	218	85	73	912	456	413	10	68	185

Acidity as $CaCO_3$	mg/l	-	-	IS 3025:P.22:1986:R.2019	-	-	-	-	-	-	-	-	-	-	-
Total Alkalinity as $CaCO_3$	mg/l	200	600	IS 3025:P.23:2023	463	312	296	255	306	487	430	290	132	255	262
Carbonate	mg/l	-	-	IS 3025:P.51:2023	86	40	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)	BDL (DL:1)
Bicarbonate	mg/l	-	-	IS 3025:P.51:2023	377	272	296	255	306	487	430	290	132	255	262
Sulfates as SO_4	mg/l	200	400	IS 3025:P.24:1986:R.2019	32	31	28	15	18	75	38	52	8	16	41
Total Iron as Fe	mg/l	0.3	0.3	IS 3025:P.53:2003:R.2019	0.08	0.08	0.09	0.07	0.06	3	2.4	1.706	0.04	0.05	0.08
Hexavalent Chromium as Cr^{+6}	mg/l	-	-	IS 3025:P.52:2003:R.2019	0.01	0.006	0.007	0.006	0.004	0.02	0.01	0.01	0.006	0.07	0.04
Sodium as Na	mg/l	-	-	IS 3025:P.45:2019	295	75	63	58	45	212	253	54	72	81	116
Potassium as K	mg/l	-	-	IS 3025:P.45:.2019	125	5	13	7	10	51	88	8	17	15	45
Dissolved Oxygen as DO	mg/l	-	-	IS 3025:P.38:1989:R.2019	6.0	5.8	8.7	5.7	5.8	5.5	5.3	5.8	6.5	6.3	5.4
Chemical Oxygen Demand as COD	mg/l	-	-	IS 3025:P.51:2023	18	17	19	8	7	33	21	21	7	12	18
Biological Oxygen Demand as BOD	mg/l	-	-	IS 3025:P.44:2023	<2	<2	<2	<2	<2	2.3	2.1	<2	<2	<2	<2
Nitrite as NO2	mg/l	-	-	IS 3025 P.34:2019	0.02	0.04	0.01	0.05	BDL (DL:0.001)	0.04	0.007	0.01	0.03	0.002	0.01
Nitrate as NO3	mg/l	-	-	IS 3025 P.34:2019	0.1	0.1	0.25	0.2	0.5	2.1	0.1	0.05	0.05	0.07	0.15
Oil & Grease	mg/l	-	-	IS 3025 P.39:2021	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

Table No: 3.17 Summary of Surface water Quality Results (Pre monsoon season)

Parameters	Units	As Per IS 10500:2018		IS Methods	Adhanur	Keelpuliyampattu	Achalpuram	Sirukattur	Anaikarai	Eyyalur	In CCA
		Requirement (Acceptable limit)	Permissible limit in the absence of alternate source								
pH value at 25°C	-	6.5 – 8.5	No relaxation	IS 3025:P.11:2022	7.2	7.82	7.45	7.63	7.77	8.15	8.19
Electrical Conductivity at 25°C	Micromhos/ cm	-	-	IS 3025:P.14:2013	612	714	823	736	554	637	625
Turbidity	NTU	1	5	IS 3025:P.10:2023	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)	BDL (DL:0.1)
Temperature	^{0}C	-	-	IS 3025:P.09:1984:R.2017	29	29	29	30	30	29	30
Taste	-	Agreeable	Agreeable	IS 3025:P.07:2017	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Color	HU	5	15	IS 3025:P.04:2021	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Odour	-	Agreeable	Agreeable	IS 3025:P.05:2018	NIL	NIL	NIL	NIL	NIL	NIL	NIL
Total Suspended Solids	mg/l	-	-	IS 3025:P.17:2022	1	1	1	1	2	1	2
Total Dissolved Solids	mg/l	500	2000	IS 3025:P.16:2023	363	389	495	432	315	320	327
Total Solids	mg/l	-	-	IS 3025:P.15:1984:R.2017	364	390	496	433	317	321	329
Total Hardness as $CaCO_3$	mg/l	200	600	IS 3025:P.21:2009:R.2019	188	212	253	245	148	105	121
Calcium as Ca	mg/l	75	200	IS 3025:P.40:1991:R.2019	65	72	88	76	51	38	42
Calcium Hardness	mg/l	-	-	IS 3025:P.40:1991:R.2019	158	192	206	189	135	96	88
Magnesium Hardness	mg/l	-	-	IS 3025:P.46:1994:R.2019	30	20	47	56	13	9	33
Magnesium as Mg	mg/l	30	100	IS 3025:P.46:1994:R.2023	12	8	17	21	5	9	14
Chlorides as Cl	mg/l	250	1000	IS 3025:P.32:1988:R.2019	135	154	187	208	77	63	59

Acidity as $CaCO_3$	mg/l	-	-	IS 3025:P.22:1986:R.2019	-	-	-	-	-	-	-
Total Alkalinity as $CaCO_3$	mg/l	200	600	IS 3025:P.23:2023	96	62	87	115	57	173	252
Carbonate	mg/l	-	-	IS 3025:P.51:2023	BDL(DL:1)	BDL(DL:1)	BDL(DL:1)	BDL(DL:1)	BDL(DL:1)	BDL(DL:1)	32
Bicarbonate	mg/l	-	-	IS 3025:P.51:2023	96	62	87	115	57	173	220
Sulfates as SO_4	mg/l	200	400	IS 3025:P.24:1986:R.2019	9	8	29	15	5	9	16
Total Iron as Fe	mg/l	0.3	0.3	IS 3025:P.53:2003:R.2019	0.06	0.05	0.08	0.08	BDL (DL:0.01)	0.06	0.06
Hexavalent Chromium as Cr^{+6}	mg/l	-	-	IS 3025:P.52:2003:R.2019	0.001	0.02	0.003	0.003	BDL (DL:0.001)	0.001	0.003
Sodium as Na	mg/l	-	-	IS 3025:P.45:2019	14	31	115	36	8	24	21
Potassium as K	mg/l	-	-	IS 3025:P.45:.2019	4	4	15	6	2	7	7
Dissolved Oxygen as DO	mg/l	-	-	IS 3025:P.38:1989:R.2019	5.2	5.2	4.8	7.3	6.1	6.8	6.2
Chemical Oxygen Demand as COD	mg/l	-	-	IS 3025:P.51:2023	4	4	14	7	4	7	6
Biological Oxygen Demand as BOD	mg/l	-	-	IS 3025:P.44:2023	<2	<2	<2	<2	<2	<2	<2
Nitrite as NO2	mg/l	-	-	IS 3025 P.34:2019	BDL (DL:0.001)	BDL (DL:0.001)	0.004	0.001	BDL (DL:0.001)	0.003	0.005
Nitrate as NO3	mg/l	-	-	IS 3025 P.34:2019	0.01	0.02	1.5	1.1	0.01	0.015	
Oil & Grease	mg/l	-	-	IS 3025 P.39:2021	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4

3.8.5. Observations on Ground Water Quality - Pre monsoon season

Ground Water Quality results were compared with Acceptable limits for Drinking Water as per the Standard IS 10500:2012. 31 parameters has been analysed including the Chromium (Cr^{+6}), Acidity, Alkalinity etc.

- pH of ground water samples in the study area around 10km radius of proposed barrage were ranged from 7.19 – 78.21 which is found within the prescribed limits. pH of water samples from cultivable command area were ranged from 7.06 to 8.50 which is also found within the limits.

- Total Iron from all the water samples in the study area of 10km radius was found within the acceptable range. In the cultivable command area, ground water samples from 12 stations were collected for analysis. From the result, it is found that the Total Iron in the water sample from Kumaratchi, Edapalayam and Nallanayagipuram were 2.1mg/l, 3.0mg/l and 2.4mg/l which are beyond the acceptable limits of 0.3mg/l.

- In the study area of 10km radius, the Total Dissolved Solids in all the water sample except from Kulasekaranallur, Kamchipuram and Kallaiyopur were found within the acceptable limits of 500 mg/L as per CPCB norms whereas the TDS from the above three villages were found between 640 to 796 mg/l which is beyond 500mg/lit. Among 12 locations in CCA, the TDS in water sample from the five locations such as Achalpuram, Kollidam, Esanai and Shevayam were found within the acceptable limits. The TDS from other locations are higher than 500mg/lit, the reason behind is the CCA are located near to coastal boundary.

- In the study area of 10km radius around proposed barrage, Total Hardness of water sample varied between 154-395 mg/l and the maximum value of 395mg/l was recorded at Veernanthapuram and the minimum value of 124mg/lit was recorded at both core zone and Vanathirayanpuram. However the maximum value was found within the permissible limits of 600mg/l. In the cultivable command area, Total Hardness of water sample varied between 82-935 mg/l and the maximum value recorded at Edapalayam village.

- Calcium and Magnesium was found to be within the permissible limits of 200mg/l and 100mg/l respectively in all the locations of study area and in CCA.

- In the study area of 10km radius, Total Alkalinity from all the water samples except in Kulasekaranallur, kamachipuram and Kallaiyopur village was found

within acceptable limits of 200mg/l whereas in Kulasekaranallur, kamachipuram and Kallaiyopur village, it is 236mg/l, 244mg/l, 256mg/l respectively. In the cultivable command area, Total alkalinity in all the location except in Achalpuram Village exceeds acceptable limits of 200mg/l whereas in Achalpuram village it is 132mg/l.

- Chloride from all the water samples in study area around barrage was ranged from 77 to 216mg/l which was within prescribed limit of 250mg/l. In CCA, chloride from all the water samples was ranged from 10 to 912mg/l. The maximum value of 912mg/l was recorded in Edapalayam village which located very close to sea shore.

- Both in study area of 10km radius and in cultivable command area, Sulphate in water samples was ranged from 4 to 62mg/l which is well within the acceptable limits of 200mg/l.

- Hexavalent Chromium (Cr^{+6}) from all the water samples were analysed and found to be in the range of 0 to 0.07 mg/l.

Prolonged consumption of water containing high TH causes Cardio vascular problems, diabetes, skin diseases, rashes, reproductive failure and renal failure. For the excellent quality of drinking, the water must be treated with reverse osmosis process to overcome above mentioned such impacts on human body. Boiling of water will remove the microorganisms effectively from all waters in the above said villages and core zone making the water aseptically fit for drinking purposes.

3.8.6. Observations on Surface Water Quality - Pre monsoon season

Surface Water Quality results were compared with Acceptable limits for Drinking Water as per the Standard IS 10500:2012. Same 31 parameters has been analysed including the Chromium (Cr^{+6}), Acidity, Alkalinity etc as ground water quality.

- pH of Coleroon River water between Lower Anicut and proposed barrage and in CCA was ranged from 7.2 to 8.19 which is found within the prescribed limits.

- Total Iron from all the surface water samples was found in the range between 0.05 and 0.08 which is within the acceptable limit of 0.3.
- TDS from the entire water sample was ranged from 320-495 mg/l which is within the acceptable limits of 500mg/l.

- The total hardness from the seven water samples was ranged from 105-253mg/l. The total hardness in Keelpuliyapattu village, Achalpuram village, and in Sirukattur village was recorded as 212, 253mg/l and 245mg/l which exceed the acceptable limits of 200mg/l.

- Calcium and Magnesium was found to be within the permissible limits of 200mg/l and 100mg/l respectively in all the locations.

- The total alkalinity in the Coleroon River water sample between Lower Anicut and proposed barrage was ranged from 57 to 173mg/l. The total alkalinity in river water sample in CCA was recorded as 252mg/l which exceeds the acceptable limit of 200mg/l.

- Chloride from all the water samples was ranged from 59 to 208mg/l which was within prescribed limit of 250mg/l. At the same time sulphate in all water sample was within the acceptable of 200 mg/l.

- Hexavalent Chromium (Cr^{+6}) from all the water samples were analysed and found to be in the range of 0 to 0.004 mg/l.

The quality of Coleroon River water is good during pre monsoon season which can be consumed without any prior water treatment. Boiling of water is must in surface water consumption to remove the microorganisms which can transmit diseases such as diarrhea, cholera, dysentery, typhoid and polio.

3.9 Geo-hydrogeological Status of the Study Area

3.9.1 Rainfall

The Lower anaicut of Kollidam River experiences tropical climate being hot and dry for the greater part of the year. The period from March to June is generally hot. The temperature ranges from 20 to 38°C. The annual normal rainfall for the period 2000-2021 ranges from 804.6mm (2016) to 1892.4mm (2021). The Average annual rainfall 22 years **1374.25**mm, annual rainfall and seasonal rainfall data is presented in the Table 3.18 and 3.19.

In order to understand the rainfall contribution to river, rainfall data has been further classified into seasonal wise such as summer, winter, south west and north east monsoon. During the south west monsoon, less than 200 mm was recorded in the year 2002, 2008 and the northeast monsoon, the rainfall record has shown a highly varied trend and observed above 800mm, similarly, falling trend where less than 500mm

were noticed in the year 2012, 2013. Graphical representation of Annual rainfall Variation, Rainfall Fluctuation and seasonal variation is shown in Fig No 18, 19 and 20. The contributions of individual seasons are as follows: NE-57%, SW-28%, summer 9% and winter 4%.

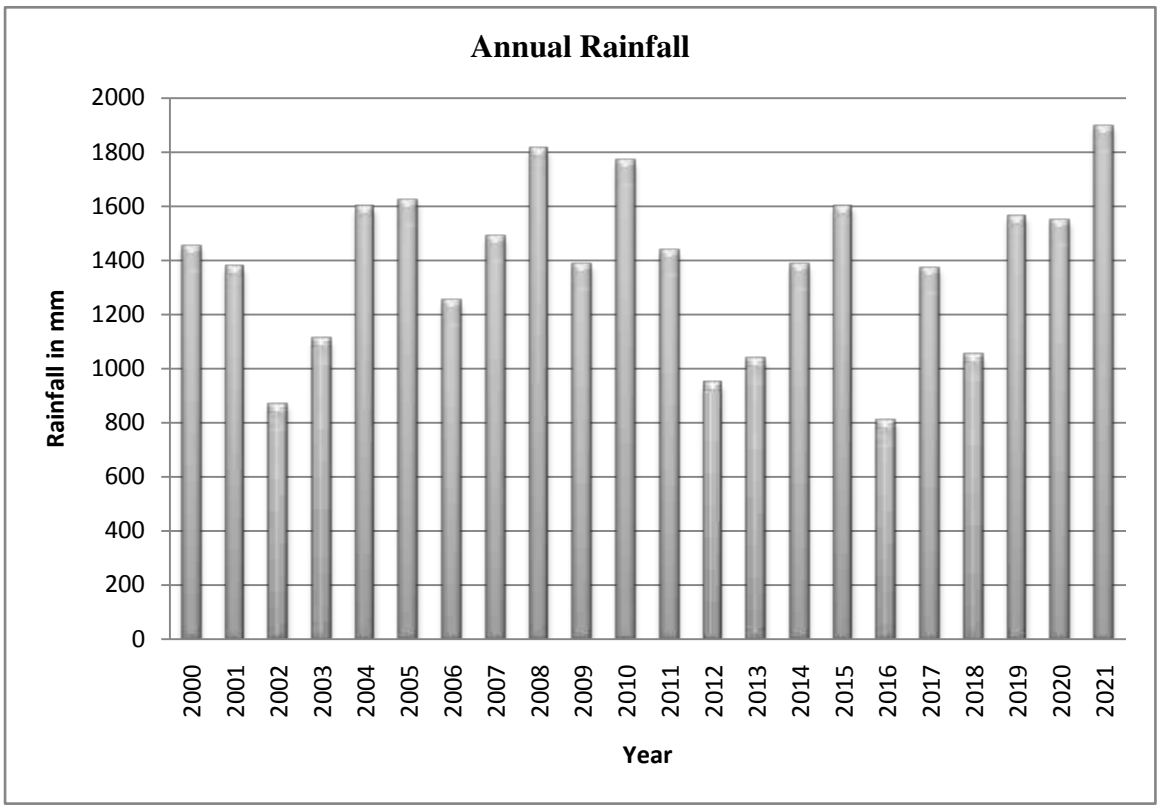


Fig No 3.18: Graphical representation of Annual rainfall Variation for the past 22 years

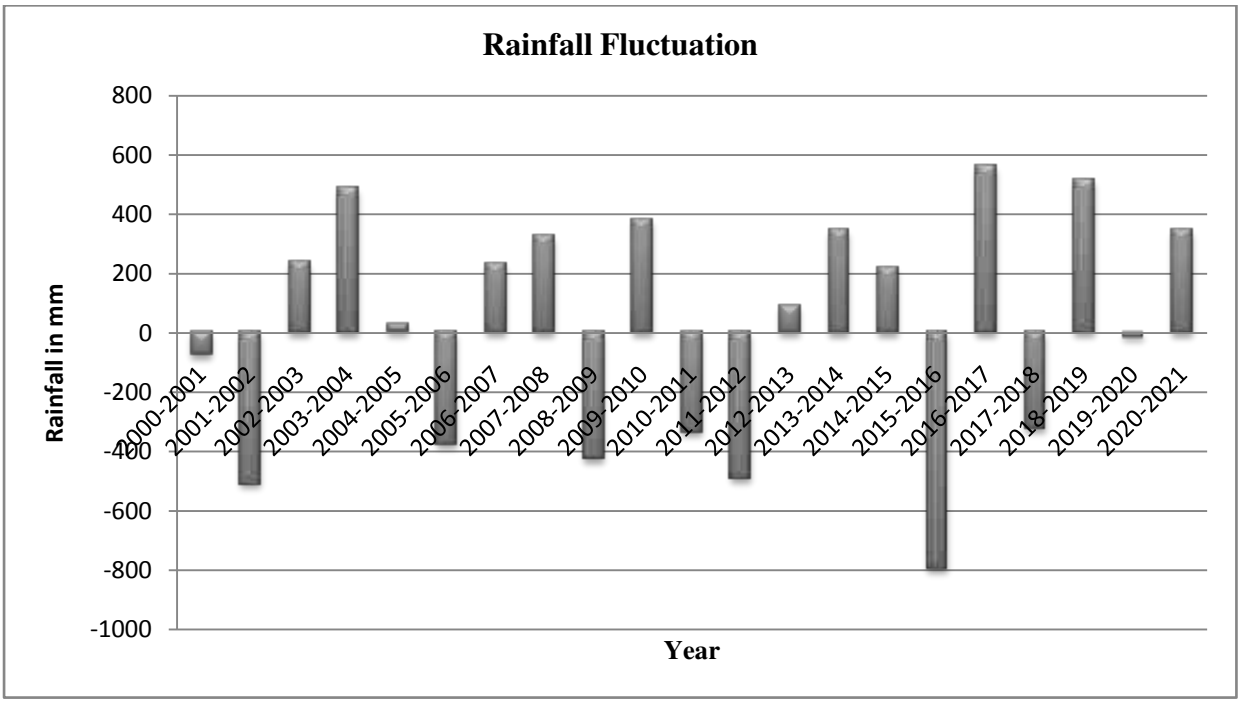


Fig No 3.19: Graphical representation of Annual rainfall Fluctuation Variation for the past 22 years

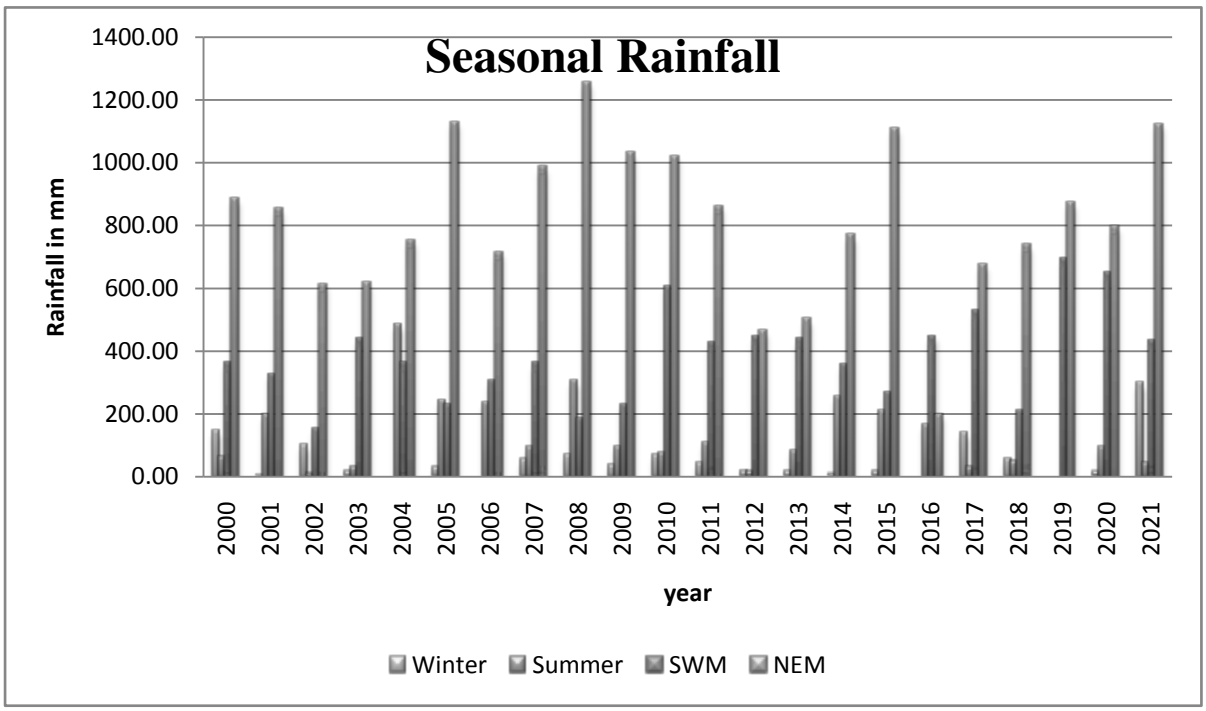


Fig No 3.20 : Graphical representation of Seasonal rainfall Variation for the past 22 years

Table No 3.18 Monthly Rainfall (in mm) of the Kollidam River Lower Anicut (2000 - 2021)

Sl.No	Year	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total Rainfall
1	2000	48	95.8	NA	61	NA	29.5	99	51	181	201	413	270	1449.3
2	2001	5	NA	NA	41.2	153	46	79.6	127	72	217	318.4	315	1374.7
3	2002	1.4	96.6	NA	NA	9	43.2	81.9	11	13	347	188.1	75.4	866.6
4	2003	18.2	NA	NA	26	5.1	73	90	168	108	205	400.8	10.4	1104.5
5	2004	NA	NA	NA	NA	482	NA	12.6	156.4	189.6	498	246.3	7.6	1592.5
6	2005	NA	27.8	NA	153.8	88	NA	25.4	50.6	147.4	191	687.9	247.7	1619.6
7	2006	NA	NA	38	67.6	127.8	52.4	NA	28.8	218.7	316	315.4	82.2	1246.9
8	2007	NA	51.6	NA	50.4	40	37.3	62.5	192	66.2	478.4	111	392.2	1481.6
9	2008	41.8	26.8	237.6	NA	64	50.6	51.6	57.4	23	164.4	873	216.2	1806.4
10	2009	36	NA	54.4	30	10	18	NA	172	35.2	94	508.3	424	1381.9
11	2010	65.8	NA	1.6	12.8	59	78	105	293.5	129	146	600.8	271.2	1762.7
12	2011	31	12	NA	102	5.8	24.6	144.7	120.2	131.4	249.8	507.8	101.8	1431.1
13	2012	10.2	8.4	1	1	14.2	7.4	115.4	122.6	198.2	361.8	82.8	18.2	941.2
14	2013	NA	18.4	23	28	31	80.5	43	170.8	139.8	49.8	359.6	89	1032.9
15	2014	3	4.6	NA	NA	251.8	28	42	158.8	125	377.4	208	179.8	1378.4
16	2015	17.6	NA	NA	66.4	140	60.2	104	85.4	15.6	169	617.2	322.6	1598
17	2016	NA	NA	NA	NA	162	13.2	97	293.2	42.6	81	70	45.6	804.6
18	2017	139	NA	25.6	NA	5	108.8	94.2	109.8	213.6	131.2	387.4	152.6	1367.2
19	2018	54.8	NA	35.2	9.6	0.8	58.2	67	77.8	5.6	224.4	415.6	95.6	1044.6
20	2019	NA	NA	NA	NA	NA	4.8	113.6	132.6	440.6	244.8	348.4	276.8	1561.6
21	2020	13.6	NA	NA	31.4	59.4	30.6	328.4	105.4	183.8	67.2	183.8	543.4	1547
22	2021	273.8	21	NA	11.6	32	50.6	111.2	158.8	112.6	306	745.4	69.4	1892.4

Table No.3.19 Seasonal Rainfall (in mm) of the Kollidam River Lower Anicut (2000 - 2021)

Sl. No	Year	Winter	Summer	SWM	NEM	Annual Rainfall
1	2000	143.80	61.00	360.50	884.00	1449.30
2	2001	5.00	194.20	324.60	850.40	1374.20
3	2002	98.00	9.00	149.10	610.50	866.60
4	2003	18.20	31.10	439.00	616.20	1104.50
5	2004	NA	482.00	358.60	751.90	1592.50
6	2005	27.80	241.80	223.40	1126.60	1619.60
7	2006	NA	233.40	299.90	713.60	1246.90
8	2007	51.60	90.40	358.00	981.60	1481.60
9	2008	68.60	301.60	182.60	1253.60	1806.40
10	2009	36.00	94.40	225.20	1026.30	1381.90
11	2010	65.80	73.40	605.50	1018.00	1762.70
12	2011	43.00	107.80	420.90	859.40	1431.10
13	2012	18.60	16.20	443.60	462.80	941.20
14	2013	18.40	82.00	434.10	498.40	1032.90
15	2014	7.60	251.80	353.80	765.20	1378.40
16	2015	17.60	206.40	265.20	1108.80	1598.00
17	2016	NA	162.00	446.00	196.60	804.60
18	2017	139.00	30.60	526.40	671.20	1367.20
19	2018	54.80	45.60	208.60	735.60	1044.60
20	2019	NA	NA	691.60	870.00	1561.60
21	2020	13.60	90.80	648.20	794.40	1547.00
22	2021	294.80	43.60	433.20	1120.80	1892.40
	Min	5.00	9.00	149.10	196.60	804.60
	Max	294.80	482.00	691.60	1253.60	1892.40
	Average	71.10	145.22	384.95	806.92	1374.26

3.9.2 Hydrogeology

3.9.2.1 Introduction

The science of hydrogeology is primarily concerned with the evaluation of occurrence, availability and quality of groundwater. Evaluation of aquifer hydraulic properties is an important aspect of all groundwater resource assessment. This helps any investigator in quantifying the groundwater potential of an area and also in development of groundwater models.

A detailed hydro geological evaluation needs to assess

1. The nature of aquifers geometry
2. The seasonal variation and flow patterns of the ground water system
3. The water storage and yielding characteristics of the porous or fractured media

3.9.2.2 Nature of aquifers

An aquifer is a water bearing reservoir capable of yielding enough water to satisfy a particular demand. Alluvial deposits of sedimentary formation and highly weathered metamorphic and igneous rock form good aquifers.

Sand stone are the most important formation storing large volume of ground water and good storage media for ground water. Shale and clay, virtually, have no storage space for ground water. Igneous and metamorphic rocks are normally affected by weathering when they are subjected to aerial agencies. Gradually, they become fractured, jointed and faulted. Only the weathered zone and shear of hard rock terrain can form good aquifers.

3.9.2.3 Aquifer types

Aquifers are geological formation containing sufficient saturated permeable material to allow extraction of water in quantities sufficient to constitute useful supplies. Depending on the ground water contained in an aquifer is at atmospheric pressure or, because of the effects of confining layer, at greater than atmospheric pressure, it is termed either unconfined.

Aquifer in which the upper surface is defined by the water table is called unconfined aquifers (or) water table. In these aquifers the water table is in vertical contact with the atmosphere through soil interstices. The groundwater body is

separated from the main groundwater by a small impermeable rock layer, such a special cases of an unconfined aquifer is termed as Perched aquifer Fig No 3.21.

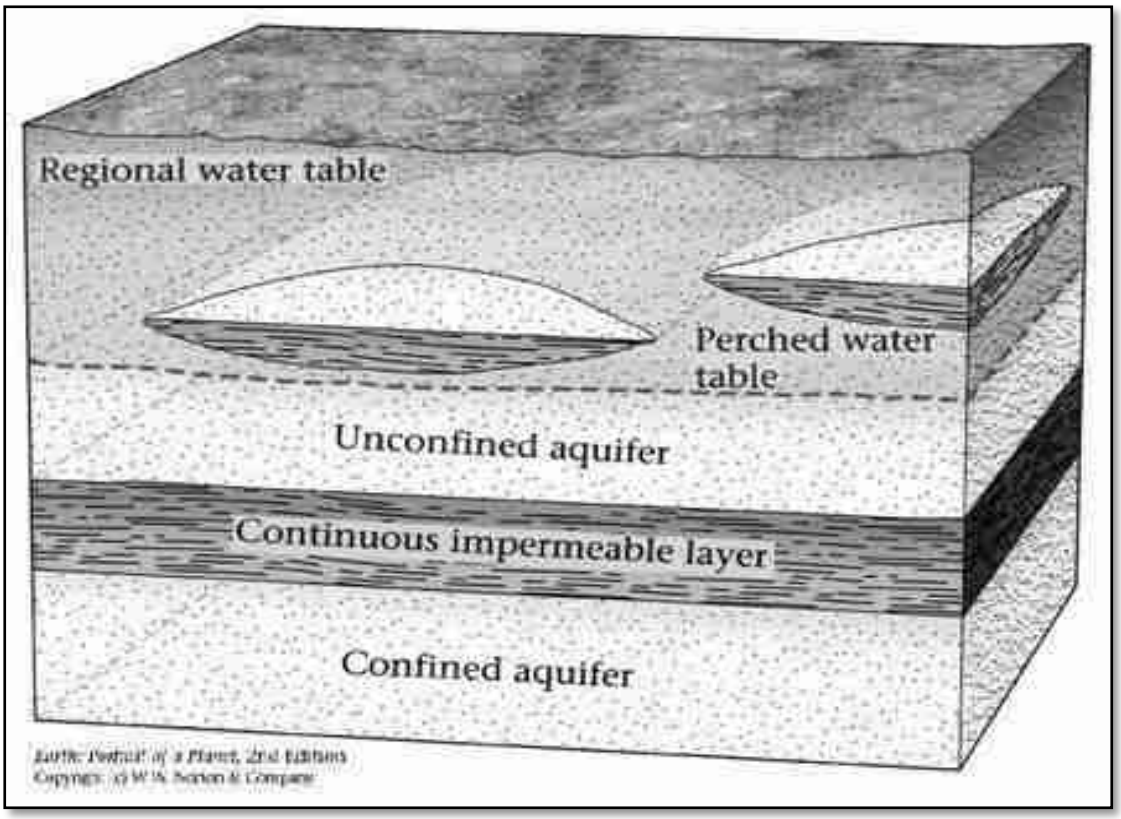


Fig No 3.21 Types of Aquifer

3.9.3 Hydrogeology of Tamilnadu

The groundwater behavior in Tamil Nadu region is highly complicated due to the occurrence of diversified geological formations, concerned with a ground water regime need an understanding of the nature of the zone saturated, the formation will be designated as heterogeneous nature or anisotropic, are not uniformwith reference to space and time, this holds good for the aquifers of crystalline terrain. In Tamilnadu the consolidated hard rock's of igneous and metamorphic origin is predominantly cover the state whereas the unconsolidated sedimentary rocks are occurred mostly along the coastal regions.

According to the hydrological factors, the state can be subdivided into three hydrogeological units namely

1. Fissured formation
2. Porous formation and
3. Semi-porous formation.

The fissured formations are generally do not posses primary porosity with local and limited groundwater. In porous formation existed mostly in the sedimentary rocks of the coastal belt include fluviatile, fluvio-marine and marine sequences. The semi-porous formation which is restricted to presence of primary porosity but discontinuous secondary porosity and fractures are existing. The hydrogeological map of Tamil Nadu is given in the Fig No 3.22.

Fig No 3.22 Hydrogeological map of Tamil Nadu

3.9.4 Hydrogeology of Lower Kollidam Anaicut

Hydrogeology of lower anaicut of Kollidam River consists Porous formations have been further subdivided into

a) Unconsolidated quaternary sediments

b) Semi consolidated formations

Unconsolidated quaternary sediments consisting of laterite and the fluvial and coastal alluvium and the semi consolidated formations comprising the Cuddalore sandstone. It includes various types of soil, fine to coarse-grained sands, silts, clays laterite and lateritic gravels.

Semi consolidated formations are essentially argillaceous, comprising silts, clay stones, calcareous sandstones, siliceous limestones and algal limestones. They are the most extensive productive aquifers in our terrain, particularly the Cuddalore sandstones. Under favorable situations, these formations give rise to free flowing wells.

3.9.5 Groundwater Level

The periodical monitoring of ground water level implies the groundwater recharge and discharge occurring in the aquifer systems. To understand the hydrogeological condition particularly, water level variation has been studied in seasonal water level data of Pre monsoon, Monsoon and post monsoon has been collected 58 Locations from the period of June 2022 to may 2023. It also reveals that the interaction between surface and sub-surface water systems. The depth to the water level in wells varies from **2 to 15** m bgl shown in graphs Fig No 3.23. The depth to the water level is closely related and controlled by the topography, surface water bodies and precipitation. The depth to the water levels in bore well of this area has been preparing the water table elevation contour shown in Fig No 3.24, 3.25 and 3.26.

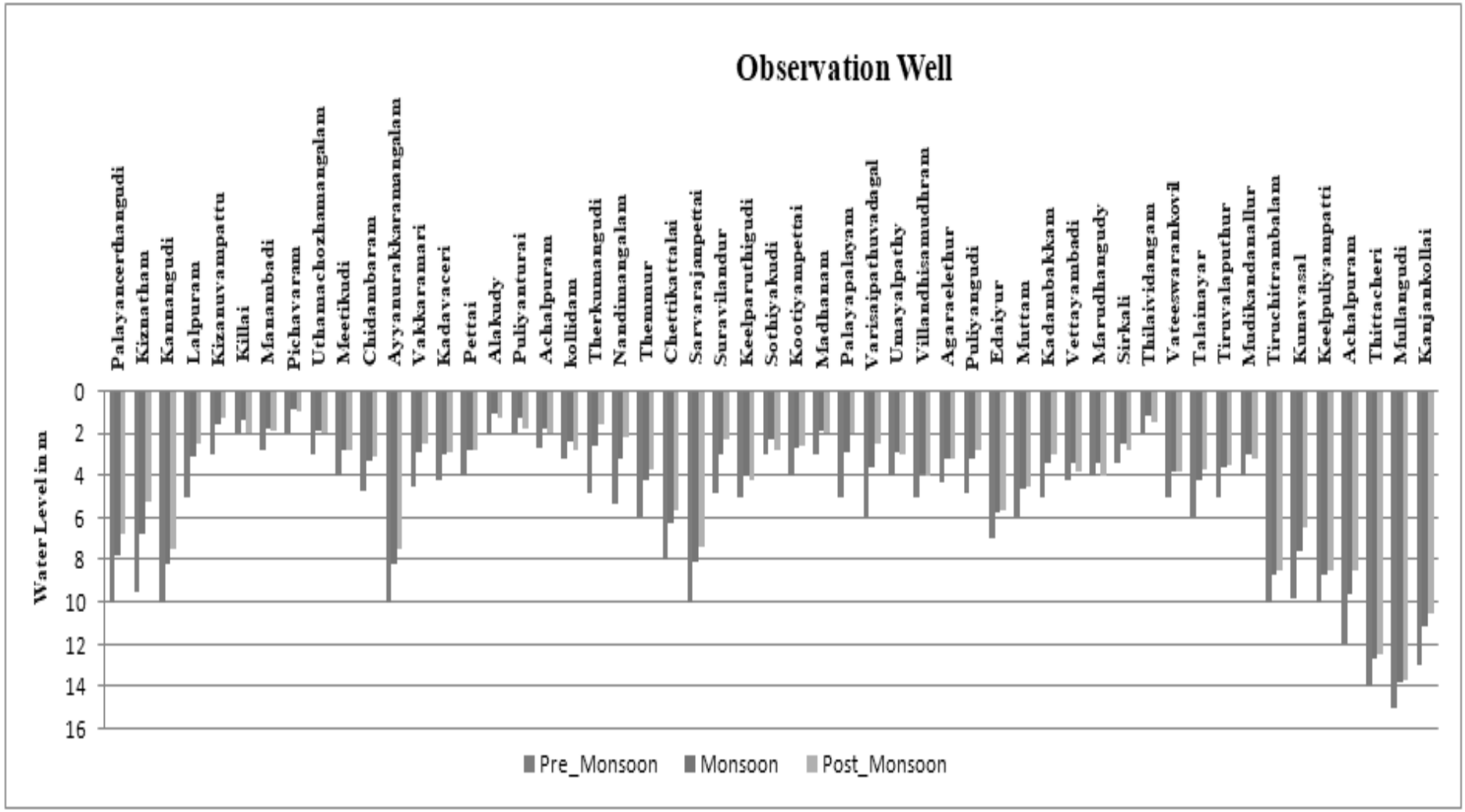


Fig No 3.23 Seasonal variation water level data of Pre monsoon and post monsoon

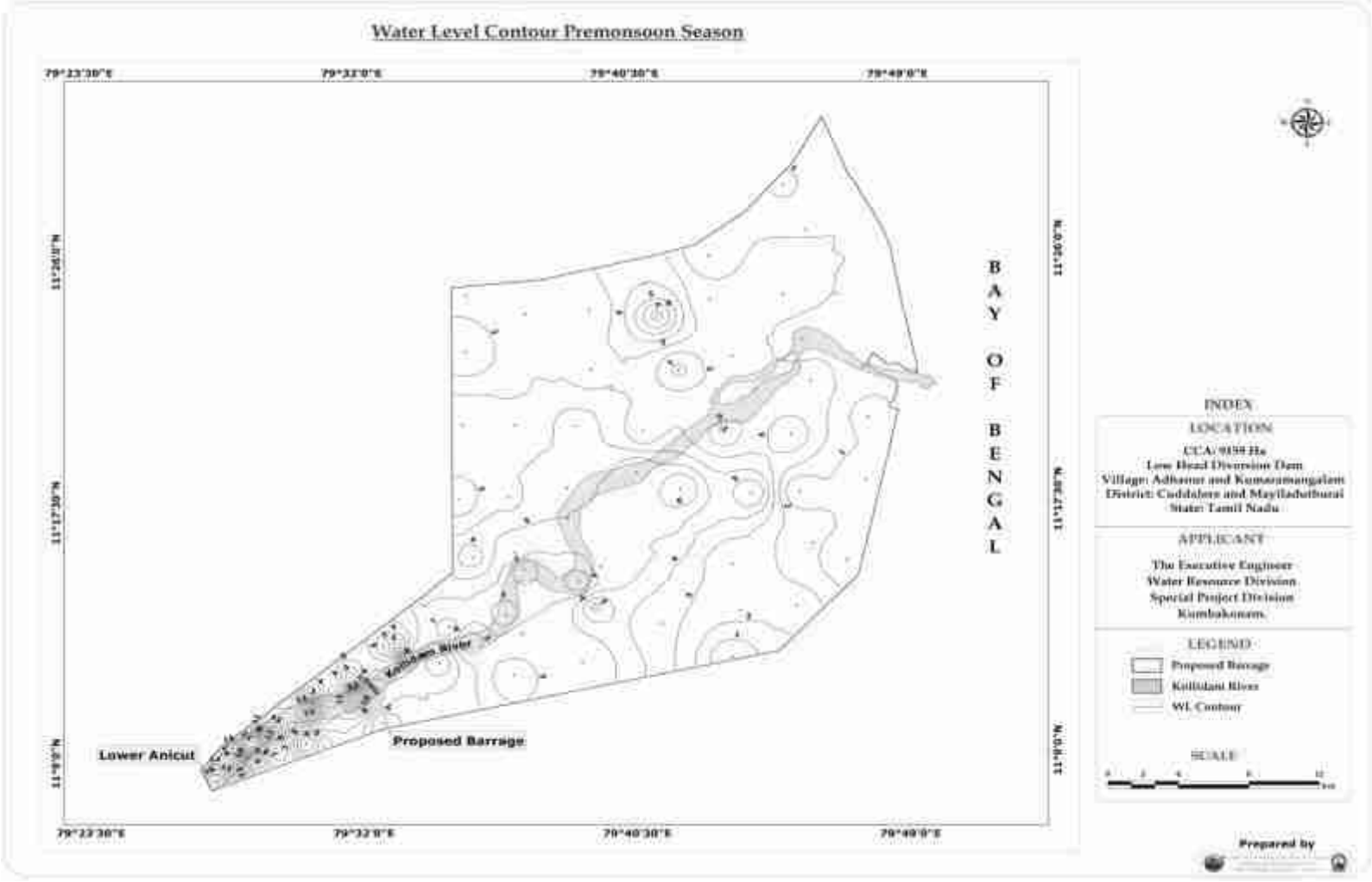


Fig No 3.24: Pre Monsoon season Water Table Elevation Contour - Cultivable command area

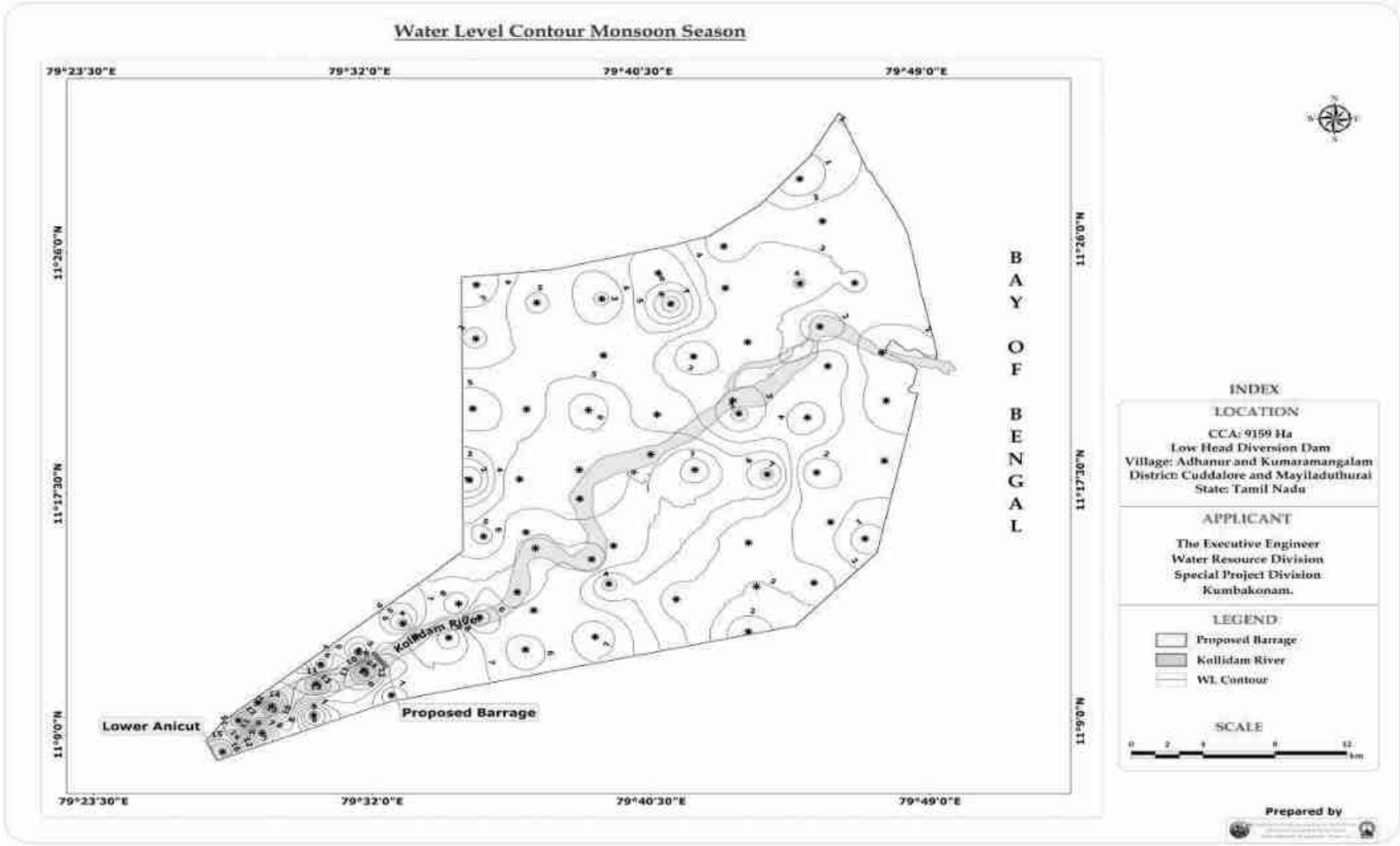


Fig. No 3.25: Monsoon season Water Table Elevation Contour - Cultivable command area

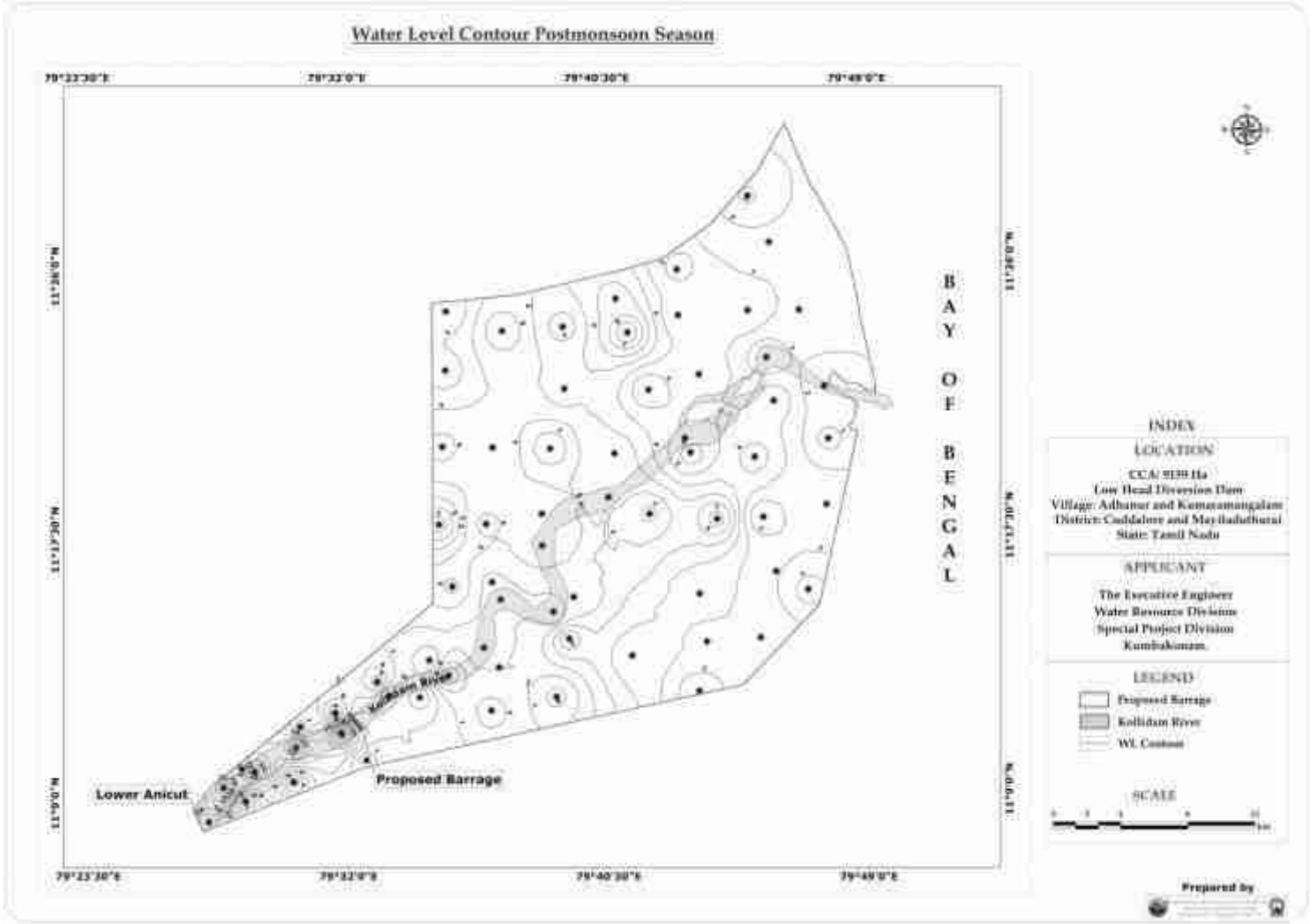


Fig No 3.26 : Post Monsoon season Water Table Elevation Contour - Cultivable command area

3.9.6 Aquifer Performance Test (APT)

The Aquifer Characteristics study was carried out three different locations around lower Kollidam anicut of Kollidam River to identify the hydraulic characteristics of an alluvial formation. The geologic setting where groundwater is stored is heterogeneous nature and is characterized by semi-confined to confined conditions.

The tests were performed using >7 HP 40 stage submersible pumps. Well Performance Test is conducted in Exploration well with a constant discharge rate. The locations map of the pumping test is shown Fig 3.30. Multiple pumping tests carried out on the same semi-confined to confined aquifer under various static Water level it allows characterization of various responses of the system.

The depth to water level was varies from 8.90 to 13.30 m bgl. The total depth of the bore well varies from 110.0 m to 215.0 m. The wells are pumped for sufficient time and dewatered. The recuperation data was recorded for 100 minute. The Drawdown data was plotted in respect of Drawdown V/s time to find out the value of Transmissivity (T) by using Jacob's straight line method (1945). The data plot showing Drawdown V/s time is presented in Fig No 3.28. Residual drawdown versus t/t' data was plotted to calculate the Transmissivity by using Theis' recovery method. The data plot showing drawdown V/s t/t' is presented in Fig No 3.29. The minimum and maximum value of transmissivity obtained from Jacob's method is 52.73 m^2/d and 316.42 m^2/d respectively and transmissivity is calculated using Theis recovery method measurement. The minimum and maximum value of transmissivity obtained from Theis method is 63.28 m^2/d and 369.17 m^2/d respectively. Aquifer parameters in the study area are given in Table No 3.20 and 3.21.

Table 3.20: The Summarized results of Pumping Wells.

S.no	Location Name	Discharge (m^3/day)	Static water level (m bgl)	Duration of pumping (minutes)	Drawdown (m)	Specific Capacity (lit/min/m)
1	Kandamangalam	604.8	13.30	100	3.96	152.72
2	Vaiyur	691.2	10.40	100	5.43	127.29
3	Duraipadi	864.0	8.90	100	10.46	82.60

Table 3.21: Hydraulic parameter of Pumping Wells

S.no	Location Name	Transmissivity (m^2/d)	
		Jacob	Theis
1	Kandamangalam	276.87	369.17
2	Vaiyur	316.42	253.14
3	Duraipadi	52.73	63.28

Fig No 3.27 Measuring water level

3.9.6.1 Analysis of Well Performance Test of Pumping Well at Kandamangalam Village

By Jacobs Method

Transmissivity calculated from Drawdown vs time data plot.

$$T = 2.3\ Q/4\pi\Delta s$$

$Q = 604.8\ m^3/day$

$\Delta s = 0.4\ m$

$$T = \frac{2.3 \times 604.8}{4 \times 3.14 \times 0.4}$$

$T = 276.87\ m^2/day$

Theis Method

Transmissivity calculated from Residual Drawdown Vs t/t' data plot.

T = 2.3 Q/4πΔs'
Q = 604.8 m^3/day
Δs' = 0.3 m
T = 2.3x604.8
4x3.14x0.3
T = 369.17 m^2/day

3.9.6.2 Analysis of Well Performance Test of Pumping Well at Vaiyur Village

By Jacobs Method

Transmissivity calculated from Drawdown vs time data plot.

T = 2.3 Q/4πΔs
Q = 691.2 m^3/day
Δs = 0.4 m
T = 2.3x691.2
4x3.14x0.4
T = 316.42 m^2/day

By Theis Method

Transmissivity calculated from Residual Drawdown Vs t/t' data plot.

T = 2.3 Q/4πΔs'
Q = 691.2 m^3/day
Δs' = 0.5 m
T = 2.3x691.2
4x3.14x0.5
T = 253.1m^2/day

3.9.6.3 Analysis of Well Performance Test of Pumping Well at Duraipadi Village

By Jacobs Method

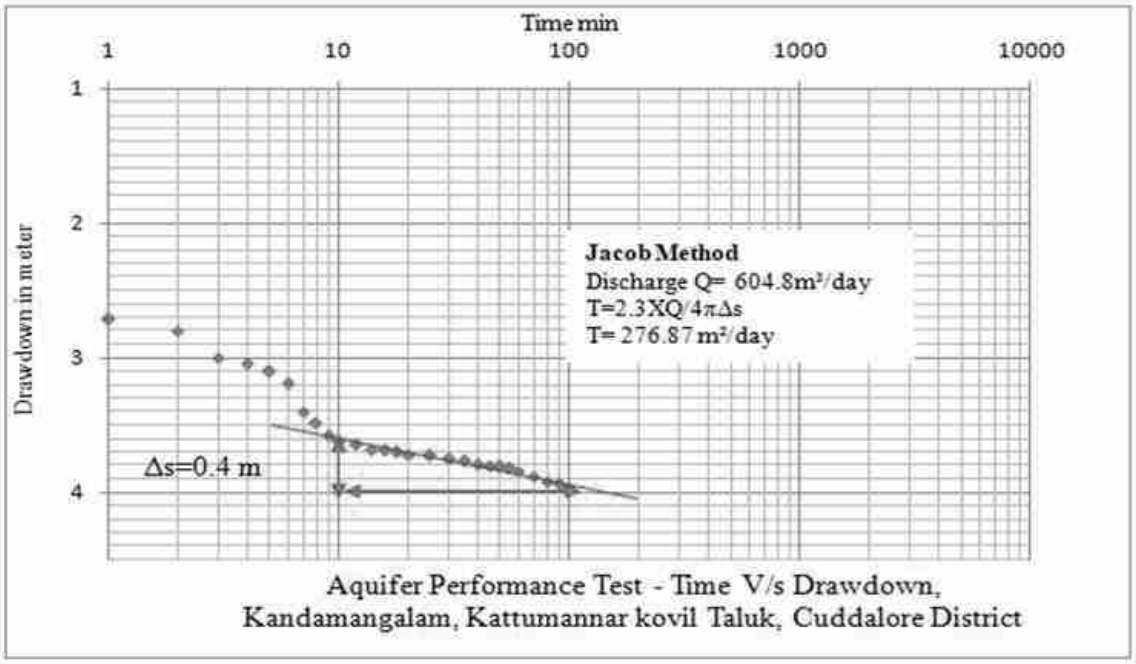
Transmissivity calculated from Drawdown vs time data plot.

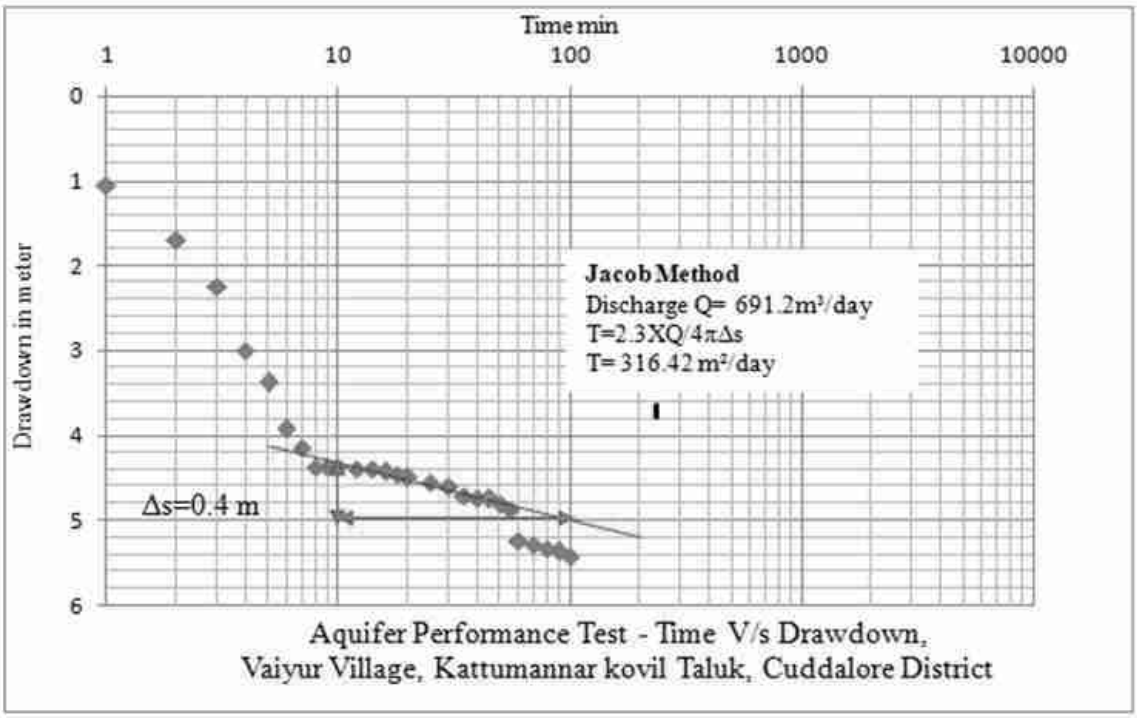
T = 2.3 Q/4πΔs
Q = 864.0 m^3/day
Δs = 3.0 m
T = 2.3x864.0
4x3.14x3.0
T = 52.73 m^2/day

By Theis Method

Transmissivity calculated from Residual Drawdown Vs t/t' data plot.

T = 2.3 Q/4πΔs'
Q = 864.0 m^3/day
Δs' = 2.5 m
T = 2.3x864.0 / 4x3.14x2.5
T = 63.28 m^2/day





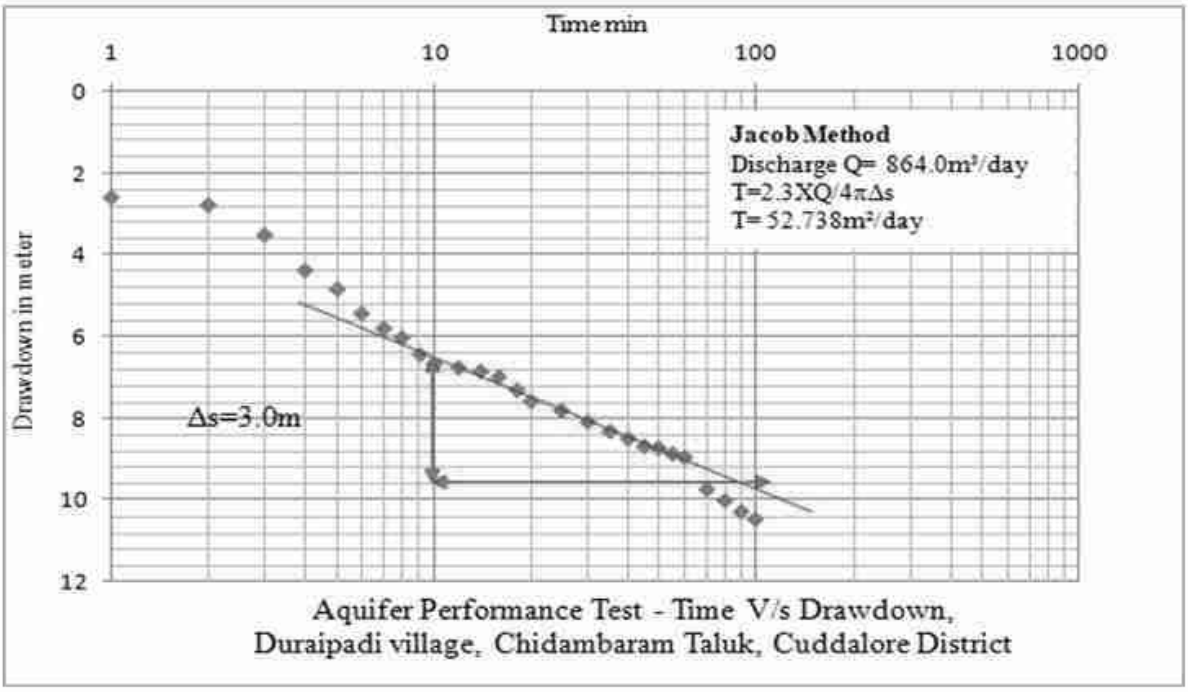
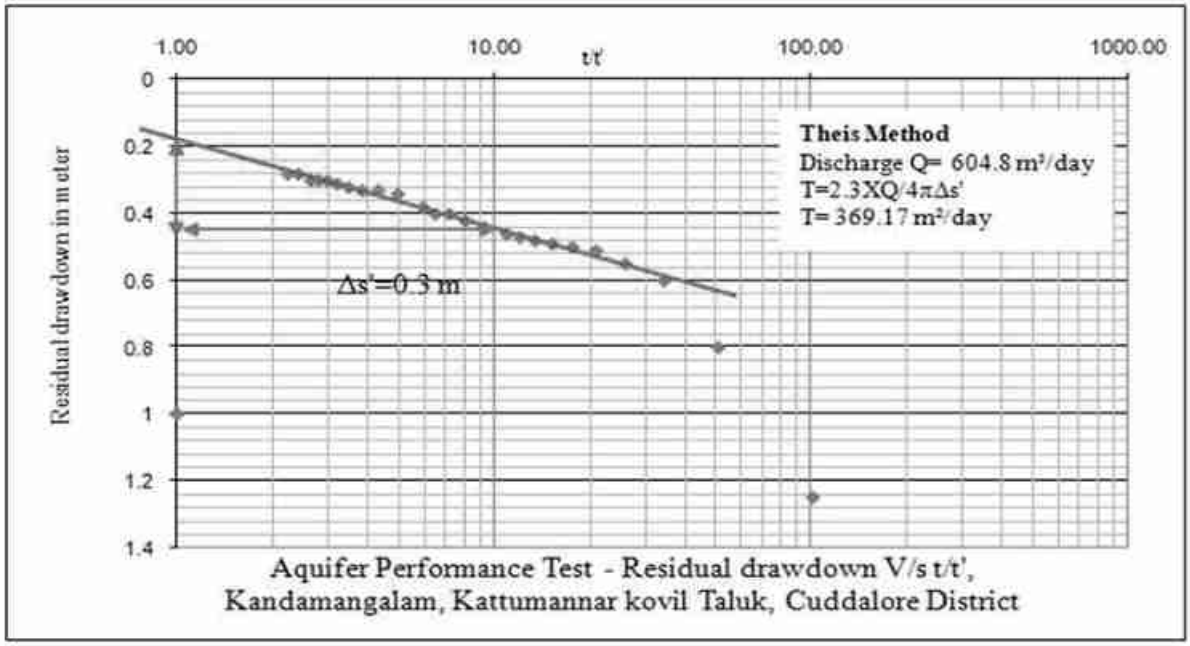
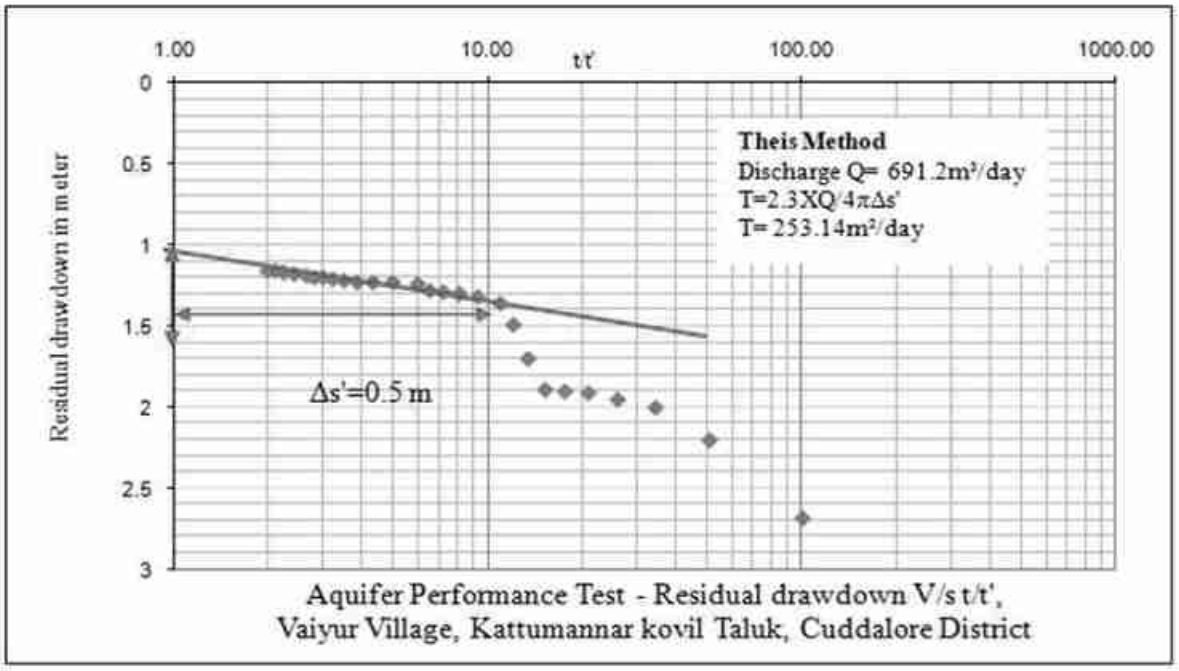


Fig No 3.28 Time V/s Drawdown data plot





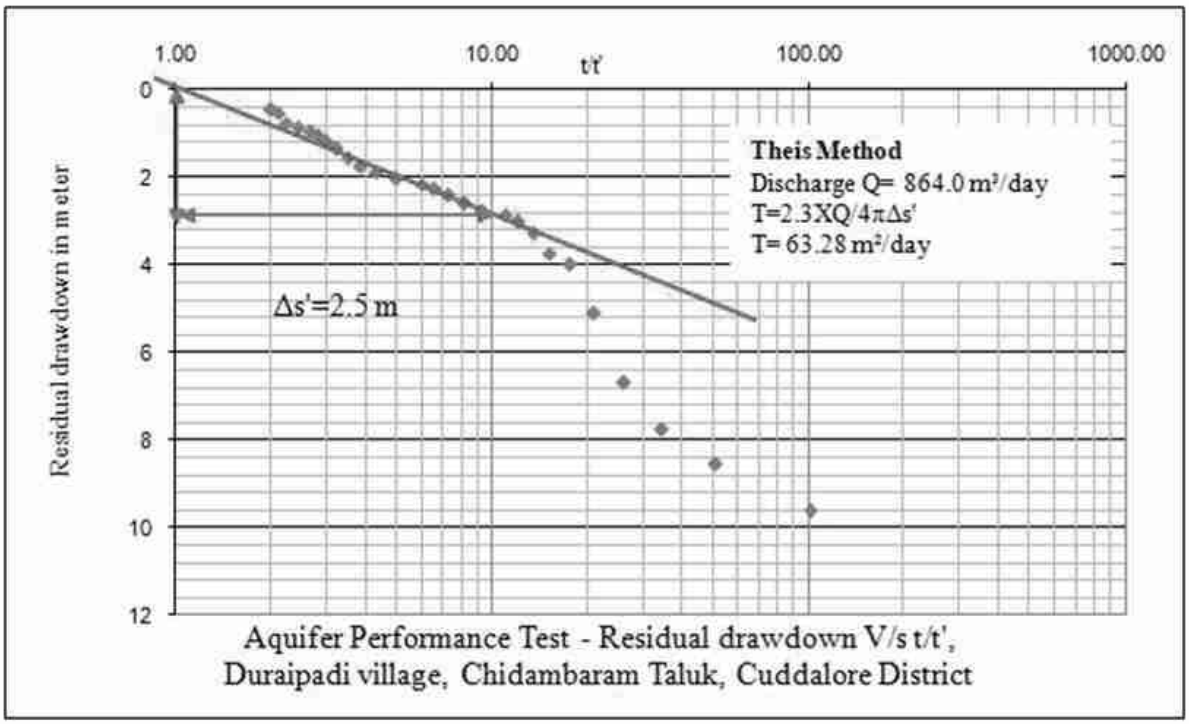


Fig No 3.29 Residual Drawdown Vs t/t' data plot

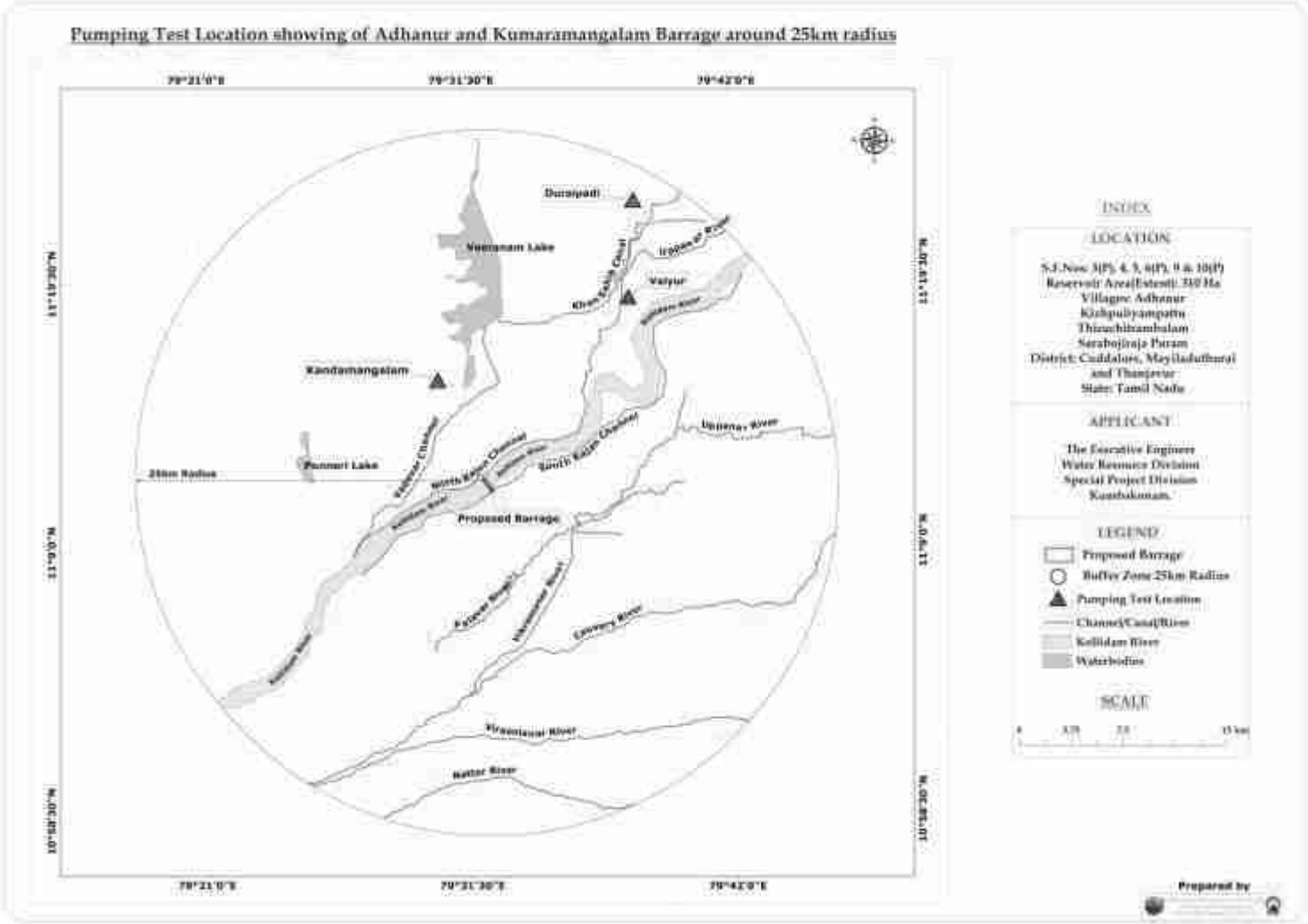


Fig No 3.30: Pumping Test Location map

Annexure – 1a

Village Name	Kandamangalam
Depth of the well	110.0 m
Static water level	13.30 m
Discharge	604.8 m^3/day

Time since pump started (min)	**Depth to water (m)**	**Drawdown (m)**	**Time (t)**	**Time since pump stopped (min) (t')**	**Depth to water (m bgl)**	**Residual Drawdown (m bgl)**	**t/t'**
1	16.01	2.71	101	1	14.55	1.25	101.00
2	16.1	2.8	102	2	14.1	0.8	51.00
3	16.3	3	103	3	13.9	0.6	34.33
4	16.35	3.05	104	4	13.85	0.55	26.00
5	16.4	3.1	105	5	13.81	0.51	21.00
6	16.49	3.19	106	6	13.8	0.5	17.67
7	16.7	3.4	107	7	13.79	0.49	15.29
8	16.78	3.48	108	8	13.78	0.48	13.50
9	16.88	3.58	109	9	13.77	0.47	12.11
10	16.92	3.62	110	10	13.76	0.46	11.00
12	16.94	3.64	112	12	13.74	0.44	9.33
14	16.98	3.68	114	14	13.72	0.42	8.14
16	16.99	3.69	116	16	13.70	0.40	7.25
18	17.00	3.70	118	18	13.70	0.40	6.56
20	17.02	3.72	120	20	13.68	0.38	6.00
25	17.03	3.73	125	25	13.64	0.34	5.00
30	17.05	3.75	130	30	13.63	0.33	4.33
35	17.07	3.77	135	35	13.63	0.33	3.86
40	17.09	3.79	140	40	13.62	0.32	3.50
45	17.10	3.80	145	45	13.61	0.31	3.22
50	17.11	3.81	150	50	13.60	0.30	3.00
55	17.12	3.82	155	55	13.60	0.30	2.82
60	17.14	3.84	160	60	13.60	0.30	2.67
70	17.18	3.88	170	70	13.58	0.28	2.43
80	17.22	3.92	180	80	13.58	0.28	2.25
90	17.24	3.94	190	90	14.55	1.25	101.00
100	17.26	3.96	200	100	14.10	0.8	51.00

Annexure – 1b

Village Name	Vaiyur
Depth of the well	180.0 m
Static water level	10.40 m
Discharge	691.2 m^3/day

Time since pump started (min)	**Depth to water (m)**	**Drawdown (m)**	**Time (t)**	**Time since pump stopped (min) (t')**	**Depth to water (m bgl)**	**Residual Drawdown (m bgl)**	**t/t'**
1	11.45	1.05	101	1	13.08	2.68	101.00
2	12.1	1.07	102	2	12.6	2.20	51.00
3	12.64	2.24	103	3	12.4	2.00	34.33
4	13.4	3.00	104	4	12.35	1.95	26.00
5	13.78	3.38	105	5	12.31	1.91	21.00
6	14.33	3.93	106	6	12.30	1.90	17.67
7	14.55	4.15	107	7	12.29	1.89	15.29
8	14.77	4.37	108	8	12.10	1.70	13.50
9	14.78	4.38	109	9	11.89	1.49	12.11
10	14.78	4.38	110	10	11.76	1.36	11.00
12	14.79	4.39	112	12	11.72	1.32	9.33
14	14.8	4.4	114	14	11.7	1.30	8.14
16	14.83	4.43	116	16	11.69	1.29	7.25
18	14.87	4.47	118	18	11.68	1.28	6.56
20	14.9	4.50	120	20	11.64	1.24	6.00
25	14.95	4.55	125	25	11.63	1.23	5.00
30	15.01	4.61	130	30	11.63	1.23	4.33
35	15.11	4.71	135	35	11.63	1.23	3.86
40	15.14	4.74	140	40	11.62	1.22	3.50
45	15.15	4.75	145	45	11.61	1.21	3.22
50	15.21	4.81	150	50	11.60	1.20	3.00
55	15.27	4.87	155	55	11.60	1.20	2.82
60	15.64	5.24	160	60	11.59	1.19	2.67
70	15.69	5.29	170	70	11.58	1.18	2.43
80	15.73	5.33	180	80	11.57	1.17	2.25
90	15.77	5.37	190	90	11.56	1.16	101.00
100	15.83	5.43	200	100	11.56	1.16	51.00

Annexure – 1c

Village Name	Duraipadi
Depth of the well	215.0 m
Static water level	8.90 m
Discharge	864.0 m^3/day

Time since pump started (min)	**Depth to water (m)**	**Drawdown (m)**	**Time (t)**	**Time since pump stopped (min) (t')**	**Depth to water (m bgl)**	**Residual Drawdown (m bgl)**	**t/t'**
1	11.49	2.59	101	1	18.51	9.61	101.00
2	11.69	2.79	102	2	17.46	8.56	51.00
3	12.42	3.52	103	3	16.66	7.76	34.33
4	13.3	4.40	104	4	15.59	6.69	26.00
5	13.72	4.82	105	5	14	5.10	21.00
6	14.34	5.44	106	6	12.89	3.99	17.67
7	14.69	5.79	107	7	12.63	3.73	15.29
8	14.91	6.01	108	8	12.2	3.3	13.50
9	15.34	6.44	109	9	11.92	3.02	12.11
10	15.55	6.65	110	10	11.79	2.89	11.00
12	15.67	6.77	112	12	11.68	2.78	9.33
14	15.75	6.85	114	14	11.51	2.61	8.14
16	15.88	6.98	116	16	11.3	2.40	7.25
18	16.23	7.33	118	18	11.17	2.27	6.56
20	16.48	7.58	120	20	11.05	2.15	6.00
25	16.71	7.81	125	25	10.94	2.04	5.00
30	16.98	8.08	130	30	10.78	1.88	4.33
35	17.22	8.32	135	35	10.67	1.77	3.86
40	17.39	8.49	140	40	10.46	1.56	3.50
45	17.57	8.67	145	45	10.24	1.34	3.22
50	17.65	8.75	150	50	10.09	1.19	3.00
55	17.76	8.86	155	55	9.97	1.07	2.82
60	17.87	8.97	160	60	9.87	0.97	2.67
70	18.62	9.72	170	70	9.78	0.88	2.43
80	18.90	10.00	180	80	9.66	0.76	2.25
90	19.18	10.28	190	90	9.43	0.53	101.00
100	19.36	10.46	200	100	9.37	0.47	51.00

3.9.7 Geophysical studies carried out in and around Proposed Barrage site

3.9.7.1 Importance of Vertical Electrical Method (VES)

Electrical resistivity methods are widely used for groundwater investigations and to determine the subsurface layer thickness and mapping geological environment of existing aquifer. The electrical resistivity technique used to determine the spatial extent of groundwater aquifers, estimation of hydraulic parameters of aquifers, monitoring of aquifer recharge and monitoring seawater intrusions for coastal groundwater. The objective of the electrical resistivity survey was to study the groundwater aquifer and its electrical properties in around the lower kollidam anaicut and to understand the resistivity of subsurface structure and to determine the depth and thickness of the aquifer and saturated zone.

3.9.7.2 Basic Principle

In electrical methods measure the electrical properties of the earth, which is artificially injected the current into the ground as a result of which the current distributes itself depending upon conductivity of the subsurface. Earth is a heterogeneous nature there will be a difference in conductivities. The electrical resistivity or specific resistance of a medium is the resistance offered by a unit cube of it, when a unit current passes normal to the surface of the cross-sectional Area 'A'. It is given by Ohm's law:

$$\rho = RA/L$$

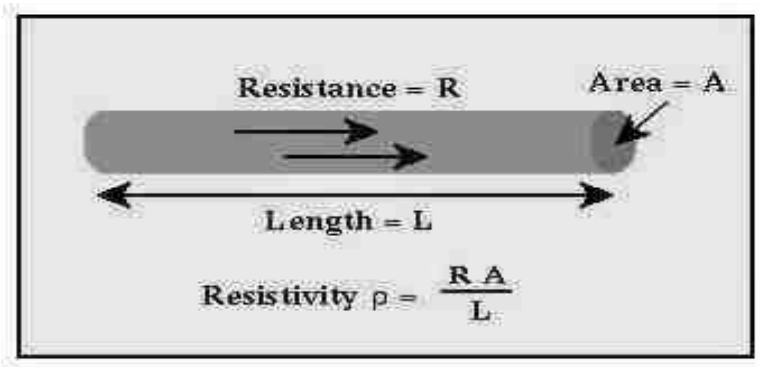
Where,

ρ = Resistivity

R = Resistance offered by the medium of length

L = Length

A = area of cross-sectional



The basis of electrical resistivity technique and flow of current is shown in Fig No 3.31 and 3.32 where a known current (I) is passed into the ground through two current electrodes (C1 and C2). The potential difference (ΔV) is measured between two more electrodes called potential electrodes (P1 and P2). The ratio ΔV/I gives the resistance (R) and multiplying R with the geometrical factor (K) of the electrode separation, the apparent resistivity 'ρa' which is inverse of conductivity of the ground can be determined.

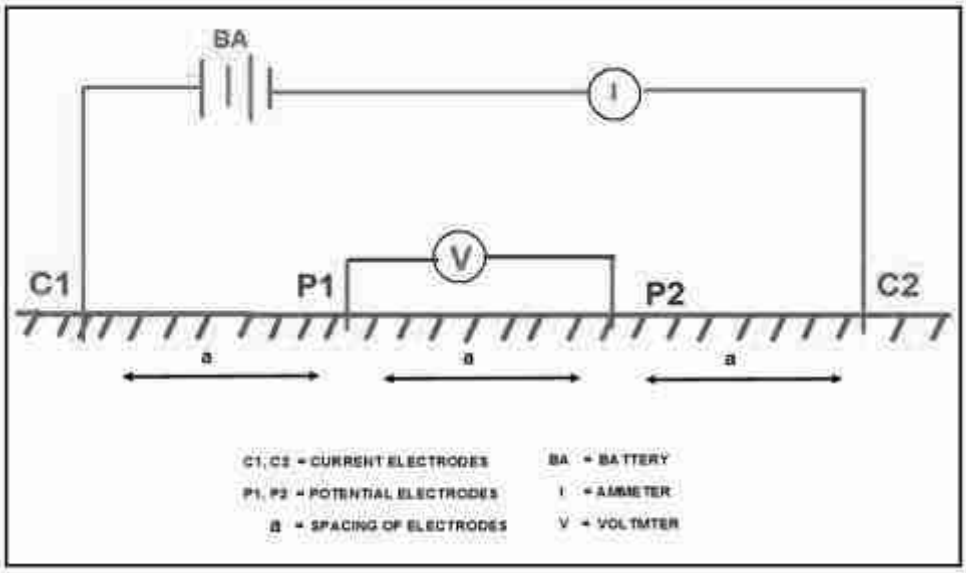


Fig No 3.31 Basic principle of electrical resistivity technique

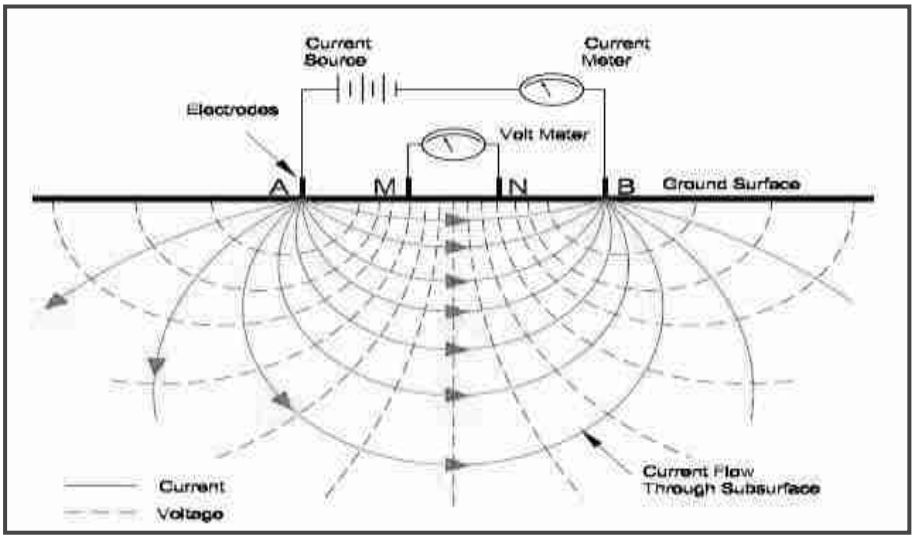


Fig No 3.32 Flow of current through the subsurface formation

3.9.7.3 Electrode Configuration

A few varieties of electrode-spacing are being employed in resistivity measurements. The two widely used configurations are The Wenner and Schlumberger configurations. The electrode arrangement of Wenner and Schlumberger is presented in the Fig No 3.33.

In Schlumberger arrangement, This array is most widely used in electrical prospecting Four electrodes (A, M, N, B) are placed along a straight line symmetrically over centre point '0'. Current is sent through the outer electrodes AB and potential across MN (the inner electrodes) is measured similar to Wenner array. Here in Schlumberger configuration, the separation between potential electrodes (M N) is kept small when compared to the current electrode separation A B.

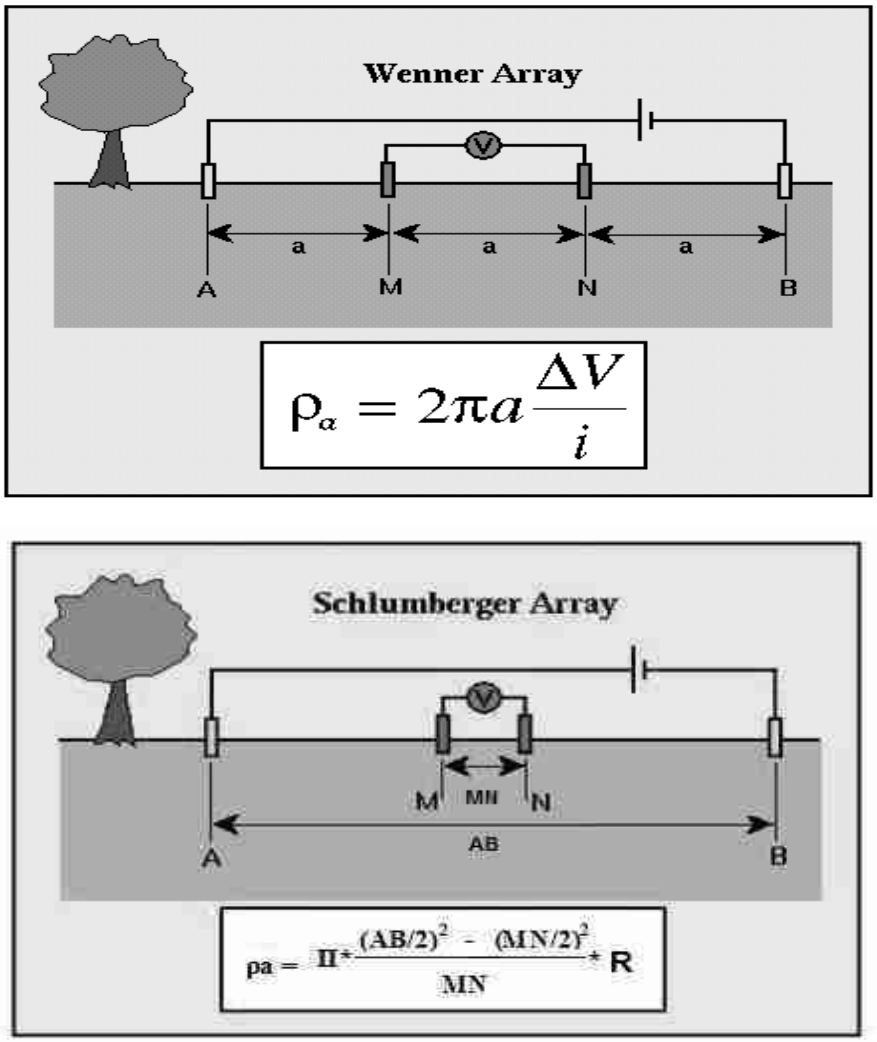


Fig No 3.33 Electrode configurations (Wenner, Schlumberger)

3.9.7.4 Vertical Electrical Resistivity

Vertical Electrical Sounding (VES) was carried out in and around Lower Kollidam anaicut by employing Symmetrical four Electrode Schlumberger and Wenner Configuration with a maximum spread length of current electrode separation (AB/2) of 100 m. The data was collected by using the DDR-3 model resistivity meter Fig No 3.35 and 3.36. A total of 10 VES were carried out to understand thickness of various subsurface geological formations the location of the VES points is given in Fig No 3.34. The field data has been interpreted quantitatively by Curve Matching Technique Fig No 3.37.

Based on interpreted VES results, 5 to 6 geo-electric layer were identified. The resistivity observed for various geological formations in the lower Kollidam anaicut. The interpretation results that the over all restivity value varies from 0.5 Ωm to 806 Ωm. Similarly the subsurface formation thickness varies from 0.73m to 82.4m. The layer wise aquifer thickness and resistivity's obtained are listed in Table 00.

Table No 3.22 Interpreted resistivity of Earth material

Resistivity (Ωm)	Formation
<1	Saline formation
1 – 5 Ωm	clay
5 – 10 Ωm	sandy clay
15 – 60 Ωm	sand
60 – 120 Ωm	sandstone

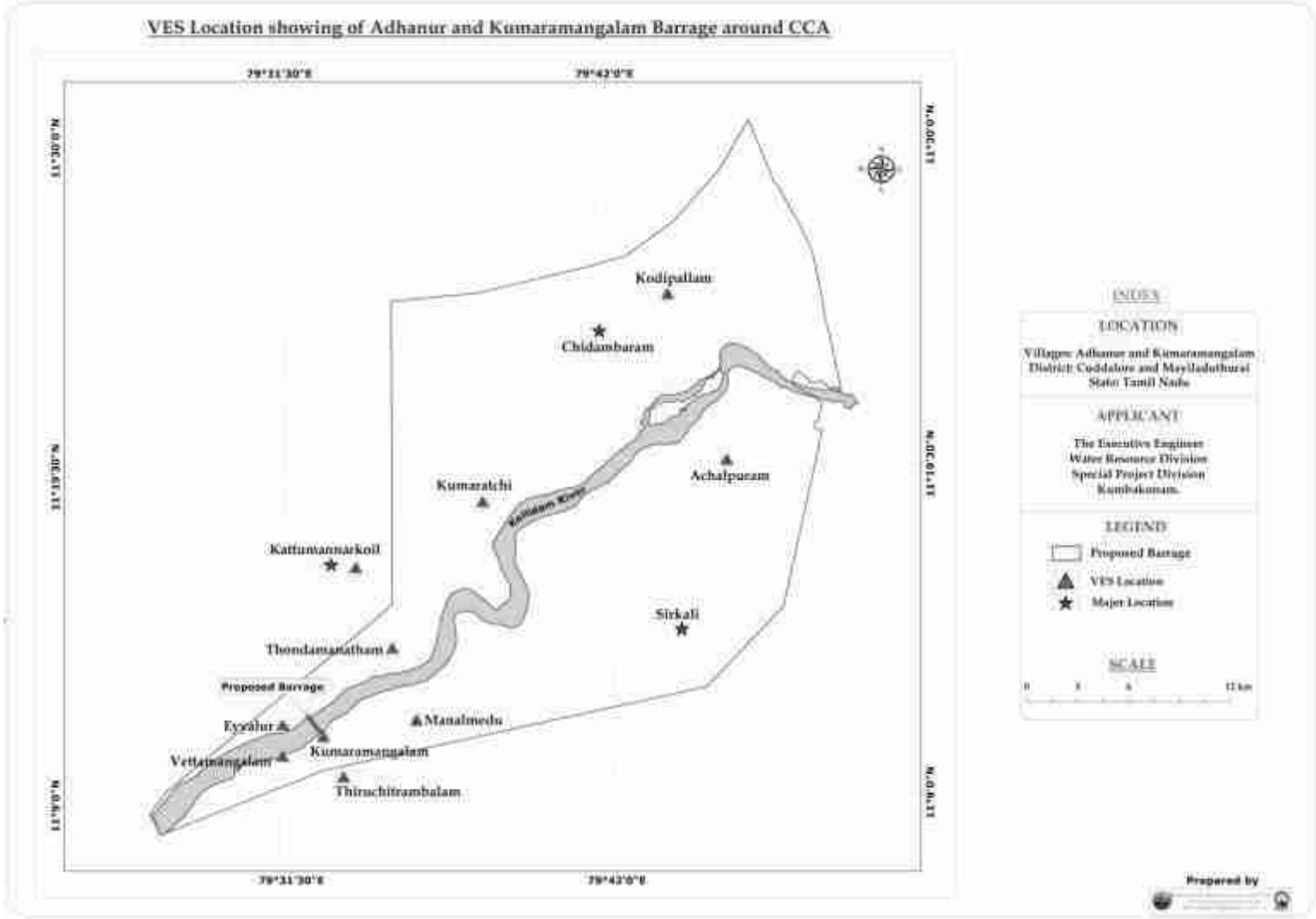
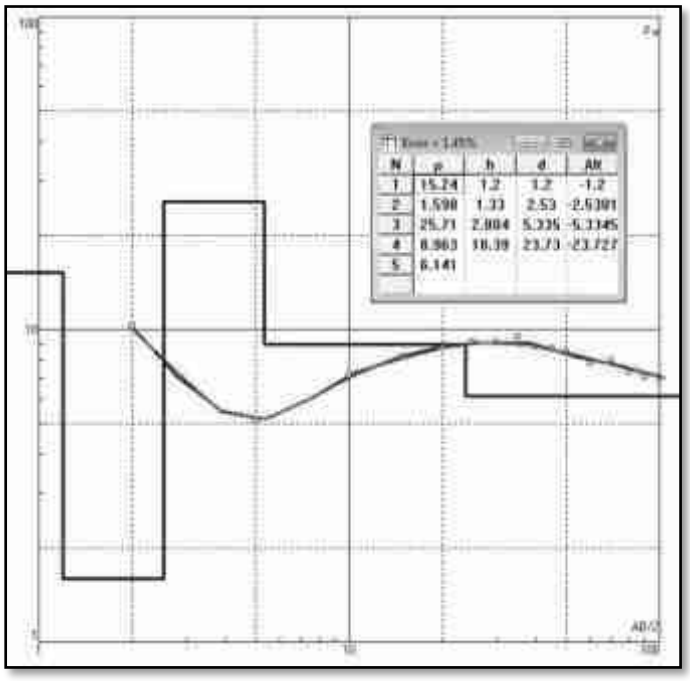


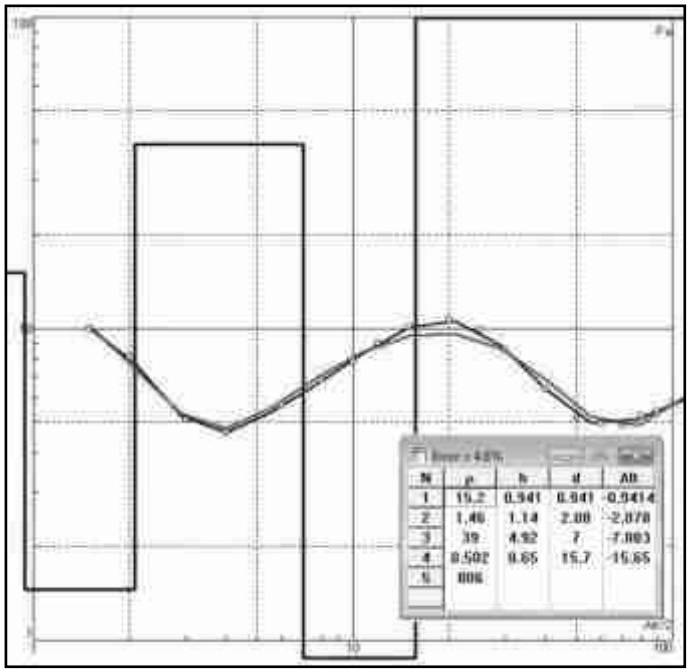
Fig No 3.34 VES locations map

Fig No 3.35 Conducting VES Cuddalore district **Fig No 3.36: Conducting VES Mayiladuthurai district**



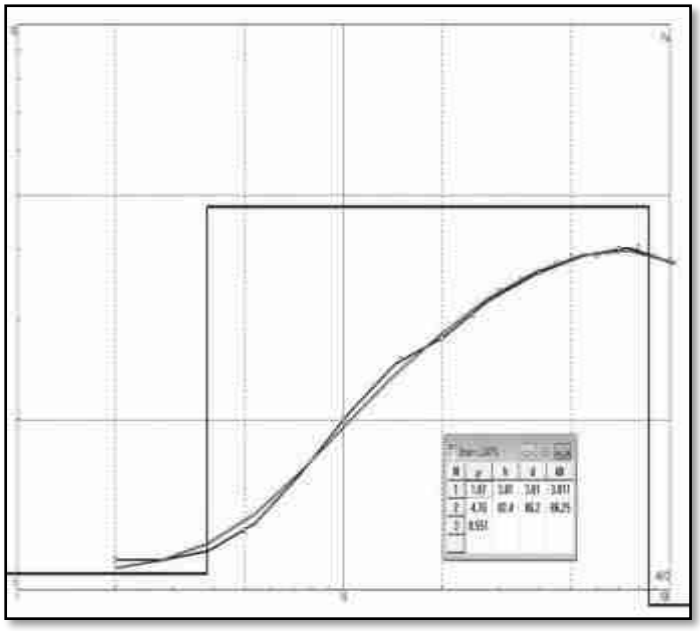
N	ρ	h	d	Δh
1	15.24	1.2	1.2	-1.2
2	1.598	1.33	2.53	-2.5301
3	25.71	2.884	5.335	-5.3345
4	0.963	18.39	23.73	-23.727
5	6.141			

VES Location: Eyyalur

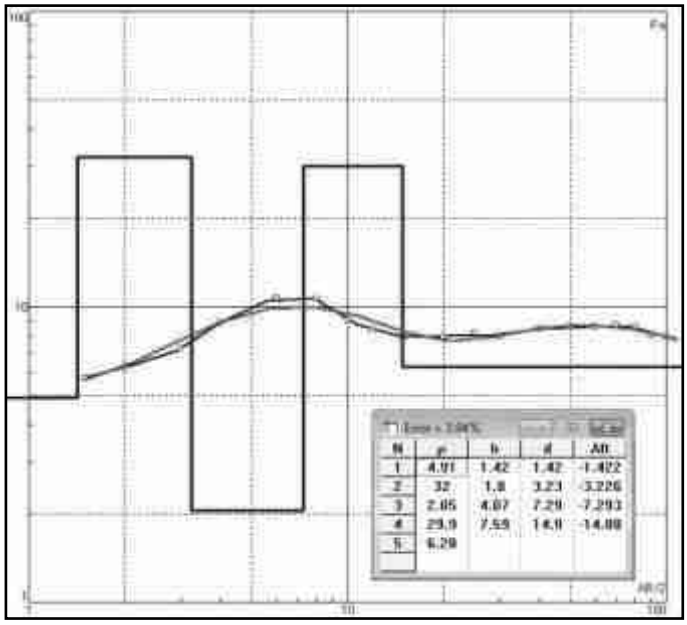


N	ρ	h	d	Δh
1	15.2	0.941	0.941	-0.9414
2	1.46	1.14	2.08	-2.078
3	39	4.92	7	-7.083
4	0.502	8.65	15.7	-15.65
5	806			

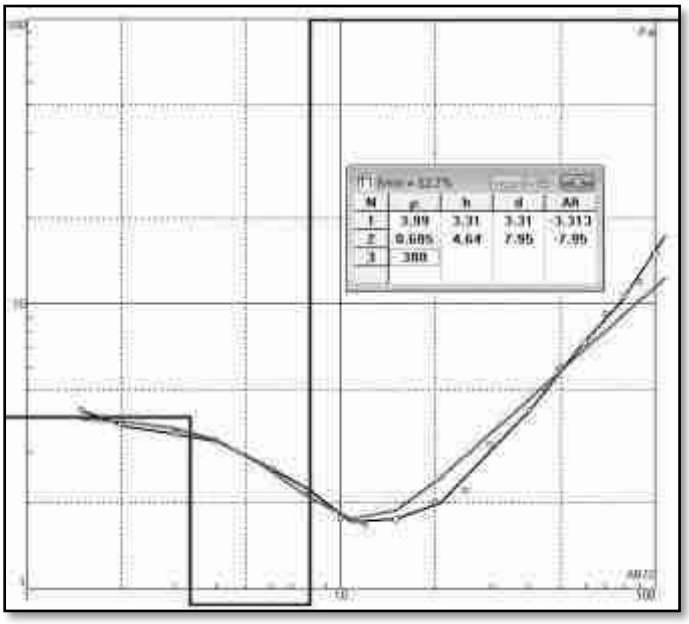
VES Location: Kattumannarkoil



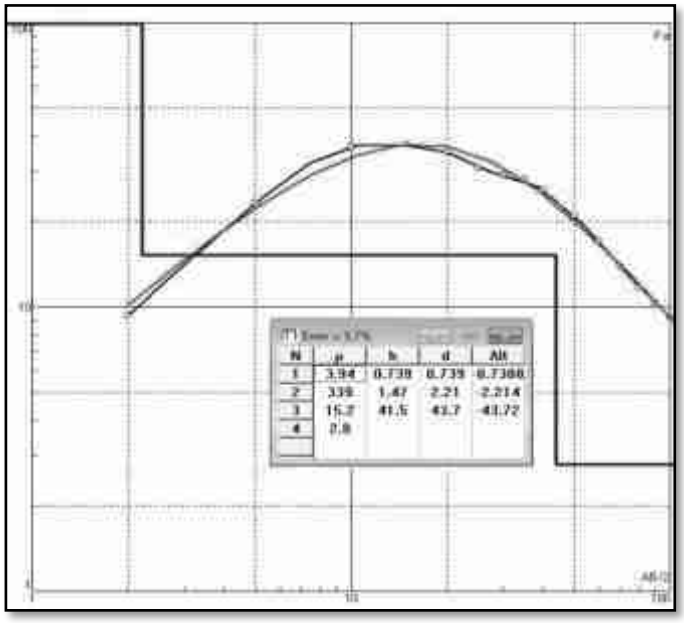
VES Location: Kumaratchi



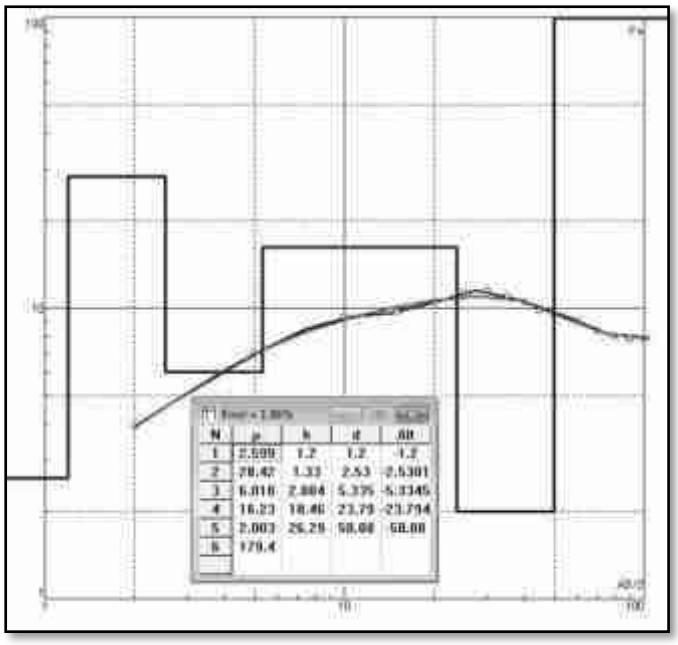
VES Location: Kumaramangalam



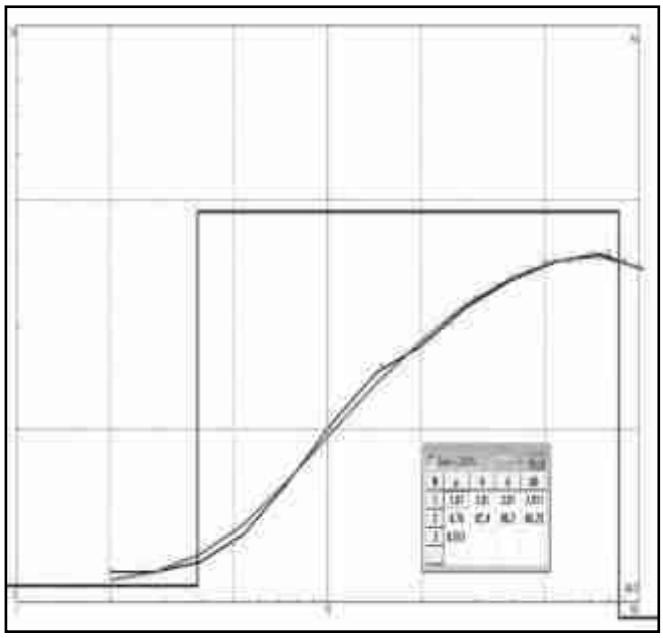
VES Location: Manalmedu



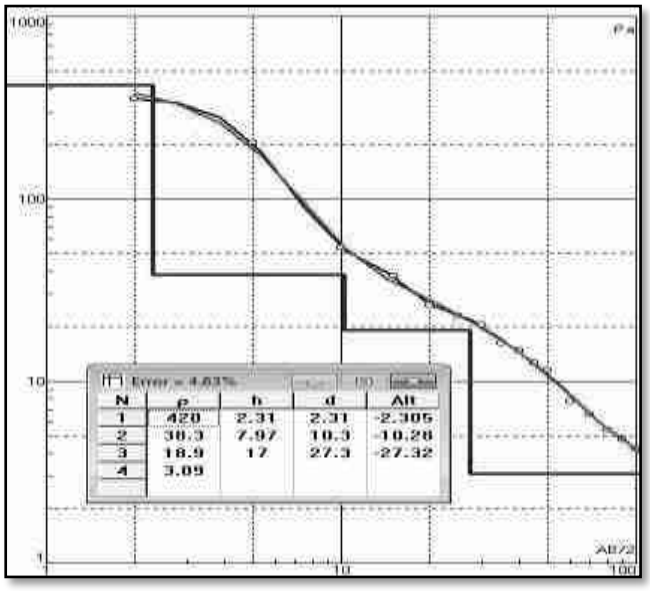
VES Location: Thiruchitrambalam



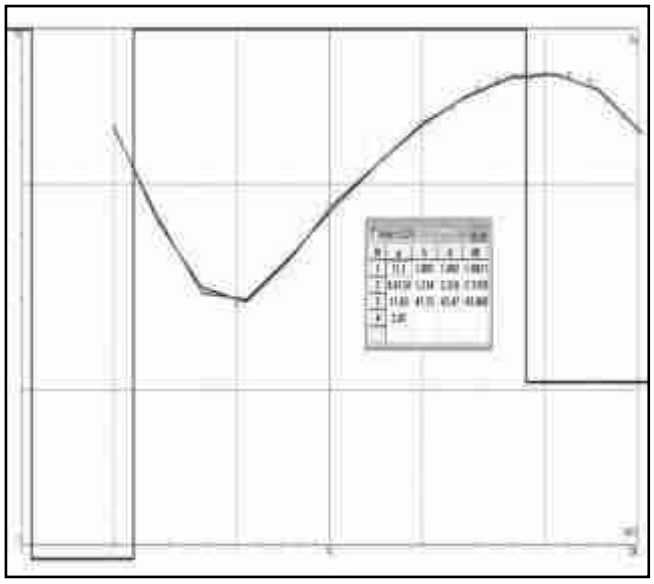
VES Location: Kodipallam



VES Location: Vettamangalam



VES Location: Achalpuram



VES Location: Kandamangalam

Fig No 3.37 Interpreted VES Curves & Layer.

Table 3.23 Electrical resistivity and layer thickness of the study area
(ρ in Ohm m, h in Thickness in m)

VES no	Location	ρ1	ρ2	ρ3	ρ4	ρ5	ρ6	h1	h2	h3	h4	h5
1	Eyyalur	15.24	1.59	25.71	8.96	6.14	-	1.2	1.33	2.8	18.39	-
2	Kattumannarkoil	15.2	1.46	39	0.502	806	-	0.94	1.14	4.92	8.65	-
3	Kumaratchi	1.07	4.76	0.55	-	-	-	3.81	82.4	-	-	-
4	Kumaramangalam	4.91	32	2.05	29.9	6.28	-	1.42	1.8	4.07	7.59	
5	Manalmedu	3.99	0.61	380	-	-	-	3.31	4.64	-	-	-
6	Thiruchitrambalam	3.94	339	15.2	2.8	-	-	0.73	1.47	41.5	-	-
7	Kodipallam	2.59	28.4	6.01	16.28	2	179	1.2	1.33	2.8	18.46	26.29
8	Vettamangalam	1.07	4.76	0.55	-	-	-	3.81	82.4	-	-	-
9	Achalpuram	420	38.3	18.9	3.09	-	-	2.31	7.97	17	-	-
10	Kandamangalam	11.1	0.87	11	2.07	-	-	1.08	1.23	41.15	-	-

3.9.7.5 Pseudo Section of Electrical Resistivity

For better understanding the subsurface litho logical variation and shallow aquifer potential an attempt has been made to prepare vertical pseudo section of resistivity and generate possible resistivity model of the lower anaicut Kollidam River. Besides, the pseudo sections will facilitate to understand the variations of subsurface lithology and helpful to delineate potential freshwater aquifer zones. The generated pseudo section of from west to east is shown in Fig No 3.38 and 3.39.

In the profile-1, (North part of Kollidam river) and profile-2, (Souther part of Kollidam river), the resistivity varied from less than 1 Ohm-m to about 100 Ohm-m. The high resistivity value is observed in top layer with 2m to 4m thickness due to the dry soil condition. where high resistivity of above 50 Ohm-m was observed in the top and it gradually decreases to less than 10 Ohm-m noticed due to presence of saline water and sandyclay formation, where 20 Ohm m to 60 Ohm m due presence of sand stone formation.

Figure No 3.38 Pseudo Section of Profile-1

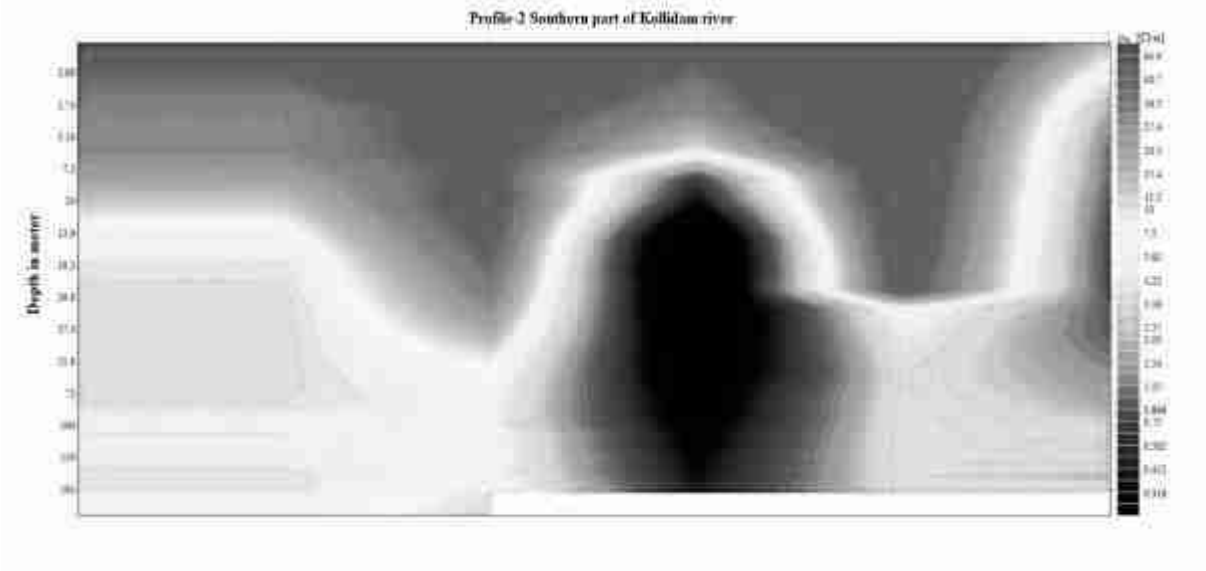
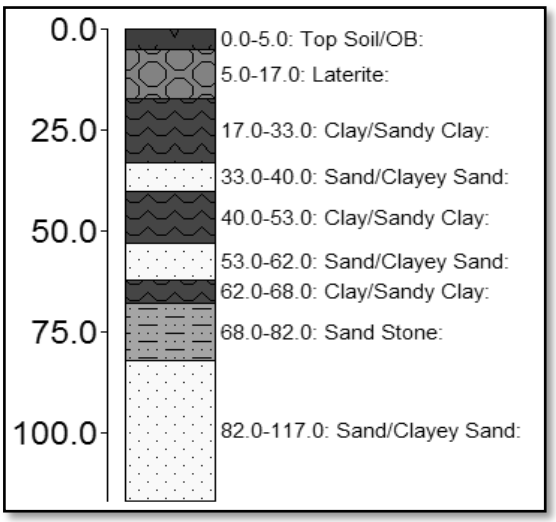


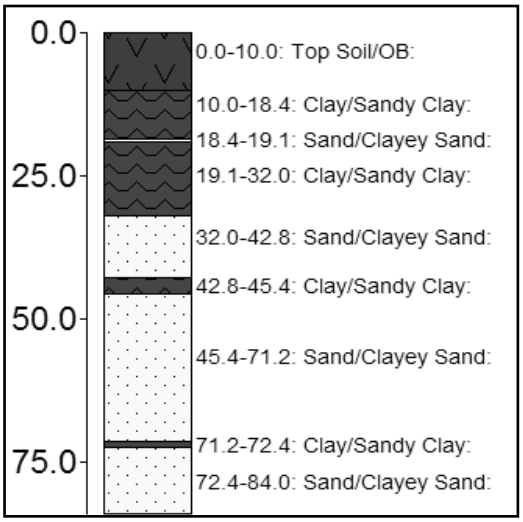
Fig No 3.39 Pseudo Section of Profile-2

3.9.8 Existing bore well Lithology of Lower Kollidam Anaicut

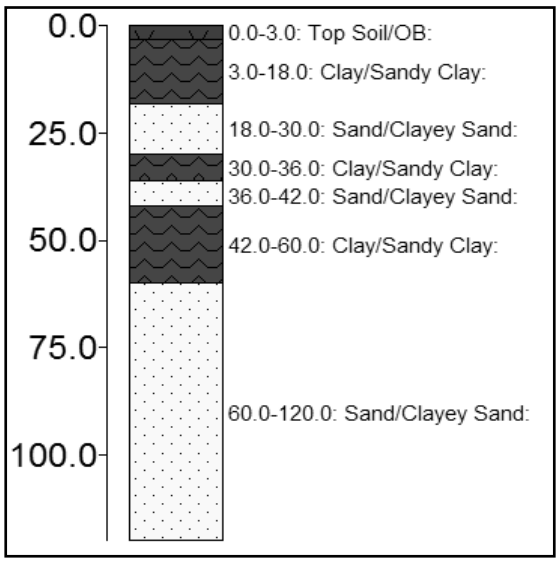
The quaternary sedimentary formation of the Lower Kollidam Anaicut covers multiple aquifer system composed by an unconfined to semi confined aquifers. This aquifer unit comprises of Sand, clay, sand stone, laterite, sandy clay and clayey sand of different thickness shown in Fig 00. The field study using geophysical technique should have significantly represented the actual terrain condition. The field measured apparent resistivity is correlated to the existing borehole lithology has shown a reliable matching.The existing borehole data collected and well inventory questioner survey conducted in farmers shown in Table No 3.24 and 3.25.



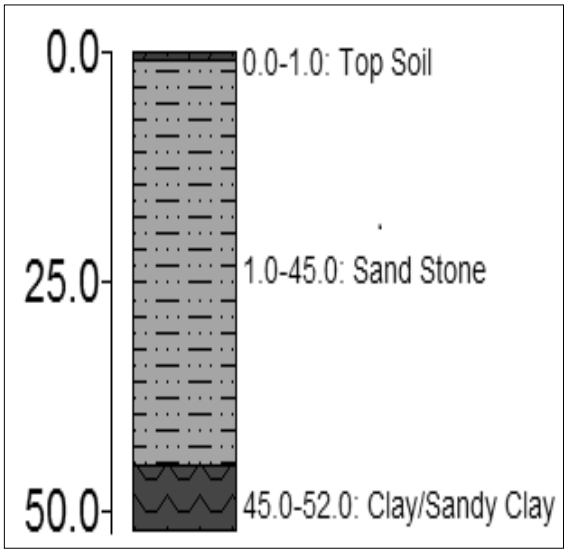
Location: Jayamkondam



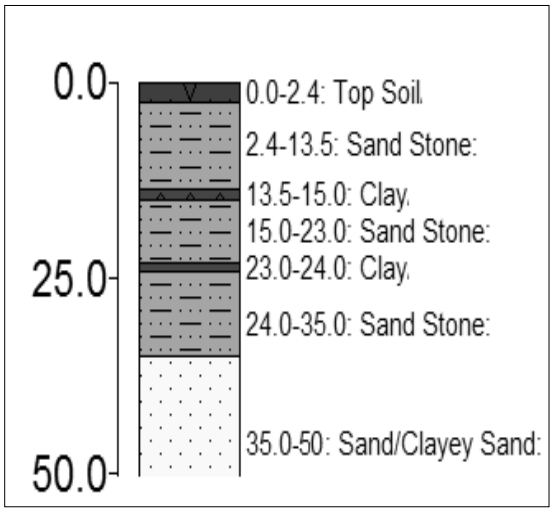
Location: Kattumannarkoil



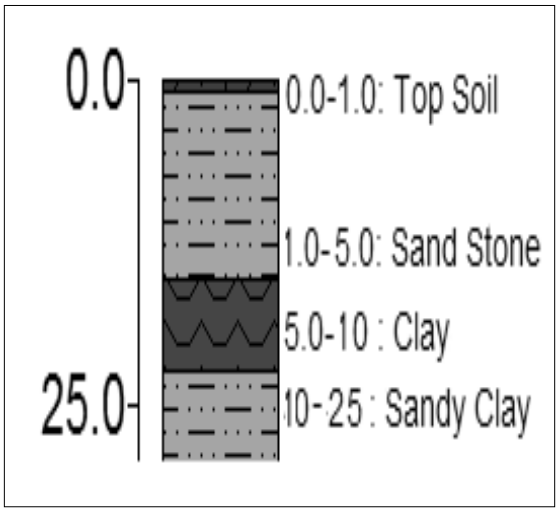
Location: Kumaratchi



Location: Thiruchitrambalam



Location: Manalmedu



Location: Kollidam

Fig No 3.40 Existing bore well Lithology of Lower Kollidam Anaicut

Table 3.24 Well inventory questioner survey conducted in Cuddalore District

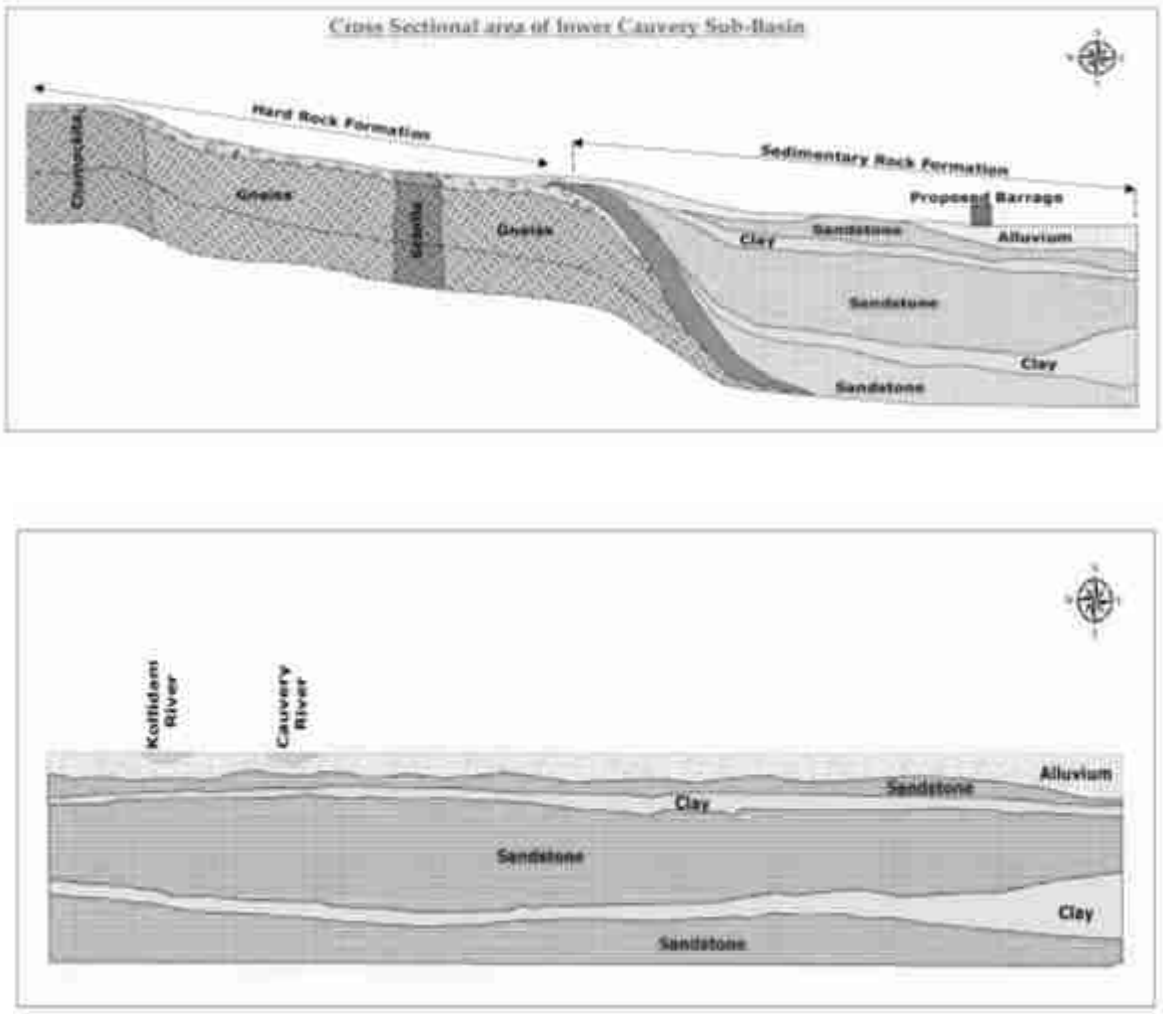
Well No	**1**	**2**	**3**	**4**	**5**
Date	9/3/2023	9/3/2023	9/3/2023	9/3/2023	9/3/2023
Village	Eyyalur	Kattumannarkoil	Kumaratchi	Kodipallam	Adhanur
District	Cuddalore	Cuddalore	Cuddalore	Cuddalore	Cuddalore
Well Type	Tube well	Tube well	Tube well	Tube well	Tube well
Depth of well in m	62 m	93m	31m	46m	46m
Hp	7.5	12.5	7.5	7.5	10
Dia of tube well	8 inch	8 inch	8 inch	8 inch	8 inch
common crop	paddy, sugarcane, pulses, Cotton	paddy, sugarcane, pulses, Cotton	paddy, vegetables, Cotton	paddy, sugarcane, pulses	paddy,vegetables, pulses
screen position in m	40	71	19	25	15
screen length in m	4.5m	6.09m	4.5m	5.48m	6.09m
Source of Energy	Eletrical energy	Eletrical energy	Eletrical energy	Eletrical energy	Eletrical energy
Use	Agriculture purpose	Agriculture	Agriculture purpose	Agriculture purpose	Agriculture purpose
Type of pump	Submersible motor	Submersible motor	Submersible motor	Submersible motor	Submersible motor
Area of irrigation	5 acre	8 acre	6 acre	8 acre	5 acre
Sub basin	Lower Cauvery sub Bsain	Lower Cauvery sub Bsain	Lower Cauvery sub Bsain	Lower Cauvery sub Bsain	Lower Cauvery sub Bsain

Table No 3.25 Well inventory questioner survey conducted in Mayiladuthurai District

Well No	**1**	**2**	**3**	**4**	**5**
Date	10/3/2023	10/3/2023	10/3/2023	10/3/2023	10/3/2023
Village	Kumaramangalam	Manamedu	Thiruchitrambalam	Achalpuram	Vettamangalam
District	Mayiladuthurai	Mayiladuthurai	Mayiladuthurai	Cuddalore	Mayiladuthurai
Well Type	Tube well	Tube well	Tube well	Tube well	Tube well
Depth of well in m	20 m	50m	31m	46m	36m
Hp	7.5	12.5	7.5	7.5	5
Dia of tube well	3 inch	8 inch	3 inch	8 inch	3 inch
common crop	paddy, pulses, Cotton,vegtables	paddy, pulses, Cotton,vegtables	paddy, pulses, Cotton,vegtables	paddy, pulses, Cotton,vegtables	paddy,vegetables, pulses, Sugarcane
screen position in m	40	71	19	25	15
screen length in m	4.5m	6.09m	4.5m	5.48m	6.09m
Source of Energy	Eletrical energy	Eletrical energy	Eletrical energy	Eletrical energy	Eletrical energy
Use	Agriculture purpose	Agriculture	Agriculture purpose	Agriculture purpose	Agriculture purpose
Type of pump	Electric motor	Submersible motor	Electric motor	Submersible motor	Electric motor
Area of irrigation	5 acre	4acre	3acre	8 acre	5 acre
Sub basin	Lower Cauvery sub Bsain	Lower Cauvery sub Bsain	Lower Cauvery sub Bsain	Lower Cauvery sub Bsain	Lower Cauvery sub Bsain

3.9.9 Cross sectional view of lower Cauvery basin

Cross sectional view of lower Cauvery basin comprises sedimentary formation east and hard rock formation in west shown in Fig No 3.41. Generally, the ground water occurs confined & Semi-confined aquifer system in Alluvial formation comprises Sand stones, sand, silt, clay, Laterite and the ground water occurs Hard rock formation aquifer unit comprises of Unconsolidated & Semi-consolidated formations and weathered and fractured Archaean crystalline rocks and interconnected shallow fractures and under semi confined to confined condition the major aquifer systems. The proposed constructed barrage site comes under alluvial formation with multiple aquifer system, fluvial deposited by river action and another coastal alluvium deposited along the coast.



(Source CGWB Report South Eastern Coastal Region, Chennai _2020)

Fig No 3.41 Cross sectional view of lower Cauvery basin

3.9.10 Groundwater and Surface Water Interactions

Groundwater and surface water interactions represent an important series of issues in water resources management. Aquifer hydraulic interaction between the river flows and the groundwater exchange of water controlled by the geological strata, Surface Water and Groundwater Interactions, Recharge from Rainfall, Interactions between Rivers and Groundwater, Artificial Recharge.

The interaction takes places in Kollidam River can be disconnected from the ground water system. Impact on proposed Barrage Before and after construction is shown in Fig No 3.42 and 3.43, the water level declined below the river bed, the rate of recharge through the river lower than the vertical flow. The rivers are disconnected from ground water level due to continuous pumping the shallow groundwater.

In some environments, river might always gain water from ground water, or it might always lose water to ground water. Barrage is also considered as check dams are one of the methods of managed aquifer recharge to expand groundwater storage in regions with non-perennial rivers and to quantify the groundwater recharge from the Kollidam River.

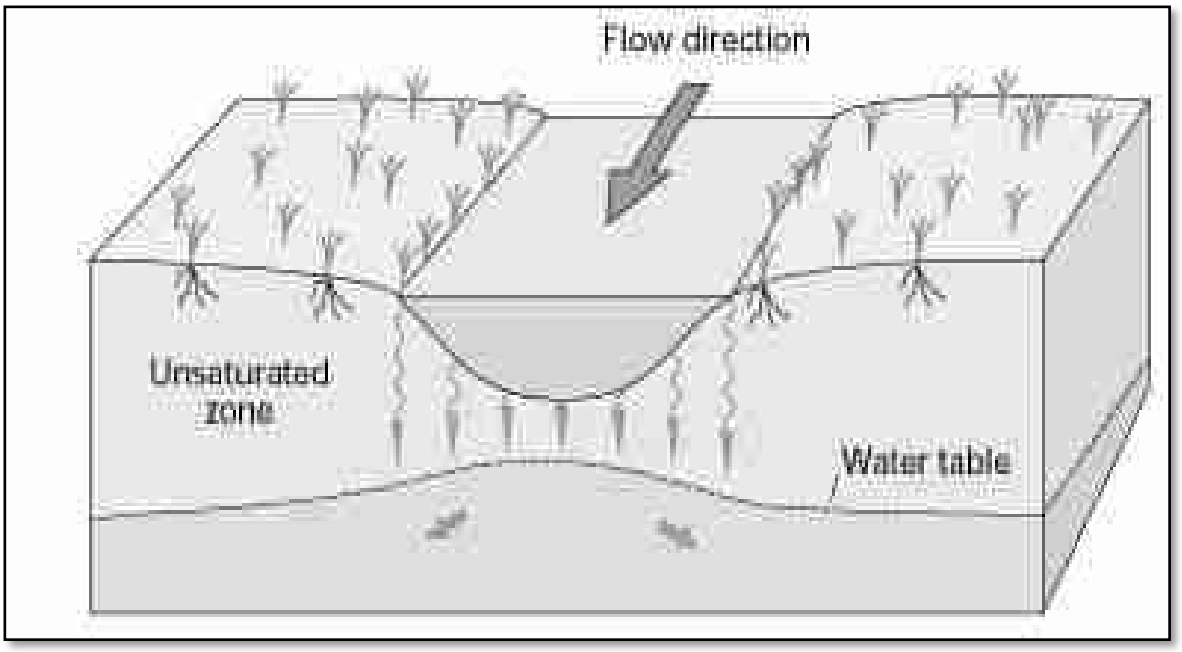


Fig No 3.42 River disconnected from the ground water system (Before construction of Barrage)

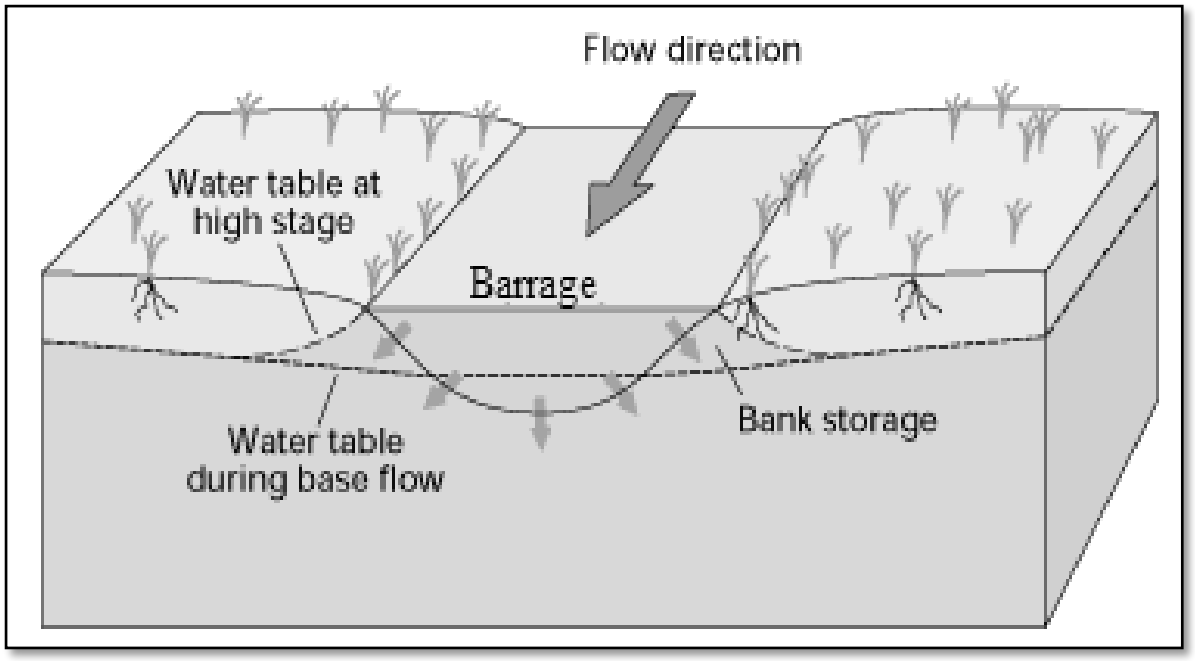


Fig No 3.43 River connected with the ground water system (After construction of Barrage)

The long pending demand of farmer's of Delta region of Cuddalore and Mayiladuthurai district for a construction of barrage across the Kollidam River storage the surplus water of river Cauvery. The Water Resources Department (WRD) is finalized to build barrage under river valley project across at Aadhanur-Kumaramangalam Village. There is a great need for to conserve water. Such structures would help groundwater recharge and improve irrigation and sustain drinking water supply through wells during drought season or failure of monsoon.

Barrage helps to recharge ground water to expected around 10 kms radius. It will help to irrigate around 9159 hectares of agricultural land benefits of 88 villages. Paddy is the main crop in these villages.

3.10 Soil Environment

3.10.1 Cuddalore District

Different types of soils found in the district are listed in Table (3.26) below:

Table No 3.26 Soil types in the Cuddalore District

S.No	Type	Area (hectares)
1	Sandy loam	91679
2	Sandy	31974
3	Clay loam	115565
4	Sandy clay loam	128573
Total		**367791**

Source: District Agricultural Plan, Cuddalore District, 2016

As could be seen from Table 4, the Sandy clay loam soil is found on the maximum area of 128573 Ha in the District, followed by clay-loam (115565 Ha), sandy-loam (91679 Ha) and sandy soil (31974 Ha).

The black soil is found in the maximum area of 38021 ha in the Mangalur Block followed by the Blocks of Nallur (12185 Ha), Kattumannarkoil (9000 Ha), Virudhachalam (7300 Ha), Keerapalayam (4720 Ha), Mel Bhuvanagiri (3450 Ha) and Kammapuram (250 Ha).

The loamy soil is found in 60709 Ha in the District. The loamy soil is also found on the maximum area of 13508 Ha in Kurinjipadi followed by Kumaratchi (12857 Ha), Kammapuram (12152 Ha), Panruti (9426 Ha), Keerapalayam (4800 Ha), Mel Bhuvanagiri (4140 Ha) etc.

Red soil is found in 44109 Ha in the District. The maximum red soil area of 13633 Ha is observed in Panruti Block followed by Nallur with 9986 Ha, Kammapuram with 7520 Ha, Virudhachalam with 3700 Ha, Kurinjipadi with 3200 Ha, Keerapalayam with 2825 Ha and Kattumannarcoil with 2000 Ha. Sizable areas of alluvial soil is found in the Blocks of Virudhachalam, Kurinjipadi, Kattumannarcoil and Mangalur Clay soil and Sandy loam are found in Parangipetai Block, while the problem soils are spotted in the Blocks of Virudhachalam, Mel Bhuvanagiri and Keerapalayam.

Overall, these soils except problem soils are highly suitable to raise the major crops like Paddy, Pulses, Sugarcane, Groundnut, Cotton etc. The problem soils however need special attention to reclaim and bring under cultivation.

3.10.2 Nagapattinam District (Mayiladuthurai was within Nagapattinam)

Sandy coastal alluvium and black soil types cover 88.71% and 6.58% respectively in this District. The other soils in the District comprise 4.71%. The soil of the District is mostly alluvial but varies greatly in quality. The rich soil is found in the north and the south of the railway line between Mayiladuthurai and Thiruthuraippundi. The saline soil is found in the Tirutturaippundi and Nagapattinam Taluks where the drainage is very defective. The Alluvial, Regar and Arenaceous are the main categories of soil found in Nagapattinam District. The quality of soil varies from one region to another. The best alluvial soil is found in the western part of the District and the poor quality has been found at least. Saline mixed soil is found at Nagapattinam, Kilvelur and Vedaranyam Taluks, especially in coastal areas.

3.10.3 Methodology

Soil quality study has been carried out at the site and in the study area of 10km radius around the project site and in CCA during June 2022 – March 2023 to understand the physico-chemical nature of the soil. The frequency and methodology of soil quality sampling process is given in Table No. 3.27. The soil quality sampling monitoring locations are given in Table No. 3.28. The soil analysis results and discussion is given in Table No. 3.29, 3.30 and 3.31. Nine soil samples were collected from core and buffer zone. At each location, soil samples were collected from three different depths as 1-5 cm, 10-20 cm, 40-50 cm below the surface. The samples were homogenized before analysis. Locations of the soil sampling villages core and buffer zone are given in Fig No.3.34 and fig No 3.35 and Georeferenced Soil Map of around 10km radius is given in Fig No.3.46. The sampling locations have been identified with the following objects:

1. To determine the baseline soil characteristics of the study area.
2. To determine the impact of the project on soil characteristics and
3. To determine the impact on soil on fertility from agricultural productivity.

Table No: 3.27 Frequency and Methodology for Soil Sampling & Monitoring

S.No	Particulars	Details
1	Frequency	One sample from each station — once during the study Period
2	Methodology	Soil Sample has been collected as per the CPCB standard

Table No: 3.28 Soil Sampling Locations

Sampling code	Location	Latitude	Longitude	Distance (km)	Direction
S1	Project site	11°11′15.17″N	79°32′28.36″ E	--	--
S2	Vembakudi	11°10′13.42″N	79°27′15.12″ E	9.0	SW
S3	Rajendrasozhagan	11°15′13.3″N	79°33′21.8″ E	6.8	NE
S4	Sarabojirajapuram	11°10'16.0"N	79°31'41.3"E	2.4	SW
S5	Irumoolai	11° 8'53.55"N	79°30'53.74"E	5.2	SW
S6	Kodipallam in CCA (Cuddalore)	11°25'4.31"N	79°43'55.64"E	-	-
S7	Keezhachavadi in CCA (Cuddalore)	11°26'25.04"N	79°45'06.85"E	-	-
S8	Nallanayagipuram in CCA (Mayiladuthurai)	11°19'14.03"N	79°44'16.41"E	-	-
S9	Nallanayagipuram in CCA (Mayiladuthurai)	11°19'14.85"N	79°44'18.79"E	-	-

Fig No 3.44 Soil Sampling at Project site

Fig No 3.45 Soil Sampling at buffer zone

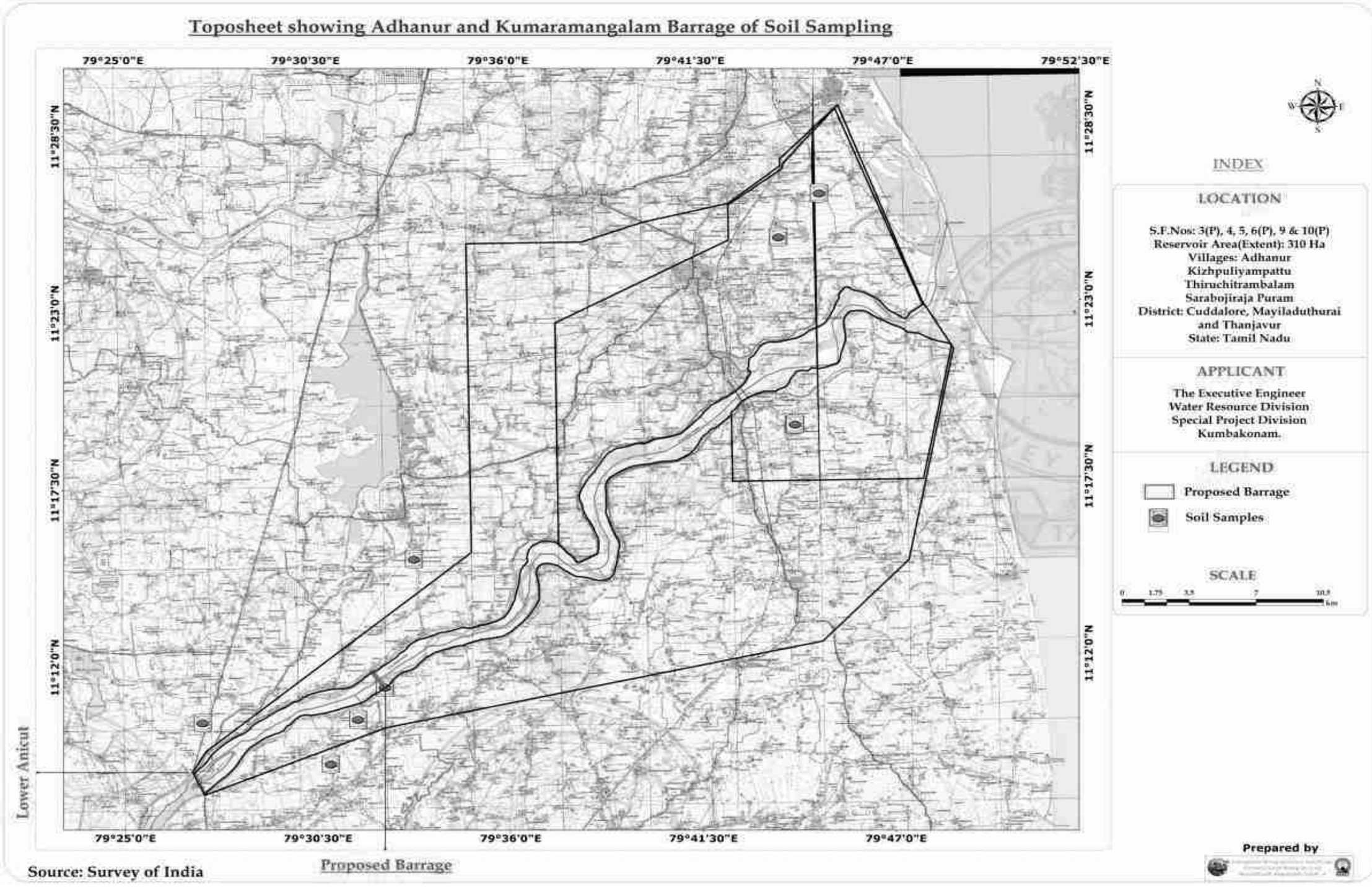


Fig No 3.46 Georeferenced Toposheet showing soil sampling locations

Table No 3.29 Result of Soil Sample Analysis during monsoon season

S.No	Parameters	Test Methods	Project site	Vembakudi	Rajendra sozhagan	Sarabojirajapuram	Irumoolai	Kodipallam in CCA (Cuddalore)	Keezhachavadi in CCA (Cuddalore)	Nallanayagipuram in CCA (Mayiladuthurai)	Nallanayagipuram in CCA (Mayiladuthurai)
1	pH value (10% Solution)	IS:2720 (P- 26):1987	8.20	7.35	9.06	8.64	8.60	7.84	7.13	8.12	6.33
2	EC@ 25°C (Micromhos/cm) (10% solution)	IS:14767:2000	84	241	70	157	450	821	135	799	74
3	Moisture %	IS:2720 (P- 2):1972	1.07	4.12	0.52	3.12	2.42	2.03	0.23	1.70	0.3
4	Bulk Density g/cc	ABMEAL/CH/SO/ SOP/18	1.08	1.02	1.09	1	1.03	1.04	1.62	1.31	1.06
5	Water holding capacity %	IS:14765:2000	58	75	48	68	58	40	44	40	60
6	Texture %	IS:10317:1982	Sand = 48 Silt =28 Clay=24 Sandy clay Loam	Sand = 52 Silt =28 Clay=20 Loam	Sand = 25 Silt =54 Clay=21 Silt Loam	Sand = 53.84 Silt =42.32 Clay=3.84 Sandy Loam	Sand = 44 Silt =52 Clay=4 Silt Loam	Sand = 52 Silt =28 Clay=20 Loam	Sand = 48 Silt =20 Clay=32 Loam	Sand = 48 Silt =28 Clay=24 Sandy clay loam	Sand = 20 Silt =56 Clay=24 Silt Loam
7	Organic Matter%	IS:2720 (P- 22):1972	1.41	2.12	1.06	0.74	1.6	1.535	1.165	1.44	1.256
8	Calcium %	ABMEAL/CH/SO/ SOP/12	0.001	0.001	0.001	0.001	0.001	0.0010	0.0004	0.0010	0.0002
9	Magnesium %	ABMEAL/CH/SO/ SOP/13	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)
10	Chlorides %	ABMEAL/CH/SO/ SOP/14	0.001	0.003	0.004	0.003	0.01	0.0056	0.003	0.0053	0.0035
11	Sodium %	ABMEAL/CH/SO/ SOP/08	0.02	0.02	0.007	0.03	0.008	0.0097	0.0084	0.01	0.0101
12	Potassium %	ABMEAL/CH/SO/ SOP/06	0.003	0.005	0.003	0.002	0.005	0.0033	0.0021	0.001	0.002
13	Phosphorus %	IS:6092 (Part-3) : 2004	0.002	0.04	0.005	0.005	0.04	0.023	0.035	0.003	0.003
14	TKN %	IS 14684:1999 (RA-2005)	0.007	0.01	0.004	0.007	0.02	0.014	0.003	0.0084	0.0056

3.10.4 Observation – Monsoon Season

Physical characteristics of soil were characterized through specific parameters viz bulk density, pH, electrical conductivity. Soil pH plays an important role in the availability of nutrients. Soil microbial activity as well as solubility of metal ions is also dependent on pH. In the study area, variations in the pH of the soil were found to be 6.33 to 9.06. The soil analysis result shows that, the pH of the soil samples collected are found to be neutral to basic in nature. Electrical conductivity (EC) is a measure of the soluble salts and ionic activity in the soil. In the collected soil samples, the conductivity ranged from 84-821 µs/cm. Total organic matter of the soil varies from 0.74 to 2.12%. Water holding capacity varies from 40-75%, from the soil analysis result it can be concluded that the soil of the area is highly fertile and suitable for agricultural purpose.

Table No 3.30 Result of Soil Sample Analysis during post monsoon season

S.No	Parameters	Test Methods	Project site	Vembakudi	Rajendra sozhagan	Sarabojirajapuram	Irumoolai	Kodipallam in CCA (Cuddalore)	Keezhachavadi in CCA (Cuddalore)	Nallanayagipuram in CCA (Mayiladuthurai)	Nallanayagipuram in CCA (Mayiladuthurai)
1	pH value (10% Solution)	IS:2720 (P- 26):1987	8.15	7.23	8.72	8.53	8.48	7.56	7.12	8.03	6.50
2	EC@ 25°C (Micromhos/cm) (10% solution)	IS:14767:2000	75	215	62	145	436	790	120	754	61
3	Moisture %	IS:2720 (P- 2):1972	1.53	5.28	1.89	6.3	5.58	3.12	1.5	2.96	2.8
4	Bulk Density g/cc	ABMEAL/CH/SO/ SOP/18	1.07	1.02	1.08	1	1.04	1.04	1.58	1.30	1.09
5	Water holding capacity %	IS:14765:2000	57	76	48	65	52	39	42	40	58
6	Texture %	IS:10317:1982	Sand = 48 Silt =28 Clay=24 Sandy clay Loam	Sand = 52 Silt =28 Clay=20 Loam	Sand = 25 Silt =54 Clay=21 Silt Loam	Sand = 53.84 Silt =42.32 Clay=3.84 Sandy Loam	Sand = 44 Silt =52 Clay=4 Silt Loam	Sand = 52 Silt =28 Clay=20 Loam	Sand = 48 Silt =20 Clay=32 Loam	Sand = 48 Silt =28 Clay=24 Sandy clay loam	Sand = 20 Silt =56 Clay=24 Silt Loam
7	Organic Matter%	IS:2720 (P- 22):1972	1.82	3.2	1.58	1.7	2.3	2.86	3.2	2.4	3.65
8	Calcium %	ABMEAL/CH/SO/ SOP/12	0.001	0.001	0.001	0.001	0.001	0.0010	0.0003	0.0010	0.0002
9	Magnesium %	ABMEAL/CH/SO/ SOP/13	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)
10	Chlorides %	ABMEAL/CH/SO/ SOP/14	0.001	0.005	0.0045	0.004	0.01	0.0063	0.0041	0.0058	0.0036
11	Sodium %	ABMEAL/CH/SO/ SOP/08	0.06	0.06	0.05	0.08	0.06	0.08	0.04	0.05	0.06
12	Potassium %	ABMEAL/CH/SO/ SOP/06	0.009	0.008	0.009	0.005	0.009	0.0085	0.0096	0.0085	0.0056
13	Phosphorus %	IS:6092 (Part-3) : 2004	0.004	0.05	0.008	0.008	0.05	0.032	0.053	0.006	0.009
14	TKN %	IS 14684:1999 (RA-2005)	0.05	0.05	0.009	0.01	0.08	0.063	0.006	0.032	0.024

3.10.5 Observation – Post Monsoon Season

Physical characteristics of soil were characterized through specific parameters viz bulk density, pH, electrical conductivity. Soil pH plays an important role in the availability of nutrients. Soil microbial activity as well as solubility of metal ions is also dependent on pH. In the study area, variations in the pH of the soil were found to be 6.50 to 7.2. The soil analysis result shows that, the pH of the soil samples collected are found to be neutral nature. Electrical conductivity (EC) is a measure of the soluble salts and ionic activity in the soil. In the collected soil samples, the conductivity ranged from 61-790 µs/cm. Total organic matter of the soil varies from 1.7 to 3.65%. Water holding capacity varies from 40-76%, from the soil analysis result it can be concluded that the soil of the area is highly fertile and suitable for agricultural purpose.

Table No 3.31 Result of Soil Sample Analysis during pre monsoon season

S.No	Parameters	Test Methods	Project site	Vembakudi	Rajendra sozhagan	Sarabojirajapuram	Irumoolai	Kodipallam in CCA (Cuddalore)	Keezhachavadi in CCA (Cuddalore)	Nallanayagipuram in CCA (Mayiladuthurai)	Nallanayagipuram in CCA (Mayiladuthurai)
1	pH value (10% Solution)	IS:2720 (P- 26):1987	8.35	7.53	9.07	8.79	8.63	7.92	7.46	8.62	7.03
2	EC@ 25°C (Micromhos/cm) (10% solution)	IS:14767:2000	96	254	93	184	477	839	147	815	99
3	Moisture %	IS:2720 (P- 2):1972	1.01	3.52	0.26	1.50	2.36	1.94	0.21	1.27	0.23
4	Bulk Density g/cc	ABMEAL/CH/SO/ SOP/18	1.04	1.01	1.04	1	1.03	1.03	1.45	1.22	1.05
5	Water holding capacity %	IS:14765:2000	62	80	55	75	63	54	58	52	72
6	Texture %	IS:10317:1982	Sand = 48 Silt =28 Clay=24 Sandy clay Loam	Sand = 52 Silt =28 Clay=20 Loam	Sand = 25 Silt =54 Clay=21 Silt Loam	Sand = 53.84 Silt =42.32 Clay=3.84 Sandy Loam	Sand = 44 Silt =52 Clay=4 Silt Loam	Sand = 52 Silt =28 Clay=20 Loam	Sand = 48 Silt =20 Clay=32 Loam	Sand = 48 Silt =28 Clay=24 Sandy clay loam	Sand = 20 Silt =56 Clay=24 Silt Loam
7	Organic Matter%	IS:2720 (P- 22):1972	1.32	2.03	0.93	0.62	1.2	1.415	1.06	1.28	1.196
8	Calcium %	ABMEAL/CH/SO/ SOP/12	0.002	0.003	0.002	0.002	0.002	0.0010	0.0008	0.005	0.0006
9	Magnesium %	ABMEAL/CH/SO/ SOP/13	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)	BDL(DL:01)
10	Chlorides %	ABMEAL/CH/SO/ SOP/14	0.001	0.001	0.002	0.002	0.005	0.0012	0.0005	0.0008	0.0092
11	Sodium %	ABMEAL/CH/SO/ SOP/08	0.02	0.02	0.005	0.02	0.005	0.0083	0.0054	0.01	0.0101
12	Potassium %	ABMEAL/CH/SO/ SOP/06	0.003	0.004	0.003	0.002	0.004	0.0033	0.0012	0.001	0.002
13	Phosphorus %	IS:6092 (Part-3) : 2004	0.001	0.035	0.0042	0.004	0.04	0.012	0.028	0.002	0.0012
14	TKN %	IS 14684:1999 (RA-2005)	0.006	0.008	0.0032	0.0065	0.0015	0.011	0.0014	0.0080	0.0035

3.10.6 Observation – Pre Monsoon Season

Physical characteristics of soil were characterized through specific parameters viz bulk density, pH, electrical conductivity. Soil pH plays an important role in the availability of nutrients. Soil microbial activity as well as solubility of metal ions is also dependent on pH. In the study area, variations in the pH of the soil were found to be 7.03 to 9.07. The soil analysis result shows that, the pH of the soil samples collected is found to be neutral to slightly basin in nature. Electrical conductivity (EC) is a measure of the soluble salts and ionic activity in the soil. In the collected soil samples, the conductivity ranged from 93-839 μs/cm. Total organic matter of the soil varies from 0.62 to 2.03%. Water holding capacity varies from 52-80%, from the soil analysis result it can be concluded that the soil of the area is highly fertile and suitable for agricultural purpose.

3.11 ECOLOGY AND BIOLOGICAL ENVIRONMENT

3.11.1 Description of Mayiladuthurai and Cuddalore District Environment

Mayiladuthurai

Mayiladuthurai District, the 38th District of Tamil Nadu was formed on March 24, 2020 when Tamil Nadu government bifurcated Nagapattinam District. The District is bounded on the north by Cuddalore District near Kollidam River, on the south by Thiruvarur District near Kollumangudi, on the west by Thanjavur District near Aduthurai, on the east by the Bay of Bengal and on the southeast, near Porayar by Karaikal District of the Union Territory Puducherry.

Cuddalore

The District of Cuddalore is one of the important Districts of the State of Tamil Nadu. The District is located along the Eastern Coastal Region of the State. The District of Cuddalore is bordered by the District at Viluppuram, Nagapattinam and Perambalur. The District is also bordered by the Bay of Bengal on the Eastern side. It lies in the Agro Climatic zone II (East Coast Plains and Hills). The area of this town is 27.69 Sq.

The total geographical area of the District is 3678 Square kilometer with coastal line of 68 Kilometer stretching from Puducherry Union Territory in the North to the mouth of the River Coleroon in the South. The Geomorphology of the Cuddalore Coastal Stretch includes the coastal plain with an average width of 6 km. Its coastal landforms include strandlines, raised beaches, sand dunes, mangrove swamps and tidal flats with predominantly sandy beaches on the northern side and mangrove swamps to the south.

The rivers in the District are Thenpennaiyar, Kedilam, Vellar, Manimuthar and Kollidam. Most of the rivers are dry and flooded only during the monsoon period.

3.11.2 Agriculture activities in Mayiladuthurai and Cuddalore District

Mayiladuthurai

Mayiladuthurai District falls under the Cauvery Delta region and the total area under cultivation is 101818.66 hectares. Horticulture crops have been cultivated in about 3713.63 hectares and the major crops under cultivation are Cashew, Mango, Banana, Guava, Tapioca, Chilli, Jasmine, Brinjal and other vegetables.

Mayiladuthurai District raised so many important agricultural crop Rice, Groundnut, Pulses, Gingelly, Sugarcane and Cotton. The principal cereal crops of this District are paddy, cholam, cumbu and ragi. Panivaragu, Kuthiraivali, Samai, Varagu and horse gram, castor, Coconut, Banana, sesame occupy important places.

Cuddalore

The cashews is ground in red soils in the areas around Panruti, Vadalur, Neyveli and Virdhachalam and 60% of the states production of cashews is accounted for by the District.

The chief crops of the District are Paddy, Cumbu, Ragi, Cholam, Redgram , Gingelly, Tapiaco, Greengram, Cashewnet and Black gram. The major cash crops viz, Sugarcane, Coconut, Groundnut and Banana are also cultivated in considerable area. Panruti is famous place for Jack fruit in Tamilnadu.

The soils of the District are classified as the black, red, ferruginous and arenacious. They are again subdivided into clays, loam and sands. Black soils are observed in the Chidambaram and Virudhachalam Taluks. The sandy soils are seen along the coast in Cuddalore and Chidambaram Taluks. The younger alluvial soils are found as small patches along the stream and river courses in the District.

3.11.3 Agricultural Activity in the proposed area

The Agricultural activity observed in the proposed area of Cuddalore and Mayiladuthurai District is shown in below photographs.

Cultivation of Paddy in command area


Cultivation of Pulses in command area


Cultivation of paddy around barrage site

Fig No 3.47: Photos showing agricultural activities in Cuddalore and Mayiladuthurai District

Table 3.32 Details of Important crops in Mayiladuthurai and Cuddalore District

Sl. No	Common name	Scientific name	Family
1.	Paddy	*Oryza sativa*	Poaceae
2.	Cholam	*Sorgham bicolor*	Poaceae
3.	kambu	*Pennisetum glaucum*	Poaceae
4.	Ragi	*Eleusine coracana*	Poaceae
5.	Groundnut	*Arachis hypogaea*	Fabaceae
6.	Sugarcane	*Saccharum officinarum*	Poaceae

7.	Black gram	*Vigna mungo*	Fabaceae
8.	Cotton	*Gossypium herbaceum*	Malvaceae
9.	Vargu	*Paspalums crobiculatum*	Poaceae
10.	Maize	*Zea mays*	Poaceae
11.	Green gram	*Vigna radiata*	Fabaceae
12.	Red gram	*Cajanus cajan*	Fabaceae
13.	Castor	*Ricinus communis*	Euphorbiaceae
14.	Kuthiraivali	*Echinochloa frumentacea*	Poaceae
15.	Horsegram	*Macrotyloma uniflorum*	Fabaceae
16.	Tapiaco	*Manihot esculenta*	Euphorbiaceae
17.	Samai Rice	*Panicum sumatrense*	Poaceae
18.	Sesame	*Sesamum Indicum*	Pedaliaceae
19.	Banana	*Musa paradisica*	Musaceae
20.	Coconut	*Coccus nucifera*	Arecaceae

3.11.4 Forest resources

Nagapattinam (Mayiladuthurai)

There are 41 forest areas in the Nagapattinam District constituting a total area of 5311.70 ha with 35 forest areas falling under the Reserve Forest category with 5037.21 ha and 6 under reserve land category with 274.49 ha forestry activities in the District are being carried out by Wildlife Division, with Wildlife Warden as the administrative head.

Tropical dry-evergreen forest covers nearly 15 sq.km of Point Calimere Wildlife sanctuary. The Forests are mostly of the nature of scrubland that stands on low sand dunes located on the western half of the sanctuary. Manilkara Hexandra, locally called Palai is the most important evergreen species of the sanctuary.

Cuddalore

The total areas covered under the Forest in the District are 4116.05 hectares. Reserve Forest covers 3689.05 Hectares and Reserve land 427 hectares. Most of the forest areas lie in Panruti, Chidambaram Kattumannarkoil, Vridhachalam and Titakudi Taluks.

3.11.5 Water resources

Mayiladuthurai

The entire block comes under sedimentary terrain and the formation consists of river Alluvial (sand) formations, sandy clay etc. Groundwater occurs both under semi-confined and water table conditions in these formation. Generally shallow to medium tube wells are drilled in these regions. The area forms part of Cauvery delta with gentle slope towards Bay of Bengal. The area mainly depends on surface and groundwater for domestic and irrigation purposes. The Cauvery river water is also used for cultivation in some places but this is not possible throughout the year because it flows only for a few months in a year.

Cuddalore

Cuddalore District is at the tail end of the Cauvery delta region. Parts of the District get water from the irrigation canals that bring water from Mettur dam. Ground water from Neyveli mines also provides irrigation coverage to crops. According to a rough estimate, 60% of the farms are dependent solely on rainfall and the rest have access to irrigation/ground water pumps. In Cuddalore District, 592 tanks, 270 canals and one major reservoir serve as the main source for irrigation. Wellington reservoir is the major reservoir in Thittagudi Taluk and Veeranam tank is the major irrigation source in Chidambaram and Kattumannar Koil Taluks.

In Cuddalore Taluk, Perumal Lake is the major surface irrigation source. Generally, for Agriculture purpose maximum amount of available water resource are utilized though minor irrigation schemes. The surface flow in the rivers can be observed only during monsoon periods.

3.11.6 Study Area Ecology

A survey was conducted to study the flora and fauna in Cultivable Command Area, and around 10 km radius of proposed barrage. Some of the information was gathered from the local habitants. All the collected data were classified to interpret the impact of pollution on the flora and fauna of that region. Survey of the mild plants as well as cultivated crop plants was made and all the available information was recorded. The primary data collected was compared with the Secondary data collected from Forest Department.

3.11.7 Methodology of Sampling

A methodology of Sampling Flora and fauna studies were carried out during the post monsoon season to assess the list of terrestrial plant and animal species that occur in the core area and the buffer area in Command Area and 10 km radius around barrage site. No damage is created to flora and fauna during the sampling. None of the specimens were collected as voucher specimens and for the herbarium. It is basically done through field observations only. The study of flora is conducted as per the guidelines of the Ministry of Environment Forest and Climate Change (MoEFCC) and Botanical Survey of India (BSI). The study involved in the collection of primary data by conducting a survey in the field, examination of flora and fauna records in previously published reports and records. Analysis of the information is the view of the possible alteration in the environment of the project site. For the survey of fauna, both direct and indirect observation methods were used

3.11.8 Flora

The present study on the floral assessment for the existing project activity is based on extensive field survey of the area. The plant species were identified with the help of plant taxonomy manual, literatures and Botanical Survey of India website (efloraindia.nic.in). In addition besides the collection of plant species, information was also collected with vernacular names of plant species made by local inhabitants.

3.11.8.1 Flora in Core Zone (around barrage site)

Taxonomically a total of 45 species distributed in 22 families have been recorded from the study area. Based on habitat classification of the enumerated plants the majority of species were tree 21 (47%) followed by shrubs 9 (20%), herbs 12 (27%) and creeper 3 (6%) Details of flora with the scientific name were mentioned in Table No. 3.33 and Fig No: 3.48. No ecologically sensitive plant species has been reported from this area.

3.11.8.2 Flora in Buffer Zone including command area

Taxonomically a total of 88 species distributed among 39 families have been recorded from the buffer area. Based on habitat classification of the enumerated plants the majority of species were tree 39 (44%) followed by shrubs 21 (24%), herbs 20 (23%) and rest 8 (9%) is a climber. Details of flora with the scientific name were mentioned in Table No. 3.33 and Fig No: 3.48.

Table 3.33 Floral Diversity in Core and Buffer area (Mayiladuthurai and Cuddalore District)

Sl. No.	Common Name	Local Name	Family	Scientific Name	Core	Buffer
TREES						
1.	Bittter Albizia Tree	Arappu Maram	Fabaceae	*Albizzia amara*	+	+
2.	White bark acacia Tree	Velvaelam Maram	Fabaceae	*Acacia leucophoea*	+	+
3.	Black catechu Tree	Karunkali Maram	Fabaceae	*Acacia sundra*	-	+
4.	Haldu Tree	Manjchakadambu Maram	Rubiaceae	*Haldina cordifolia*	-	+
5.	Siris Tree	Vagai Maram	Fabaceae	*Albizzia lebbek*	-	+
6.	Neem Tree	Vempa Maram	Meliaceae	*Azadirachta india*	+	+
7.	Madhuka Tree	Iluppai Maram	Sapotaceae	*Madhuca longifolia*	-	+
8.	Malapari Tree	Pungai Maram	Fabaceae	*Pongamia pinnata*	+	+
9.	Elephantapple Tree	Vilankai Maram	Rutaceae	*Limonia acidissima*	-	+
10.	Khejri Tree	Vanni Maram	Fabaceae	*Prosopis spicigera*	-	+
11.	Ceylon olive Tree	Ularga karai Maram	Elaeocarpaceae	*Elaeocarpus serratus*	-	+
12.	Palmyra palm Tree	Panai Maram	Arecaceae	Borassus flabellifer	+	+
13.	Mango Tree	Maa Maram	Anacardiaceae	*Mangifera indica*	+	+
14.	Papaya Tree	Papali Maram	Caricaceae	Carica Papaya	-	+
15.	Teak Tree	Tekku Maram	Lamiaceae	*Tectona grandis*	+	+
16.	Sandal wood Tree	Santhana Maram	Santalaceae	*Santalum album*	-	+
17.	Chebulicmyrobalan Tree	Kudukkai Maram	Combretaceae	*Terminalia chebula*	+	+

18.	Lemon-Scented Gum Tree	Thaila Maram	Myrtaceae	*Eucalyptus citriodora*	+	+
19.	Black plum Tree	Naval Maram	Myrtaceae	*Syzygium cumini Sps.*	+	+
20.	Banana Tree	Vaazhai Maram	Musaceae	*Musa paradisica*	-	+
21.	Thorn mimosa Tree	Karuvelam Maram	Mimosaceae	*Acacia nilotica*	+	+
22.	Coconut Tree	Tennai Maram	Arecaceae	*Coccus nucifera*	+	+
23.	Guava Tree	Koiya Maram	Myrtaceae	*Psidium guajava*	-	+
24.	Indian date Tree	Elandhai Maram	Rhamnaceae	*Ziziphus jujuba*	+	+
25.	Sweet acacia Tree	Kastuurivel Maram	Fabaceae	*Vachellia farnesiana*	-	+
26.	Iron wood Tree	Savukku Maram	Casuarinaceae	*Casuarina equisetifolia*	+	+
27.	Broome rain Tree Tree	Vagai Maram	Fabaceae	*Albizia lebbeck*	-	+
28.	Custard apple Tree	Seethe pazham Maram	Annonaceae	*Annona squamosa*	+	+
29.	Cannonbal Tree Tree	Nagalinga Maram	Lecythidaceae	*Couroupita guianensis*	-	+
30.	Tanner's cassia Tree	Avaram poo Maram	Fabaceae	*Senna auriculata*	-	+
31.	Blackboard Tree	Aezhilai Paalai Maram	Apocynaceae	*Alstonia scholaris*	-	+
32.	Drumstick Tree	Murungai Maram	Moringaceae	Moringa oleifera	-	+
33.	Banyan Tree	Ala Maram	Moraceae	*Ficus benghalensis*	-	+
34.	Tamarind Tree	Puliya Maram	Fabaceae	*Tamarindus indica*	+	+
35.	Bodhi Tree	Aarasa Maram	Moraceae	*Ficus religiosa*	+	+
36.	Pomegranate Tree	Mathulai Maram	Punicaceae	*Punica granatum*	+	+
37.	Indian gooseberry Tree	Nelikai Maram	Phyllanthaceae.	*Phyllanthus emblica L.*	+	+
38.	lemon Tree	Ealumichai Maram	Rutaceae	*Citrus limon*	+	+
39.	Portia Tree	Poovarasa Maram	Malvaceae	*Thespesia populnea*	+	+

SHRUBS						
1.	Chaff flower	Nayiruvi	Amaranthaceae	*Achyranthes aspera*	-	+
2.	Sensitive plant	Thottal surungi	Fabaceae	*Mimosa pudica*	-	+
3.	Red spiderling	Mukaratte kirai	Nyctaginaceae	*Boerhavia diffusa*	+	+
4.	Mexican Prickly Poppy	Birama-dandu	Papaveraceae	*Argemone mexicana*	+	+
5.	Horn of Plenty	Ummathai	Solanaceae	*Datura metel*	+	+
6.	Gwar patha	Katrazai	Liliaceae	*Aloe barbadensis miller*	+	+
7.	Spiral cactus	Thirugu kalli	Euphoribiaceae	*Euphorbi tortilis*	+	+
8.	Indian Abutilon	Thuthi keerai	Meliaceae	*Abutilon indicum*	+	+
9.	Peacock flower	Mayil kontai	Fabaceae	*Caesalpinia pulcherrima*	+	+
10.	Marigold	Samanthi cheedi	Asteraceae	*Tagetes erecta*	-	+
11.	Jasmine	Mali cheedi	Oleaceae	*Jasminum officinale*	-	+
12.	Firecracker flower	Kanakambaram	Acanthaceae	*Crossandra infundibuliformis*	-	+
13.	Hibiscus	Cembarutti	Malvaceae	*Hibiscus rosanaceae*	-	+
14.	Crown flower	Erukku cheedi	Apocynaceae	*Calotropis gigantean*	+	+
15.	Jimson weed	Ummathai cheedi	Solanaceae	*Datura stramonium*	+	+
16.	Coat buttons	Veddukaiya cheedi	Asteraceae	*Tridax porcumbens*	-	+
17.	Rose	Rosa	Rosaceae	*Rosa rubiginosa*	-	+
18.	Hop bush	virali	Sapindaceae	*Dodonaea viscos*	-	+
19.	Orange berry	Kocholam	Rutaceae	*Glycosmis pentaphylla*	-	+
20.	Wild hops	Aada, Aaccha	Fabaceae	*Flemingia bracteata*	-	+
21.	Damask rose	Panner rose	Rosaceae	*Rosa damascena*	-	+

HERBS & GRASS						
1.	Castor oil plant	Amanakku	Euphorbiaceae	*Ricinus communis L.*	+	+
2.	Hairy Spurge	Amman Pacharasi	Euphorbiaceae	*Euphorbia hirta*	+	+
3.	Balloon Vine	Mudakkatran	Sapindaceae	*Cardiospermum helicacabum*	-	+
4.	Holy Basil	Thulasi	Lamiaceae	*Ocimum santum*	-	+
5.	Thumbai	Thumbai	Lamiaceae	*Leucas aspera*	-	+
6.	Chaste	Nochi	Verbinaceae	*Vitex negundo*	-	+
7.	Purple fruited pea egg	Thuthuvalai	Solanaceae	*Solanum trilobatum*	-	+
8.	Febrifuge plant	Kandan kattiri	Solanaceae	*Solanum xanthocarpum*	+	+
9.	Coat Buttons	Vettukaya poondu	Asteraceae	Tridax procumbens	+	+
10.	Indian Copper leaf	Kuppaimeni	Euphorbiaceae	*Acalypha indica*	-	+
11.	Devil bean	Kilukiluppai	Fabaceae	*Crotalaria retusa*	+	+
12.	Indian comet grass	Narival	Poaceae	*Perotis indica*	-	+
13.	Villosa	Kavali	Fabaceae	*Tephrosia villosa*	-	+
14.	Sickle senna	Thagarai	Fabaceae	*Senna tora*	+	+
15.	Indian doab	Arugampul	Poaceae	*Cynodon dactylon*	+	+
16.	Carrot grass	Mookkuthi poo	Asteraceae	*Parthenium hysterophorus*	+	+
17.	Black nightshade	Manathakkali	Solanaceae	*Solanum nigrum*	+	+
18.	Cogongrass	Darbhaipul	Poaceae	*Imperata cylindrica*	+	+
19.	Tussock grass	Uchipul	Poaceae	*Heteropogon contortus*	+	+
20.	Kangaroo grass	Red pul	Poaceae	*Themeda eriandra*	+	+
CREEPERS/CLIMBERS						

1.	Bitter cucumber	Petikari	Cucurbitaceae	*Citrullus colocynthis*	-	+
2.	Bitter melon	Pavakkai	Cucurbitaceae	*Momordica charantia*	-	+
3.	Veldt grape	Perandai	Vitaceae	*Cissusqua dranqularis*	+	+
4.	Ivy gourd	Kovakkai	Cucurbitaceae	*Coccinia grandis*	-	+
5.	Gurmar	Sirukurujavai	Apocynaceae	*Gymnema sylvestre*	-	+
6.	Green milkweed	Kodippaalai	Aslepiadaceae	*Marsdenia volubilis*	+	+
7.	Emetic Secamone	Aangaaravalli	Apocynaceae	*Secamone emetica*	-	+
8.	Orange climber	Kindu mullu	Rutaceae	*Toddalia asiatica*	+	+

Ricinus communis L.

Euphorbia hirta

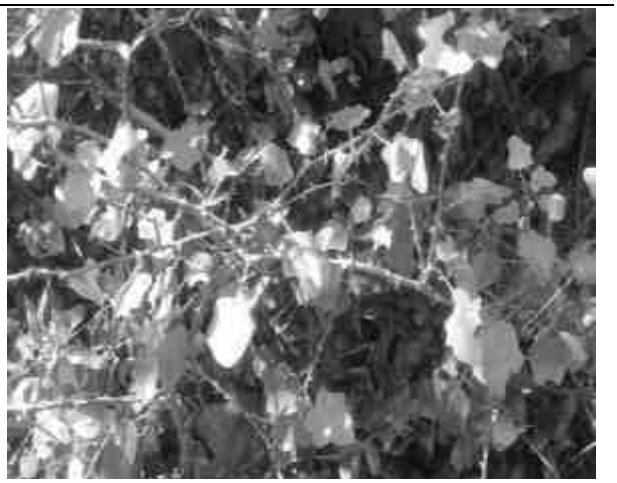
Cardiospermum helicacabum

Pongamia pinnata

Ocimum santum

Leucas aspera

Vitex negundo



Solanum trilobatum

Limonia acidissima

Syzygium cumini

Argemone Mexicana

Boerhavia diffusa

Mimosa pudica

Datura metel

Solanum xanthocarpum

Abutilon indicum

Tridax procumbens

Calotropis gigantea

Fig No 3.48 Photos of Flora in Core and Buffer Area

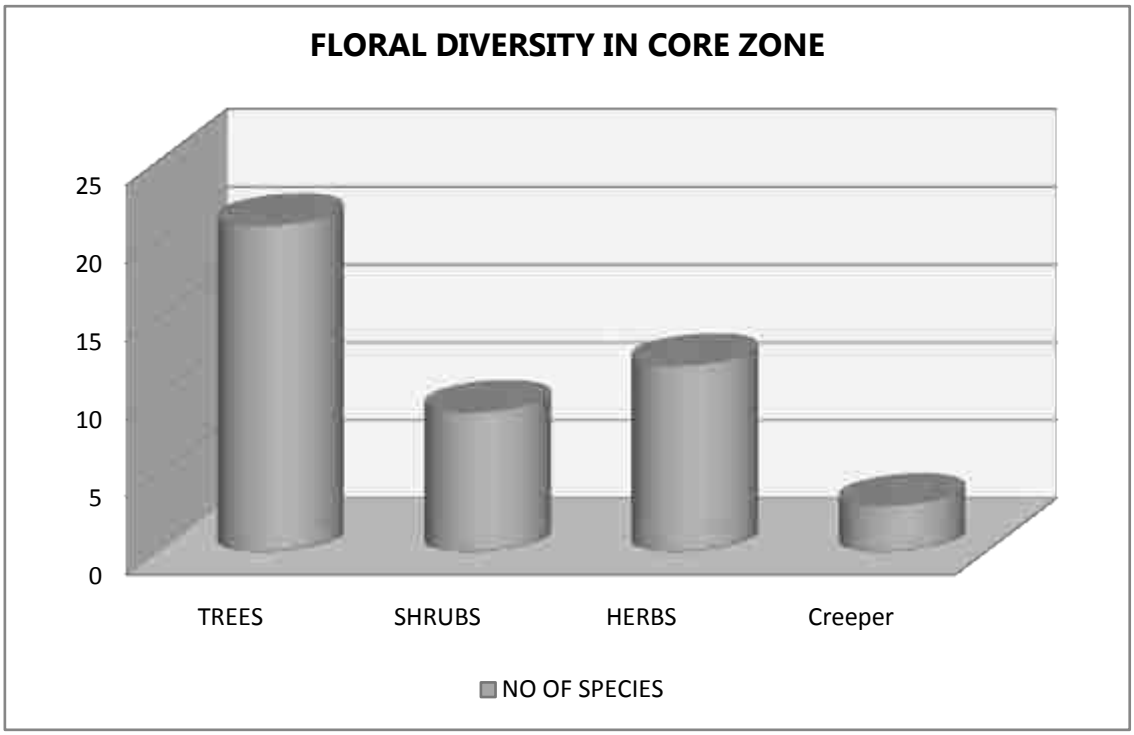


Fig No 3.49 Floral diversity in Core Zone

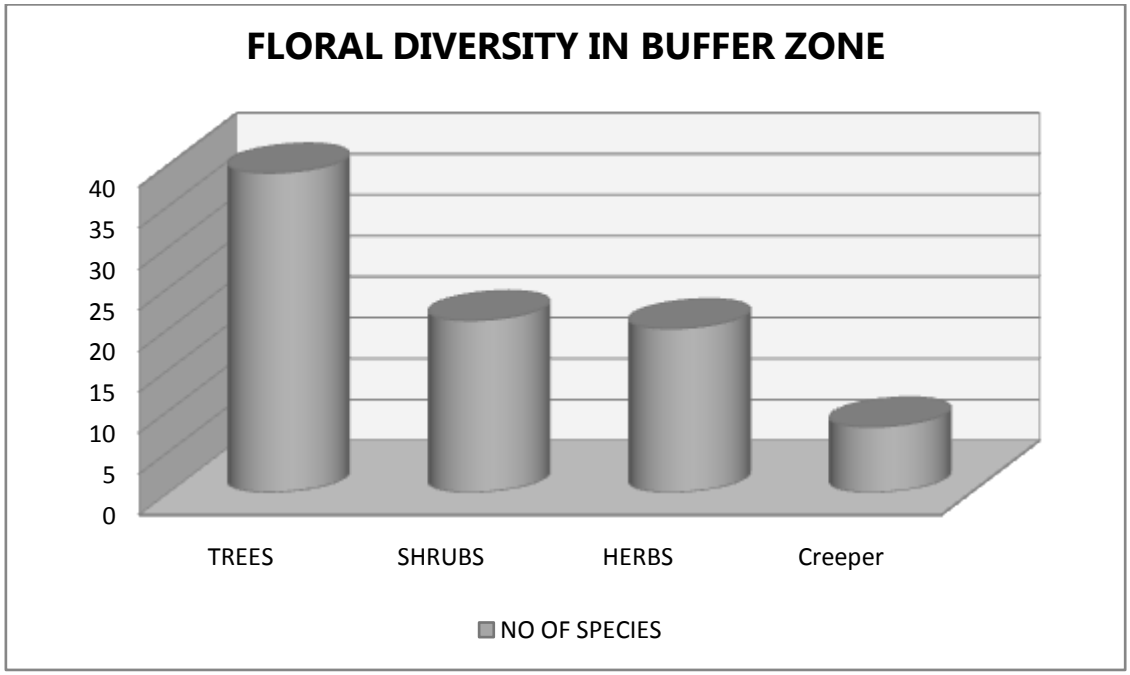


Fig No 3.50 Floral diversity in Buffer Zone

3.11.9 Fauna

The fauna survey has been carried out as per the methodology cited and listed out Mammals, birds, Reptiles, Amphibians, and Butterflies. All the listed species were compared with Red Data Book and Indian Wildlife Protection Act, 1972.

The study of fauna takes a substantial amount of time to understand the specific fauna characteristics of the area. The assessment of fauna has been done on the bases of primary data collected from the lease sites. The presence was also confirmed from the local inhabitants depending on the animal sightings and the frequency of their visits in the project area. In addition officials, local peoples were another source of information for studying the fauna of the area. Field activities are physical/active search, covering rocks, burrows, hollow inspection and location of nesting sites and habitat assessment etc. Taxonomical identification was done by the field guide book and wildlife envis database (wiienvis.nic.in/Database/Schedule Species Database) and Zoological Survey of India (ZSI).

Table 3.34 Methodology applied during survey of fauna

S. No	Taxa	Method of Sampling	References
1	Insects	Random walk, Opportunistic observations	Pollard (1977); Kunte (2000)
2	Reptiles	Visual encounter survey (Direct Search)	Daniel J.C (2002)
3	Amphibians	Visual encounter survey (Direct Search)	
4	Mammals	Tracks and Signs	Menon V (2014)
5	Avian	Random walk, Opportunistic observations	Ali S (1941); Grimmett R (2011); Collins 2015

3.11.9.1 Fauna in Core Zone (around barrage site)

Varieties of species were observed in the core zone (0-2km radius) of the barrage. Number of species decreases towards the barrage area this might be due the lack of vegetation and forest cover in project site. None of these species are threatened or endemic. Taxonomically a total of 58 species belonging to 41 families have been recorded from the core area. Based on habitat classification the majority of species were birds 24 (41%) followed by insects 7 (12%), reptiles 3 (5%), mammals 5 (9%), Fish 11(19%), Crab 3(5%) and Shrimps 5(9%). Dominant species were mostly birds and insects no amphibians were observed during the extensive field visit. Details of fauna with the scientific name were mentioned in Table 3.35. and Fig.No 3.51.

There are no critically endangered, endangered, vulnerable and endemic species were observed.

3.11.9.2 Fauna in Buffer Zone including command areas

Taxonomically a total of 61 species belonging to 43 families have been recorded from the buffer desilting lease area. Based on habitat classification the majority of species were birds 36 (59%) followed by insects 12 (20%), reptiles 4 (6%) and mammals 9 (15%). There were no critically endangered, endangered, vulnerable and endemic species were observed. Details of fauna with the scientific name were mentioned in Table 3.35 and Fig. No.3.51

There were no critically endangered, endangered, vulnerable and endemic species were observed.

Table 3.35 Faunal in Core and Buffer area (: Mayiladuthurai and Cuddalore District)

Sl. No	Common Name	Family Name	Scientific Name	Core Area	Buffer Area	Schedule list wildlife protection act 1972	IUCN Red list data
MAMMALS							
1.	House mouse	Muridae	*Musmus culus*	+	+	NL	LC
2.	Leopard cat	Felidae	*Prionailurus bengalensis*	+	+	NL	LC
3.	Jungle cat	Felidae	*Felis chaus*	+	+	NL	LC
4.	Fruit bat	Pteropodidae	*Cynopterus sphinx*	-	+	NL	LC
5.	Hare (Black naped)	Leporidae	*Lepus nigricollis*	-	+	NL	LC
6.	Common mangoose	Herpestidae	*Herestes edwardsii*	-	+	NL	NL
7.	Bat	Pteropodidae	*Pteropus medius*	+	+	NL	NL
8.	Palm squirrel	Sciuridae	*Funambulus pennantii*	-	+	NL	NL
9.	Wild bore	Suidae	Sus scrofa	+	+	NL	LC
INSECTS							
1.	Mottled emigrant	Pieridae	*Catopsilia pyranthe*	+	+	Schedule IV	LC
2.	Common grass yellow	Pieridae	*Eurema brigitta*	-	+	Schedule IV	LC
3.	Marbled white	Nymphalidae	*Melanargia galathea*	-	+	Schedule IV	LC
4.	Banded hairstreak	Lycaenidae	*Satyrium calanus*	-	+	Schedule IV	NE
5.	Blue basher	Libellulidae	*Pachydiplax longipennis*	+	+	NL	LC
6.	Slaty skimmer	Libellulidae	*Libellula incesta*	-	+	NL	LC
7.	White butterfly	Pieridae	*Pieris rapae*	-	+	Schedule IV	LC
8.	Baronet	Nymphalidae	*Euthalia nais*	+	+	Schedule IV	NE

9.	Milkweed butterfly	Nymphalidae	*Danaus plexippus*	+	+	NL	LC
10.	Red-veined darter	Libellulidae	*Sympetrum fonscolombii*	+	+	NL	LC
11.	Common Tiger	Nymphalidae	*Dananus genutia*	+	+	NL	NE
12.	Plain Tiger	Nymphalidae	*Dananus chrysippus*	+	+	NL	NE
REPTILES							
1.	Peninsular rock agama	Agamidae	*Psammophilus dorsalis*	+	+	NL	NL
2.	Keeled viper	Viperidae	*Schis carinata*	+	+	NL	LC
3.	Common house gecko	Gekkonidae	*Hemidactylus frenatus*	-	+	NL	NL
4.	Fan-Throated Lizard	Agamidae	*Sitana ponticeriana*	+	+	NL	LC
BIRDS							
1.	Ashy Swallo Shrike	Artamidae	*Artamus fuscus*	+	+	NL	LC
2.	Ashy wren wabbler	Cisticolidae	*Prinis socialis*	-	+	Schedule IV	LC
3.	Baby becked shrike	Laniidae	*Lanlus vittatus*	-	+	NL	LC
4.	Black drongo	Dicruridae	*Dicrurus macrocercus*	-	+	NL	LC
5.	Brahminy kite	Accipitridae	*Haliastur indus*	+	+	NL	LC
6.	Plumheaded parakeet	Psittaculidae	*Psittacula cynaceephala*	+	+	NL	LC
7.	Blue pigeon	Columbidae	*Columba livia*	+	+	NL	LC
8.	Indian roller	Coraciidae	*Coracius bengalensis*	+	+	NL	LC
9.	Black headed oriole	Oriolidae	*Oriolus xanthornus*	+	+	NL	LC
10.	Barred botton quail	Turnicidae	*Turnix suscitator*	+	+	Schedule IV	LC
11.	Crested Serpent Eagle	Accipitridae	*Spilornis cheela*	+	+	Schedule IV	LC
12.	Chest nut headed Bee eater	Meropidae	*Merops leschenaulti*	+	+	Schedule IV	LC

13.	Crow pheasant	Cuculidae	*Centropus sinesis*	+	+	Schedule IV	LC
14.	Cuckoo shrikes	Campephagidae	*Corcina melanoptrera*	-	+	Schedule IV	LC
15.	Chest nut bellied nuthatcha	Sittidae	*Sitta cinnamoventris*	-	+	Schedule IV	LC
16.	Common mynah	Sturnidae	*Acridotheres tristis*	-	+	Schedule IV	LC
17.	Common hawk	Cuculidae	*Hierococcyx varius*	-	+	Schedule IV	LC
18.	Cattle egret	Aredidae	*Bubulcus ibis*	-	+	Schedule IV	LC
19.	Common king fisher	Alcedinidaes	*Alcedo atthis*	-	+	Schedule IV	LC
20.	Emerald dove	Columbidae	*Chalcophaps indica*	+	+	Schedule IV	LC
21.	Ashy-crownedsparrow-lark	Alaudidae	*Eremopteryx grisea*	+	+	Schedule IV	LC
22.	White-browed fantail	Rhipiduridae	*Rhipidura aureola*	+	+	Schedule IV	LC
23.	Fairy blue bird	Irenidae	*Irena puella*	+	+	Schedule IV	LC
24.	Grey babbler	Leiothrichidae	*Turdoides malcolmi*	+	+	Schedule IV	LC
25.	Grey wagtail	Motacillidae	*Motacilla cinerea*	+	+	NL	LC
26.	Grey jungle fowl	Phasianidae	*Gallus sonnerati*	+	+	NL	LC
27.	Eurasian eagle-owl	Strigidae	*Bubo bubo*	+	+	NL	LC
28.	Great horned-owl	Strigidae	*Bubo Virginianus*	-	+	NL	LC
29.	Great tit	Paridae	*Parus major*	-	+	NL	LC

30.	Gold mantled chloropsis	Chloropseidae	*Chloropsiscochin chinensis*	-	+	NL	LC
31.	Ashy dronge	Dicruridae	*Dicrurus leucophaeus*	+	+	NL	LC
32.	Grey patridge	Phasianidae	*Francolinus pondiceranus*	+	+	NL	LC
33.	Black-rumped flame back	Picidae	*Dionpium benghalense*	+	+	NL	LC
34.	Hen Harrier	Accipitridae	*Circus cyaneus*	+	+	NL	LC
35.	House sparrow	Passeridae	*Passer domesticus*	+	+	NL	LC
36.	Indian robin	Muscicapidae	*Copsychus fulicatus*	+	+	NL	LC
FISH							
1.	Catla fish	Cyprinidae	*Labeo catla*	+	-	-	-
2.	Rohu fish	Cyprinidae	*Labeo rohita*	+	-	-	-
3.	Mackerel	Scombridae	*Scombrus scombrus*	+	-	-	-
4.	Sardines	Clupeidae	Sardina pilchardus	+	-	-	-
5.	Silver Pomfret	Bramidae	Pampus argenteus	+	-	-	-
6.	Black Pomfret	Bramidae	*Parastromatniger*	+	-	-	-
7.	Cat Fish	Lctaluridae.	*Siluriformes*	+	-	-	-

8.	Smallmouth bass	Centrarchidae	*Micropterus dolomieu*	+	-	-	-
9.	Largemouth bass	Centrarchidae	*Micropterus salmoides*	+	-	-	-
10.	Walleye	Percidae	*Sander vitreus*	+	-	-	-
11.	Bluegill	Centrarchidae	*Lepomis macrochirus*	+	-	-	-
CRAB							
1.	Mediterranean Crab	Potamidae	*Potamon fluviatile*	+	-	-	-
2.	fiddler crab	Ocypodidae	*Uca rapax*	+	-	-	-
3.	Red claw crab	Sesarmidae	*Perisesarma bidens*	+	-	-	-
SHRIMP							
1.	Green tiger prawn	Penaeid	*Penaeus semisulcatus*	+	-	-	-
2.	Flower tail prawn	Penaeid	*Metapenaeus dobsoni*	+	-	-	-
3.	Yellow shrimp	Penaeid	*Metapenaeus brevicornis*	+	-	-	-
4.	Rainbow Shrimp	Penaeid	*Parapenaeopsis stylifera*	+	-	-	-
5.	Mud Prawm	Solenoceridae	*Solenocera crassicornis*	+	-	-	-

((+) Symbol indicate presence of Species, (-) Symbol indicate absence of Species, *NL- Not listed, NE- Not evaluated, LC- Least concer

Herestes edwardsii

Funambulus pennantii

Bubulcus ibis

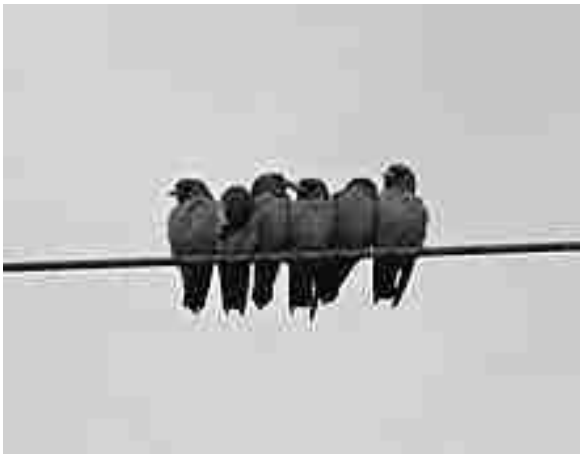
Haliastur indus

Centropus sinesis

Lanius vittatus

Hemidactylus frenatus

Passer domesticus



Artamus fuscus

Psittacula cynaceephala

Dicrurus leucophaeus

Oriolus xanthornus

Parus major

Irena puella

Catopsilia pyranthe

Pachydiplax longipennis

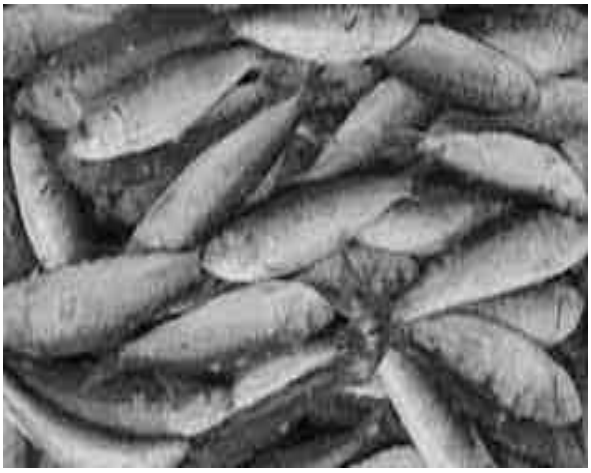
Metapenaeus dobsoni

Acridotheres tristis

Labeo catla

Labeo rohita

Scombrus scombrus



Sardina pilchardus

Fig No 3.51 Photos of Fauna in Core Area

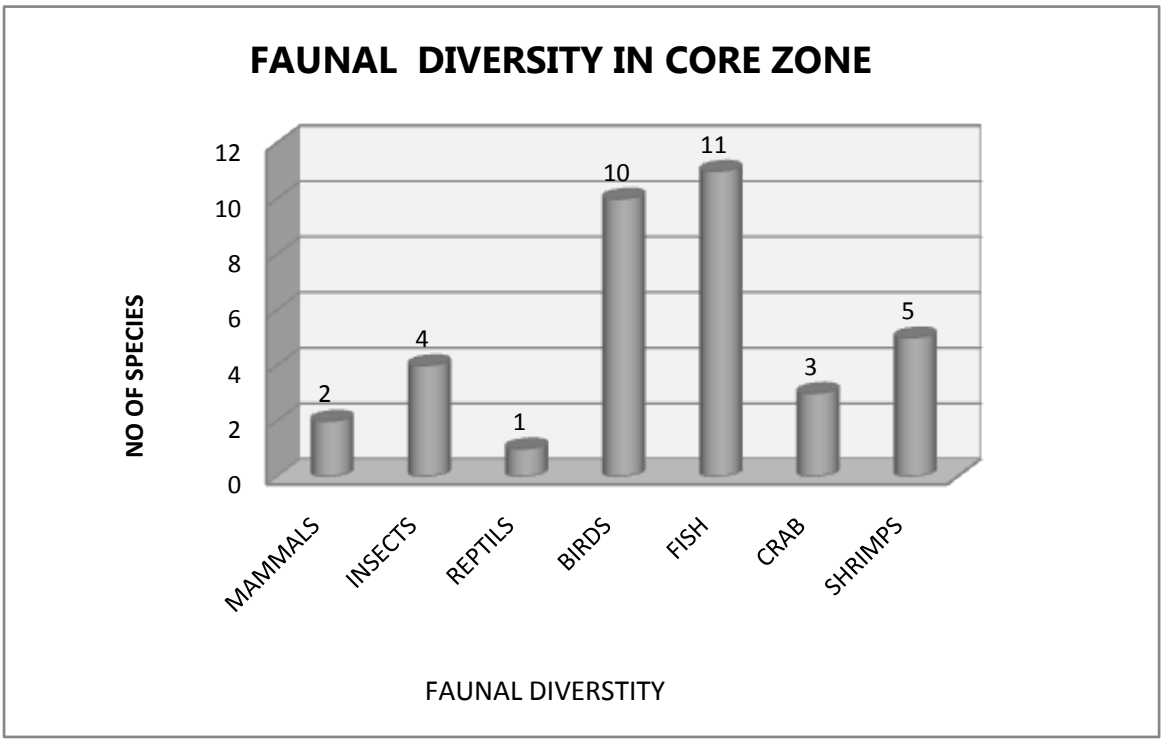


Fig No 3.52 Faunal diversity in Core Zone

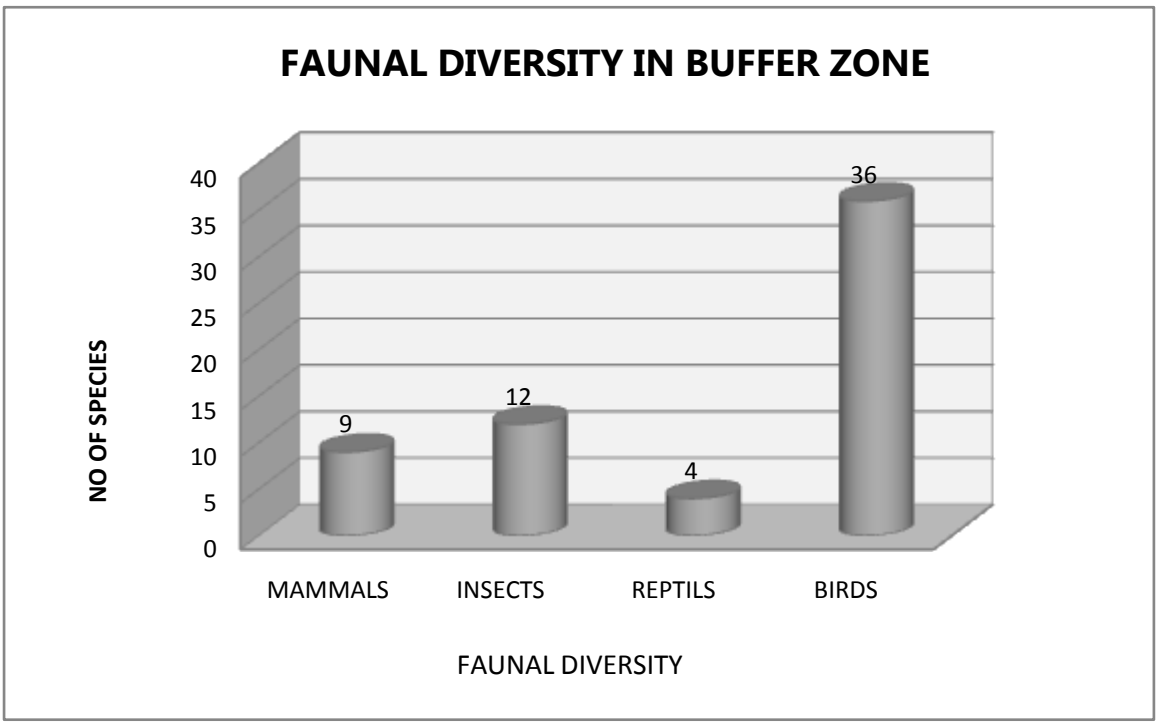


Fig No 3.53 Faunal diversity in Buffer Zone

3.12 SOCIO-ECONOMIC ENVIRONMENT

3.12.1 Introduction

Socio-economic study is an essential part of environmental study. It includes demographic structure of the area, provision of basic amenities viz., housing, education, health and medical services, occupation, water supply, sanitation, communication, transportation, prevailing diseases pattern as well as feature like temples, historical monuments etc., at the baseline level. This will help in visualizing and predicting the possible impact depending upon the nature and magnitude of the project.

It is expected that the Socio- Economic Status of the area will substantially improve because of this proposed project. The proposed project will provide direct and indirect employment and improve the infrastructural facilities in that area and, thus, improve their standard of living.

3.12.2 Objectives of the Study

The report deals with the Socio-Economic Impact Assessment of the proposed barrage promoted by proponent the Executive Engineer, Water Resource Department, Special Project Division, and Tamil Nadu.

The objectives of the socio-economic study are as follows:

- To study the socio-economic status of the people living in the study area of the proposed barrage project.
- To assess the impact on quality of life of the people in the study area.
- To recommend community development measures needs to be taken up in the study Area.

3.12.3 Scope of Work

- To study the Socio-economic Environment of the area from the secondary sources;
- Data Collection & Analysis
- Prediction of project impact
- Mitigation Measure

3.12.4 Study Area – Adhanur village

Gram Panchayat name of the Adhanur village is Adhanur. Adhanur village is in Kattumannarkoil Taluk of Cuddalore District in Tamil Nadu, India. It is situated 8.67km away from sub-district headquarter Kattumannarkoil (Tahsildar office) and 67.83km away from district headquarter Cuddalore. As per 2009 status, Adhanur village is also a gram panchayat.

Table 3.36 Adhanur village Census 2011 Data

S.No	Description	Census 2011 Data
1	Village Name	Adhanur
2	Taluk Name	Kattumannarkoil
3	District Name	Cuddalore
4	State Name	TamilNadu
5	Total Population	927

3.12.4.1 Population Characteristics – Adhanur Village, Kattumannarkoil Taluk, Cuddalore District (2001-2011)

Adhanur village had a total household 188 in 2001, which is increased to 230 in according to census 2011. Village had a total person of 927 in 2011 census previous census 794 persons in 2001. There were about 477 men (51.46%) according to 2011 census and 400 men (50.38%) in 2001 census marking increase of about 77 men over the previous census. During 2001 there were about 394 women (49.62%), which is an increase to 450(48.54%) in 2011 census.

Adhanur village had a literate accounted for 588 persons (74.06%) in 2001 and decreased to 575 persons (62.03%) in 2011. There were about 325 males (40.93%) in 2001 and 328 males (35.38%) in 2011. During 2001 there were about 263 women (33.12%), which is a decreased to 247 (26.65%) in 2011.

Sex composition is the most important demographic characteristics that affect the incidence of birth and death. The average sex ratio in Kattumannarkoil Taluk, Adhanur village was 985 during 2001 and decreased to 943.4 the year of 2011. The lowest sex ratio may be either due to the migrants for educational purpose and employment opportunities. The population characteristics of Adhanur Village (2001-2011) are shown in Table 3.37 and Fig no. 3.54.

Table 3.37 Adhanur Village Population Facts

S. no	Characteristics	2001	%	2011	%
1	Total Household	188	23.68	230	24.81
2	Rural population	794		927	
3	Male Population	400	50.38	477	51.46
4	Female Population	394	49.62	450	48.54
5	Rural Literacy	588	74.06	575	62.03
6	Male Literacy	325	40.93	328	35.38
7	Female Literacy	263	33.12	247	26.65
8	Sex Ratio		985		943.4

Source: https://www.census2011.co.in/data/ village/635204- Adhanur -tamil-nadu.html

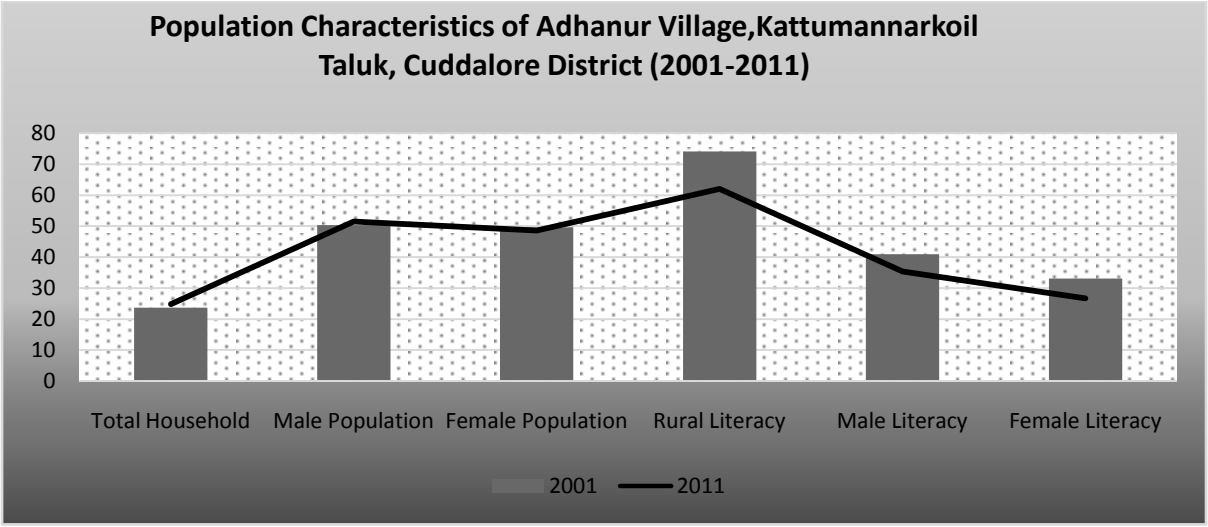


Fig No 3.54 Population Characteristics of Adhanur village Cuddalore (2001-2011)

3.12.4.2 Occupational profile of Adhanur Village

The term workers denote the population engaged in primary, secondary and tertiary activities classified in the census reports of Indian government.

As per census data, Adhanur village had total workers of 457 out 794 in 2001 and 415 out of 927 in 2011. It shows that there was decrease in total workers. The total workers represent the people involved in various activities in this village. Total cultivators in this village as per 2001 census are 9 and as per 2011 census are 38. There was increase in cultivators in this area during 10 years period.

The total main agricultural laborers decreased from 167 (2001) to 141(2011). In this, male agricultural labours are 163 in 2001 and 59 in 2011 whereas female agricultural

labours are 4 in 2001 and 82 in 2011. It shows that decrease trend in male agricultural labours and increase trend in female agricultural labours.

Adhanur village had non workers population accounted of 512 (55.23%) according to census 2011 which increased from census 2001 had population non workers population 337 (42.44%). The rate of non workers is increased in 2011 when compared to 2001.

The study area has experienced a change in the occupational structure in the form of a decline in the proportion of agricultural laborers and an increase in the proportion of Non workers. The reason behind decline in the proportion of agricultural laborers is most of the people educated and migrates to cities for employment. The reason for non workers both in 2001 and 2011 is due to decline in agricultural activities. The proposed project will improve agricultural activity and brings changes in working population positively.

Table 3.38 Adhanur Working Population-Census 2011

S.No	Census Parameters	2001	%	2011	%
1	Total Population	794		927	
2	Total Workers	457	57.56	415	44.77
3	Male Workers	228	28.72	270	29.13
4	Female Workers	229	28.84	145	15.64
5	Total Main workers	210	26.45	224	24.16
6	Male Main workers	198	24.94	137	14.78
7	Female Main Workers	12	1.51	87	9.39
8	Total Cultivators	9	1.13	38	4.1
9	Male Cultivators	9	1.13	37	3.99
10	Female Cultivators	0	0	1	0.11
11	Total Main Agricultural Labourers	167	21.03	141	15.21
12	Male Agri.Labourers	163	20.53	59	6.36
13	Female Agri.Labourers	4	0.5	82	8.85
14	Total Main HHI	9	1.13	3	0.32
15	Male HHI	8	1.01	2	0.22
16	Female HHI	1	0.13	1	0.11
17	Total Main Other Tertiary workers	25	3.15	42	4.53
18	Male OT	18	2.27	39	4.21

19	Female OT	7	0.88	3	0.32
20	Total Nonworkers	337	42.44	512	55.23
21	Male Nonworkers	172	21.66	207	22.33
22	Female Non workers	165	20.78	305	32.9

Source: https://www.census2011.co.in/data/ village-Adhanur tamil-nadu.html

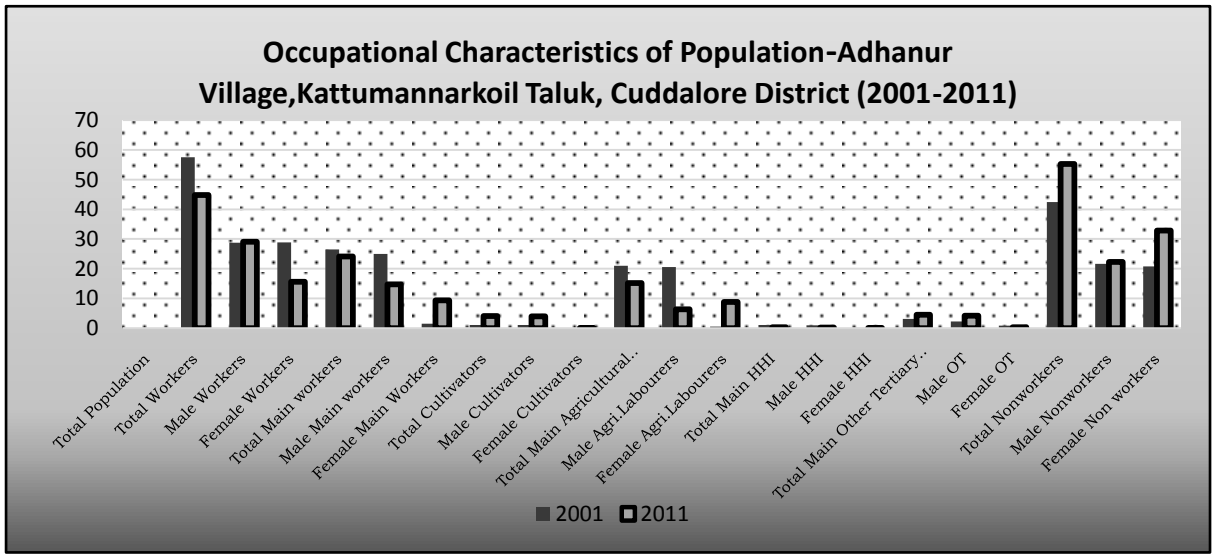


Fig No 3.55 Occupational Characteristics – Adhanur Village, Cuddalore District (2001-2011)

3.12.5 Study Area – Kumaramangalam village

Gram Panchayat name of the Kumaramangalam village. Kumaramangalam village is in Mayiladuthurai taluk of Nagapattinam district in Tamil Nadu, India. It is situated 28.56km away from sub-district headquarter Chidambaram (tahsildar office) and 69.05km away from district head quarter Cuddalore. As per 2009 states, Kumaramangalam village is also a gram panchayat.

Table 3.39 Kumaramangalam village Census 2011 Data

S.No	Description	Census 2011 Data
1	Village Name	Kumaramangalam
2	Taluk Name	Mayiladuthurai
3	District Name	Nagapattinam
4	State Name	Tamilnadu
5	Total Population	557

3.12.5.1 Population Characteristics – Kumaramangalam Village, Mayiladuthurai Taluk, Nagapattinam District (2001-2011)

Kumaramangalam village had a total household 418 in 2001, which is increased to 557 in according to census 2011. Village had a total person of 2131 in 2011 census previous census 1772 persons in 2001. There were about 1074 men (50.40%) according to 2011 census and 875 men (49.38%) in 2001 census marking increase of about 359 men over the previous census. During 2001 there were about 434 women (24.49%), which is increased to 642 (30.13%) in 2011 census.

Kumaramangalam village had a literate accounted for 1032 persons (58.24%) in 2001 and increased to 1492 persons (70.01%) in 2011. There were about 33.75 percent males in 2001 and 39.89 percent males in 2011. During 2001 there were about 434 women (24.49%), which is a increased to 642 (30.13%) in 2011.

Sex composition is the most important demographic characteristics that affect the incidence of birth and death. The average sex ratio in Kumaramangalam village was 1025.14 during 2001 and decreased to 984.17 the year of 2011. The lowest sex ratio may be either due to the migrants for educational purpose and employment opportunities.. The population characteristics of Kumaramangalam Village (2001-2011) are shown in Table No 3.40 and Fig No. 3.56.

Table 3.40 Kumaramangalam Village Population Facts

S. no	Characteristics	2001	%	2011	%
1	Total Household	418	23.59	557	26.14
2	Rural population	1772		2131	
3	Male Population	875	49.38	1074	50.40
4	Female Population	897	50.62	1057	49.60
5	Rural Literacy	1032	58.24	1492	70.01
6	Male Literacy	598	33.75	850	39.89
7	Female Literacy	434	24.49	642	30.13
8	Sex Ratio		1025.14		984.17

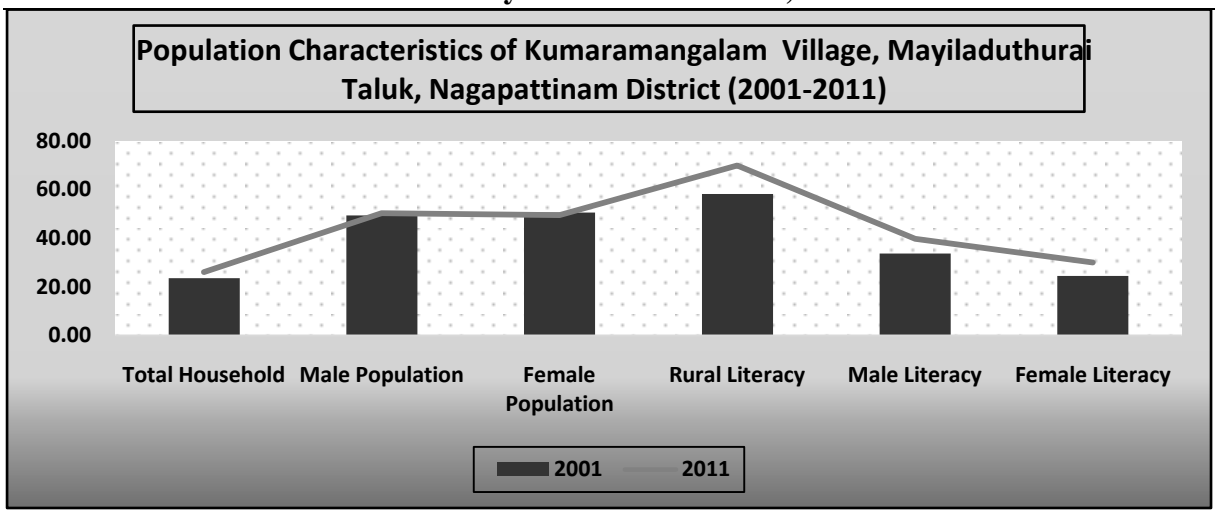


Fig No 3.56 Population Characteristics of Kumaramangalam village (2001-2011)

3.12.5.2 Occupational profile of Kumaramangalam Village

As per census data, Kumaramangalam village had total workers of 788 out 1772 in 2001 and 1254 out of 2131 in 2011. It shows that there was increase in total workers. The total workers represent the people involved in various activities in this village. Total cultivators in this village as per 2001 census are 151 and as per 2011 census are 101. There was decrease in cultivators in this area during 10 years period.

The total main agricultural laborers increased from 381 (2001) to 903(2011). In this, male agricultural labours are 216 in 2001 and 438 in 2011 whereas female agricultural labours are 165 in 2001 and 465 in 2011. It shows that increase trend in both in male agricultural labours in female agricultural labours.

Kumaramangalam village had non workers population accounted of 877 (55.23%) according to census 2011 which decreased from census 2001 had non workers population of 984 (42.44%).

The study area has experienced a change in the occupational structure in the form of a increase in the proportion of agricultural laborers and an decrease in the proportion of Non workers. The reason behind increase in the proportion of agricultural laborers is agricultural activity in this village. However there are still non workers in this village. The proposed project will further improve agricultural activity and brings changes in working population positively.

Table 3.41 Kumaramangalam Working Population-Census 2011

S.No	Census Parameters	2001	%	2011	%
1	Total Population	1772		2131	
2	Total Workers	788	44.47	1254	58.85
3	Male Workers	490	27.65	687	32.24
4	Female Workers	298	16.82	567	26.61
5	Total Main workers	660	37.25	1167	54.76
6	Male Main workers	461	26.02	633	29.70
7	Female Main Workers	199	11.23	534	25.06
8	Total Cultivators	151	8.52	101	4.74
9	Male Cultivators	138	7.79	69	3.24
10	Female Cultivators	13	0.73	32	1.50
11	Total Main Agricultural Labourers	381	21.50	903	42.37
12	Male Agri.Labourers	216	12.19	438	20.55
13	Female Agri.Labourers	165	9.31	465	21.82
14	Total Main HHI	15	0.85	12	0.56
15	Male HHI	11	0.62	2	0.09
16	Female HHI	4	0.23	10	0.47
17	Total Main Other Tertiary workers	113	6.38	151	7.09
18	Male OT	96	5.42	124	5.82
19	Female OT	17	0.96	27	1.27
20	Total Non workers	984	55.53	877	41.15
21	Male Non workers	385	21.73	387	18.16
22	Female Non workers	599	33.80	490	22.99

Source: https://www.census2011.co.in/data/ village- Kumaramangalam tamil-nadu.html

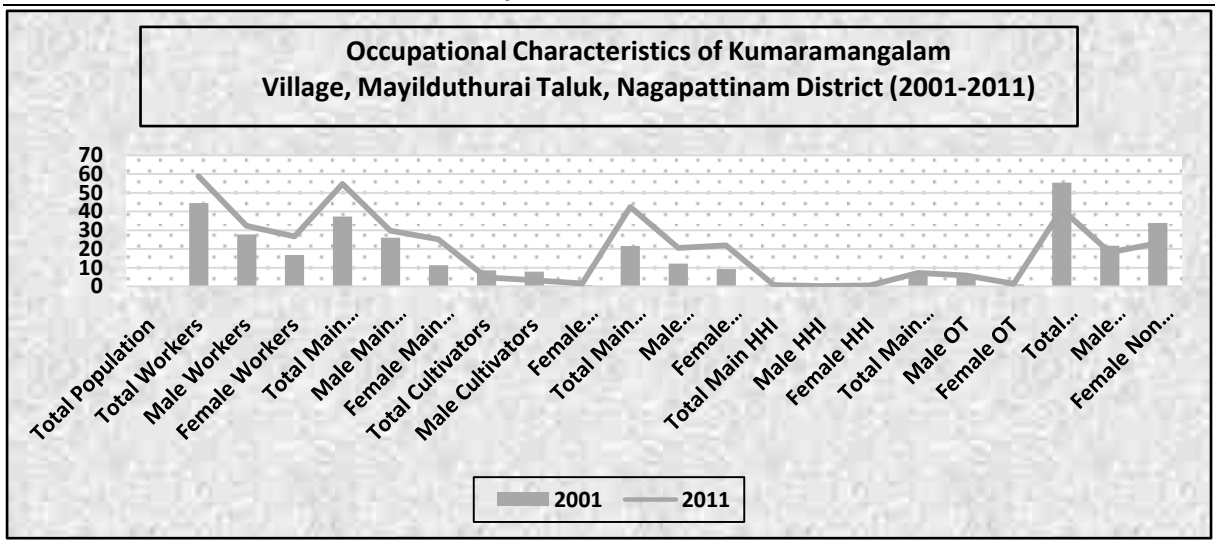


Fig No 3.57 Occupational Characteristics – Kumaramangalam Village, Nagapattinam District (2001-2011)

3.12.6 Socio economic benefits of projects in buffer zone

The impact of proposed project will be up to the distance of 10km surrounding the project site. The socio - economic benefits of proposed project is given below.

1. The proposed project will generate employment within 10km radius
2. As the workers and tippers from various villages move to and fro projects site, shops such as mechanic, welding, tea and hotels will be developed around the project site. It will generate indirect employment to the village people.
3. The surrounding village people will get benefits under CER Scheme. CER is 1.5% of project cost.
4. When people get employment, it will upgrade the living standard of the people.
5. As the people getting employment in their native places, migration towards developed cities in search of employment may be prevented. Thereby, agricultural activities will not be affected.

3.12.7 Study area – Command areas in Cuddalore and Mayiladuthurai District

Table 3.42 List and Details of Revenue villages within 10km radius

Name	Cuddalore (Population)
Komaratchi	3938
Mannargudi	1385
Vallampadugai	3945
Chidambaram	467909
Pichavaram	1605
Killai (TP)	13608
Vasaputhur	824
Name	**Mayiladuthurai (Population)**
Alakkudy	3971
Serunallur	1732
Mahendrapalli	1601
Arapallam	3260

Source: www.census india.gov.in-Tamil nadu Census of India –2011

Table 3.43 Population Data of Study Area

Districts	Cuddalore						Mayiladuthurai			
NAME	Komaratchi	Mannargudi	Vallampadugai	Chidambaram	Pichavaram	Killai (TP)	Alakkudy	Serunallur	Mahendrapalli	Arapallam
Tot_P	3938	1385	3945	467909	1605	13608	3971	1732	1601	3260
Tot_Work_P	1529	698	1634	205020	697	5932	1876	829	610	1421
Main work_P	723	633	1369	130755	512	3952	1167	653	591	928
Main_Cl_P	207	173	106	16722	147	172	169	46	83	126
Main_Al_P	92	340	638	44025	210	598	648	469	423	545
Main_Hh_P	60	15	16	3301	0	41	12	17	8	24
Main_Ot_P	364	105	609	66707	155	3141	338	121	77	233
Non_Work_P	2409	687	2311	262889	908	7676	2095	903	991	1839

Table 3.44 Communication & Transport Facilities in the Study Area

S. No		Village Name	PO	SPO	PTO	T	PCF	BS	PBS	RS	SH	MDR	BTR	GR	FP
1.	Cuddalore	Komaratchi	1	1	1	1	2	1	1	0	2	1	1	1	1
2.		Mannargudi	0	1	1	1	2	1	1	2	1	1	1	1	1
3.		Vallampadugai	1	1	1	1	2	1	1	0	2	1	1	1	1
4.		Chidambaram	3	4	1	1	2	1	1	0	2	1	1	1	1
5.		Pichavaram	1	1	1	1	1	1	1	1	2	1	1	1	1
6.		Killai (TP)	1	1	1	1	1	1	1	0	2	1	1	1	1
7.	Mayiladuthurai	Alakkudy	0	0	1	1	2	1	1	0	2	2	1	2	1
8.		Serunallur	2	1	1	1	2	1	1	0	2	1	1	1	1
9.		Mahendrapalli	1	1	1	1	1	1	1	0	1	1	1	1	1
10.		Arapallam	1	1	1	1	2	1	1	0	2	1	1	1	1

Abbreviations: PO - Post Office; RS - Railway Station; GR - Gravel Roads; SPO - Sub Post Office; PTO - Post & Telegraph office; PCF - Private Courier Facility; SH - State Highways; FP - Foot path; T- Telephone (Landline); BS -Public Bus Service; MDR - Major District Road; PBS - Private Bus Service; BTR - Black Topped (Pucca Road).

Note: 1 - Available within the village; 2 -Not available

Table 3.45 Water & Drainage Facilities in the Study Area

S.No		Village Name	TP	CW	UCW	HP	TW/BH	S	R/C	T/P/L	CD	OD	CT
1.	Cuddalore	Komaratchi	2	1	1	1	1	2	2	1	1	1	2
2.		Mannargudi	2	2	1	1	1	2	2	2	1	1	2
3.		Vallampadugai	2	2	1	1	1	2	2	2	1	1	2
4.		Chidambaram	5	1	1	2	1	1	2	2	1	1	2
5.		Pichavaram	2	1	1	2	2	2	2	2	1	1	2
6.		Killai (TP)	2	1	1	1	1	1	2	1	1	1	2
7.	Mayiladuthurai	Alakkudy	2	1	1	2	1	1	2	2	1	1	2
8.		Serunallur	2	1	1	1	1	2	2	2	1	1	2
9.		Mahendrapalli	2	1	1	1	1	2	2	2	1	1	2
10.		Arapallam	2	1	1	2	1	2	2	2	1	1	2

Abbreviations: TP-Tap Water; R/C-River/Canal; CW-Covered Well; T/P/L-Tank/Pond/Lake; UCW-Uncovered Well; CD-Covered Drainage; HP-Hand Pump; OD-Open Drainage; TW/BH-Tube/Bore Well; CT-Community Toilet Complex for General public; S– Spring

Note– 1-Available within the village;

2-Not available

Table 3.46 Other Facilities in the Study Area

S.No		Village Name	ATM	CB	COB	ACS	SHG	PDS	AMS	NC	NC-AC	CC	SF	PL	NPS	APS	BDRO	PS
1.	Cuddalore	Komaratchi	2	1	1	2	2	1	2	2	1	2	2	1	1	2	1	1
2.		Mannargudi	2	2	2	2	2	1	2	2	1	2	1	1	1	1	1	1
3.		Vallampadugai	2	2	2	2	2	1	2	2	1	1	1	1	1	1	1	1
4.		Chidambaram	5	2	2	2	2	1	2	2	1	2	2	1	1	1	1	1
5.		Pichavaram	1	2	2	2	2	1	2	2	1	2	2	2	1	1	1	1
6.		Killai (TP)	1	2	2	2	2	1	2	2	1	2	2	2	1	1	1	1
7.	Mayiladuthurai	Alakkudy	2	2	2	2	2	1	2	2	1	1	1	1	1	1	1	1
8.		Serunallur	2	2	2	2	2	1	2	2	1	1	1	2	1	1	1	1
9.		Mahendrapalli	2	2	1	2	2	1	2	1	1	1	1	2	1	1	1	1
10.		Arapallam	2	1	2	2	2	1	2	1	1	1	1	1	1	1	1	1

Abbreviations: ATM - Automatic Teller Machine; PDS - Public Distribution System (Shop); CB - Commercial Bank; COB - Co-operative Bank; AMS - Agricultural Market

Society: ACS –Agricultural Credit Societies; NC- Nutritional Centre; SHG-Self Help Group; NC-AC-Nutritional Centre – Anganwadi Centre; BDRO-Birth & Death Registration Office; PS-Power Supply; CC- Community Centre (without TV); SF – Sports field; PL- Public library, NPS – News paper supply; APS – Assembly polling station.

Note: 1-Available within the village; 2- Not available

Table 3.47 Educational Facilities in the Study Area

			PPS		PS		MS		SS		SSS		DC		EC		MC		MI		PT		VTS		SSD	
S.No		Village Name	G	P	G	P	G	P	G	P	G	P	G	P	G	P	G	P	G	P	G	P	G	P	G	P
1.	Cuddalore	Komaratchi	1	2	1	2	2	2	1	2	2	2	1	1	2	2	0	0	2	2	2	2	2	2	2	2
2.		Mannargudi	1	2	1	2	1	2	2	2	2	2	1	1	2	2	0	0	2	2	2	2	2	2	2	2
3.		Vallampadugai	1	2	1	1	2	1	2	1	2	2	0	1	2	2	0	0	2	2	2	2	2	2	2	2
4.		Chidambaram	1	2	1	2	1	2	2	2	2	2	1	2	2	2	0	1	2	2	2	2	2	2	2	2
5.		Pichavaram	1	2	1	2	1	2	2	2	2	2	0	1	2	2	0	0	2	2	2	2	2	2	2	2
6.		Killai (TP)	1	2	1	2	1	2	1	2	1	2	1	1	2	2	0	0	2	2	2	2	2	2	2	2
7.	Mayiladuthurai	Alakkudy	1	2	1	2	1	2	2	2	2	2	1	0	2	2	0	0	2	2	2	2	2	2	2	2
8.		Serunallur	1	2	1	2	1	2	1	2	2	2	1	1	2	2	0	0	2	2	2	2	2	2	2	2
9.		Mahendrapalli	1	2	1	2	1	2	2	2	2	2	0	1	2	2	0	0	2	2	2	2	2	2	2	2
10.		Arapallam	1	2	1	2	2	2	2	2	2	2	1	0	2	2	0	0	2	2	2	2	2	2	2	2

Abbreviations: PPS-Pre Primary School; SSS-Senior Secondary School; DC-Degree School; PT-Polytechnic; PS-Primary School; G-Government ; EC-Engineering College; VTS-Vocational School /ITI; MS-Middle School; P-Private; MC-Medical College; SSD-Special School for Disabled; SS-Secondary School; MI-Management College/Institute;

Note–1-Available within the village; 2-Not available

Table 3.48 Medical Facilities in the Study Area

S.No		Village Name	CHC	PHC	PHSC	MCW	TBC	HA	HAM	D	VH	MHC	FWC	NGM-I/O
1.	Cuddalore	Komaratchi	0	0	1	2	1	2	0	2	1	2	2	a
2.		Mannargudi	0	0	1	2	1	2	0	2	1	2	2	b
3.		Vallampadugai	0	0	1	2	0	2	0	2	2	2	2	b
4.		Chidambaram	2	1	1	2	1	2	2	2	1	2	2	b
5.		Pichavaram	0	0	1	2	1	2	0	2	1	2	2	b
6.		Killai (TP)	0	0	1	2	1	2	0	2	2	2	2	c
7.	Mayiladuthurai	Alakkudy	0	0	1	2	1	2	0	2	2	2	2	a
8.		Serunallur	0	0	1	2	0	1	0	2	1	2	2	b
9.		Mahendrapalli	1	0	2	2	1	2	1	2	2	2	2	b
10.		Arapallam	0	0	1	2	1	2	0	2	1	2	2	b

Abbreviations: CHC-Community Health Centre; TBC- TB Clinic; VH- Veterinary Hospital; PHC-Primary Health Centre; HA-Allopathic Hospital; FWC-Family Welfare Centre; PHSC-Primary Health Sub Centre; HAM-Alternative Medicine Hospital; MHC-Mobile Health Clinic; MCW-Maternity and Child Welfare Centre; D-Dispensary; NGM-I/O-Non Government Medical Facilities In & Out Patient

Note–1-Available within the village;2 –Not available; a- Facility available at<5kms; b- Facility available at>10kms

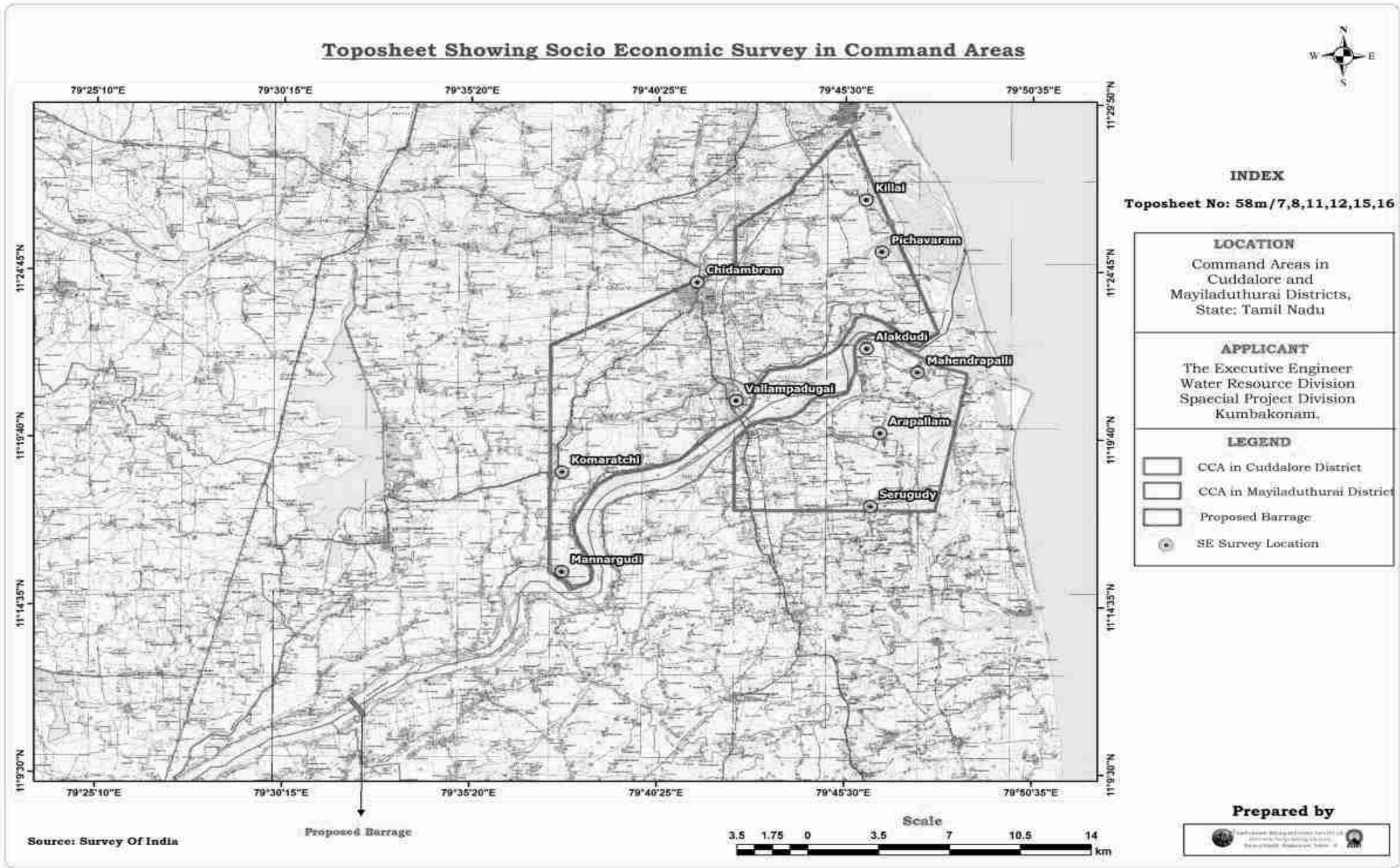


Fig No 3.58 Socioeconomic Survey Location

3.12.8 Primary survey conducted by FAE- SE

Primary survey is conducted around 10 villages by Functional area expert in socio economics

3.12.8.1 Primary survey methodology

The study was carried out with a participatory approach by involving the stakeholders, particularly the project beneficiaries and probable affected persons through a series of consultative process. The population groups that were consulted include beneficiary group of people in the project influence area, particularly the shopkeepers, farmers, Gram Panchayat members, village elders etc. Proportionate and purposive sampling methods were used for selecting respondents for household survey. Male and female respondents, both were selected for household survey. Structured questioners were used for survey.

3.12.8.2 Data structures

The data collected with the help of questionnaire survey for list of villages of Bargur Taluk were suitably converted into uni-variate, bi-variate and multivariate tables. The selection of these blocks were meaningfully done in order to get complete details of the surveyed population, their living environment, socio economic and socio-cultural and healthcare practices so as to conceptualize the findings with the help of interrelationships between Occupation and income status. the surveyed population were examined and interpreted with reference to socioeconomic living area, family structure and Educational, Sanitation etc.,

The Survey was conducted by SE expert Mrs. S.Santhi (FAE) along with her team.

Fig No 3.59 PRIMARY SURVEY PHOTOGRAPHS

3.12.9 Summary and Conclusion

From the primary survey, it is found that the basic facilities such as water road, PHSC, schools are available within the surveyed villages. The people stated that they did not get benefits under CER activities. Also they suggested that to operate the truck at minimum speed while crossing villages, schools, hospitals. The strongly asked to provide the employment opportunities only to the village people and registered their complaint on employment opportunities to other state people.

The proponent assured that he will improve facilities in government schools and hospitals under CER and CSR Schemes.

The socio-economic wellbeing of the area and its people is represented by the infrastructure and the social assets available in the area. The study area constituted of various infrastructures related to education, health care, communication, transportation, drinking waters etc.

3.13 Land Environment

3.13.1 General:

In order to assess impacts of project activities on existing physical, biological and social environment, it is necessary to collect information of Land Environment. The main objective of this section is to provide the details of land use/land cover of the study area covering 10km radius around the proposed barrage and in the command area so that temporal and permanent changes in the land use due to the construction activities and operation of barrage can be assessed. Studies on Land use aspects of eco-system play an imperative role in identifying susceptible issues and to take appropriate action to uphold ecological equilibrium in the region.

3.13.2 Changes in LU/LC due to Proposed Barrage across River Coleroon:

The construction of barrage and its allied activities involved in river bed leads to creation of temporary haul roads / transportation track and formation of garages, labour sheds, toilet facilities, etc along the river banks and it may cause temporary changes in the land use around the project site. This will leads to impact on ecology and biodiversity as the fauna which depends on flora for habitation will be disturbed.

During operation phase of barrage, the water stored and water supply from proposed barrage increase agricultural activity around the barrage and in the command area and land use of the area will be dramatically changed. So many barren lands will be changed as agricultural land due to supply of irrigation water from the proposed barrage. To analyse the change in land use in future, the study on present land use in the proposed area is important.

3.13.3 LU/LC Map by ARC GIS

Land use/Land Cover map is prepared by adopting interpretation techniques of the image classification. Various activities has been included in the preparation of Land Use Land Cover Maps such as Satellite Image/Data Acquisition, pre-processing, Rectification, Ground trotting etc. Satellite Images are processed and LU/LC maps are prepared by using Arc GIS 10.8.

Remote sensing data provides reliable accurate baseline information for land use mapping and it is a rapid method of acquiring up to date information of over a large geological area. Studies on land use aspects of eco-system play an imperative role in identifying susceptible issues and to take appropriate action to uphold ecological equilibrium in the region.

3.13.4 Methodology adopted for thematic data extraction from the satellite imageries:

ERDAS image processing software and ArcGIS Software were used for the project. Erdas 9.2 Image Processing Software was used for digital processing of the spatial data. Digital image processing techniques were applied for the mapping of the land use/land cover classes of the provided area from the satellite data. The methodology applied comes under following steps:

a. **Image Extraction**: Satellite imageries were obtained and a sub set for the Area of Interest was created through ERDAS image processing software. Processing functions primarily done to improve the appearance.

b. **Geo-Rectification**: Geometric correction includes correction for geometric distortions due to sensor, earth geometry variations and conversion of the data to real world coordinates (e.g. Latitude and Longitude) on the Earth's surface. The satellite imagery was geometrically rectified with reference to the geo-referenced toposheets and vector data.

c. **Image Enhancement:** Image enhancement is one of the important images. Imagery to assist in visual interpretation and analysis. Various options of image enhancement techniques were tried out to get the best image for visual interpretation. Histogram equalized stretch enhancement techniques was applied to the imagery of the study area for better interpretation of different features in the satellite imagery.

d. **Classification:** Satellites images are composed of array of grid, each grid have a numeric value that is known as digital number. Smallest unit of this grid is known as a pixel that captures reflectance of ground features represented in terms of Digital number, which represent a specific land features. Using image classification technique, the satellite data is converted into thematic information map based on the user's knowledge about the ground area.

Hybrid technique has been used i.e. visual interpretation and digital image processing for identification of different land use and vegetation cover classes based on spectral signature of geographic feature. Spectral signature represents various land use classes. Image interpretation keys are developed based on image characteristics like colour, tone, size, shape, texture, pattern, shadow, association etc which enables interpretation of satellite images for ground feature. Training sites are then assigned based on their spectral signature and interpretation elements.

Land use/Land cover Map has been broadly classified into five classes namely, Built-up Area, Plantation, Agriculture, Water Bodies, Non-agriculture, Barren Land and desilting areas have been categorized in others class. Using image classification algorithm land use map is then generated.

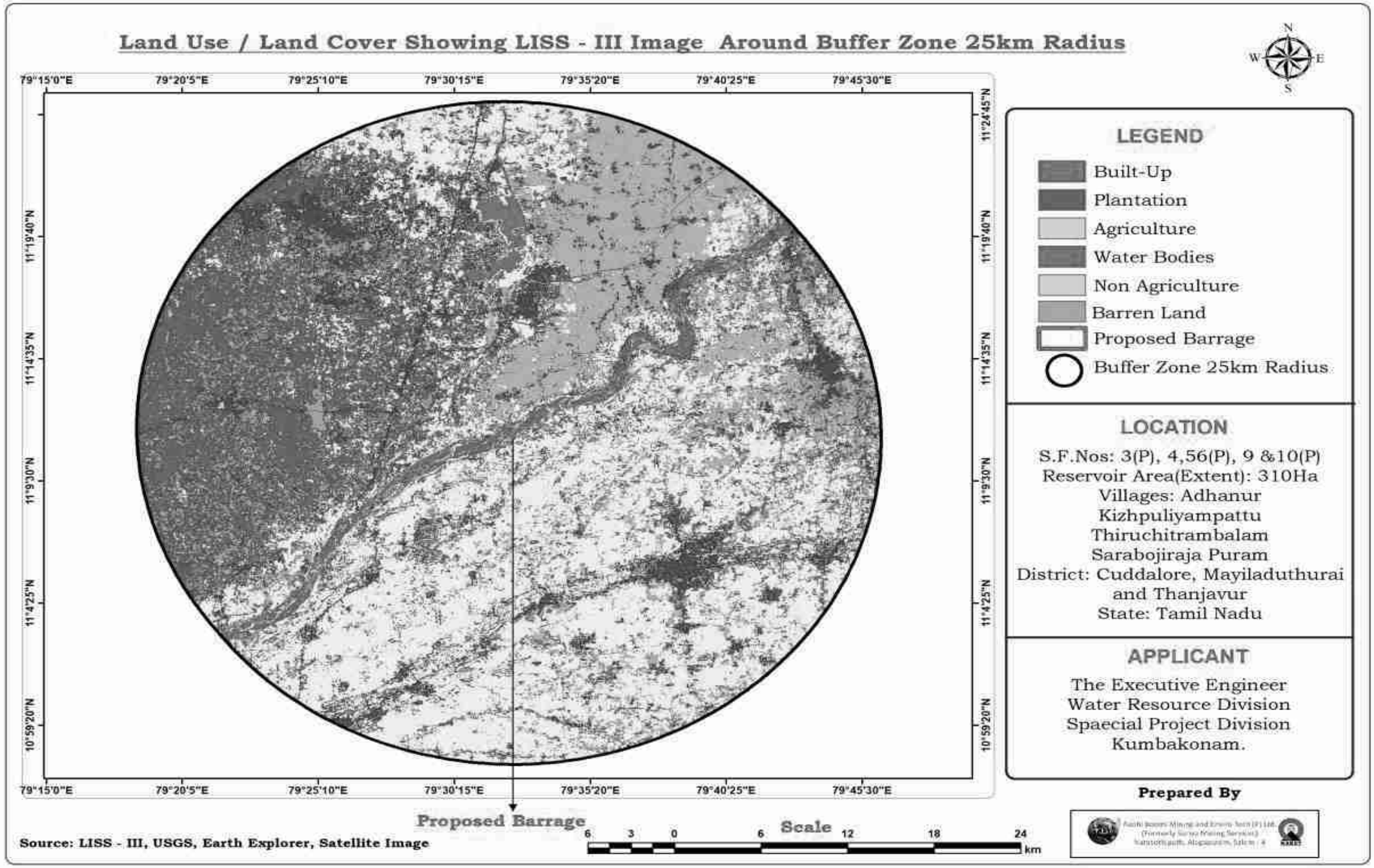


Fig No. 3.60 Land use / Land cover of project study area around 25km radius of proposed barrage

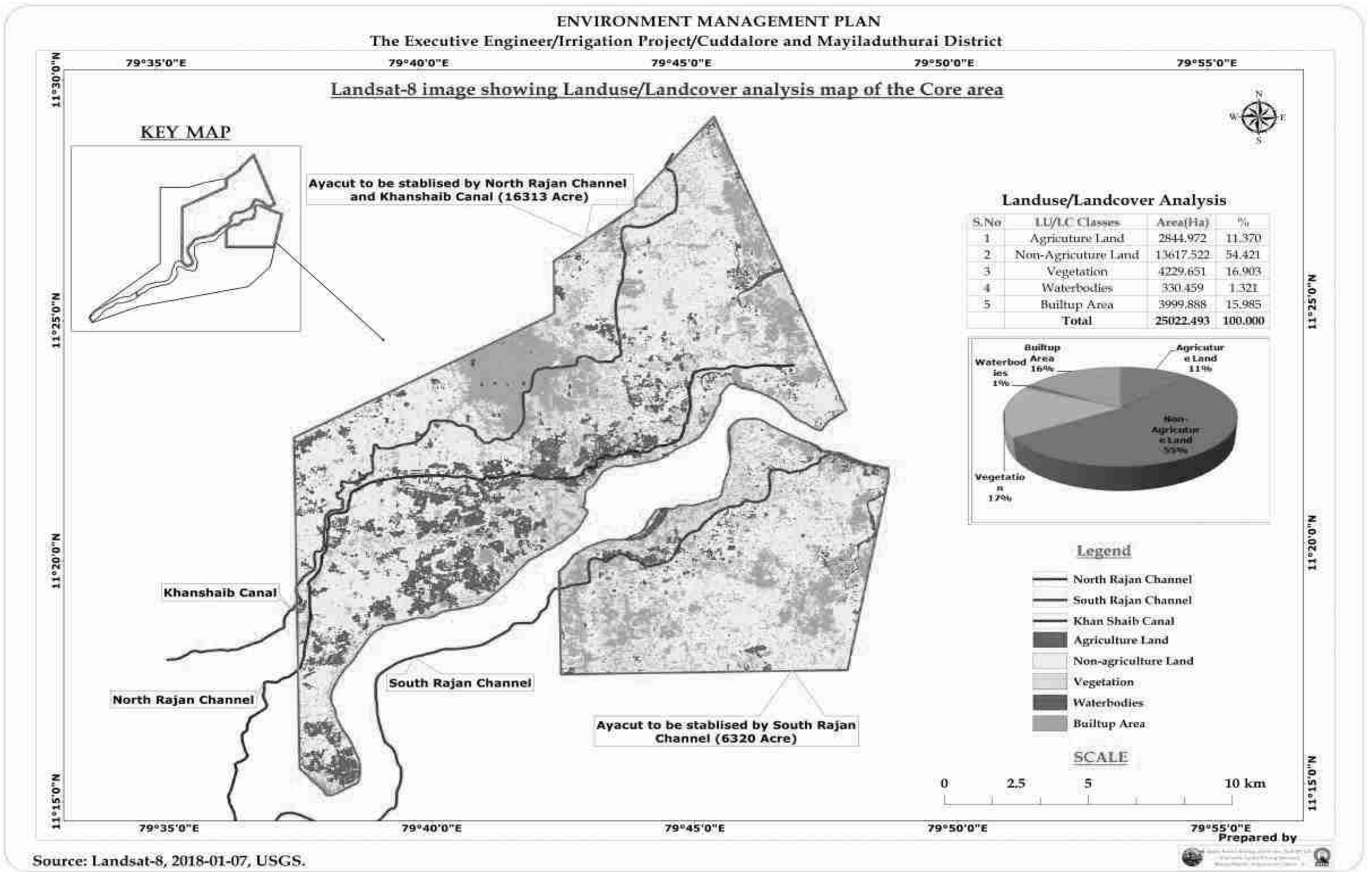


Fig No. 3.61 Land use / Land cover of in the cultivable command area in Cuddalore and Mayiladuthurai District

Table No: 3.49 Area of different land cover within 25km radius of proposed barrage

S.No	LU/LC Classes	Area(Ha)	(%)
1	Built-up	27523.20	13.64
2	Water Bodies	5204.63	2.58
3	Non Agriculture	29319.88	14.53
4	Plantation	45128.80	22.37
5	Agriculture	87223.90	43.24
6	Barren Land	7329.07	3.63
	Total	201729.47	100

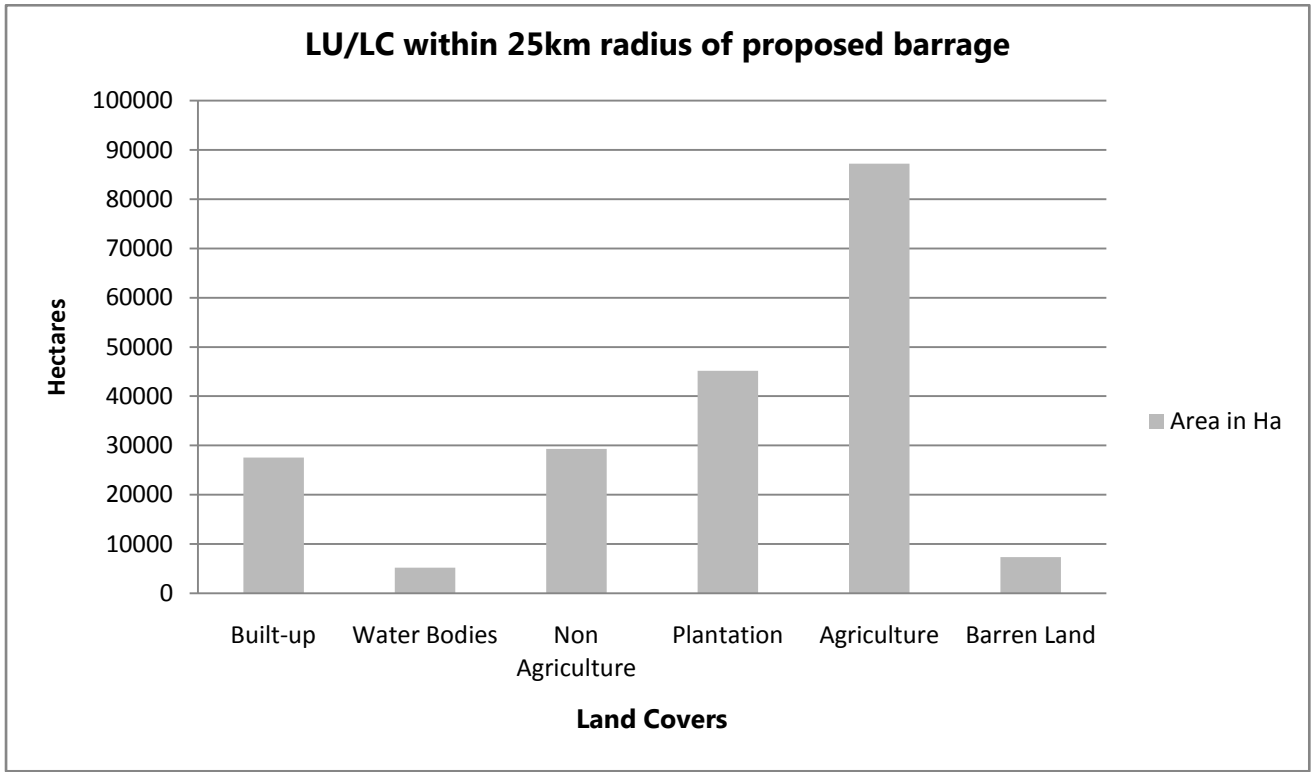


Fig No. 3.62 Land use/Land covers statistics of study area of 25km radius around proposed barrage

Table No: 3.50 Area of different land covers within command area of Cuddalore and Mayiladuthurai District

S.No	LU/LC classes	Area (Ha)	(%)
1	Agricultural land	2844.972	11.370
2	Non- Agricultural land	13617.522	54.421
3	Vegetation	4229.651	16.903
4	Water bodies	330.459	1.321
5	Built-up Area	3999.888	15.985
Total		25022.493	100.00

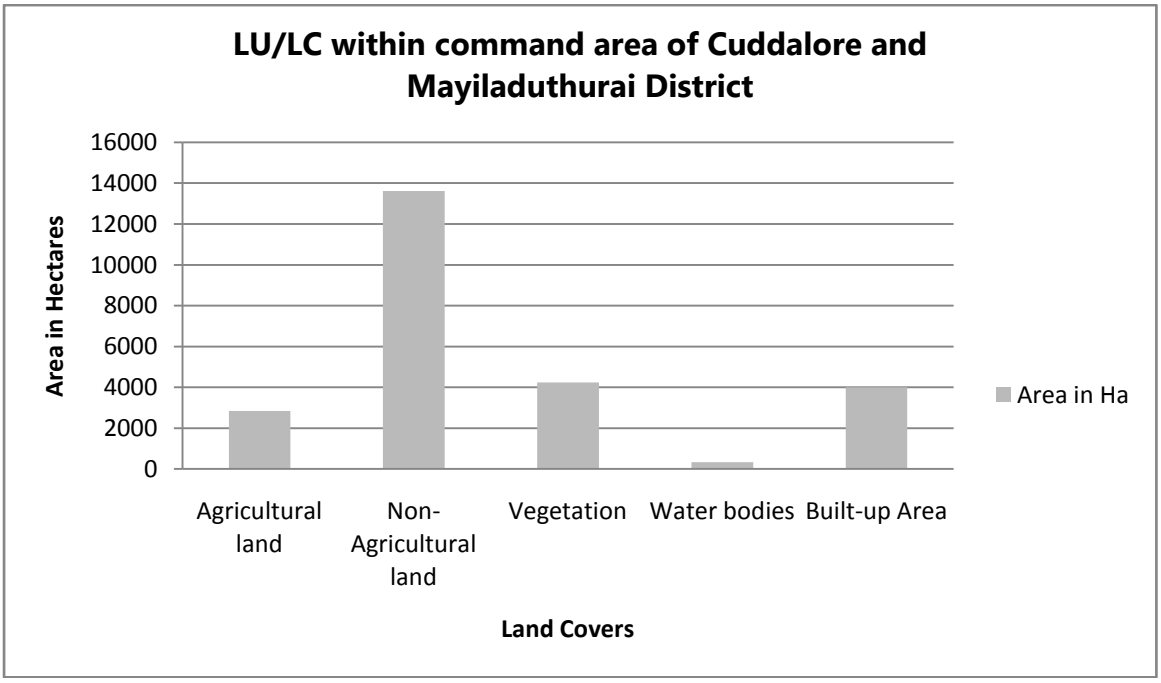


Fig No. 3.63 Methodology use for land- use classification and mapping

3.13.5 Topography

3.13.5.1 Around Proposed Barrage

The proposed barrage is planned to construct across the River Coleroon at RD 74/3 to irrigate cultivable command area of 9159 Ha in Cuddalore and Mayiladuthurai Districts. The elevation of the river bed level is +9.5m and the sill level of the barrage is proposed as +10.00. The topography of the surround areas are flat terrain without any undulations. No reserve forest, wild life sanctuaries are located within 10km radius of the proposed barrage. Veeranam lake is a big lake situated at the distance 6.4km in north side and the Bay of Bengal is located at the distance of 35km in eastern side. Out of 33596.01 Ha, 16437.82 Ha are covered by agricultural activities within 10km radius.

3.13.5.2 Cultivable Command areas

The topography of command areas in Cuddalore and Mayiladuthurai District is flat terrain without any undulations. There is no major water bodies located within command areas of both district. Picharavaram Extension R.F is located within command area of Cuddalore District in east side 3.0km away from Bay of Bengal. No wildlife sanctuaries located within both command areas.

3.13.6 Drainage Pattern of study area around 25km radius of project site and in CCA

Drainage pattern of the area is dendritic in nature. The drainage is mostly easterly and north easterly in this area in both study area of 25km radius and in CCA. There are four fourth order streams and one fifth order stream located within 25km radius of proposed barrage. Seven rivers flowing within 25km radius of the proposed barrage are given below.

1. River Coleroon
2. River Palavar
3. River Vikramanar
4. River Cauvery
5. River Virasolanar
6. River Nattar
7. River Uppanar

As the geology of the both study area is sedimentary formation the water table is identified at shallow depth. So the depth of ground water table in study area during pre monsoon is 2m-15m below ground level and during post monsoon season is 1.5m-14.0m below ground level. There is no scarcity of water in this area.

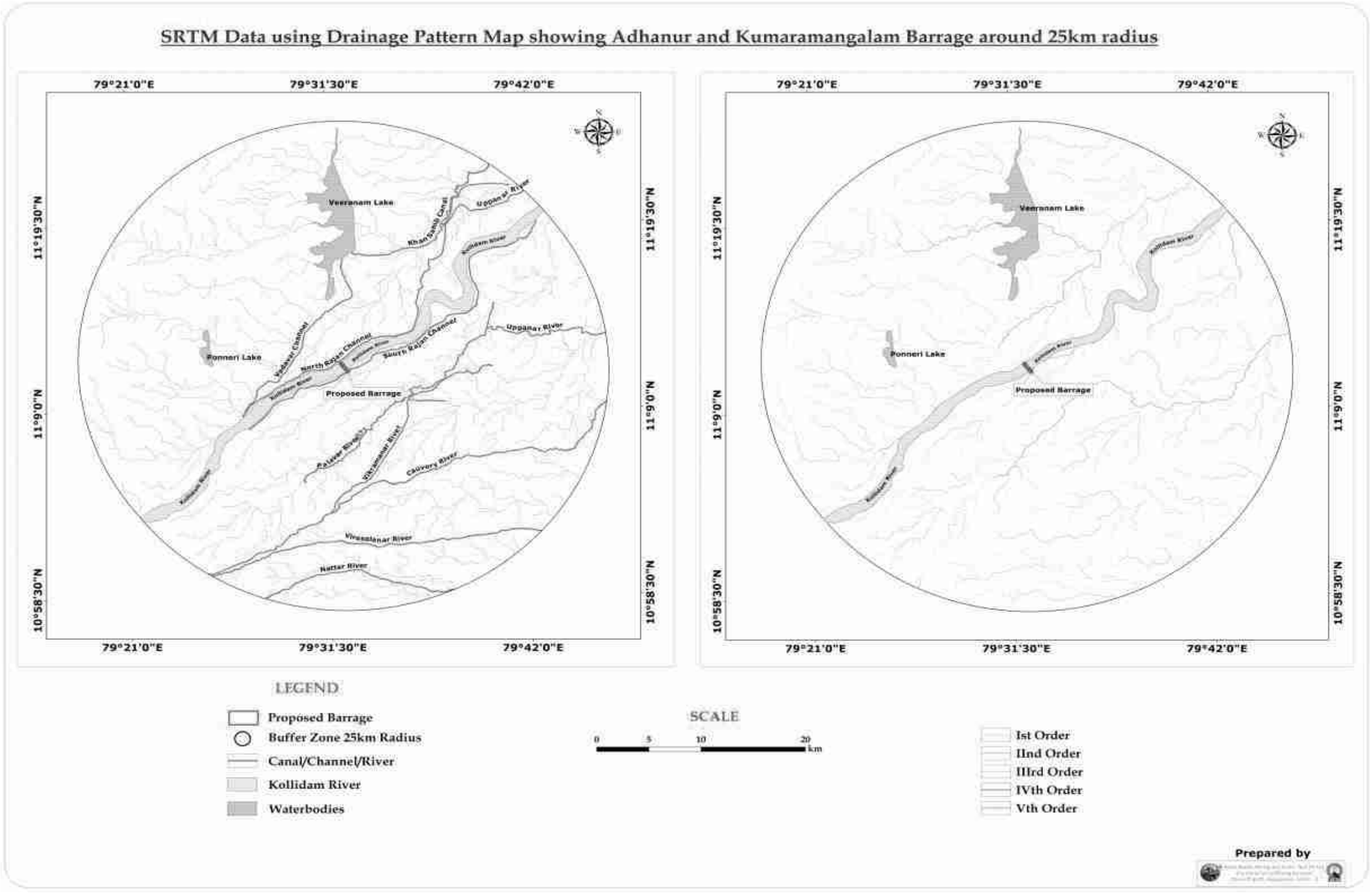


Fig No. 3.64 Image Representing the River/Streams (Drainage) of the study area within 25km radius from the project site

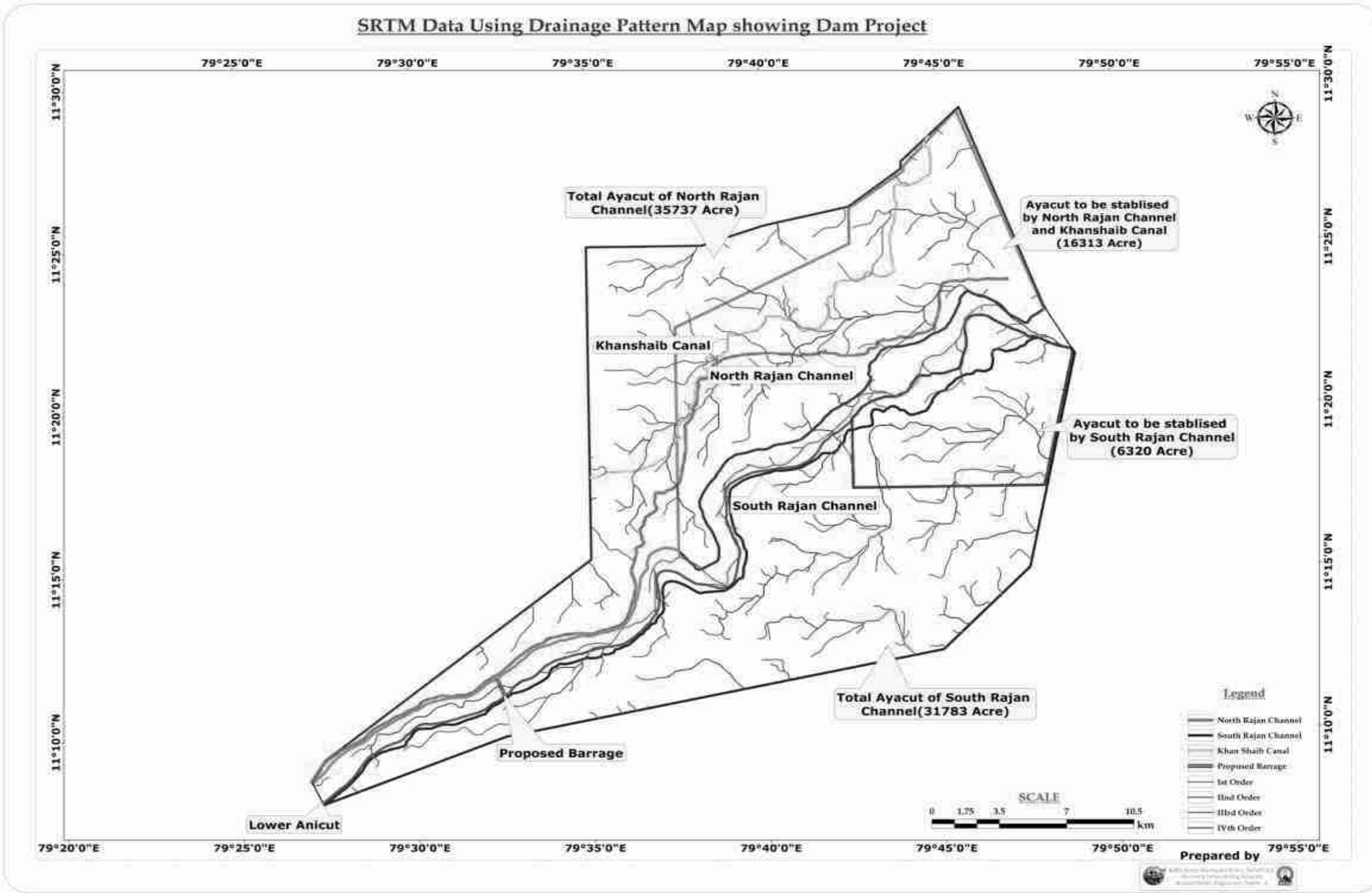


Fig No 3.65 Image showing Drainage Pattern in command areas of Cuddalore and Mayiladuthurai District

3.13.7 Geology of Study area around 25km of project site

The geology of the study area is following:

1. Fluvio Marine
2. Fluvial
3. Sandstone stone with clay

1. Fluvio Marine deposit

Fluviomarine Deposit – Stratified materials (clay, silt, sand, or gravel) formed by both marine and fluvial processes, resulting from sea level fluctuations and stream migration. The deposition of fluvio marine is minimum in this study area.

2. Fluvial deposit

Fluvial deposits are sediments deposited by the flowing water of a stream. The fluvial deposit is majorly seen in the study area of 25km radius. It shows that there are number stream located within the study area.

3. Sandstone stone with clay

Sandstone is a sedimentary rock composed mostly of quartz sand, but it can also contain significant amounts of feldspar, and sometimes silt and clay. In the study area, next to fluvial deposit, sandstone with clay is deposited in the study area.

Apart from above three deposits, two major water bodies such as River Coleroon and are Veeranam lake is located within the study area of 25km radius.

3.13.8 Geomorphology of Study area around 25km of project site

Geomorphology is the study of the surface features which arise when the rocks and overlying deposits at the surface are acted on by forces, usually thought of as water(rivers, floods, tsunamis and rain), winds(and the particles carried by them) and ice(mechanical fracturing by water in the act of freezing and glaciers). The geomorphology of the study area is given below.

1. Alluvial plain
2. Shallow weathered pediplain
3. Moderately weathered pedi plain
4. Shallow flood plain
5. Older coastal plain deep

6. Upland
7. Alluvial plain younger

The landforms of the study area are majorly alluvial. An alluvial plain is a largely flat landform created by the deposition of sediment over a long period of time by one or more rivers coming from highland regions.

Next to alluvial form, the land form of the study area is Shallow weathered pediplain. These are the areas of nearly level terrain with low gradient. These are covered with shallow weathering material ranging from 0 to 5 m. The top soil is generally red soil. The groundwater prospect in such zone is described as poor to moderate.

After that, the geomorphology of the study area is moderately weathered pediplain. Pediplain moderately weathered land form is formed due to coalescence of several pediments which forms good recharge zone due to thick weathering (10-20 m).

Flood plain in this study area is Colerron River. It carries flood water from Cauvery River during monsoon seasons. The older coastal plain is seen over the fluvio marine deposit. Coastal plain is a flat, low-lying piece of land next to the ocean. Coastal plains are separated from the rest of the interior by nearby landforms, such as mountains. Upland is higher elevation of the study area which is seen in North West side at the boundary of study area.

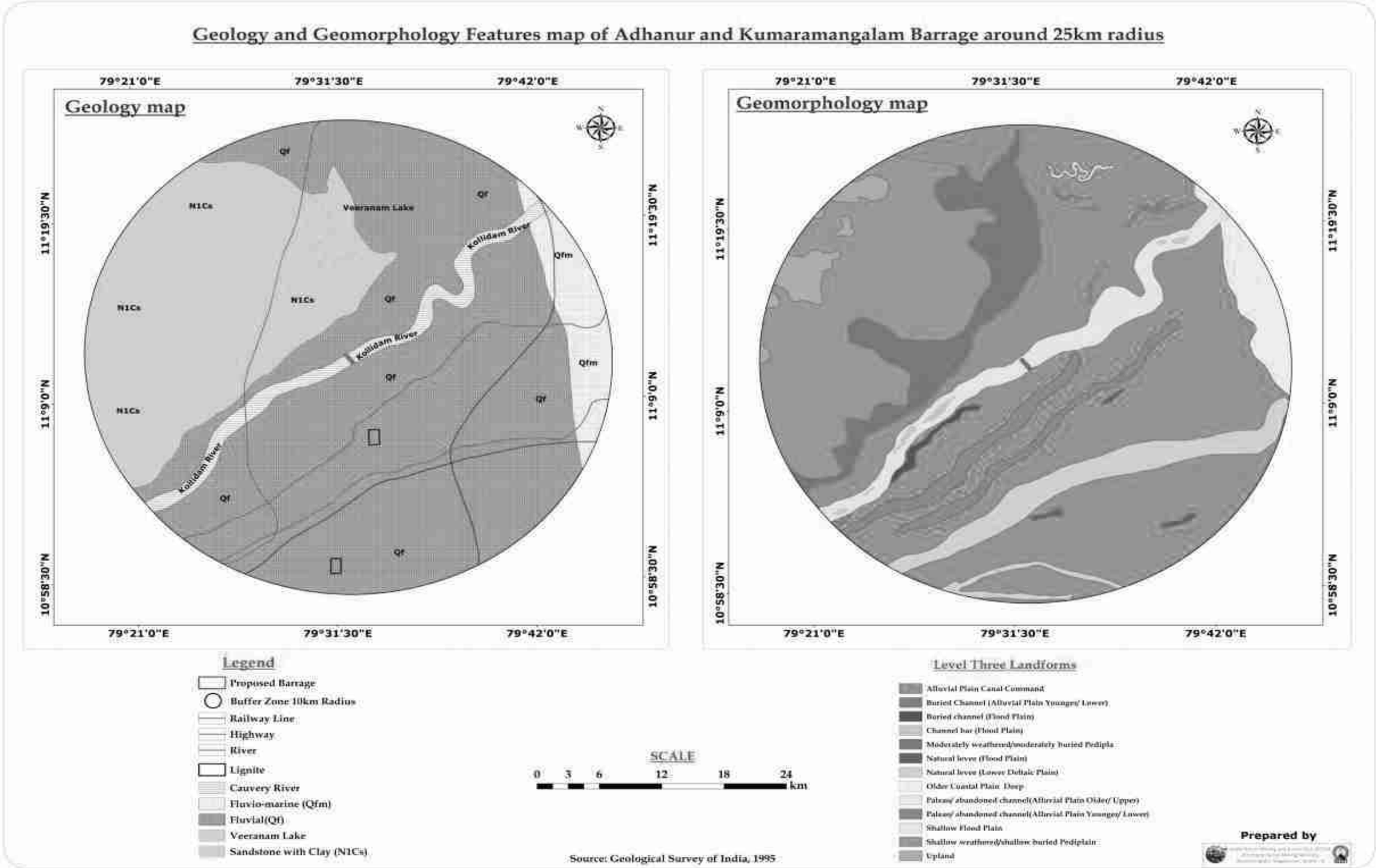


Fig No. 3.66 Image showing Geology and Geomorphology of the study area around 25km radius of project site

3.13.9 Geology of command areas

The geology of the study area is following:

1. Fluvio Marine
2. Fluvial
3. Marine

The command area is majorly deposited with fluvio marine. Next ti fluvio marine, the area is deposited with fluvial. The marine deposit is seen in eastern side boundary of command areas. It is adjacent to Bay of Bengal. Marine deposits are sediments that come from different sources by different means and it settle down in the ocean floor.

Marine deposits are classified into many types based on sediments and location: Classification based on sediments:

Pelagic- open sea, not close to the shore.
Littoral- close to the shore.

3.13.10 Geomorphology of command areas

The geomorphology of the study area is given below.

1. Alluvial plain
2. Shallow flood plain
3. Older coastal plain deep
4. Coastal plain deep
5. Salt flat

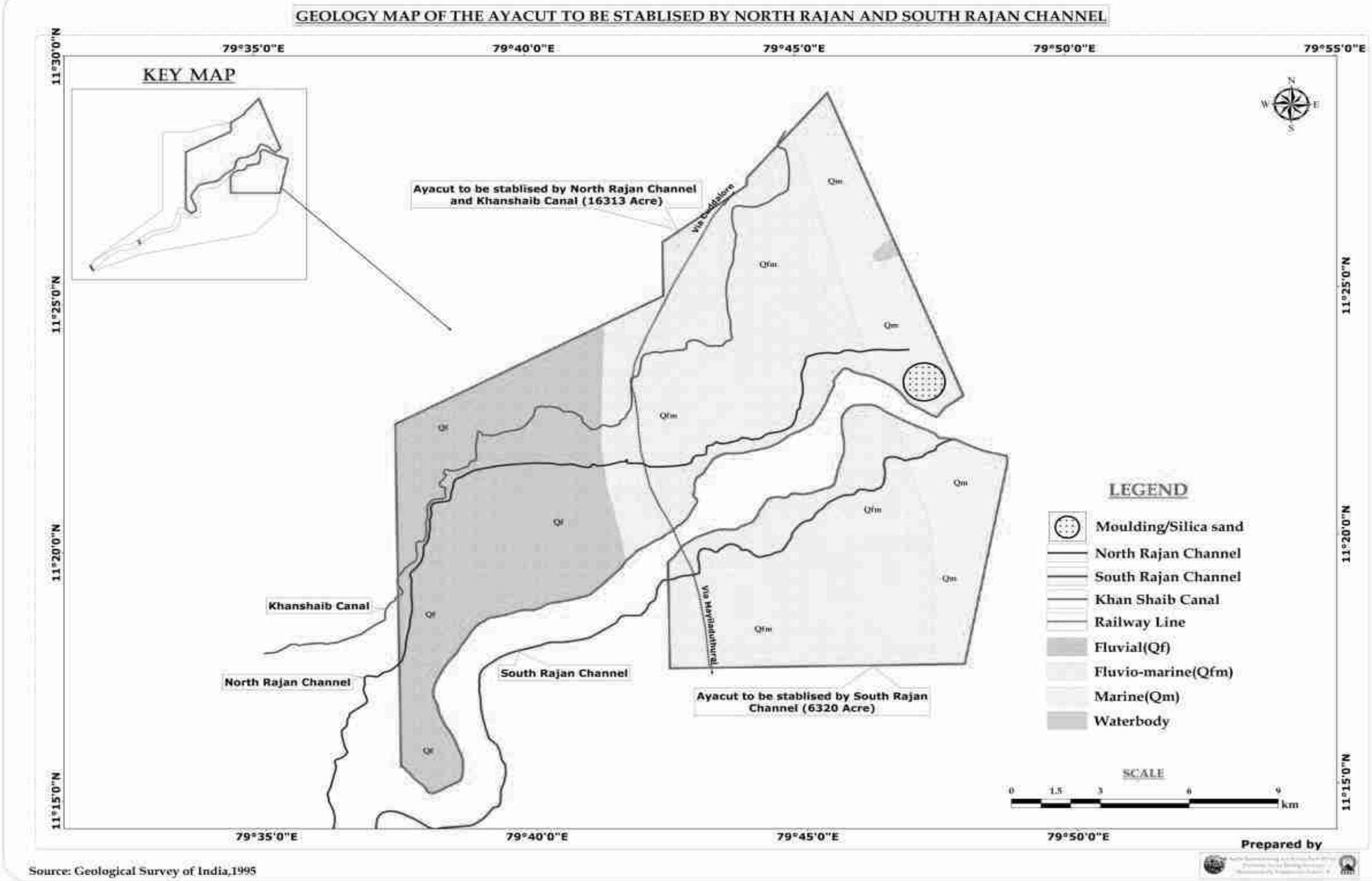


Fig No. 3.67 Image showing Geology of command area of Cuddalore and Mayiladuthurai District

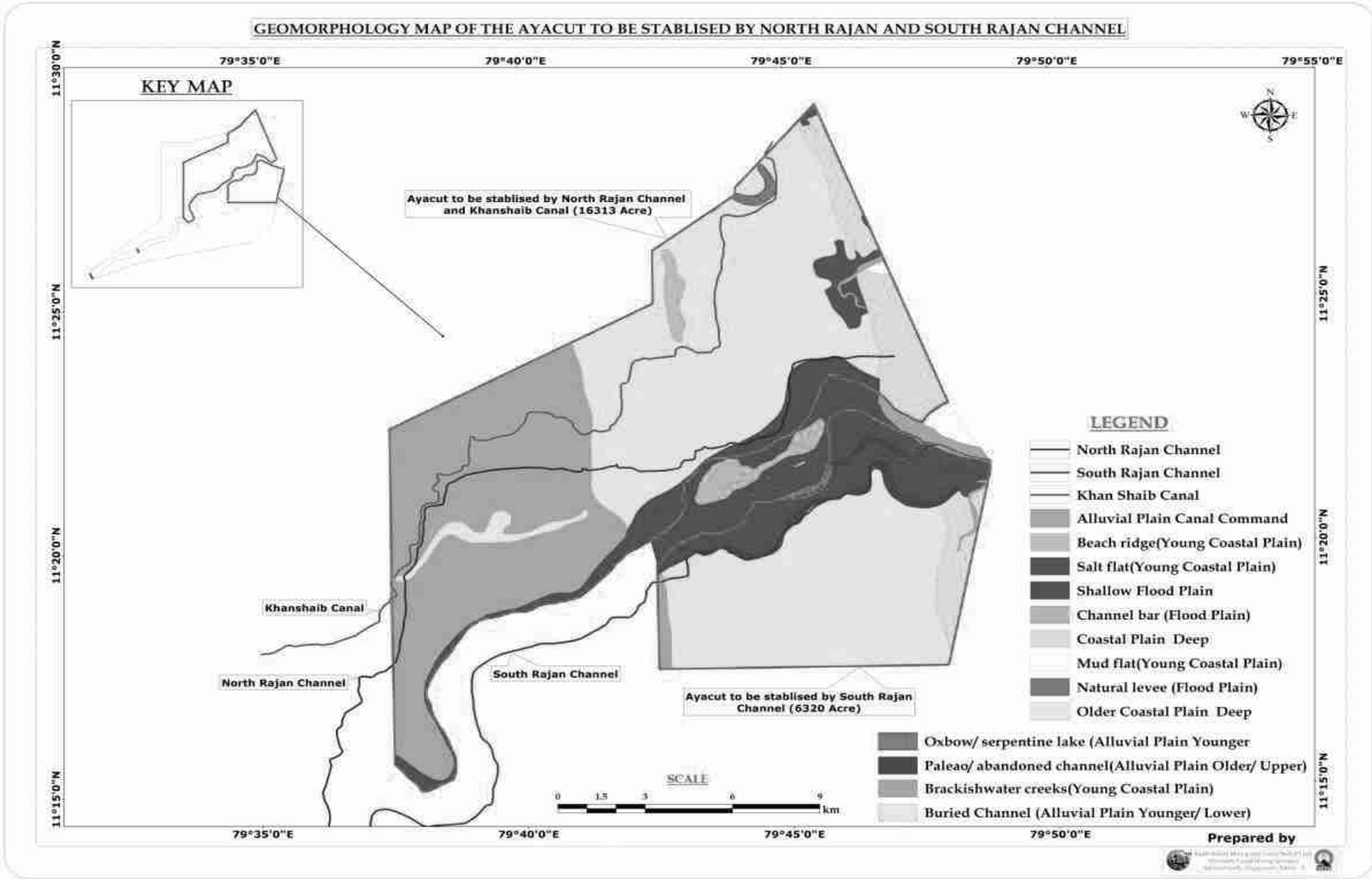


Fig No. 3.68 Image showing Geomorphology of command area of Cuddalore and Mayiladuthurai District

3.13.11 Contour around 25km radius of proposed barrage and in command areas

Contour lines are the greatest distinguishing feature of a topographic map. Contour lines are lines drawn on a map connecting points of equal elevation, meaning if you physically followed a contour line, elevation would remain constant. Contour lines show elevation and the shape of the terrain in the study area. The contour map of 25km radius around proposed barrage and command areas was derived from a SRTM data of the study area.

The minimum and maximum elevation of the study area of 25km radius is +10.00m and +70.00m above MSL. The elevation of the barrage sill level is +10.00m above MSL.

The minimum and maximum elevation of the command areas is +0.00m and +10.00m above MSL.

3.13.12 Slope around 25km radius of proposed barrage and in command area

The slope map was derived from a SRTM data of the study area. The slope of the study area was classified into five classes, such as less than 10 Percent/degree flat to almost flat no meaningful denudation process. The contour map is prepared in 1:50000 scale from SOI topo sheets. The slope map of 25km radius around project site and command areas has been prepared. In the slope map it is found that, the slope of the study area around 25km is less than 4.87% and slope of the command area is less than 3.8% which shows that the land is flat or very gentle slope.

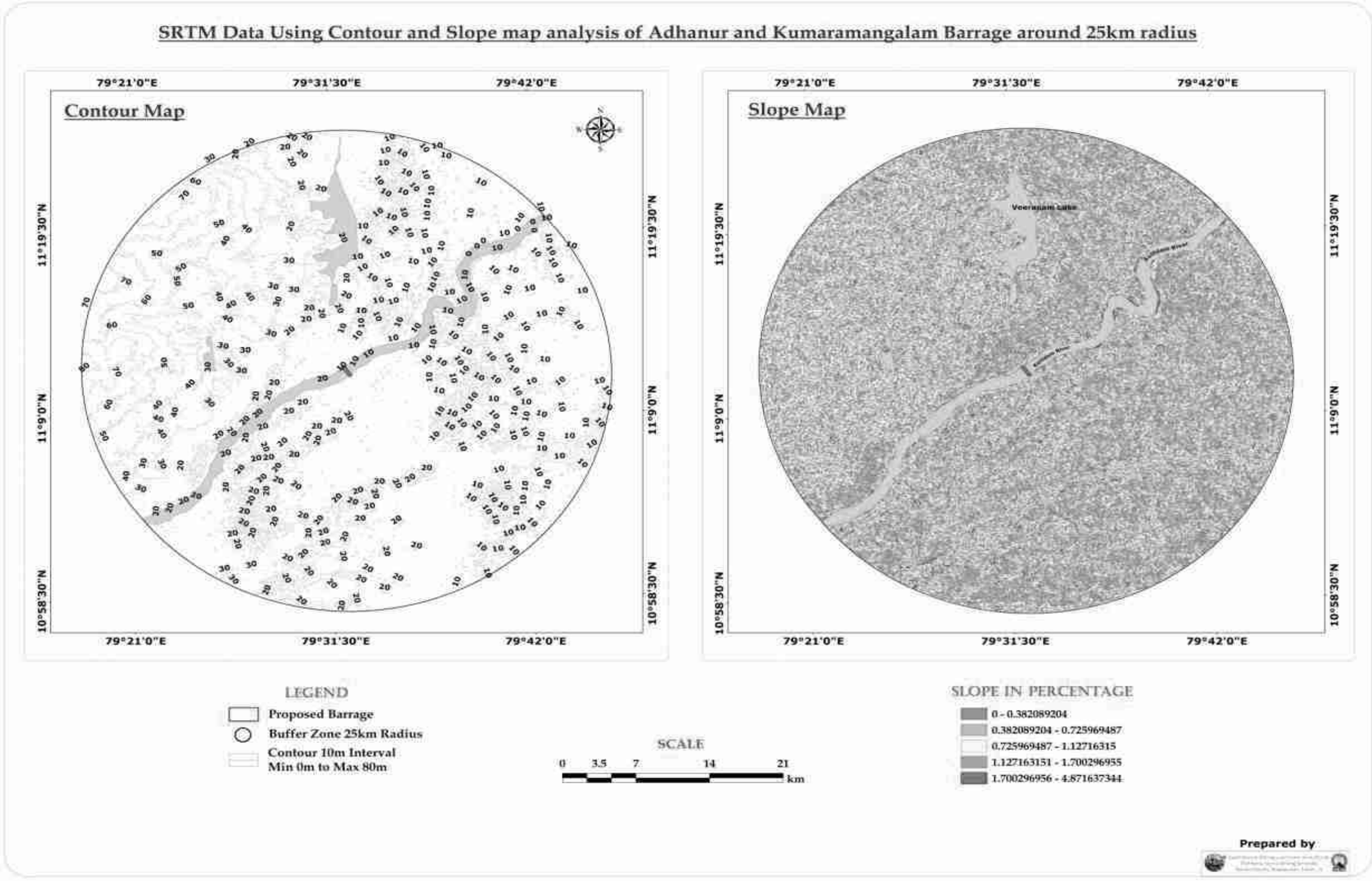


Fig No. 3.69 Image showing Contour and slope of study area around 25km radius of proposed barrage

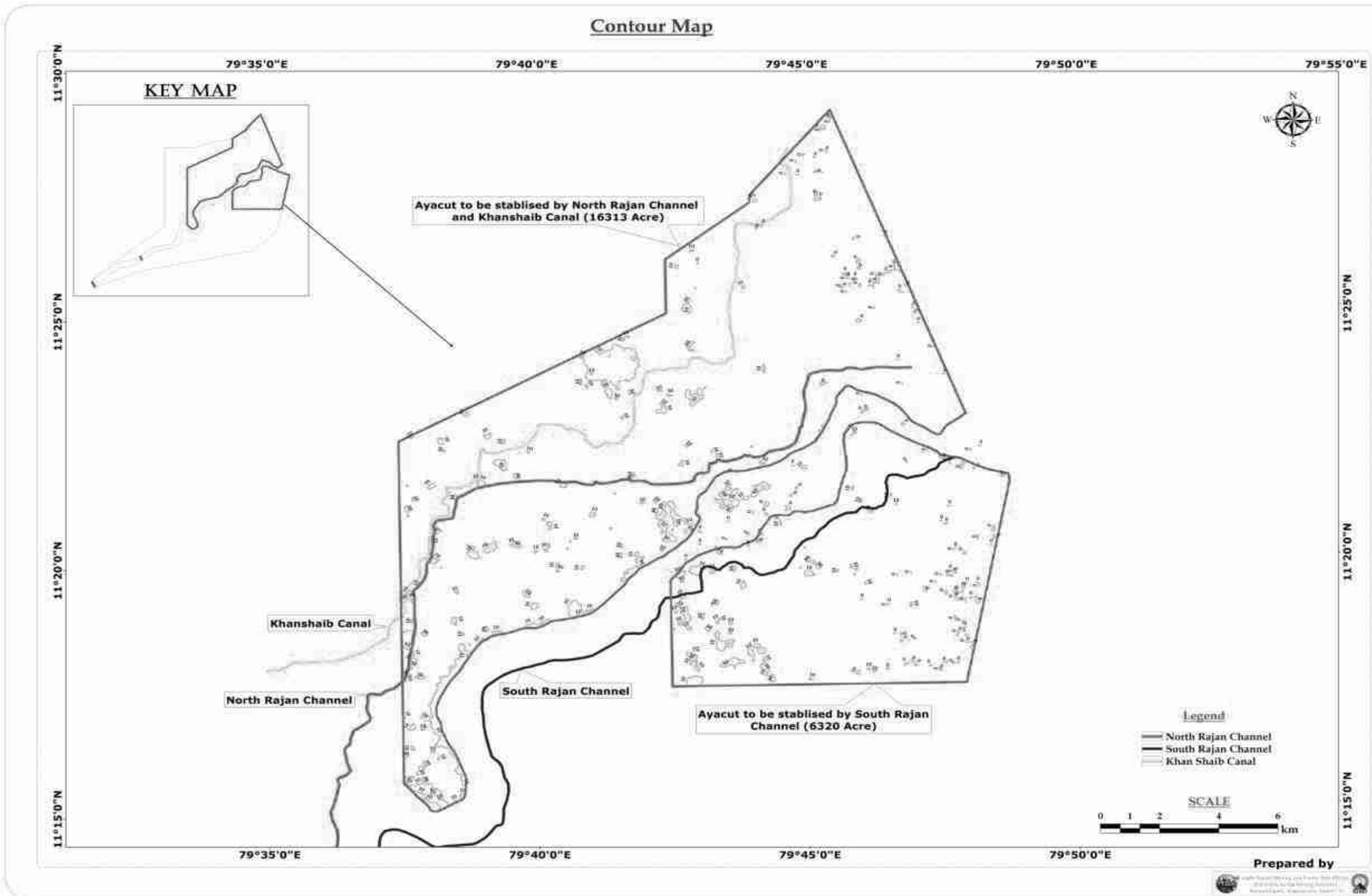


Fig No. 3.70 Image showing contour of command area of Cuddalore and Mayiladuthurai District

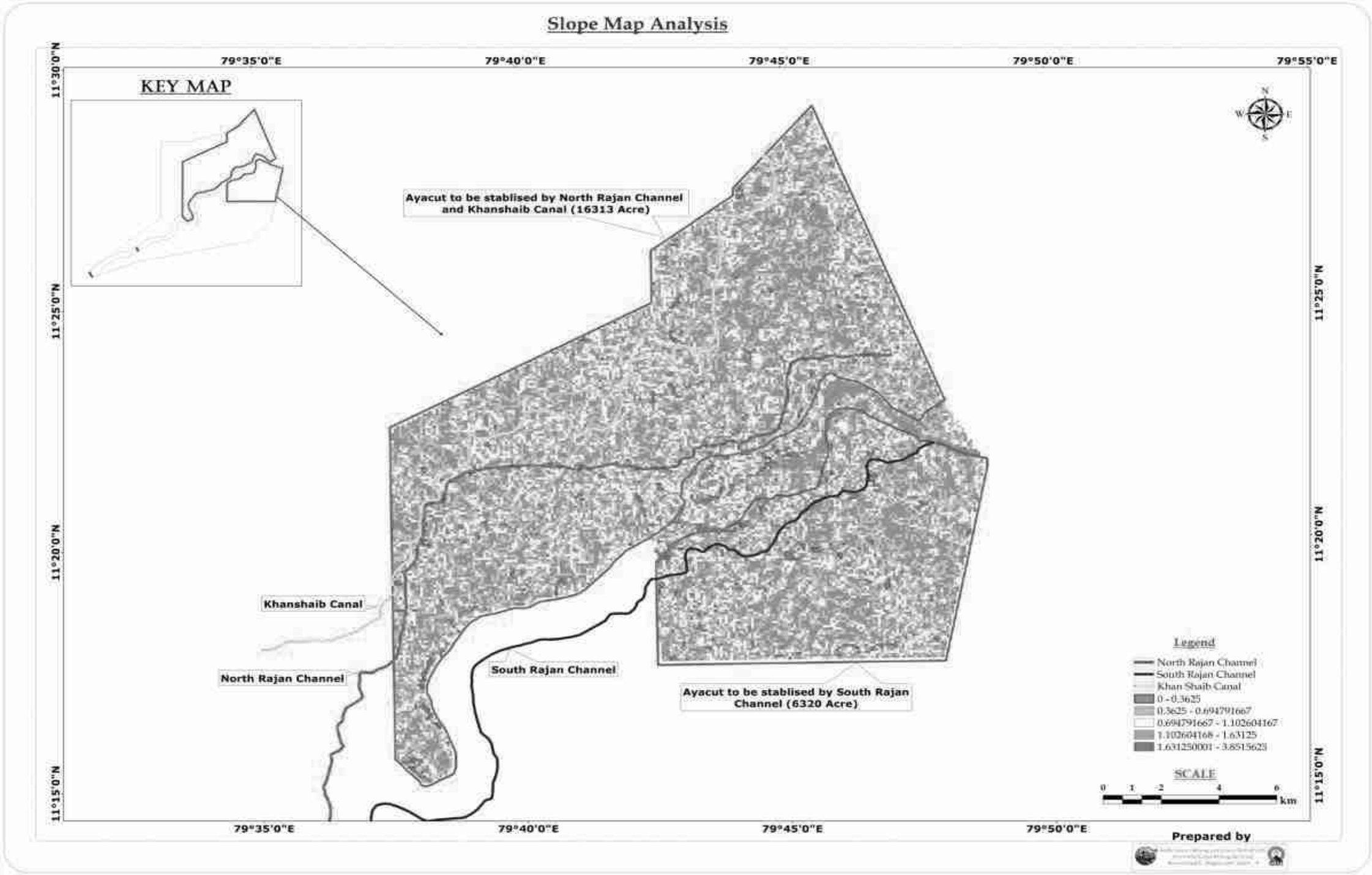


Fig No. 3.71 Image showing slope of command area of Cuddalore and Mayiladuthurai District

3.13.13 Soil type in study area of 25km radius.

Soil is an upper most layer of the earth and contains diverse rock particles and organic matter. As per United States Department of Agriculture (USDA) classification, there are four major soil types such as Vertisols, Entisols, Alfisols and Inceptisol.

The study area is majorly covered with Vertisols. Vertisols are clay-rich soils that shrink and swell with changes in moisture content. During dry periods, the soil volume shrinks and deep wide cracks form. The soil volume then expands as it wets up.

Next to the Vertisols, the study area is covered with Inceptisols. Inceptisols are soils of relatively new origin and are characterized by having only the weakest appearance of horizons, or layers, produced by soil-forming factors. They commonly are found either with underlying weathering-resistant parent material (for example, quartzite or siliceous sandstone) or in topographic settings conducive to soil erosion or water logging.

Entisols and Alfisols covered few areas of the study area. Entisols are soils that show little or no evidence of pedogenic horizon development. Entisols are commonly formed in recently deposited materials, or in parent materials resistant to weathering (eg. sand). Entisol soils also occur in areas of very dry or cold climate, on steep slopes, or in sandy areas. Alfisols are moderately leached soils that have relatively high native fertility. These soils have mainly formed under forest and have a subsurface horizon in which clays have accumulated. Alfisols are primarily found in temperate humid and sub-humid regions.

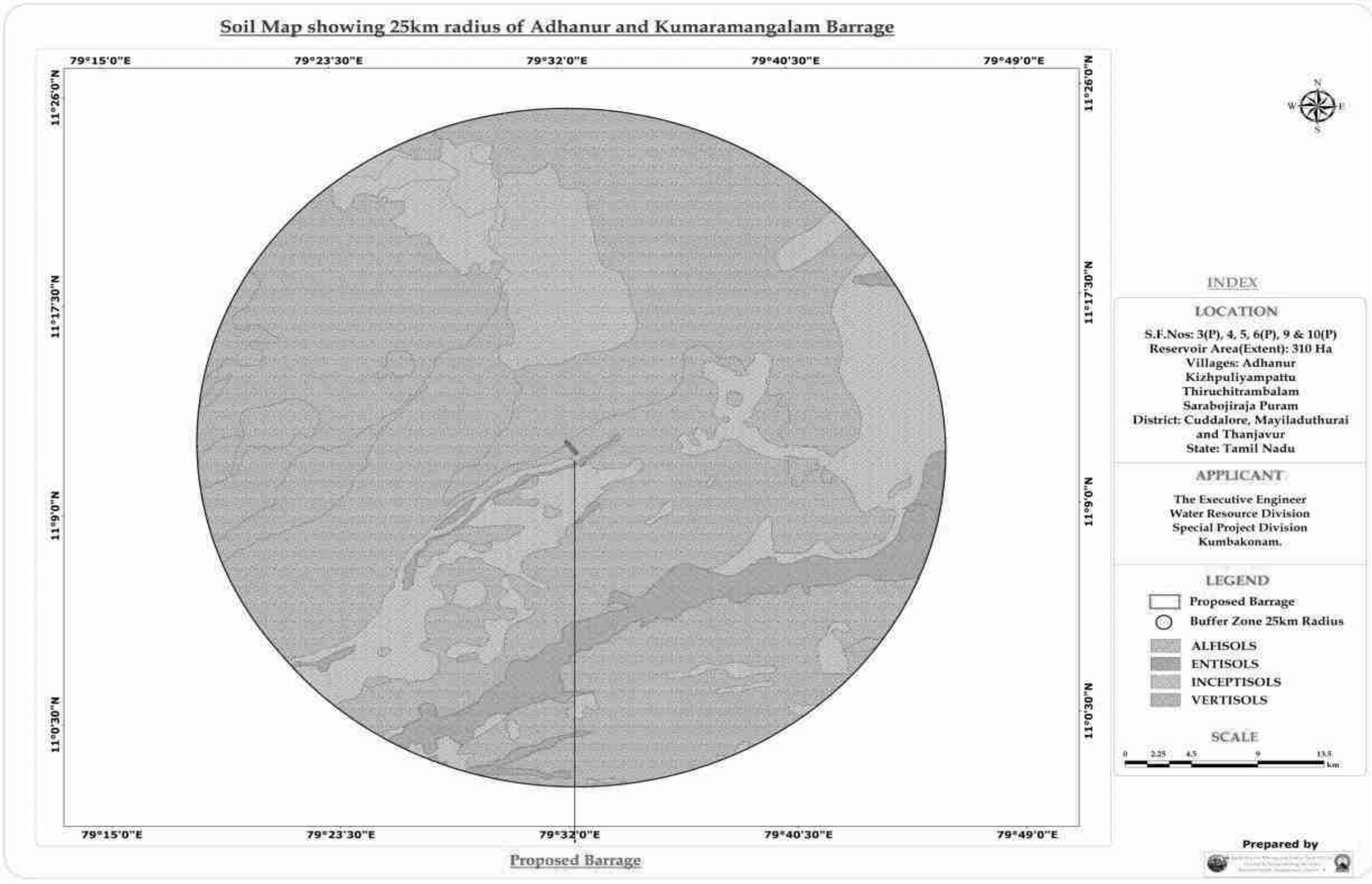


Fig No. 3.72 Image showing soil types of study area around 25km radius of proposed barrage

CHAPTER – 4: ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.0 General

Generally, the construction of barrage across the river requires ancillary construction work such as construction of canals, culverts, bridges, roads, syphon aqueduct and diversion of drainage through construction of baffle walls. The materials required for construction work are cement, coarse aggregates, fine aggregates, TMT steel bars in different diameter and metal poles used for scaffolding, paints, resins, retarders, hardeners, mould releasing agents etc. The construction work involves built up of temporary sheds with toilet facilities, transportation, unloading and stacking of construction materials, loading of excavated earth, dumping of earth, usage of DG sets etc.

It is found that all these activities disturb the environment in various ways. Therefore, it is essential to assess the impacts of construction of barrage on different environmental parameters in details to prepare sound environment management plan to imply during construction phase and post-construction phase for the sustainable environment and welfare of villages in the surrounding areas. The impacts of construction work on various environments are given below.

4.1 Air Environment

The following structures has been planned to construct in this proposed project.

a) Barrage with 72 barrage vent and 12 scour vent. The Barrage consists of
   - Surplus Regulator
   - Scour Vent.
   - Upstream Protection works
   - Downstream Protection works
   - Barrage Shutters
   - Operating Platform
b) Two lane bridges over the barrage
c) Head sluice for North Rajan Channel with 5 vents
d) Head sluice for South Rajan Channel with 3 vents
e) Formation of Channel for Narimudukku Drain
f) Two Lane Bridge over North Rajan Channel
g) Two Lane Bridge over South Rajan and Narimudukku Drain
h) Syphon Aqueduct
i) Reconstruction of Kondappan Cauvery infall Regulator

The construction work of the barrage, two lane bridges over the barrage, head sluice for North Rajan and South Rajan Channel has been completed by 90% and the formation of channel work for Narimudukku drain has been completed by 60%. The remaining work of two lane bridges over channels, syphon aqueduct and infall regulators have to be carried out. The air borne particulate matter and emissions of sulphur dioxide (SO_2), oxides of Nitrogen (NOx) contributed by diesel operated equipment and vehicles are the main air pollutant by construction activities. During operation phase, the storage of water by the barrage and discharge of water from the barrage may change weather in the surrounding area.

4.1.1. Anticipated impact on air environment during construction phase

The impacts on air environment during construction activities are given below.

1. During non monsoon seasons, the transportation of raw materials to project site through the earthen and gravel road will generate the fugitive dust. It will affect the people using that road for transportation and it also affects the growth of plants, crop plantations along the road by covering the dust over it.

2. At the project site, the unloading of construction materials, excavation of earth and loading of earth into tippers, stacking of cements and aggregates will generate fugitive dust in the environment which may travel and affects the habitations located in the predominant wind directions. Based on the meteorological data and AERMOD software, the predominant wind direction in the proposed project is from North to South and the isopleths of emissions from the project site has travel up to the distance of 8 km in south direction. There are three villages in the south side which is likely to affect by air pollution due to proposed project.

3. Workers with long term exposure to fine particulate dust are at risk of pneumoconiosis, emphysema, bronchitis, silicosis and fibrosis.

4. As the structures are planned to construct over the water bodies such as river, channels and drainages, the generated dust get deposited in the water body and it affects aquatic organisms which will disturb the ecosystem.

5. The usage of DG sets in the site and continuous operation of diesel operated vehicles and equipment will generate gaseous emission such as carbon monoxide, carbon dioxide and nitrogen oxide into the atmosphere. When those gases are emitted into the atmosphere it affects the amount of greenhouse gases, which are linked to climate change and global warming.

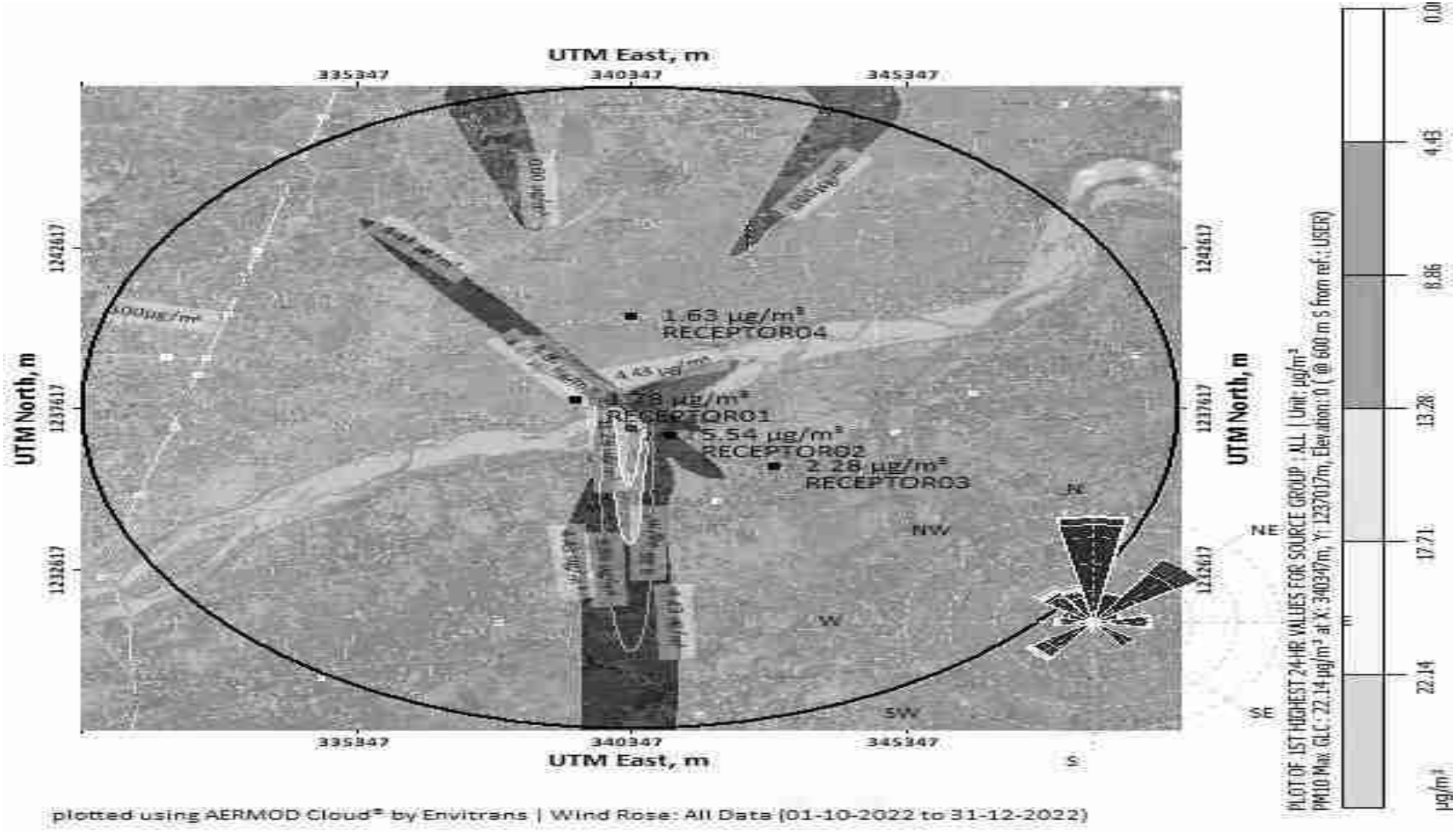


Fig No 4.1 Isopleths of PM_{10} is 22.14 µg/m^3 occurred near the project site during the combined action of unloading & transportation of raw materials during construction Phase

4.1.1.1 Mitigation Measures

During construction phase, the following mitigation measures will be followed.

- Covering of truck carrying raw material to the project site to control the dust emission from truck.
- Sprinkling of water in the gravel and earthen road during the movement of trucks for the suppression of dust.
- Covering of raw materials stored in the project site with tarpaulin to prevent dust emission due to wind movement in the site specific.
- Covering of the project site using dust control curtains at the boundary of project site to prevent the escape of dust to the adjacent agricultural lands and villages.
- Regular maintenance of tippers and other equipments for the controlled gaseous emission of CO, SO_x and NO_x.
- Provision of PPE such as mask and ear plugs to the labors worked to dust prone zone.
- The Retrofit Emission Control Device will be fitted with all DG set to control the emission of particulate matter and carbon.
- The ambient air quality will be monitored three months once to adopt the environmental management plan effectively to comply the air quality with NAAQS.
- Regular health has to be carried for the workers engaged in the project and people living adjacent to project site and in the predominant wind direction.

4.1.2. Anticipated impact on air environment during operational phase

During operational phase, the Coleroon river water will be stored in the proposed barrage to the capacity of 0.33 TMC and it is diverted towards Cuddalore and Mayiladthurai District through north and south rajan canal respectively for the irrigation purposes. The storage of water in the barrage and the discharge of water in the open atmosphere will cause evaporation of water.

When water evaporates, it rises and disperses into the surrounding air as the gaseous water vapor. Humidity is the presence of water vapor in the atmosphere. When more water evaporates in an area, the humidity in the particular area will be high.

High humidity in the area can alter the air quality. Due to high humidity, airborne pollution particles can't disperse into the atmosphere easily. Humidity holds these particles close to the ground, increasing and sustaining the levels of air pollution in the atmosphere.

High humidity can have an adverse effect on the human body. Naturally, when human body gets heat up the body releases sweat. This sweat is then evaporated from the skin, which in turn, helps to cool the human body. When the air has high moisture content this sweat cannot evaporate, leaving the body feeling hot and sticky. To cool off, our bodies must work even harder. This results in excessive sweating, increased rate and depth of blood circulation and increased respiration. Excessive sweating can cause a loss of water and chemicals that the body needs in order to function properly.

Some health risks which result from overexposure to humidity (hyperthermia) include:

- Dehydration
- Fatigue
- Muscle cramps
- Heat exhaustion
- Fainting
- Heat stroke

4.1.2.1 Mitigation Measures

- ❖ It is suggested to use the stack in sufficient height for all the industries and DG sets in houses to exhaust the flue gases to the outside air.
- ❖ If there is any mud road or non paved road, the road should be properly compacted with bull dozers to control the emission from road during any transportation.
- ❖ To overcome the effects of humidity, any people who are working continuously should take break and hydrate often. Moreover finding air conditioners or ceiling or table fan during break is better to reduce the stress level due to humidity.

4.2 Noise Environment

The impact on noise environment due to proposed project is only during construction phase. During operation phase, the storage of water will not generate major noise level. The discharge of water between sill level and shutters generate noise. The Noise survey has been conducted in the study area to assess the background noise levels in different zones. The anticipated noise level due to

proposed project has been assessed considering baseline noise level, distance involving project site to nearest village and noise generated due to proposed construction work. Following are the sources of noise in the proposed dam project.

- Vehicular Movement – tippers, heavy earth movers, concrete mixer trucks, cranes, excavators etc.
- Operation of DG sets
- Construction works – operation of concrete mixtures, operation of rod cutting and electric saw machine, shuttering works and scaffolding working, excavation of earth.

Based on the Geo physical resistivity survey conducted in the project site and in the study area, the geology of the area is identified as sedimentary formation. The 90% of the barrage work has been completed. The remaining work of two lane bridges over channels, syphon aqueduct and infall regulators have to be carried out. As the geology of the area is sedimentary formation, the foundation work and super structure work for remaining construction activities does not require blasting. The foundation work will be carried by easy excavation of earth by hydraulic excavators.

The noise level in the working environment has to be maintained within the standards prescribed by Occupational Safety and Health Administration (OSHA). These standards were established with the emphasis on reducing the hearing loss. The permissible limits, as laid down by CPCB, are presented in below Table 4.18.

Table 4.1: Permissible Exposures in Cases of Continuous Noise (CPCB)

Sound Level (dB A)	Continuous Duration (Hours)
85	8
88	4
91	2
94	1
97	0.5
100	0.25

The noise levels in many situations will be above Threshold Limit Value. Exposure to noise levels, above Threshold Limit Value may have detrimental effect on the workers' health. The adverse effects of high noise levels on exposed workers may result in Annoyance, Fatigue, Temporary shift of threshold limit of hearing, permanent loss of hearing and hypertension and high blood cholesterol, etc. The noise pollution due to this project may affect the movement of river fauna but it is unavoidable and also it will be temporary.

Table 4.2: Noise Exposure Levels & Its Effects

Noise Levels dB(A)	Exposure Time	Effects
85	Continuous	Safe
85-90	Continuous	Annoyance and Irritation
90-100	Short term	Temporary shift in hearing threshold, generally with complete recovery
Above 100	Continuous	Permanent loss of hearing
100-110	Several years	Permanent deafness
110-120	Few months	Permanent deafness
120	Short term	Extreme discomfort
140	Short term	Discomfort with actual pain
150 and above	Single exposure	Mechanical damage to the ear

Source: Hand Book of EIA, Rao & Wooten

4.2.1 Anticipated noise level in core zone and buffer zone due to construction activity

The likely generations of noise levels due to operation of truck, excavator, cranes are given in Table 4.26.

Table 4.3: Expected Noise Levels

Equipment's	Expected Noise Levels dB(A)
Tipper	75-80
Excavators	85-90
Cranes	90-95

Predicted noise levels due to construction activity using Mathematical Equations

$L_2 = L_1 - 20 \log_{10} (R_2/R_1)$ Where L_1dB (A) = Noise level at a distance R_1 (m)
L_2dB (A) = Noise level at a distance R_2 (m) &
$L = 10 \log_{10} (10^{L_1/10} + 10^{L_2/10} + \text{---------- } + 10^{Ln/10})$
Where L_1, L_2 and Ln are noise level dB (A)

Table 4.4: Predicted Noise levels in Core Zone and buffer zone

Location Code	Distance km	Source Noise Level, dB(A)	L(Day) dB(A)	L(Night) dB(A)	Noise level at Receptor from construction activity dB(A)	Resultant noise level, dB(A) day time	Resultant noise level, dB(A) Night time
Core Zone	--	80	42.5	40.7	80	80.0	40.7
Left bank of the river	0.08	80	41.8	39.2	65	65.0	39.2
Right bank of the river	0.08	80	43.5	41.6	65	65.0	41.6
Nattarmangalam (N)	8.8	80	47.5	43.4	24.2	47.5	43.4
Periyapogene (NW)	5.2	80	43.4	39.6	28.7	43.5	39.6
Palavaykandan (NW)	3.8	80	45.1	41.3	31.5	45.3	41.3
Pandanallur (SW)	6.5	80	44.8	40.5	26.8	44.8	40.5
Thiruchitrambalam (SW)	2.5	80	46.5	42.8	35.1	46.8	42.8
Manalmedu (SE)	5.7	80	48.1	43.9	27.9	48.1	43.9

Green colour- Baseline Value, Red Colour – Noise level due to Construction, Blue colour- Baseline + Noise level due to mining

Although the noise level due to the operation of various construction activities is 80dB(A), the noise level at different receptors is lower due to the distance involved and other topographical features adding to the noise attenuation. The calculated values at the receptors and resultant noise level are based on the mathematical formula as mentioned above.

To overcome the noise pollution due to construction of barrage the following mitigation measure should be followed.

4.2.2 Mitigation measures for Control of Noise

The following noise mitigation measures are proposed for control of Noise.

- Use of personal protective devices i.e., earmuffs and earplugs by workers, who are working in high noise generating areas.
- Limiting time exposure of workers to excessive noise.
- Proper and regular maintenance of vehicles, machinery and other equipments.
- The noise generated by the machinery will be reduced by proper lubrication of the machinery and other equipments.
- Speed of trucks entering or leaving the site will be limited to moderate speed to prevent undue noise from empty vehicles.

- Providing proper noise proof enclosure for the workers separated from the noise source and noise prone equipment
- Provision of Quiet areas, where employees can get relief from workplace noise.
- Regular medical check–up and proper training to personnel to create awareness about adverse noise level effects.
- During operational phase, the noise generated during discharge of water between sill level and shutters will be controlled by greenbelt development on both sides of river banks.

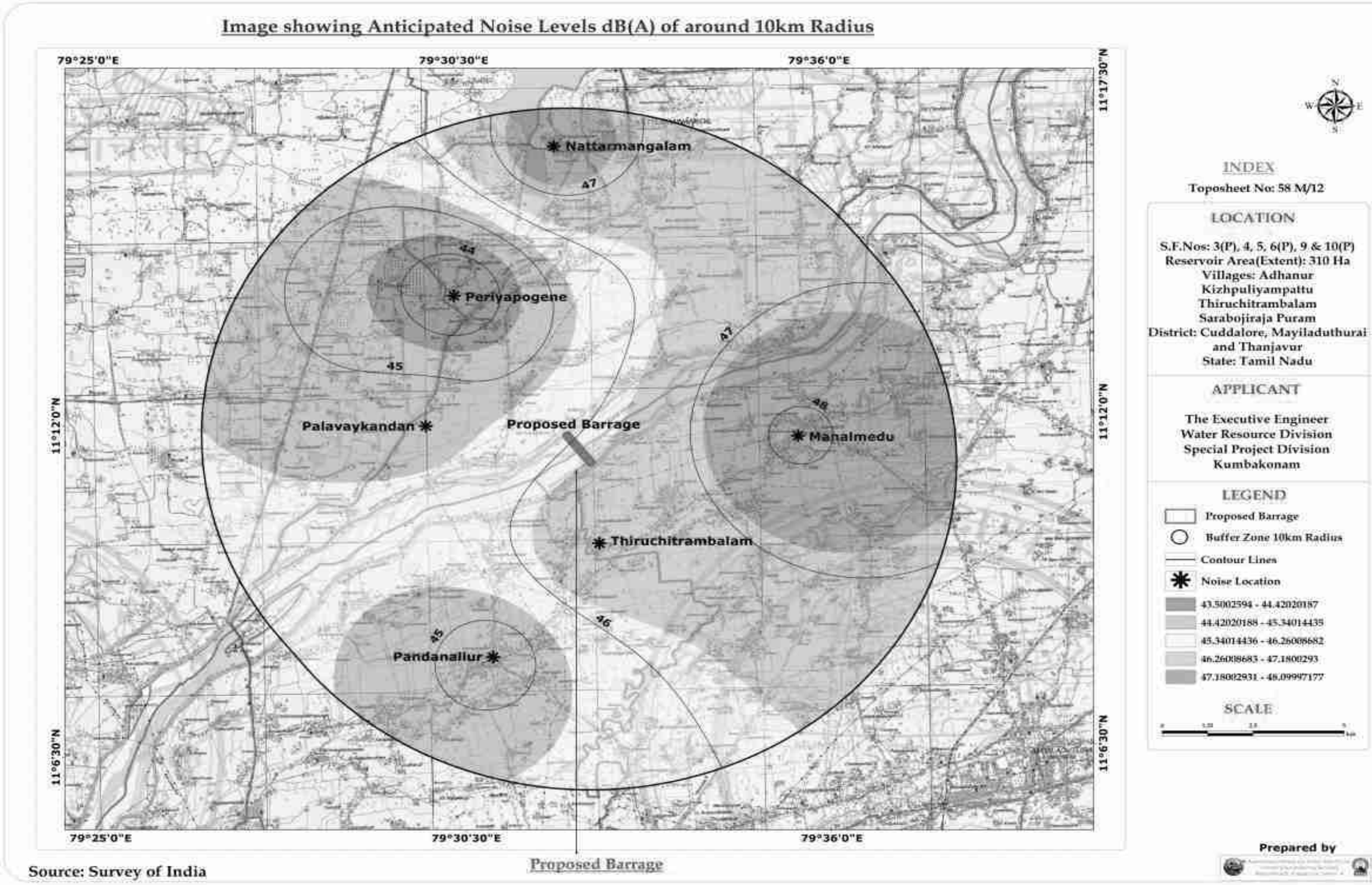


Fig 4.2: Noise dispersion in Buffer zone due to proposed construction activity of barrage

4.3 Ground Vibrations

Ground vibration in construction works are anticipated due to operation of excavators, wheel loaders, transportation vehicles, drilling and blasting etc. However, the major source of ground vibration is blasting. Blasting activity in the construction work is required for blasting rock situated above/beneath the ground to carry out basement work and superstructure work. As the geological formation of the project area is sedimentary, blasting activity is not required for the proposed project. The ground vibration due to movement of heavy earth machinery will be very less and temporary during construction phase only.

4.4 Water Environment

The barrage construction and its ancillary work affect the ground water as well as surface water quality in several ways. The ground water quality is affected when the rain water infiltrates into the ground along with surface materials. The diversion of natural drains for the proposed project indirectly affects ground water level, agricultural activity and aquatic ecosystem. The impact of this project on ground water and surface water resources has been given detail below.

4.4.1 Impact on ground water during construction phase

The depth of ground water table in the river water body is identified as 6 to 7m. As the soil bearing capacity is low in river bed, the raft foundation has been selected for the construction of barrage. The raft foundation is the type of shallow foundation. The longitudinal cut off wall below the raft foundation has been laid with the depth of 5.0m in upstream side and 9.0m in downstream side and they are connected by cross cut off wall. Longitudinal cut-off walls safeguard the structure from scour whereas the cross-cut-off walls keep the longitudinal cut-off walls in position.

The foundation work intersects the ground water table and it disturbs the flow of ground water. During the construction of bridge over north rajan and south rajan channel, the same thing will be happened. However, the ground water will find route to flow as the geological formation of the area is sedimentary.

As coffer dam was used during the foundation work, the ground water and surface water quality was not affected by usage of cement or any other chemicals used for construction. The stacking of raw materials such as cement and other building materials such as paints, resins, retarders, hardeners, mould releasing agents etc on the open land affects the soil quality and it indirectly affects the ground water quality when the surface water infiltrates into the ground along with surface materials. The

spillages of materials in the construction place will affect both surface and ground water and soil qualities. To overcome the above issue, the mitigation measure given below has to be followed.

The desiltation of sand (shoal) for increasing the water holding capacity of the dam widely affects the ground water table in the villages adjacent to the proposed barrage.

4.4.1.1 Mitigation measure to protect the ground water quality during construction phase.

All the raw materials should be stacked over the impervious layer and it should be covered with rain proof materials along the bank of river. During construction activities, only the required materials have to be shifted to working place (river bed) and it should be placed over impervious layer to protect the ground water quality. Tarpaulin has to be placed over the river bed and other ground surface to carry the spillages.

The desiltation of sand (Shoal) in the proposed barrage may temporarily reduce the ground water level in the adjacent villages but during the operational phase the water stored in the barrage will dramatically increase the ground water level in the adjacent area.

4.4.2 Impact on ground water during operational phase

During operational phase, the storage of water in the barrage will raise the ground water level along the river bank upto 1 to 2m from the present water level. The discharge of water through north and south rajan channel will raise the water level in the 9159 Ha of cultivable command area.

Ground water recharge during water supply in the unlined channel

The north and south rajan channel is unlined channel which pass over the Cuddalore, Thanjavur and Mayiladuthurai Districts. Before reaching the proposed cultivable command area from proposed barrage, the north rajan and south rajan channel travel upto the distance of 27km and 41km respectively. Within the cultivable command area, the length of the north rajan and south rajan channel is 28.1km and 13.1km respectively.

Calculation of recharge from Channel (As per CGWB, Ministry of Water Resources, Govt. of India, 2009)

a) Ground water recharge due to water supply in north rajan channel between proposed barrage and cultivable command area.

1) Wetted perimeters = 2 x 0.6 x depth of flow/ sin(slope angle) + base width

Depth of flow = 2m

Base Width = 12m

Slope angle = 60°

Wetted perimeters = 2 x 0.6 x 2/ sin (60°) + 12
= 14.75 m

2) Wetted area in million square meter = wetted perimeters in meter x Length of the channel /10^6

Wetted perimeters in meter = 14.75m

Length of the channel = 27000m

Wetted area in million square meter = 14.75 x 27000/10^6
=0.4 million m^2

3) Recharge from channel segment in hectare meters = channel seepage factor x Wetted area in million square meter x Number of days the canal segment is in operation

The channel seepage factor for channel type -unlined and for soil type – Normal soil is 15 to 20 but in the case of channels located in shallow water table and water logged area the seepage factor may be suitably reduced. As the north rajan channel between barrage and proposed CCA is lying close to Coleroon River, the seepage factor is taken as 5.

Wetted area in million square meter for north rajan channel = 0.4 million m^2

Number of days the canal segment is in operation = 51days

The No. of days of discharge of water in channel is based on the maximum discharge in channel and requirement of water for paddy crop. The requirement of water for one cycle of paddy crop plantation in Cuddalore district is 3273 Mcft (including evapotranspiration) or 181.8 Mcft/day and the maximum discharge of water per day is 64.4 Mcft

Recharge from canal segment (North Rajan) in hectare meters = 5 x 0.4 x 51

= 102Ha.m

= 1020000 m^3 or 36 Mcft

For two periods, it will be 72 Mcft. During one cycle of paddy cultivation there is seepage or loss of 36 Mcft of water however it enhances the ground water table in that particular area.

b) Ground water recharge due to water supply in north rajan channel within cultivable command area.

1) Wetted perimeters = 2 x 0.6 x depth of flow/ sin(slope angle) + base width

Depth of flow = 2m

Base Width = 12m

Slope angle = 60°

Wetted perimeters = 2 x 0.6 x 2/ sin (60°) + 12

= 14.75 m

2) Wetted area in million square meter = wetted perimeters in meter x Length of the channel /10^6

Wetted perimeters in meter = 14.75m

Length of the channel = 28100m

Wetted area in million square meter = 14.75 x 28100/10^6

=0.41 million m^2

3) Recharge from channel segment in hectare meters = channel seepage factor x Wetted area in million square meter x Number of days the canal segment is in operation

As the north rajan channel within proposed CCA is away from Coleroon River and also the water table in that area is shallow, the seepage factor is taken as 10.

Wetted area in million square meter for north rajan channel = 0.41 million m^2

Number of days the canal segment is in operation = 51days

Recharge from canal segment (North Rajan) in hectare meters = 10 x 0.41 x 51

= 209Ha.m

= 2090000 m^3 or 74 Mcft

For two periods, it will be 148 Mcft

The recharge of 74 Mcft of water in the cultivable command area can be withdrawn through bore well and will be used for agricultural purposes.

c) Ground water recharge due to water supply in south rajan channel between proposed barrage and cultivable command area.

1) Wetted perimeters = 2 x 0.6 x depth of flow/ sin(slope angle) + base width

Depth of flow = 2m

Base Width = 12m

Slope angle = 60^{o}

Wetted perimeters = 2 x 0.6 x 2/ sin (60^{o}) + 12

= 14.75 m

2) Wetted area in million square meter = wetted perimeters in meter x Length of the channel /10^6

Wetted perimeters in meter = 14.75m

Length of the channel = 41000m

Wetted area in million square meter = 14.75 x 41000/10^6

=0.6 million m^2

3) Recharge from channel segment in hectare meters = channel seepage factor x Wetted area in million square meter x Number of days the canal segment is in operation

As the south rajan channel between barrage and proposed CCA is lying close to Coleroon River, the seepage factor is taken as 5.

Wetted area in million square meter for north rajan channel = 0.6 million m^2

Number of days the canal segment is in operation = 25days

The No. of days of discharge of water in channel is based on the maximum discharge in channel and requirement of water for paddy crop. The requirement of water for one cycle of paddy crop plantation in Mayiladuthurai district is 1377.6 Mcft (including evapotranspiration) or 76.5 Mcft/day and the maximum discharge of water per day is 55.3 Mcft

Recharge from canal segment (South Rajan) in hectare meters = 5 x 0.6 x 25

= 75Ha.m

= 750000 m^3 or 26 Mcft

For two periods, it will be 52Mcft. During one cycle of paddy cultivation there is seepage or loss of 26 Mcft of water however it enhances the ground water table in that particular area.

d) Ground water recharge due to water supply in south rajan channel within cultivable command area.

1) Wetted perimeters = 2 x 0.6 x depth of flow/ sin(slope angle) + base width

Depth of flow = 2m

Base Width = 12m

Slope angle = 60^{o}

Wetted perimeters = 2 x 0.6 x 2/ sin (60^{o}) + 12

= 14.75 m

2) Wetted area in million square meter = wetted perimeters in meter x Length of the channel /10^6

Wetted perimeters in meter = 14.75m

Length of the channel = 41000m

Wetted area in million square meter = 14.75 x 13100/10^6

=0.2 million m^2

3) Recharge from channel segment in hectare meters = channel seepage factor x Wetted area in million square meter x Number of days the canal segment is in operation

As the south rajan channel within proposed CCA is away from Coleroon River and also the water table in that area is shallow, the seepage factor is taken as 10.

Wetted area in million square meter for north rajan channel = 0.2 million m^2

Number of days the canal segment is in operation = 25days

Recharge from canal segment (South Rajan) in hectare meters = 10 x 0.2 x 25

= 50Ha.m

= 500000 m^3 or 18 Mcft

The recharge of 18 Mcft of water in the cultivable command area can be withdrawn through bore well and will be used for agricultural purposes.

The ground water recharge due to seepage from the channel increase the quality of ground water by diluting the concentration of Total dissolved solids. The TDS in ground water was found to be 530-3006 mg/l which is beyond acceptable limits and even permissible limit of 2000mg/l. The TDS in river was found to be 314 to 320 mg/l which is within the acceptable limits of 500mg/l. When the channel seepage infiltrates and reaches the water table, the concentration of TDS will be reduced. Likewise, the soil in the agricultural land of both Cuddalore and Mayiladuthurai

district is having high pH and electrical conductivity due to insufficient of irrigation water from the Anaicut dam. This will be rectified by the proposed project. During operational phase, it is found there will be only **positive impact on the ground water** in the proposed area.

4.4.3 Impact on surface water environment during construction phase

The water required for construction of barrage and other structures has been withdrawn from bore well and no river water was used for any purposes during construction work. The flow of river water was diverted without affecting any aquatic organism during construction of each pier and each segment of raft foundation. Hence Coleroon River water resources and its quality has not been affected by this project.

The bridge over the north rajan and south rajan channel will be constructed during summer season when the flow of channel water is nil.

Narimudukku drain is the only drain located 1.6km away from the proposed barrage in the upstream side. Since the barrage was proposed, it was planned to be diverted and taken to downstream of the barrage. The diversion of Narimudukku drain was done by constructing P.C.C baffle wall in the middle of south rajan channel upto the distance of 1700m. At 1800m, the drain crosses the channel through syphon aqueduct with four vents and runs further 200m to infall into Coleroon through Kondappan Cauvery Infall Regulator. The baffle walls upto 1700m was constructed during non monsoon season without affecting flow of channel water and its quality. The construction of syphon aqueduct is still under process without affecting the flow of water.

The diversion of natural drainage to the south rajan channel activity affects the ground water level in that particular area and also it causes the migration of aquatic habitants to new ecology. It is found that the land use along the south rajan channel is agricultural land. The diversion of drain into the channel will increase number of days and quantity of water flow which supports the agricultural activity along the channel.

Narimudukku drain is the natural drain which supports various aquatic flora and fauna for that's livelihood. The dense flora in the drain provides habitation and food for the aquatic fauna. As the south rajan channel is also natural water ways the diversion of drain into channel will not affect the aquatic fauna migrate from Narimudukku drain. Finally the drains will infall into Coleroon River 2km away from the previous place by crossing the channel through syphon aqueduct.

4.4.4 Impact on surface water environment during operational phase

There are no surface water bodies such as lakes and ponds found within cultivable command area of Cuddalore and Mayiladuthurai Districts. The purpose of the proposed barrage is to store and divert the surplus water from Lower Anicut barrage to irrigate CCA of two districts.

4.4.4.1 Recommendations

The north rajan channel with the length of 55.1 km and south rajan channel with length of 54.1km has to be desilted every year before discharge the river water into each channel. Bushes which are obstacles to water flow and garbage which will cause water pollution has to be cleared periodically.

4.5 Soil Environment

4.5.1 Impact on Soil Environment during Construction Phase

The storage of construction materials directly on the soil surface will affect the soil quality in that particular area and during rainy season, the leachate from storage affect the soil quality in the surrounding areas. It indirectly leads to ground water and surface water pollution. As the major land use around the project site are agricultural activity the leachates affects the growth of crop plantations.

The sand is deposited upto the depth of 3m below theoretical bed level and below 3m depth, clay and gravel are deposited. For the construction of raft foundation and construction of cut off wall below the raft foundation upto the depth of 5m in downstream side and 9m in upstream side, sand and deposit below sand were excavated. The excavated sand was dumped in the deepest bed level of Coleroon River and the excavated silt, gravel and clay were dumped along the river bed. It will be used for strengthening of river banks in upstream side of proposed barrage.

4.5.1.1 Mitigation Measure

- All the construction materials should be stored on impervious layer and it should be covered with rain proof materials.
- The dumping of sand over the deepest bed level should be properly leveled and the silt, gravel and clay properly stacked without affecting the flow of river water.
- Part of mineral rich soil has to be used for green belt development in the earmarked site.

4.5.2 Impact on Soil Environment during operation Phase

The primary purpose of proposed barrage is to irrigate river water to cultivable command area of Cuddalore and Mayiladuthurai Districts. The irrigation water tends to dissolve the nutrients present in the soil of a crop field to form a Solution. This Solution of nutrients is then absorbed by the roots of crops for the development of the plants.

Irrigation provides soil moisture for good plant growth throughout the growing season. The proposed project provides sufficient water for irrigation which leaches out salts present in soil. The microbial community is an essential component of the soil and plays an important role in maintaining the ecological functions of the soil. It is directly involved in nutrient cycling, energy flow, and degradation of organic matter. Maintaining the complexity and diversity of soil microbial communities is critical to the sustenance of soil fertility because soil microbes mediate the biogeochemical cycles of carbon and nitrogen, and serve as important reservoirs for plant nutrients. Scarcity of water reduces soil organic carbon, thereby altering the soil microbial community structure. The richness and evenness of bacteria is increased with an increase in the soil relative water content. Therefore, irrigation of sufficient water plays an important role in the soil bacteria community which supports growth of crops. During operational phase, the proposed project has **positive impact on the soil environment.**

4.5.2.1 Recommendation

In the operation phase, the maintenance works involves white wash, painting of barrage, bridges, infall regulators, syphon aqueduct, baffle walls, lubrication of gearing shutters etc. During these works, the spillages will affect the quality of soil. So, it is suggested to use water proof tarpaulin on the soil surface during such works to protect the soil environment from spillages. The waste oil generated from DG sets and during maintenance of other equipment should be stored in MS drums and collected by the authorized recyclers for recycling and reuse.

4.6 Impact of Solid Waste Generation during construction phase

4.6.1. Construction Waste

The solid waste generated during construction phase are soil, sand & gravel, brick & masonry, concrete, metals, bitumen, wood etc. According to Technology Information, Forecasting and Assessment Council's (TIFAC), solid waste of 40-60kg per sq.m will be generated for the new construction. The dumping of waste into the river body affects the quality of water, flow of river water and river carrying capacity. The project

proponent has disposed the solid waste generated during construction of barrage and construction of head sluice for north and south rajan channel as per Construction and Demolition Waste Management Rules 2016. For the remaining construction work, the following mitigation measures should be followed.

4.6.1.1 Mitigation Measures.

As per Construction and Demolition Waste Management Rules 2016, the mitigation measures are given below.

No solid waste should be dumped along the river bank, natural drains, public places, road side, wet lands for making plots. All the solid waste should be sold to authorized recyclers and recycled materials can be used for remaining construction work. Uses of various recycled construction materials are given below.

- From the waste concrete, aggregates can be recycled which will be used in plain concrete, reinforced concrete and lean concrete as coarse aggregates.
- Broken bricks can be used for manufacturing debris paver blocks.
- Recycled Stone can be reused for plinth formation, masonry construction, and landscape purpose.
- Ferrous Metals are the most profitable and recyclable material. Scrap steel is almost totally recycled and allowed repeated recycling. Structural steel can be reused as well as 100% steel can be recycled to avoid wastage at construction site.
- Construction debris can be recycled to manufacture paver blocks which can be used in light traffic areas and masonry blocks. The access road from power room to barrage and from security room to barrage can be done by using paver blocks. It gives aesthetic view around the barrage.

4.6.2 Other Municipal solid waste

Totally 300 numbers of labors and 30 numbers of skilled persons were involved in the construction of barrage. Out 300 persons, 150 were engaged from nearby villages and towns. The labour shed, office rooms and toilet facilities were made by semi permanent structures along the both sides of river bank. The municipal solid waste such as clothing, bottles, food scraps, newspapers, plastic carry bags, use and through cups, water canes etc has been collected and segregated into biodegradable and non-biodegradable in the separate bins. The collected biodegradable wastes were disposed through nearby village garbage collector and non-biodegradable wastes were sold to authorized recyclers. The latrine wastes were treated by septic

tanks built near to toilet rooms and cleared periodically once it attained its capacity. The same will be followed during remaining period of construction. The total generation of biodegradable waste and the non-biodegradable waste is estimated and given below. As per Central Public health and Environment Engineering Organization (CPHEEO), the quantity of solid waste generated varies from 0.2-0.6 kg / day.

Table 4.5 Solid Waste Generation during Construction Phase

Total number of labors and skilled workers	Waste generation per capita (kg/day)	Total solid waste generation (kg/day)	Total Biodegradable Waste Generation (kg/day)	Total Non-Biodegradable Waste Generation (kg/day)
330	0.2	66	40	26

4.6.2.1 Mitigation measures

- The board has to be placed in the entire construction site, near to labor shed mentioning not to use one time usage plastic materials in Tamil, English and Hindi languages.
- Board mentioning "use garbage bin" should be placed in random places.
- Sufficient number of Bins for biodegradable waste and non biodegradable waste should be placed at the convenient places.
- Septic tank should be monitored periodically to clean the septic tank once it attains its capacity.

4.7 Impact of Solid Waste Generation during operational phase

During maintenance work in operational phase, no solid waste will be generated. Nearly 5 persons will be employed at the barrage for monitoring and operation of barrage. So, the generation of municipal solid waste will also be less.

4.8 Impact of Hazardous materials and its waste during construction and operational phase

The hazardous waste generated during construction phase and maintenance works in operational phase are lead, asbestos, paint thinners, fluorescent bulbs, and etc. The health issues related to hazardous materials are given below.

- The exposure to lead causes nervous system, kidneys, blood forming organs, and reproductive system if inhaled.
- Asbestos materials present a risk to your health when the fibres become airborne. When the asbestos are cut during construction work, the inhalation of dust causes lung cancer.
- Inhalation of harmful vapor from Paint thinner leads to respiratory irritation, dizziness, nausea, and headaches.
- Fluorescent bulbs contain mostly mercury vapor, but can contain small amounts of liquid mercury. The nervous system and kidneys are sensitive to mercury exposures.

4.8.1 Mitigation measures

- Face shield, gloves, aprons and boots should be used while handling materials. The required number of PPE has to be made available during construction and operational phase.
- The hazardous waste should be stored in separate room and locked from unauthorized entry.
- The storage box should be labeled with appropriate hazardous waste label.
- Portable fire extinguishers and fire control equipment, including special extinguishing should be made available at the storage area.
- The storage area should be under surveillance through authorized person and camera.
- At the end of work Hazardous waste & other wastes shall be sent or sold to an authorized actual user or disposed in an authorized disposal facility only as per Hazardous Waste Management Rule 2016.

4.9 Ecology and Biodiversity

4.9.1 Impact on Ecology and Biodiversity

The details and list of flora, fauna, reserved forest and cropping pattern within the 10km radius of study area is given in chapter 3. The impact on ecology and biodiversity due to the proposed barrage project has to be studied in detail to prepare the management plan to safeguard the flora, fauna, forest products and aquatic living organism etc.

A detailed anticipated impact of Ecology and Biodiversity due to proposed is described in Table 4.36.

Table 4.6: Ecological Impact Assessments

Ecological Criteria	Identified Impacts	Ecological significance of Impact	Magnitude	Duration /Timing/ Frequency	Reversibility	Mitigation	Cumulative Impact
Zone of Influence	**Project site Habitat due to Site Clearance.**	The proposed barrage is located located in Coleroon River. Only few shrubs were cleared at the river banks. No endangered flora and fauna found within project zone. The fauna depends on the flora will be affected for their habitations. No clearance of vegetation in the buffer zone	**Low Impact**	During the construction activity only.	**Reversible**	The fauna depends on flora to be cleared will find the habitation adjacent to the proposed barrage. Moreover Project Proponent is planned to develop green belt along the river banks and in nearest villages	**No Cumulative Impact**
Zone of Influence	**Ecological Impact Surrounding habitat due to fugitive emission**	The fugitive emission due to the construction activities such as unloading and handling of raw material, transportation on the haul road will be deposited on the flora and crops adjacent to project site which affects growth and its productivity. No fugitive emission will be generated during operation phase of barrage.	**Temporary Impact**	During the construction activity only.	**Reversible**	Before unloading the sand and aggregate, it will be moisturized to minimize the emission. The sprinkling of water over the exposed ground will be done. The transportation vehicles will be maintained and serviced Properly.	**No Cumulative Impact**
Accessibility	**Ecological Impact due to road construction**	The bitumen road along both the bank rivers will be formed upto to lower Anaicut from the proposed barrage for the inspection purposes. The external roads already exist for transportation of raw materials and products.	**Positive impact – easy movement of vehicle**		-	-	**No negative Impact**
Zone of Influence	**Ecological Impact on Surrounding/ Eco sensitive habitat due to waste water generated from the project activity.**	Water has been used for concrete mixing and curing of concrete only during construction phase. Municipal waste water will be generated due to the workers during both the phase.	**No Impact**	-	-	Domestic Sewage will be properly treated by septic tank and soak pit in the project site and dispose periodically or as per MOEF&CC and TNPCB guidelines.	**No Impact**

Zone of Influence	**Ecological Impact on Surrounding / Eco sensitive habitat due to Noise generated from the project activity.**	It is found that there is no Reserve Forest, Protected Forest and Wildlife Sanctuary within 10km radius of Barrage. The noise generated by continuous movement of trucks, construction activity affects the movement of faunas and normal life of people in the surroundings.	**Low impact**	During the construction activity only.	No	Regular maintenance of vehicles and machineries by proper lubrications. All the sound producing will be put in closed chamber with silencers. The unnecessary horns sound produced by vehicles will be avoided.	**Mild impact**
Zone of Influence	**Ecological Impact On Surrounding/ Eco sensitive habitat due to Transportation**	Due to proposed project, the increase of traffic will be expected in the existing road which affects the movement of fauna. Those fauna will be get accident due to truck movement.	**Moderate**	During the construction activity only.	No	The truck driver will be advised to drive the vehicle within speed as per sign board placed along the road. The high sound and unnecessary horns will be avoided.	**Mild impact**
Zone of Influence	**Ecological Impact on Natural ecosystem, the soil micro flora and fauna and soil seed banks.**	The construction of barrage, bridges, baffle walls, head sluice has been carried out in the water bodies. The excavation of soil for foundation work affects the soil micro flora and fauna.	**High impact**	Temporary during construction phase only	--	During construction phase it is unavoidable. It will be restored automatically once the construction work is completed.	**Temporary impact**
Zone of Influence	**Fish habitats and the Food web/food chain in the water body and Reservoir**	As said above, the construction work has been carried out in water bodies. As the flow of water in river was diverted, the construction activity does not affect the river fauna directly. However it disturbs the habitation of fishes. During operation phase, the water stored in the barrage provides habitation for fishes and other aquatic organisms. The fish culture in the barrage provides both a food source and an extra source of income to supplement those who live in these regions.	**No Impact**	Nil	--	--	**No Impact**

4.9.2 Green Belt Development of the Proposed Project

The plantation will be done along the river banks, village roads. The green belt plan for the proposed cement is given in below table

Table 4.7: Afforestation Plan of the Proposed Cement Plant

Period	Place	Type of Trees	Number	Rate of survival
Within 3 Years after the commencement of project	River banks, Village roads, along the both channels	Eucalyptus -250 Ashoka Tree -250 Neem – 250 Badham -250	1000	80%

4.10 Socio Economic

4.10.1 Anticipated Impact during construction phase

The proposed barrage project provides job opportunities of 300 people in construction phase. Out of 300 people, 150 people from the surrounding village have been benefited. The living standard of the nearest village people is getting increased since inception of this project. Until the completion of this project, preference will be given to the local population for employment in all categories including semi-skilled and unskilled.

For executing this project, both the patta and poramboke land in both the bank river has been acquired. The details are given below.

Table No 4.8 Land Acquisition Details-Left Bank

Sl. No	Name of Village	Patta in Ha.	Porampokae in Ha.
1	Adhanur	11.73	8.935
2	Kilpuliyampattu	0.955	3.965
3	Eyyalur	-	7.47
4	Achalpuram	25.885	21.385
5	Sirukattur	2.865	7.070
Total		**41.435**	**48.825**

Table No 4.9 Land Acquisition Details-Right Bank

Sl. No	Name of Village	Patta in Ha.	Poramboke in Ha.
1	Thiruchitrambalam	6.04	-
2	Sarabojirajapuram	22.15	1.02
3	Kulasekaranallur	6.505	-
4	Mullangudi	14.835	0.05
5	Thittacherry	12.11	0.045
	Total	**61.64**	**1.115**

Table No 4.10 Land Acquisition Summary

Sl. No	Description	Patta in Ha.	Poramboke in Ha.
1	Left Bank	41.435	48.825
2	Right Bank	61.64	1.115
Total		**103.075**	**49.94**

4.10.1.1 Mitigation Measures

The Government has accorded Administrative approval for the scheme and administrative sanction for land acquisition charges for Rs 31.3457 crore vide GO (Ms) No 48 dated 23.02.2018.

4.10.2 Anticipated Impact during operational phase.

The water stored in the barrage of 0.334 TMC will recharge the ground water table in the surrounding villages which improves the agricultural activity in the villages. On contract basis, each year different people can invest money on fish culture in the barrage. It provides employment to many people in the village throughout the year.

During discharge of water through north and south rajan channels to proposed cultivable command area, the paddy and pulse cultivation will be increased dramatically. The fish culture activity and improved agricultural activity improves the economic and living standard of the people living along the barrage and in CCA. The increase in production of paddy and pulses may help to eradicate the poverty and starvation throughout the country. The detailed impact on crop cultivation is given in Clause 4.14

The impact of barrage is inundation of nearest agricultural land if the dam is broken unfortunately.

It is small barrage constructed across River Coleroon with water holding capacity of 0.334 TMC. The water stored in the barrage is within the river banks only. The details of water level, bed level are given in below table.

Table No: 4.11 Levels in the barrage site.

S.No	Particulars	Levels	Unit
1	River Bed Level	+9.5	m
2	Crest level	+10.0	m
3	Water storage level	+13.05	m
4	Bund level (right)	+17.475	m
5	Bund level (left)	+17.430	m

The level of both the bank is 4.4m higher than the water storage level. Hence breakage of barrage will not submerge the agricultural land in the surrounding. As the width of river in the downstream side also more than 1000m, water will easily find the way to flow within the river during breach of barrage. However the stability of the Barrage has been designed well to withstand the flood for more than 100 years.

4.10.2.1 Mitigation Measures

- The barrage and head sluice of north and south rajan should be maintained yearly once. The rope of shutters, gear mechanism for lifting the shutter should be checked.
- The desilting of barrage below the level (+9.50m) should be avoided to maintain the stability of foundation.
- The WRD staffs should be engaged in the barrage all days to monitor the storage of water in the barrage and movement of vehicles over the bridge.
- Danger boards should be placed around the barrage to not to swim in the water body and not to take photographs near the parapet wall.
- During flood season, before discharge river water into the river and channels, the announcement has to be made to alert the public people.
- The sewage of village should not be discharged into the water body.
- The stability of Kumaramangalam Water intake located at 140m away from proposed barrage should be inspected periodically.

4.11 Land Environment

4.11.1 Anticipated Impact on Land Use / Land Cover during construction phase and operational phase

The land use of the project site is water body as river. The Lower Anicut is located 11km away in the upstream side of proposed barrage. The surplus water from the Lower Anicut drains into the sea as waste. To utilize the surplus water for stabilizing Ayacuts of 9159 Ha in Cuddalore and Mayiladuthurai Districts, a barrage across River Coleroon with Head sluices is proposed. The proposed low head diversion dam(barrage) store the water of 0.334 TMC and divert the water through north rajan and south rajan channel for irrigating proposed CCA of 9159 Ha and the excess water will automatically drain into the Coleroon River by surplus over the sluice of barrage. The land use of river water body will remain river; only the part of water will be stored and diverted for irrigation purposes.

In the cultivable command area, due to insufficient irrigation water, most of the lands are seen without agricultural activity. During the operational phase of barrage, those lands will be cultivated with paddy, pulses and with other regional crops. Hence land use of CCA will remain agricultural land but all the land gives greenery looks.

There will be no negative impact on land environment due to this project.

4.12 Occupational Health Risks

4.12.1 Anticipated Impact

Occupational health and safety hazards occur only during the construction phase of barrage.

Excessive dusts, noise, falls, electrical and hazardous substances are the chief health hazards. Exposure to fine particulates is associated with work in most of the dust generating stages in construction of barrage. Workers with long term exposure to fine particulate dust are at risk of pneumoconiosis, emphysema, bronchitis, silicosis and fibrosis. Precautions would be adopted to prevent dust generation at site and dispersing in the environment. Occupational Safety hazards related to noise generation may result in following problems, if not properly mitigated.

Problem on human due to noise generation

1. Hearing Impairment

2. Interference with Spoken communication
3. Decrease in efficiency
4. Lack of concentration
5. Fatigue
6. Disturbance in mental health
7. Temporary or permanent Deafness

Diseases caused by noise pollution

1. High BP
2. Heart Attack
3. Deafness
4. Stress
5. Anxiety

Physical injuries during construction project are related to near slips and falls. Other injuries may be due to contact with or capture in, moving machinery like trucks, loaders and other equipment in the construction site etc. Contact with electrical wiring without casing and insulation causes severe injury and even to death. All the workers involved in the construction activity should be insured and be conducted health check up six month once health status of workers will be submitted along the EC compliance to TNPCB or as per MOEF&CC guidelines.

Table No 4.12 Plan and fund allocations towards occupational health & safety of the workers by contractor

Frequency of Health Examination	Total Workers	Fund allocated for Health Check up
Six months once	300	6.0 Lakhs

4.12.2 Mitigation measures

For the safety of workers at site, the following mitigation measures are proposed

- Regular inspections of the site and the machineries to detect hazards in the first place
- Selection of the right PPE (respirators, helmets) to avoid inhalation of asbestos, dust and fibre with provision for appropriate trainings.

- ❖ Excavators, dumpers, other automated equipments will be enclosed.
- ❖ Spraying with water on exposed ground during construction phase by water–sprinkler
- ❖ Pneumatic silencers should be used to reduce noise; electrical hazards (faulty wiring) must be checked and firefighting equipment should be in place
- ❖ No employee will be exposed to a noise level greater than 75 dB(A) for a duration of more than 8 hours per day without hearing protection
- ❖ Ear muffs provided will be capable of reducing sound levels at the ear to at least 75 dB(A).
- ❖ Site traffic (for vehicles or moving equipment) should be planned and managed to avoid fatalities onsite
- ❖ Forklifts should be used carefully in material handling
- ❖ Make sure that workers are protected from wet concrete (provide PPE and proper washing facilities)
- ❖ Ensure safe dismantling procedures are in place.
- ❖ Regular health monitoring of workers once in 6months for silicosis and other disease
- ❖ First Aid facility will be made available in project site during construction phase.
- ❖ Insurance will be taken in the name of the laborers working in the construction site.

4.13 Anticipated impact on Agricultural Environment during construction phase

The general impacts on agricultural lands will be dust pollution, as volume of dust is discharged into the air during the construction phase. Dust gets deposited on the leaves of plants, flowers and soil. This affects the photosynthetic and fruiting ability of the crops.

There is a need for dust control on exposed road movements. Vehicles emit fugitive gases during transportation of materials. Those gases enter the plants through the stomata pores; it destructs chlorophyll and affects photosynthesis leading to stunted growth or death of crops.

4.13.1 Mitigation Measures

- During construction phase, spraying of water on the exposed ground will be done to suppress the dust in the source itself. Interval of sprinkling depends on the environmental factors such as temperature, rainfall and humidity of the proposed site.
- Regular check and proper maintenance of Vehicles will be carried out to minimize the emission of pollutants.
- During monsoon season the dust deposited on the surface of plant body is washed out naturally.

4.14. Anticipated impact on Agricultural Environment during operational phase

The Adhanur barrage with head sluice built across the Kollidam River has the water storing capacity of 0.334 TMC or 9.457 Million Cu.m or KLD. It is reported that the dam will be filled for four times in a year. The main aim of newly built Adhanur barrage is to irrigate the agricultural land in the villages in Cuddalore and Mayiladuthurai District which is unable to irrigate by the Anaikarai barrage situated 11km away in the upstream side of Adhanur dam. The water stored in the dam will be discharged through the North and South Rajan Channels respectively.

Impact on Cultivation of crops

4.14.1 Villages irrigated by Adhanur barrage through North Rajan Channel is given below table:

Table 4.13 Villages irrigated through Adhanur Barrage in Cuddalore District

S.No	Villages	Block	Taluk	District
1	Agaranallur	Kumaratchi	Chidambaram	Cuddalore
2	Vetchiyur	Kumaratchi	Kattumannarkoil	Cuddalore
3	Melaparuthigudi	Kumaratchi	Kattumannarkoil	Cuddalore
4	Elangambur	Kumaratchi	Kattumannarkoil	Cuddalore
5	Kadavacherry	Kumaratchi	Chidambaram	Cuddalore
6	Keezhaparuthikudi	Kumaratchi	Kattumannarkoil	Cuddalore
7	Komaratchi (Block)	Kumaratchi	Kattumannarkoil	Cuddalore
8	Nandhimangalam	Kumaratchi	Kattumannarkoil	Cuddalore
9	Keelakarai	Kumaratchi	Kattumannarkoil	Cuddalore
10	Nalamputhur	Kumaratchi	Kattumannarkoil	Cuddalore
11	Poolamedu	Kumaratchi	Chidambaram	Cuddalore

12	Sivayam	Kumaratchi	Chidambaram	Cuddalore
13	Meyyathur	Kumaratchi	Kattumannarkoil	Cuddalore
14	Varahur	Kumaratchi	Chidambaram	Cuddalore
15	Kattukudalur	Kumaratchi	Chidambaram	Cuddalore
16	Athipattu	Kumaratchi	Kattumannarkoil	Cuddalore
17	Therkumangudi	Kumaratchi	Kattumannarkoil	Cuddalore
18	Vadakkumangudi	Kumaratchi	Kattumannarkoil	Cuddalore
19	Vellur	Kumaratchi	Kattumannarkoil	Cuddalore
20	Agaranallur	Kumaratchi	Chidambaram	Cuddalore
21	Keezhakundalapadi	Kumaratchi	Chidambaram	Cuddalore
22	Vaiyur	Kumaratchi	Chidambaram	Cuddalore
23	Themmur	Kumaratchi	Kattumannarkoil	Cuddalore
24	Vakkaramari	Kumaratchi	Chidambaram	Cuddalore
25	Perampattur	Kumaratchi	Chidambaram	Cuddalore
26	Nanjalur	Kumaratchi	Chidambaram	Cuddalore
27	Usuppur	Kumaratchi	Chidambaram	Cuddalore
28	Jayakondapattinam	Kumaratchi	Chidambaram	Cuddalore
29	Vallampadugai	Kumaratchi	Chidambaram	Cuddalore
30	Sivapuri	Kumaratchi	Chidambaram	Cuddalore
31	Kavarapattu	Parangipettai	Chidambaram	Cuddalore
32	Kumaramangalam	Parangipettai	Mayiladuthurai	Cuddalore
33	Keezhaperambai	Parangipettai	Chidambaram	Cuddalore
34	Nakkravanthangudi	Parangipettai	Chidambaram	Cuddalore
35	Kanakkarapattu	Parangipettai	Chidambaram	Cuddalore
36	Meethikudi	Parangipettai	Chidambaram	Cuddalore
37	Kothangudi	Parangipettai	Chidambaram	Cuddalore
38	Kodipallam	Parangipettai	Chidambaram	Cuddalore
39	Radhavilagam	Parangipettai	Chidambaram	Cuddalore
40	Keezhanuvampattu	Parangipettai	Chidambaram	Cuddalore
41	Tillaividegam	Parangipettai	Chidambaram	Cuddalore
42	Pitchavaram	Parangipettai	Chidambaram	Cuddalore
43	TS Pettai	Parangipettai	Chidambaram	Cuddalore
44	Kille	Parangipettai	Chidambaram	Cuddalore
45	Pinnathur	Parangipettai	Chidambaram	Cuddalore
46	Nanjaimagattuvazhkai	Parangipettai	Chidambaram	Cuddalore
47	Kovilampoondi	Parangipettai	Chidambaram	Cuddalore
48	Uthamasozhamangalam	Parangipettai	Chidambaram	Cuddalore
49	Vasaputhur	Parangipettai	Chidambaram	Cuddalore
50	Mannargudi	Kattumannarkoil	Kattumannarkoil	Cuddalore

51	Oblanjimedu	Kattumannarkoil	Kattumannarkoil	Cuddalore
52	Kodiyallam	Keerapalayam	Chidambaram	Cuddalore
53	Sengalmedu	Keerapalayam	Chidambaram	Cuddalore

The above table shows that the village covered by North Rajan Channels comes under four blocks namely Kumaratchi, Parangipettai, Kattumannarkoil and Keerapalayam. Out of 53 villages, 30 villages comes under Kumaratchi block, 19 villages comes under Parangipettai block and four villages comes under Kattumannarkoil and Keerapalayam block. The major villages irrigated by proposed project are comes under Kumaratchi and Parangipettai blocks.

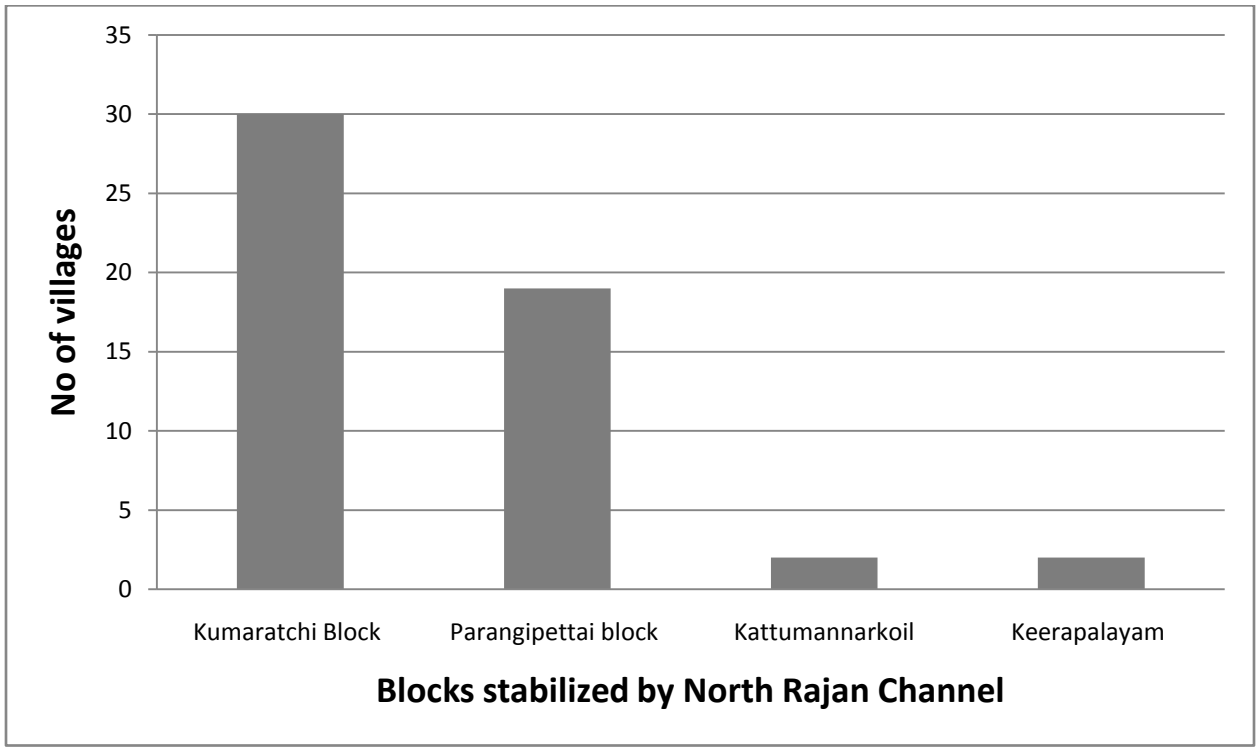


Fig : 4.3 Number of villages in the four blocks stabilized by North Rajan Channel

Table : 4.14 Total number of villages and No. of villages stabilized by this project

S.No	Block Name	Total No Panchayat villages	No of village stabilized by this project	%
1	Kumaratchi	57	30	53
2	Parangipettai	41	19	46
3	Kattumannarkoil	55	2	3
4	Keerapalayam	63	2	3

4.14.2 Crop Pattern in four Blocks (2019)

4.14.2.1 Crop Pattern in Kumaratchi Block

The major crops cultivated in the Kumaratchi block are Paddy, Pulses (Black and Green gram), Banana, cashew, vegetables and flowers. Pulses namely green gram and black gram are cultivated on the maximum area of Kumaratchi block (8581 Ha). Paddy is cultivated about 2000 Ha which is included in the 8581 Ha. Green gram and black gram are cultivated in the rice fallows. The Kharif crop such as paddy are sown in monsoon season which is at the end of May or earlier June and harvesting started post the monsoon i.e. October – December. After the harvesting in the post monsoon, the Rabi crops such as pulses are sown from the mid of November and harvesting started at beginning of April/May. Cashews are cultivated only 200 Ha in this block.

i) CCA in Kumaratchi Block irrigated by Anaikarai Barrage

Kharif Crop (Paddy) – 1060 Ha

Rabi Crop (Pulses) – 4548 Ha

ii) CCA in Kumaratchi Block stabilized by Adhanur Barrage

Kharif Crop (Paddy) – 4548 Ha

Rabi Crop (Pulses) – 4548 Ha

4.14.2.2 Crop Pattern in Parangipettai Block

The major crops cultivated in the Parangipettai block are Paddy, Pulses (Black and Green gram), Vettiver, Cashew, Flowers. Pulses namely green gram and black gram are cultivated on the maximum area of Parangipettai block (2110 Ha). Paddy is cultivated about 1000 Ha which is included in the 2110 Ha. Cashews and Groundnut are cultivated for 300 Ha and 500Ha respectively in this block. Vettiver an herb which is cultivated in the coastal villages of Parangipettai block to the tune of 100 Ha has commercial value and is widely used by the cosmetic industries like Cuticura and Kevincare.

i) CCA in Parangipettai Block irrigated by Anaikarai Barrage

Kharif Crop (Paddy) – 460 Ha

Rabi Crop (Pulses) – 970 Ha

ii) CCA in Parangipettai Block stabilized by Adhanur Barrage

Kharif Crop (Paddy) – 970 Ha

Rabi Crop (Pulses) – 970 Ha

4.14.2.3 Crop Pattern in Kattumannarkoil Block

The major crops cultivated in the Kattumannarkoil block are Paddy, Flowers, cashews, Groundnut and Black gram. Pulses namely green gram and black gram are cultivated on the maximum area of Kattumannarkoil block (7374 Ha). Paddy is cultivated about 4000 Ha which is included in the 7374 Ha. Cashews and Groundnut are cultivated for 500 Ha and 500Ha respectively in this block.

i) CCA in Kattumannarkoil Block irrigated by Anaikarai Barrage

Kharif Crop (Paddy) – 120 Ha

Rabi Crop (Pulses) – 221 Ha

ii) CCA in Kattumannarkoil Block stabilized by Adhanur Barrage

Kharif Crop (Paddy) – 221 Ha

Rabi Crop (Pulses) – 221 Ha

4.14.2.4 Crop Pattern in Keerapalayam Block

The major crops cultivated in the Keerapalayam block are Paddy, Black gram, Groundnut and Sugarcane. Moringa oleifera are planted in few places and flower farming is taking place in some places in this block. Pulses namely green gram and black gram are cultivated on the maximum area of Keerapalayam block (8967 Ha). Paddy is cultivated about 3000 Ha which is included in the 8967 Ha. Cashews, Groundnut and Sugarcane are cultivated for 50 Ha, 400Ha and 1000 Ha respectively in this block.

i) CCA in Keerapalayam Block irrigated by Anaikarai Barrage

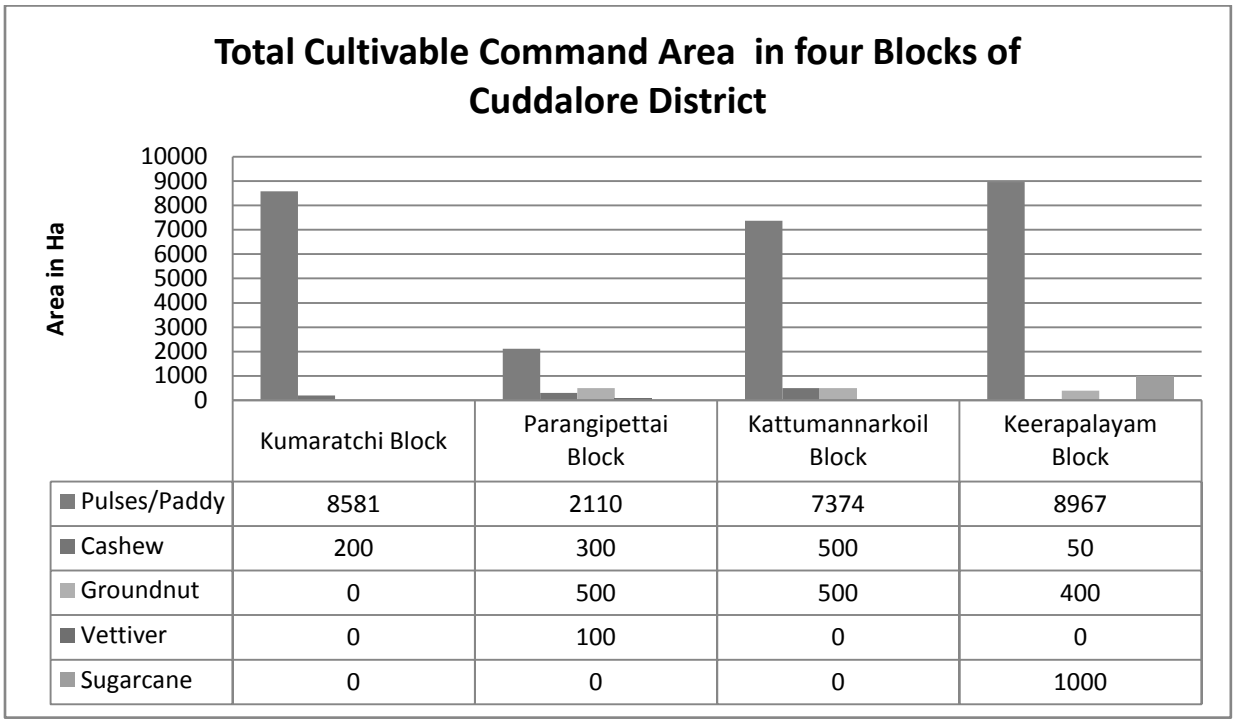
Kharif Crop (Paddy) – 90 Ha

Rabi Crop (Pulses) – 269 Ha

ii) CCA in Keerapalayam Block stabilized by Adhanur Barrage

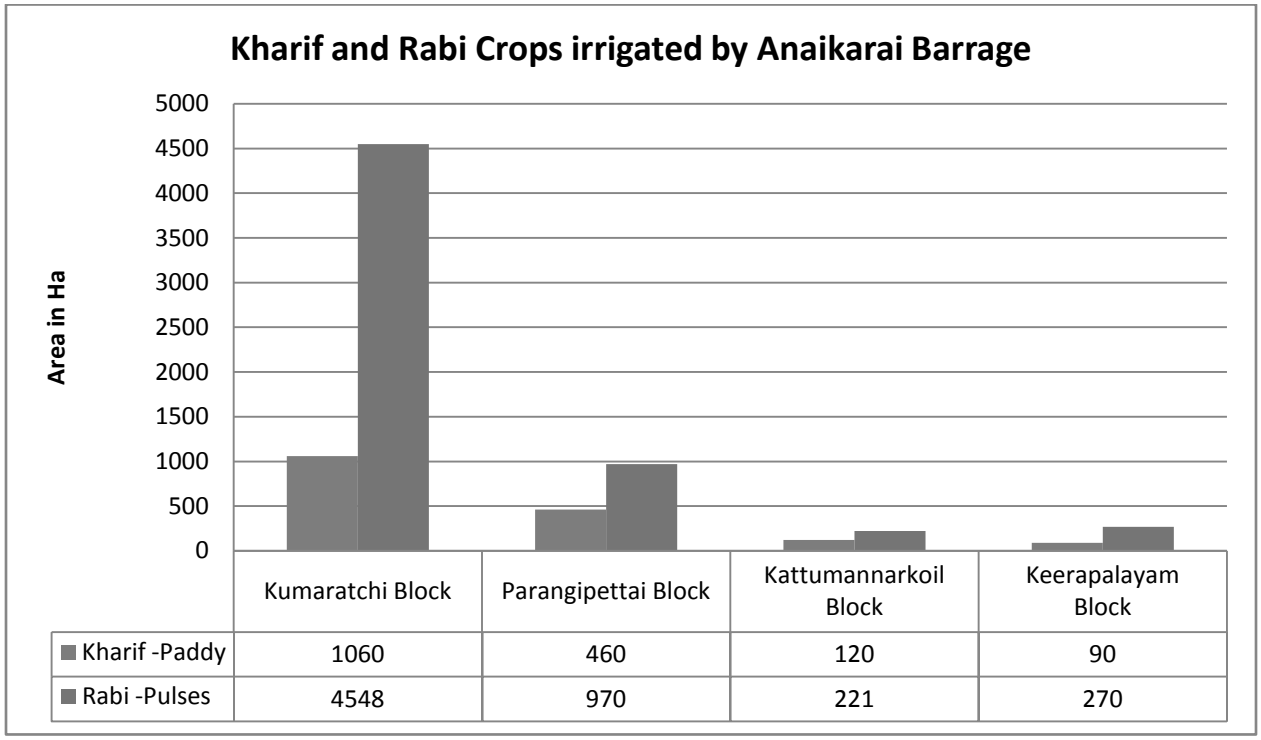
Kharif Crop (Paddy) – 269 Ha

Rabi Crop (Pulses) – 269 Ha



	Kumaratchi Block	Parangipettai Block	Kattumannarkoil Block	Keerapalayam Block
Pulses/Paddy	8581	2110	7374	8967
Cashew	200	300	500	50
Groundnut	0	500	500	400
Vettiver	0	100	0	0
Sugarcane	0	0	0	1000

Fig No 4.4 Chart showing overall CCA in four block of Cuddalore District



	Kumaratchi Block	Parangipettai Block	Kattumannarkoil Block	Keerapalayam Block
Kharif -Paddy	1060	460	120	90
Rabi -Pulses	4548	970	221	270

Fig No.4.5 Chart showing cultivatable command area in Cuddalore District irrigated by Anaikarai Barrage

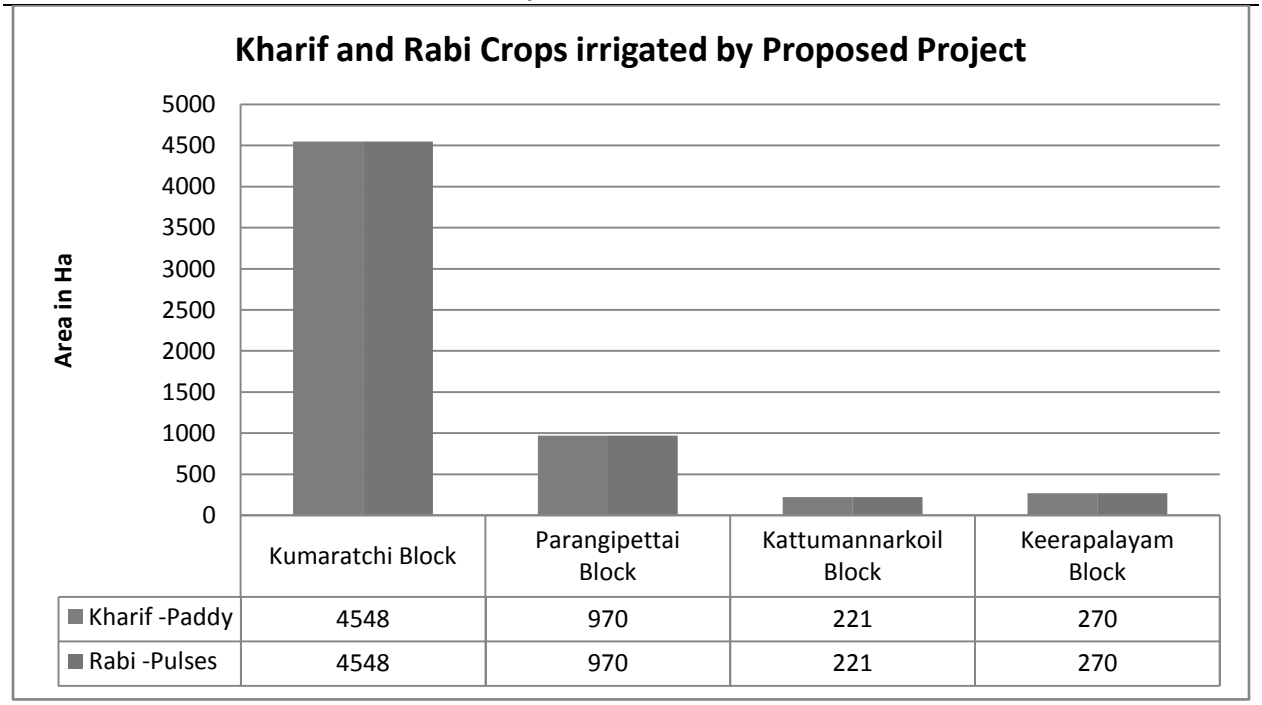


Fig No.4.6 Chart showing cultivatable command area in Cuddalore district to be stabilized by Proposed Project (Adhanur Barrage)

4.14.3 Requirement of Water for proposed crop pattern in each Block

Table No 4.15 Water Requirements for different major crops

S.No	Crops	Duration in days	Water Requirement (mm)	No. of Irrigation
1	Rice	135	1250	18
2	Groundnut	105	550	10
3	Sorghum	100	350	6
4	Maize	110	500	8
5	Sugarcane	365	2000	24
6	Ragi	100	350	6
7	Cotton	165	550	11
8	Pulses	65	350	4

4.14.3.1 Kumaratchi Block

In Kumaratchi block, 97.7% of the agricultural lands are cultivated with Pulses/Paddy. 2.3 % of lands are cultivated with Cashews and less than 1 % is banana, vegetables and

flowers. The water requirement of rice varies from 6-10 mm and total water is ranges from 1100 to 1250 mm depending upon the agro climatic situation. Of the total water required for the crop, 3% or 40 mm is used for the nursery, 16% or 200 mm for the land preparation i.e. puddling and 81% or 1000 mm for field irrigation of the crop.

Pulse crops like Red gram, Black gram and Green gram are grown in summer season as irrigated crop which need 3 to 4 irrigation at critical stages like germination, flowering and pod formation. Total water requirement for pulses is 200-350 mm. Cashew is best adapted to seasonally dry tropical climates, with optimum growth occurring at temperatures from 63°F to 100°F and a relative humidity of 65–80%. Trees are drought tolerant, but production is improved if sufficient soil moisture is provided (either rainfall or irrigation) during fruit set and development. So the drip irrigation is enough for the cashew plantation. Therefore, in Kumaratchi Block, paddy and pulses cultivation require more water from the Adhanur barrage. The cultivable command areas for paddy and pulses in this block are 4548 Ha and 4548 Ha respectively. The water requirement for the CCA of paddy cultivation (Kharif) during monsoon season is estimated as 1770 Mcft. The water requirement for the CCA of pulses cultivation (Rabi) during post-monsoon and summer season is estimated as 320 Mcft.

4.14.3.2 Parangipettai Block

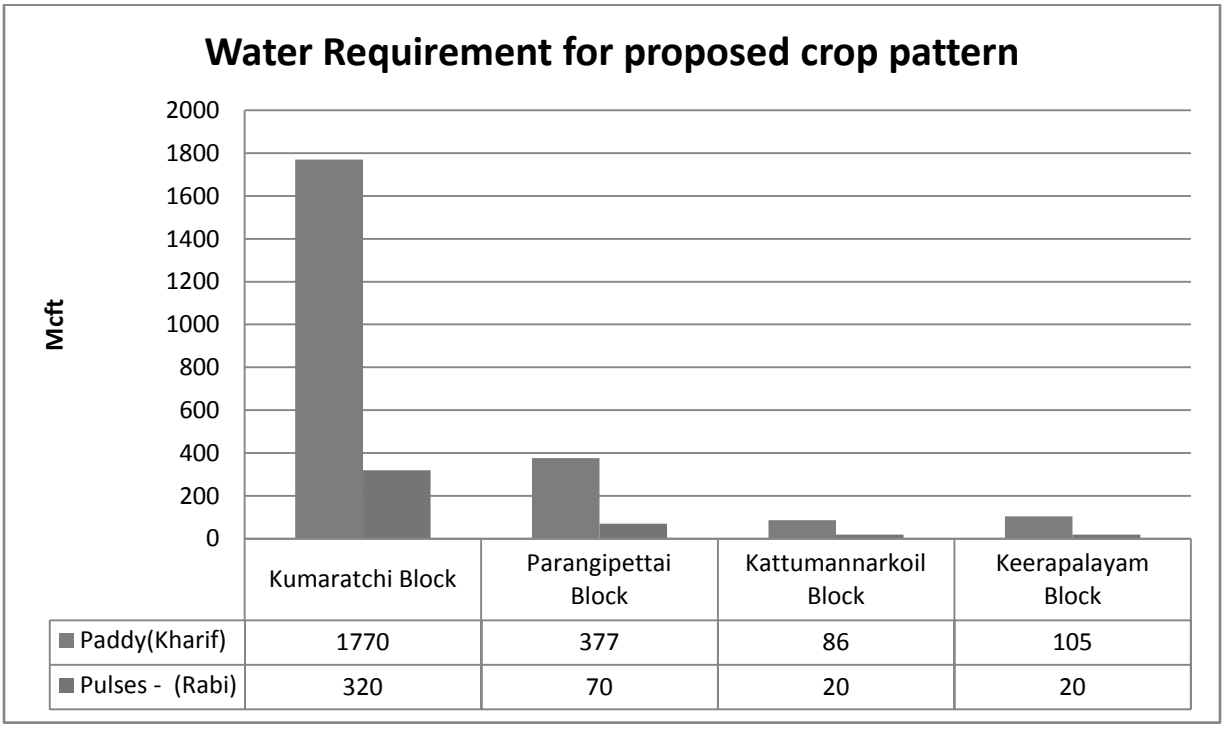
In Parangipettai block, 70% of the agricultural lands are cultivated with Pulses/Paddy. Cashew, groundnut and vettiver are cultivated with 9.96%, 16.6% and 3.3% respectively and flowers are planted with less than 1%. The cultivable command areas for paddy and pulses in this block are 970 Ha and 970 Ha respectively. The water requirement for CCA of paddy (Kharif) is estimated as 377 Mcft and the water requirement for the CCA of pulses cultivation (Rabi) during post-monsoon and summer season is estimated as 70 Mcft.

4.14.3.3 Kattumannarkoil Block

In Kattumannarkoil block, 88% of the agricultural lands are cultivated with Pulses/Paddy. Cashew and groundnut are cultivated with 6% and 6% respectively and flowers are planted with less than 1%. The cultivable command areas for paddy and pulses are 221 Ha, 221 Ha respectively. The water requirement for CCA of paddy (Kharif) and pulses cultivation (Rabi) are estimated as 86 Mcft and 20 Mcft respectively.

4.14.3.4 Keerapalayam Block

In Keerapalayam block, 86% of the agricultural lands are cultivated with Pulses/Paddy. Sugarcane, Cashew and groundnut are cultivated with 9.6%, 0.5% and 3.84% respectively and flowers are planted with less than 1%. Sugarcane requires nearly 2000mm of water throughout the year. The cultivable command areas for paddy and pulses in this block are 270 Ha and 270 Ha respectively. The water requirement for CCA of paddy (Kharif) and pulses cultivation (Rabi) are estimated as 105 Mcft and 20 Mcft respectively.



	Kumaratchi Block	Parangipettai Block	Kattumannarkoil Block	Keerapalayam Block
Paddy(Kharif)	1770	377	86	105
Pulses - (Rabi)	320	70	20	20

Fig No.4.7 Chart showing water requirements of proposed crop pattern in Cuddalore District

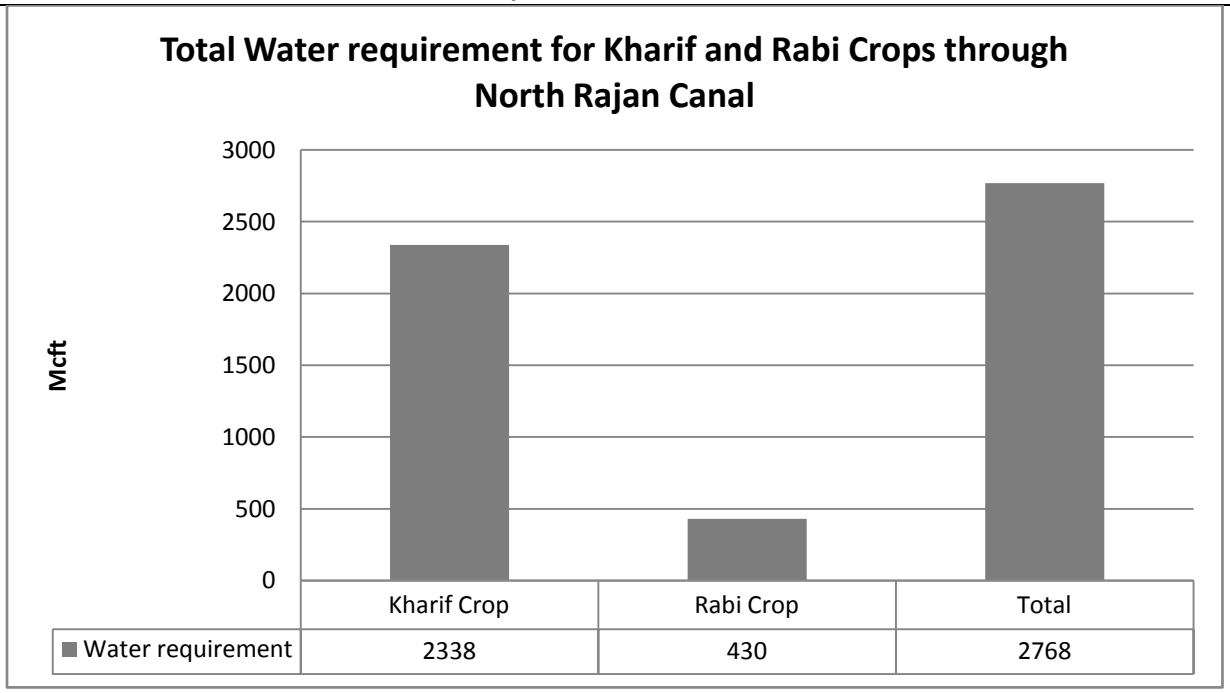


Fig No.4.8 Chart showing water requirements of Kharif and Rabi crops in Cuddalore District (Proposed)

4.14.4 Villages irrigated by Adhanur barrage through South Rajan Channel is given below table:

Table No. 4.16 Villages irrigated through Adhanur Dam in Cuddalore District

S.No	Villages	Block	Taluk	District
1	Achalpuram	Kollidam	-	Cuddalore
2	Agaravattaram	Kollidam	Sirkazhi	Mayiladuthurai
3	Koothiyanpeetai	Kollidam	Sirkazhi	Mayiladuthurai
4	Mahendrapalli	Kollidam	Sirkazhi	Mayiladuthurai
5	Alakkudi	Kollidam	Sirkazhi	Mayiladuthurai
6	Gopalasamuthiram	Kollidam	Sirkazhi	Mayiladuthurai
7	Madhanam	Kollidam	Sirkazhi	Mayiladuthurai
8	Puliyanthurai	Kollidam	Sirkazhi	Mayiladuthurai
9	Shiyalu	Kollidam	Sirkazhi	Mayiladuthurai
10	Thirumailadi	Kollidam	Sirkazhi	Mayiladuthurai
11	Palayapalayam	Kollidam	Sirkazhi	Mayiladuthurai
12	Payapala	Kollidam	Sirkazhi	Mayiladuthurai
13	Palmpade	Kollidam	Sirkazhi	Mayiladuthurai
14	Naluer	Kollidam	Sirkazhi	Mayiladuthurai
15	Aalasundaram	Kollidam	Sirkazhi	Mayiladuthurai

16	Kagenur	Kollidam	Sirkazhi	Mayiladuthurai
17	Nallanayakipuram	Kollidam	Sirkazhi	Mayiladuthurai
18	Manganampattu	Kollidam	Sirkazhi	Mayiladuthurai
19	Cherila	Kollidam	Sirkazhi	Mayiladuthurai
20	Kodakobam	Kollidam	Sirkazhi	Mayiladuthurai
21	Mudhalaimedu	Kollidam	Sirkazhi	Mayiladuthurai
22	Malamad	Kollidam	Sirkazhi	Mayiladuthurai
23	Kodakkaramoolai	Kollidam	Sirkazhi	Mayiladuthurai
24	Palundera	Kollidam	Sirkazhi	Mayiladuthurai
25	Utaguer	Kollidam	Sirkazhi	Mayiladuthurai
26	Achchangaadu	Kollidam	Sirkazhi	Mayiladuthurai
27	Kattur	Kollidam	Sirkazhi	Mayiladuthurai
28	Nanalpadugai	Kollidam	Sirkazhi	Mayiladuthurai
29	Serugudy	Kollidam	Sirkazhi	Mayiladuthurai
30	Kannapirandi	Kollidam	Sirkazhi	Mayiladuthurai
31	Thrigopam	Kollidam	Sirkazhi	Mayiladuthurai
32	Pannangudi	Kollidam	Sirkazhi	Mayiladuthurai
33	Karpala	Kollidam	Sirkazhi	Mayiladuthurai
34	Thaikka	Kollidam	Sirkazhi	Mayiladuthurai
35	Alakkudi	Kollidam	Sirkazhi	Mayiladuthurai

4.14.5 Crop Pattern in Sirkazhi Taluk, Nagapattinam District (Then Mayiladuthurai)

The major crops cultivation in Sirkazhi Taluk is paddy, Sugarcane, Coconut, Pulses, Millets and oil seeds. Brinjal, Tapiaco and chilles are planted very few acres. The areas of cultivation of different crops in Sirkazhi Taluk are given in below table.

Table 4.17 Crop Pattern in Sirkazhi Taluk (Mayiladuthurai District)

S.No	Name of the Crop	Area of Cultivation (Ha)	% of Area
1	Paddy	31515	99
	Kuruvai	7058	22.2
	Samba	17488	54.9
	Thaladi	6969	21.9
2	Sugarcane	42	0.13
3	Coconut	230	0.72
4	Pulses	-	-
5	Millets (Maize)	22	0.07
6	Cotton	2	0.006
7	Groundnut	-	-
Total		**31811**	**100**

From the above table it is noted that, 99% of the agricultural lands in Sirkazhi Taluk are cultivated with Paddy Crop (Kharif). The Kollidam Block which is proposed to be irrigated by the Adhanur barrage comes under the Sirkhazhi Taluk. Based on the percentage of different crops cultivated in this Sirkhazhi Taluk, the cultivable command area of different crops in the proposed area is arrived. The overall CCA proposed to be stabilized in this Taluk is 2557.613 Ha. The crops cultivated in the Kollidam blocks are Kharif.

Table 4.18 CCA of different crop to be irrigated through South Rajan Channel

S.No	Name of the Crop	Area of Cultivation (Ha)	% of Area
1	Paddy	2532.03	99
	i. Kuruvai	567.8	22.2
	ii. Samba	1404.13	54.9
	iii. Thaladi	560.12	21.9
2	Sugarcane	3.32	0.13
3	Coconut	18.41	0.72
4	Pulses	-	-
5	Millets (Maize)	1.8	0.07
6	Cotton	0.15	0.006
7	Groundnut	-	-
Total		**2557.613**	**100**

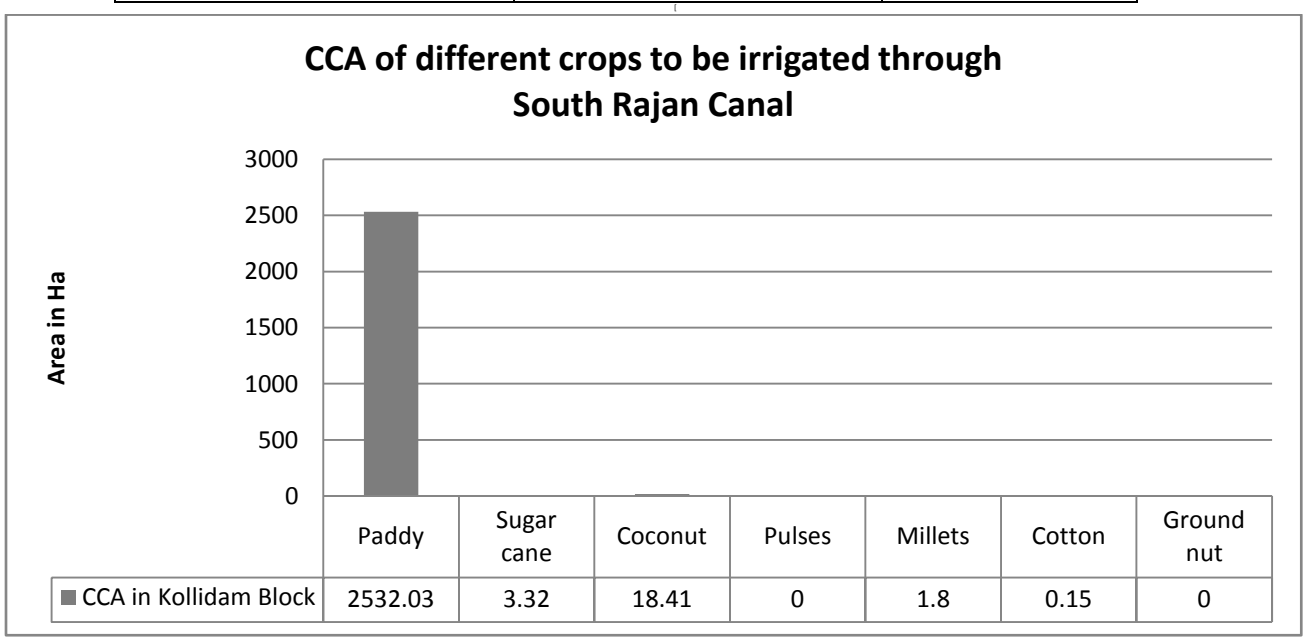


Fig No.4.9 Chart showing cultivable command area of different crops to be irrigated in Mayiladuthurai District

4.14.6 Requirement of Water for different crops in Kollidam Block

In Kollidam block, 99% of the agricultural lands are cultivated with Paddy. Less than 1% is cultivated with sugarcane, coconut, millets and cotton. The plantation of sugarcane requires water of 2000mm for 365 days. The cultivation of maize and cotton requires water of 500mm and 550mm for 110 days and 165 days respectively. The water requirement for CCA of paddy (Kharif), Sugarcane (Kharif), Maize (Kharif) and Cotton (Kharif) are estimated as 984 Mcft, 2.3 Mcft, 0.32 Mcft and 0.03 Mcft respectively.

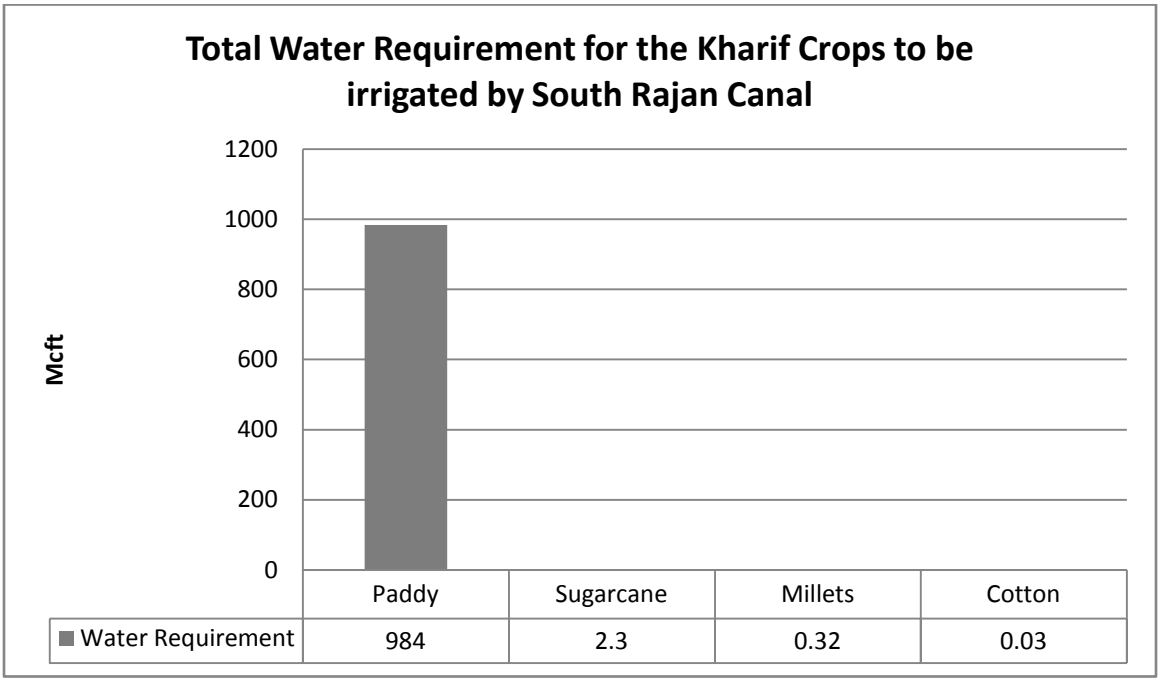


Fig No.4.10 Chart showing water requirements of Kharif crops in Mayiladuthurai District

4.14.7 Ground water availability in the proposed area due to annual rainfall

The groundwater availability can be estimated by ground water recharge in the particular area based on annual rainfall. By considering the annual rain fall data of proposed area for the past 21 years, the average annual rainfall is 1377mm. The total catchment area in the proposed area is 9159 Ha. The Chaturvedi formula has been used to estimate the ground water recharge in the particular area.

$R = 1.35(P-14)^{0.5}$

Where

R = net recharge due to precipitation during the year, in inches

P = annual precipitation, in inches

It may be noted that there is a lower limit of the rainfall below which the recharge due to rainfall is zero.

$R = 1.35 (55 – 14)^{0.5}$

R = 8.6 inches

It is found that the annual ground water recharge in the proposed area is 8.6 inches based on the annual rainfall of 55 inches. The total extent of the proposed area is 91500000m^2. The total quantity of water recharged into the ground is estimated below.

Q = Area x Net recharge due to precipitation in m

Q = 91590000 x 0.218

Q = 19966620 m^3 or **0.7 TMC**

Table No 4.19 Month wise Average Rainfall and Ground water recharge in the proposed area of 9159 Ha

Month	Average Rainfall in mm	% of Rainfall	Total Ground water recharge m^3	TMC	Mcft
January	34.1496	2.48	495172.2	0.017487	17.48684
February	16.34133	1.19	237602.8	0.008391	8.390863
March	18.74797	1.36	271546	0.00959	9.589558
April	31.19709	2.27	453242.3	0.016006	16.0061
May	78.24032	5.68	1134104	0.040051	40.05051
June	41.59612	3.02	602991.9	0.021294	21.29446
July	84.18263	6.11	1219960	0.043082	43.0825
August	127.9576	9.29	1854899	0.065505	65.50514
September	124.7884	9.06	1808976	0.063883	63.88338
October	230.5019	16.74	3342412	0.118036	118.0362
November	400.1151	29.06	5802300	0.204906	204.9063
December	189.1633	13.74	2743414	0.096883	96.88274
Total	**1377**	**100**	**19966620**	**0.7051**	**705.1**

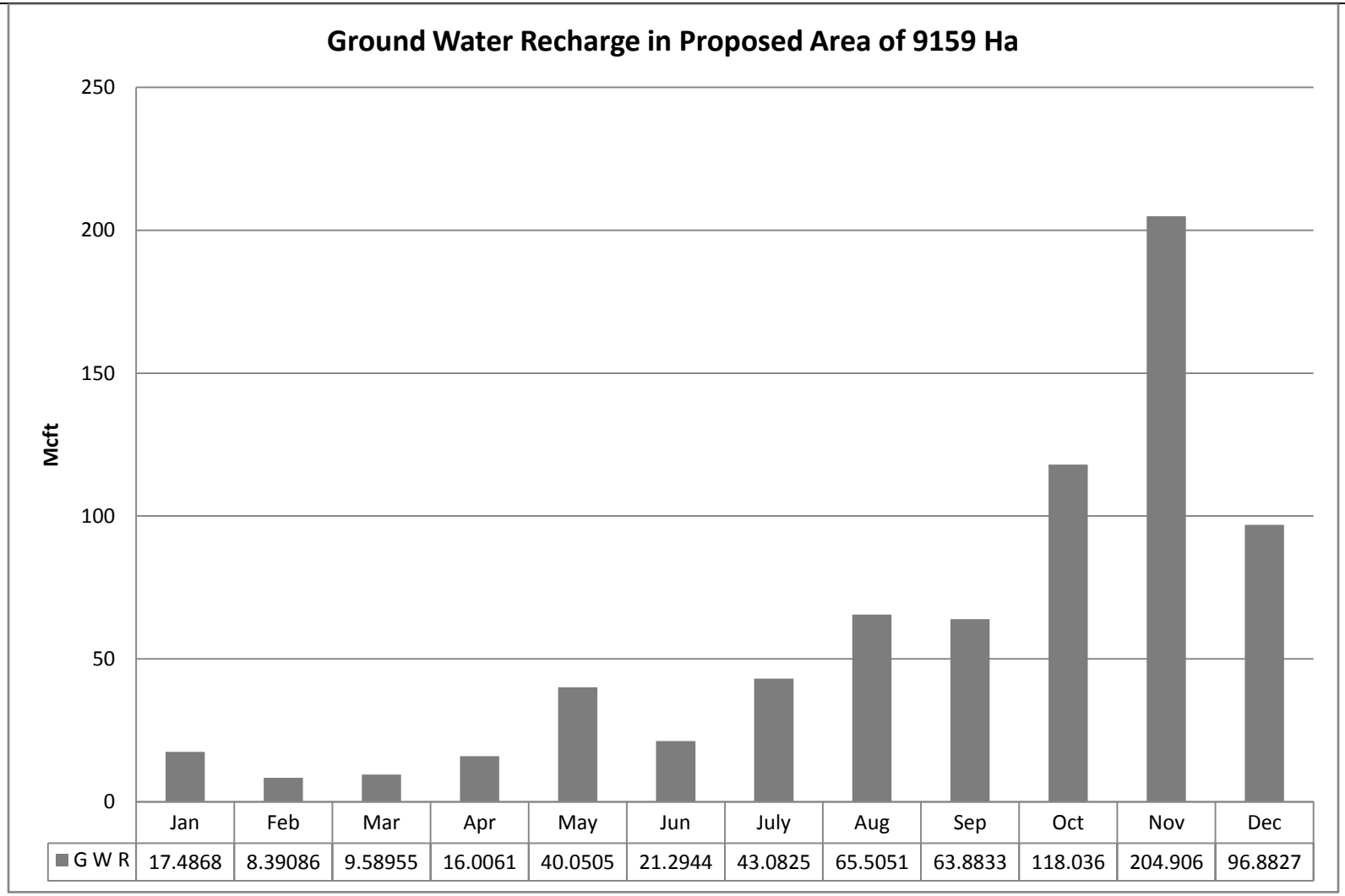
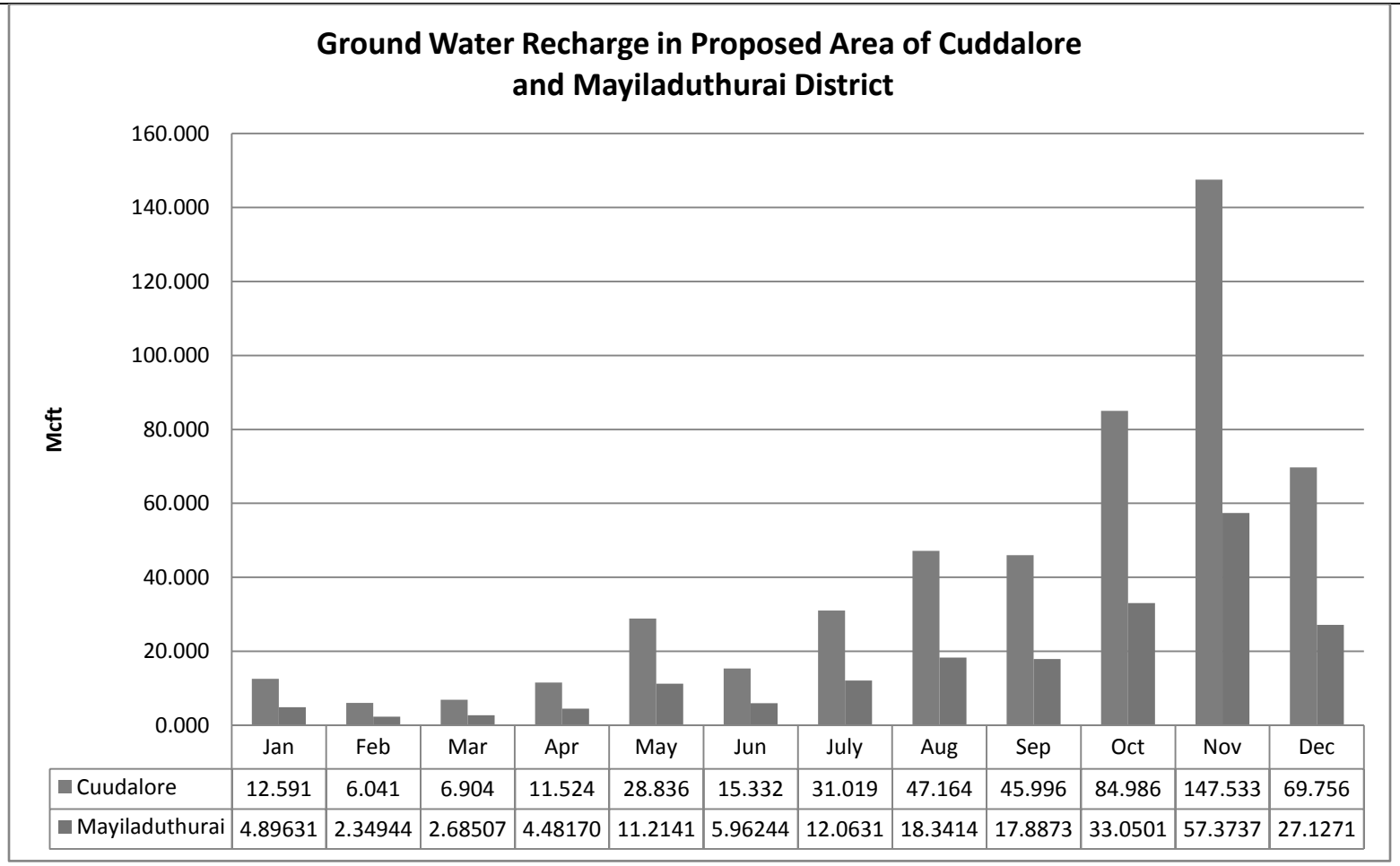


Fig No.4.11 Chart showing ground water recharge in the proposed area of 9159 Ha

Table No 4.20 Ground water recharge in the proposed area of Cuddalore and Mayiladuthurai District

Month	Ground water Recharge in Cuddalore District m^3	TMC	Mcft	Ground water Recharge in Mayiladuthurai District m^3	TMC	Mcft
January	356524	0.012591	12.59053	138648.2	0.004896	4.896315
February	171074	0.006041	6.041421	66528.78	0.002349	2.349442
March	195513.1	0.006904	6.904481	76032.89	0.002685	2.685076
April	326334.4	0.011524	11.52439	126907.8	0.004482	4.481708
May	816554.9	0.028836	28.83636	317549.1	0.011214	11.21414
June	434154.2	0.015332	15.33201	168837.7	0.005962	5.962448
July	878371.5	0.031019	31.0194	341588.9	0.012063	12.0631
August	1335527	0.047164	47.1637	519371.7	0.018341	18.34144
September	1302463	0.045996	45.99603	506513.2	0.017887	17.88735
October	2406537	0.084986	84.98604	935875.4	0.03305	33.05013
November	4177656	0.147533	147.5325	1624644	0.057374	57.37376
December	1975258	0.069756	69.75557	768155.8	0.027127	27.12717
Total	**14375966**	**0.507682**	**507.6825**	**5590654**	**0.197432**	**197.4321**



	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
Cuudalore	12.591	6.041	6.904	11.524	28.836	15.332	31.019	47.164	45.996	84.986	147.533	69.756
Mayiladuthurai	4.89631	2.34944	2.68507	4.48170	11.2141	5.96244	12.0631	18.3414	17.8873	33.0501	57.3737	27.1271

Fig No.4.12 Chart showing ground water recharge in the proposed area of Cuddalore and Mayiladuthurai District

4.14.8 Water Availability in the newly built Adhanur barrage

Based on the monthly water surplus from the lower Anaicut Dam for the past 10 ten years, the water availability in Adhanur barrage in every month has been estimated in below table.

Table No 4.21 Month wise Surplus water from Anaikarai Dam and Water storage in Adhanur Dam

Month	Water Surplus in Anaicut Dam (Mcft)	Availability of Adhanur dam (Mcft)	Water get stored in Adhanur dam (TMC)	Mcft
January	808	808	0.33 (Rare)	330(Rare)
February	21.5	21.5	-	
March	-	-	-	-
April	-	-	-	-
May	-	-	-	-
June	-	-	-	-
July	857	857	0.33 (Rare)	330(Rare)
August	14800	14800	0.33 (Rare)	330(Rare)
September	1340	1340	0.33 (Rare)	330(Rare)
October	1310	1310	0.33	330
November	8400	8400	0.33	330
December	5100	5100	0.33	330

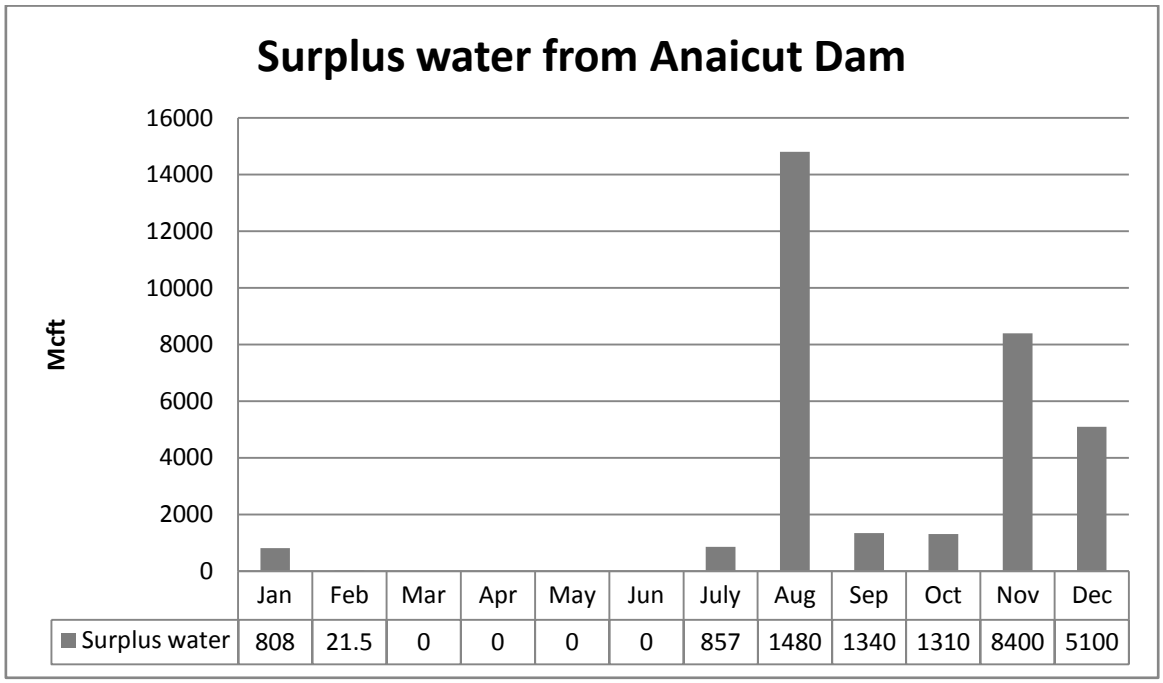
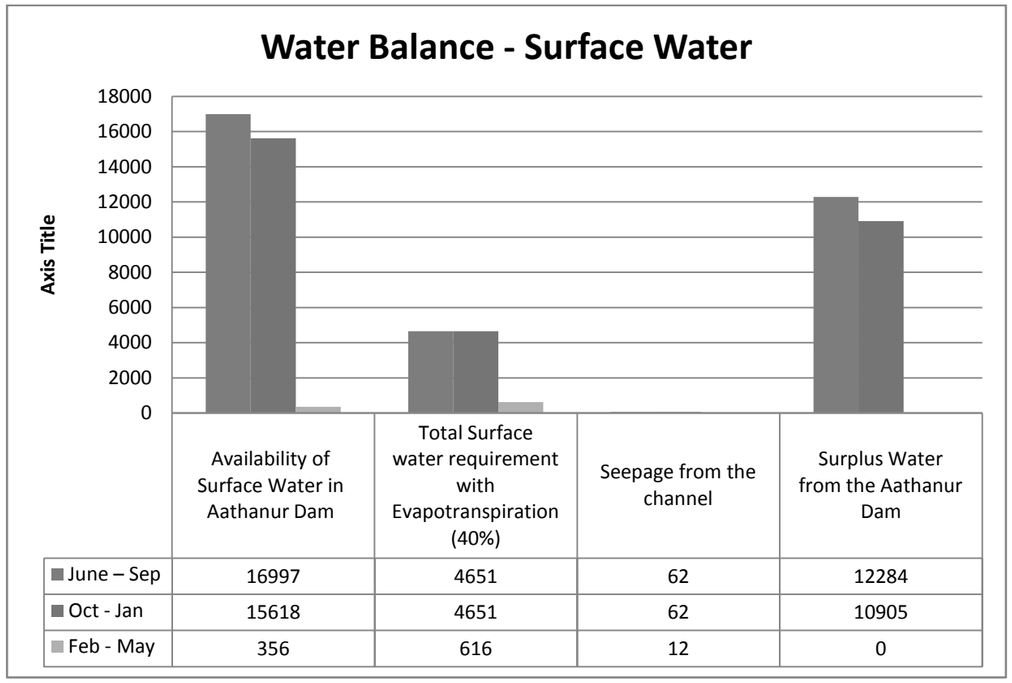


Fig No.4.13 Chart showing month wise surplus water from Anaicut Dam

Table No 4.22 Water balance chart based on crops, cultivable command area, water demand and Supply

Crops	Period	CCA in Cuddalore District (Ha)	CCA in Mayiladuthurai District (Ha)	Water Requirement for Cuddalore District (Mcft)	Water Requirement for Mayiladuthurai District (Mcft)	Ground Water - Cuddalore District (Mcft)	Ground Water- Mayiladuthurai District (Mcft)	Availability of Surface Water in Adhanur Dam (Mcft)	Surface Water - Cuddalore District (Mcft)	Surface Water - Mayiladuthurai District (Mcft)	Total Surface water requirement including Evapotranspiration (40%) (Mcft)	Seepage loss (Mcft)	Surplus Water from the Adhanur Dam (Mcft) entering into Sea
Kharif (Paddy)	June – Sep	6009	2532	2338	984	137.5 (Not Enough)	54.25 (Not Enough)	16997	2338(Rare)	984(Rare)	4651(Rare)	62	12284(rare)
	Oct - Jan	6009	2532	2338	984	314.86 (Not Enough)	122.4 (Not Enough)	15618	2338(100%)	984(100%)	4651(100%)	62	10905
Rabi (Pulses)	Feb - May	6009	-	430	-	53.31		21.5(rare) + 334(Stored water)	356	-	616	12	Nil



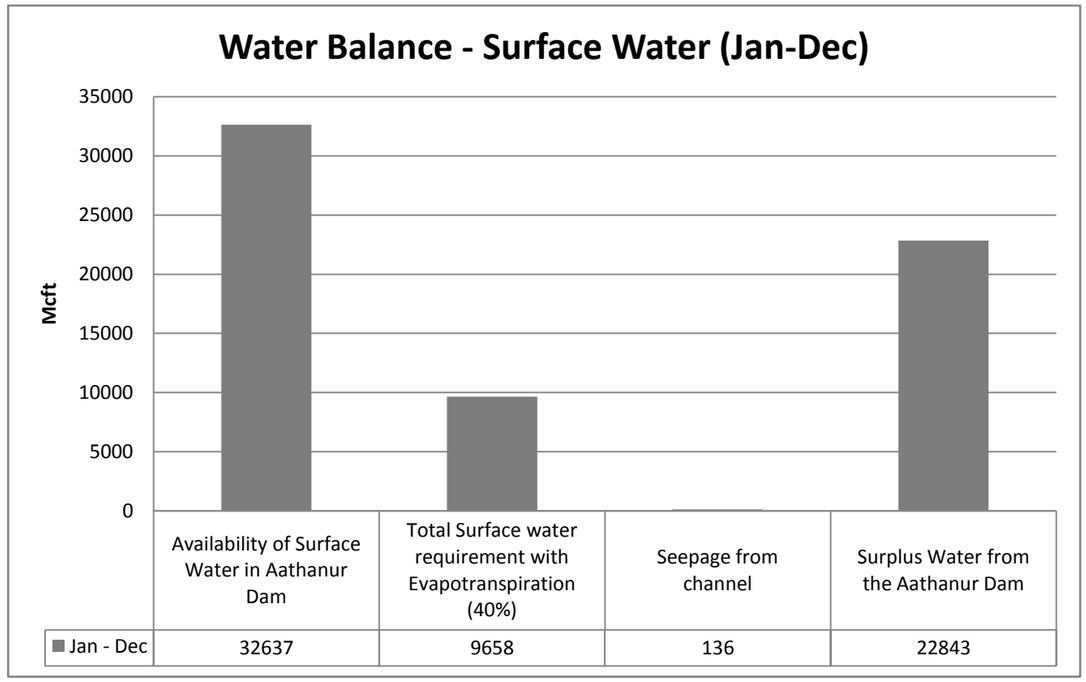


Fig No 4.14 Chart showing water balance of surface water

4.14.9 Impact Assessment and Suggestions based on Crop Pattern and Demand and Supply

Table No 4.23 Trend in Area of Cultivation of Major Cultivation crops in Cuddalore district

S.No	Crop	16-17	17-18	18-19
1	Paddy	123847	122535	34345
2	Blackgram	50982	51304	51641

Source: Joint Director of Agriculture, Cuddalore district.

It could be noted from above table that the area of cultivation was increasing in Black gram whereas it has decreasing trend for Paddy. As enough water is not available for irrigation, there is great decrease in cultivation of paddy. In 18-19, only 1730 Ha of CCA was cultivated out of 6009 Ha in the proposed area of Cuddalore district due to insufficient water from Anaikarai Barrage. The proposed project will provide sufficient water to irrigate more than 6009 Ha in Cuddalore District.

Table No: 4.24 Present and future production of paddy crop in Cuddalore District

S.No	Area of Paddy Cultivation in Ha (Present)	Production (MT)	Area of Paddy Cultivation in Ha (Post Project)	Production (MT)	Productivity (MT/ha)
1	1730	8529	6009	29624	4.93

The Table 4.24 shows that the proposed project can irrigate 8541Ha of cultivable command area paddy in both Cuddalore and Mayiladuthurai district at the rate of 100% during the period October - January. Based on last ten year records of Anaikarai Dam, the water surpluses the weir only one time during period (July to September) of 2018. If Adhanur barrage attain its capacity during the period (July – September), it can irrigate nearly 8541Ha of Paddy crop one more period. After the irrigation of Paddy Crop up to beginning of January, the Water should be properly stored for the irrigation of pulses in Cuddalore district during the period February – May.

CHAPTER – 5: ANALYSIS OF ALTERNATIVES (TECHNOLOGY AND SITE)

5.1. Introduction to Analysis of Alternatives

The accuracy of the identification and selection of project location/alignment/scheme depends on the availability and accuracy of field data. As such the survey has a greater importance in this kind of Irrigation projects. The objective of the proposed topographical surveys/ Reconnaissance study is to assess the topography of the project area, type of terrain, profile of alignment, ground features etc to enable identification of suitable location, alignment and planning and implementation of projects as per the project requirements.

5.2 Analysis of Alternatives

The flood water that occur in River Cauvery are being diverted through River Coleroon and these water, after meeting the needs of Lower Anicut drain into sea as waste, since no irrigation structures are in existence at the downstream of Lower Anicut.

To store and use the surplus water from Lower Anicut for the agricultural purposes in the downstream of barrage, Thiru N. Renganathan, M.L.A. and public requested Honorable Minister to construct barrage below Lower Anicut.

Based on the request from public, the Chief Engineer, PWD, Plan Formulation, Chennai gave instructions to conduct a feasibility study for construction of a suitable structure across Coleroon River. The Planning and Design Division conducted a feasibility study for construction of new barrage. From the study it was decided to construct a Barrage across Coleroon River at RD mile 74/3 between Adhanur and Kumaramangalam Villages in Cuddalore and Mayiladuthurai districts.

Justification for selecting the location

- The North Rajan and South Rajan Channel are located adjacent to the proposed barrage. So the channels will be easily connected to the proposed barrage to divert water for irrigation purposes.
- There is no transportation bridge located within the storage area of proposed barrage.
- Road facility is available on both left and right banks of proposed barrage. So the raw materials will be easily transported to project site for construction activity.

- Initially, the barrage was proposed to construct at RD mile 74/4 in which Kondappan Cauvery Drain is located upstream of the proposed barrage. The Kondappan Cauvery Drain bed level is (+8.505m) much lower than the crest level fixed for the proposed regulator (i.e., +10.000m). It was found that this will lead to cause stagnation of water to a depth of 1.495m in upstream side of the proposed regulator and into the drain also. So it was planned to construct proposed barrage at RD mile 74/3.
- Two major water supply intakes and more than five minor water supply intakes are located storage area of proposed barrage. So the water stored in the barrage will regularly supply water to existing villages.
- The stretch of the river is straight in this location.
- As the elevation of proposed sill level is less than the surrounding area, the storage of water in the barrage will not submerge the surrounding lands.
- The length of the river from the proposed barrage to sea shore is 45km and the proposed barrage is not last barrage in this river. The Government of Tamil Nadu has proposed to construct two more barrages in the downstream of proposed project. From analysis all the aspects, RD 74/3 is the suitable place to construct this proposed barrage.

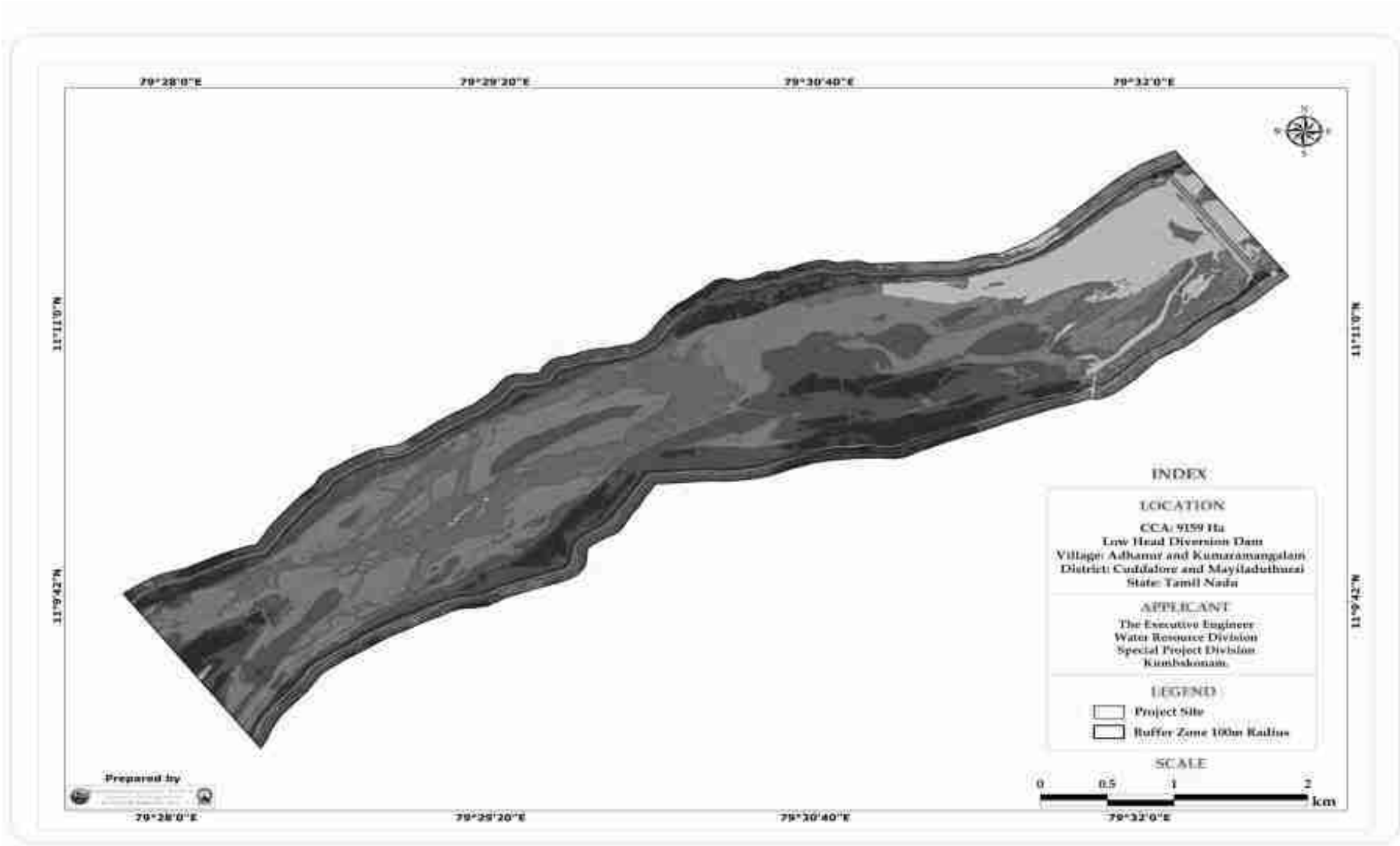


Fig 5.1 Image showing Digital Terrain Model of water spread area of reservoir in Adhanur and Kumaramangalam village

CHAPTER – 6: ENVIRONMENTAL MONITORING PROGRAMME

Environmental Monitoring program is mandatory to check the impact of the construction and irrigation activity in the core and buffer zone. Hence regular monitoring of various environmental parameters helps in maintaining sound operating practices of the construction and irrigation activity and environmental regulations. Environmental Monitoring program will be conducted for various environmental components as per conditions stipulated in Environmental Clearance Letter issued by SEIAA & Consent to Operate issued by TNPCB.

6.1 Measurement methodologies

The following instruments will be used for environment monitoring for various environmental parameters.

Table 6.1: Instruments used for Monitoring

S. No	Instruments	Purpose of Monitoring
1	Respirable Dust Sampler	Air Pollution
2	Fine Particulate Sampler	Air Pollution
3	Sound level meter	Noise level
4	Digital Seismograph	Vibration monitoring
5	Water level indicator	Water level
6	Geophysical Instruments (DDR3)	Water table
7	Camera, Binocular & Lens	Flora, Fauna, Agricutural activity
8	GPS & DGPS	For fixing the coordinates of sampling location
9.	Electronic Total station	Reduced level & topography monitoring

In addition to the above, data on land use, socio economics will be collected by visiting the field and utilized from secondary sources from Govt. Dept and other source.

6.2 Monitoring Schedule and Frequency

The sampling and analysis of the environmental attributes will be as per the guidelines of Central Pollution Control Board (CPCB). Monitoring program will be followed during the construction phase and operational phase as per the schedule below.

6.2.1 Monitoring Schedule during construction phase

The proposed project envisages construction of barrage across River Coleroon at Adhanur and Kumaramangalam Villages. The construction activities involves clearing of vegetation, transportation and unloading of raw required for construction, excavation for foundation work, etc. It generates fugitive dust, gas emission from vehicles, and noise which affects the ambient environment.

The monitoring of ambient air quality, noise level, clearing of plants, trees are essential for adopting mitigation measures for keeping sustainable environment.

Table 6.2: Monitoring Schedule during construction phase

S. No	Environment Attributes	Location	Monitoring		Remarks
			Duration	Frequency	
1	Meteorology and Air Quality	Continuous monitoring weather station in core zone/ nearest IMD station	24 hours	Monthly Once	Wind speed, direction, Temperature,Relative humidity and Rainfall.
2	Air Pollution Monitoring – $PM_{2.5}$, PM_{10}, SO_2 and NO_x	5 locations (One station in the core zone and at least one in nearby residential area, one in the upwind, one station on the downwind direction and one in cross wind direction).	8 hours	Once in six months	Fine Dust Sampler and Respirable Dust Sampler
3	Water Pollution Monitoring	No Effluent generation during the construction phase. Set of grab samples during pre and post monsoon nearby ground and surface water in the vicinity.	–	Once in six months	Physico–chemical, micro-biological characteristics
4	Hydrogeology	Water level in open wells in buffer zone around 1km at specific wells	-	During Foundation Work and desilting work	Water level monitoring devices will be used.
5	Noise	Project site Boundary, high noise generating areas within the site due to heavy machineries and at the nearest residential area	24 hours	Monthly Once	Sound level meter
6	Soil	Core Zone and Buffer zone (Grab samples)	–	Once in six months	Physical and Chemical characteristics
7	Loss of flora and fauna	Project site	During Site Clearance	During Site Clearance	Visual inspection
8.	Vibration Test	Project site	-	When the blasting involved during foundation work	Ground vibration test

6.2.2 Monitoring Schedule during Operational phase

During Operational phase, the water stored in the barrage will be discharged through the north and south rajan channels to the cultivable command areas for the agricultural activity. The water stored in the barrage and discharge through the channels will increase ground water table and may change the gound water quality in that particular area. Also it may alter the climation condition and increase the humidity of the area. The supply of water changes the soil quality with respect to pH, EC and organic matter etc in agricultural land. The irrigation of water in the area will massively increase the agricultural activity in CCA. So the monitoring of storage water quality, ground water level and its quality, soil quality, climate change and crop production is essential in this project during operation phase.

Table 6.3: Monitoring Schedule during Operation Phase

S. No	Environment Attributes	Location	Monitoring		Remarks
			Duration	Frequency	
1	Meteorology and Air Quality	Continuous monitoring weather station in core zone and in CCA/nearest IMD station	24 hours	Monthly Once	Wind speed, direction, Temperature, Relative humidity and Rainfall.
2	Air Pollution Monitoring – $PM_{2.5}$, PM_{10}, SO_2 and NO_x, CO, SPM	Ambient Air Quality Monitoring 8 locations (Two stations in two villages located in left and right of storage area, 3 random locations in CCA of Cuddalore Districts and 2 random locations in CCA of Mayiladuthurai Districts.	8 hours	Once in six months	Fine Dust Sampler and Respirable Dust Sampler
3	Water Pollution Monitoring	1. Collection of surface water sample in storage area 2. Collection of ground water sample in left and right side of storage area 3. Collection of ground water sample in cultivable command areas.	–	Once in six months	Physico–chemical, micro-biological characteristics
4	Hydrogeology	1. Left and right side of storage area 2. Cultivable command area	-	Once in six months	Ground water levels in MSL
5	Soil	Both agricultural and non agricultural land in core zone and in CCA(Grab samples)	–	Once in six months	Physical and Chemical characteristics
6	Greenbelt development	Project site, village roads, river banks, along the channels	-	Daily	Watering and care taking of plants
7	Agricultural activity	Cultivable command area	-	Yearly once	Both pulses and paddy

6.3 Data Analysis

Data analysis will be done by MoEFCC approved laboratory as per CPCB guidelines & compliance reports shall be submitted to concerned authority (specified in Environment Clearance Letter issued by SEIAA, TN) and Consent issued by TNPCB on regular basis.

6.4 Detailed Budget

Detailed budgetary provisions for monitoring program are detailed in the following Table 6.3.

Table 6.4: Environment monitoring budget during Construction Period

S. No	Monitory and Analysis Description	No. of Locations	Rate per sample	Total Charges/ six months (Rs.)	Total Charges/ one year period (Rs.)
1	Ambient Air Quality Monitoring	5	3,000	15,000	30,000
2	Noise Level Monitoring	5	1,000	5,000	10,000
3	Soil sampling and analysis	5	1,500	7,500	15,000
4	Water Sampling and Analysis (Ground and Surface Water)	10	2,000	20,000	40,000
5	Ground water level monitoring	10	1,500	15,000	30,000
Total EM Cost				**Rs. 62,500**	**1,25,000**

Table 6.5: Environment monitoring budget during Operational Period

S. No	Monitory and Analysis Description	No. of Locations	Rate per sample	Total Charges/ Six Months	Total Charges for one year period (Rs.)
1	Ambient Air Quality Monitoring	8	3,000	24,000	48,000
2	Soil sampling an analysis	20	1,500	30,000	60,000
3	Water Sampling and Analysis (Ground and Surface Water)	20	2,000	40,000	80,000
4	Ground water level monitoring	20	1,500	30,000	60,000
Total EM Cost				1,24,000	**2,48,000**

The Executive Engineer proposed to engage third party to monitor the ambient air quality, soil and water quality, water levels, and noise level during construction phase and operational phase of proposed barrage.

CHAPTER – 7: ADDITIONAL STUDIES

7.1. Public Consultation

The present draft EIA report is for Public Consultation only. The proceedings of the Public Consultation will be included in the Final EIA report.

7.2 Risk Assessment and Disaster Management Plan

Risk Assessment is all about prevention of accidents and to take necessary steps to prevent it from happening. Both the construction activity and operation of the proposed barrage will be takes place under site supervisor, safety engineer, Technical Engineer etc. The safety engineer will follow all the rules and regulation of safety aspects and conduct the safety awareness program to the labors and other employees, mock drill to prevent the accidents due to the various activities.

To overcome such risks, help/aid would be sought from emergency services providers like Police station, fire station, Hospital, Ambulance services in the vicinity of the project site. Their telephone numbers and communication facilities are to be provided and displayed on the board at the site office. Responsibility of coordinating rescue activities is entrusted to Safety engineer at the project site.

Name and Address of the Proponent	**The Executive Engineer,** Water Resource Department, Special Project Division, Kumbakonam – 612001, (Government of Tamil Nadu).

7.2.1 Scenarios Considered For Risk Assessment

1. Knowledge of work

The application of risk assessment depends upon full understanding of all aspects of the job being undertaken. In carrying out a risk assessment in relation to a particular task, the evaluation must include a review of the knowledge, experience and training of those persons carrying out the work.

2. Personal Competence

It follows that the knowledge, experience and training of personnel involved in work is critical to evaluate any risk assessment. A knowledgeable, experienced well-trained and competently supervised workforce will be at a lower risk of accidents occurring than a poorly trained and badly supervised workforce.

3. Co-ordination

It is essential that the coordinator ensures that everyone engaged in the work is capable and understands the role of others and their responsibility for each other.

4. Health hazards

Health hazards are associated with the dust and noise, it is necessary to quantify the key pollutants during construction phase that may result into health hazard.

5. Inundation

Inundation may be taken place during operational phase of barrage if the barrage is breached unfortunately during high flood times.

6. Noise

Noise is considered as a common occupational hazard in industrial environment. Prolonged exposure to noise over a period of years may cause permanent damage to auditory nerves and its sensory components (Noise Induced Hearing Loss). In order to avoid Noise Induced Hearing Loss (NIHL) to the workers during construction phase, they should be provided withthe PPE such as ear plugs. Rotation of workers should be enabled for limiting exposure of workers to high noise generation zone. No worker will be allowed to enter high noise generating areas without wearing proper protection equipment's.

7. Surface Fire

There will be no ignitable materials in used in this project.

8. Traffic Movement

The frequent transportation of raw materials will be taken place during construction phase. Therefore there will be risk of accidents due to the traffic movement. However, proper signal for transportation shall be implied on the vehicles plying for material transport to avoid accidents.

7.3 Risk assessment and Disaster Management Plan during Construction Phase

Many works are involved during the construction phase work such as site leveling, excavation work for foundation, shuttering work, scaffolding work, installation of tower crane for transport of construction materials within the site. During such activities, there are more possibilities of taking place of accident. The various risk

raised during the construction phases has been identified and proper management plan has been prepared based on the risk assessment.

Table No. 7.1 Risk Assessments and Disaster Management Plan during Construction Phase

S. No	Hazards	Mitigation measures
1	Installation/Operation of Tower crane	➢ Monitoring the stability of Tower crane if it is stationary crane. ➢ Regular maintenance of the crane to prevent the accident during the transport of materials. ➢ Operating the crane by the trained operator
2	Foundation Work	➢ Check the stability of the soil around the foundation area to prevent the accident due to sliding until the completion of foundation work.
3	Transportation	➢ Concave mirrors should be kept at all corners. ➢ All vehicles should be fitted with reverse horn with one spotter at every tipping point. ➢ Loading according to the vehicle capacity. ➢ Regular checking of brakes to avoid failures. ➢ Periodical maintenance of vehicles.
4	Shuttering work	➢ Ensure the interconnection of the shutters provided for walls, slab, columns and beams. ➢ Only experienced worker will be allowed to do this type of work.
5	Scaffolding work	➢ Ensure the stability of the scaffold in all the floors until the roof slab get set with the curing process. ➢ Only experienced worker will be allowed to do this type of work.
6	Electrical Wiring Work	➢ The workers should wear the safety belt and helmet while doing the electrical work. ➢ All the site workers are trained well enough to identify any faulty connections and report immediately. ➢ Electrical equipments such as concrete vibrator, hand drills, chain saws are operated only by trained professionals.
7	Welding Work	➢ Welding work should be carried out in isolated area. ➢ Welders should be provided with safety glass,

		safety gloves, and shoes. ➢ The waste scrap from welding should be cleared periodically.
8	Handling of Construction materials	➢ The construction materials such as cement bags, steel rod are heavy. So adequate numbers of labors should be engaged while handling such materials. ➢ Mechanical assistance will be provided wherever necessary to handling the construction materials within the site.
9	Noise	➢ Rotation of workers to minimize exposure time of noise. ➢ The equipments and machineries shall be maintained properly. ➢ Provision of earmuffs to workers.
10	Dust	➢ Periodical wetting of land by spraying $MgCl_2$ solutions. ➢ Regular water sprinkling on haulage roads. ➢ Provision of Dust mask to workers.
11	Flooding of Rain water	➢ Diversion of storm water will be provided to drain the rain water along the river.
12	Fire hazards	➢ Smoking is prohibited inside the work premises. ➢ Volatile and flammable materials will be stored separately and are protected. ➢ Trained First aiders will be made available in the work premises in order to treat any persons injured accidentally by fires.

7.4 Risk assessment and Disaster Management Plan during Operational Phase

The risk during the operation phase of barrage is only due to failure of barrage but it is higher than risk during construction phase. The reason is that failure of barrage causes inundation in the area located in downstream and it affects the life of people, cattle, agricultural activities and other properties.

The area of inundation, the velocity and depth of breached out water will depend on lateral inflow hydrograph of barrage. It is necessary to carry out dam break analysis to identify the severity of impact during failure of barrage and to prepare disaster management plan to minimize the loss of life and properties.

7.5 Dam Break Analysis and Disaster Management Plan

7.5.1 General

The construction of barrage across the river provides considerable benefits such as supply of sufficient irrigation water, fish culture in the storage area and drinking water to nearest villages. On the other hand, the consequences will be severe during breakage of dam due to any reasons. It may causes loss of life people living in downstream, damages to crop plantation. So it is highly important to identify the area to be affected due to submergence during dam breach. This will help the Water Resource Department, Tamil Nadu to prepare the mitigation measure to prevent any damages and loss of life if the dam is broken.

7.5.2 Details of Proposed barrage

The **Executive Engineer, Water Resource Department, Special Project Division** planned to construct Barrage with 84 vents (Low Head Diversion Dam) across the River Coleroon at RD 74/3 mile in Adhanur and Kumaramangalam Villages to irrigate the cultivable command area of 9159 Ha in Cuddalore and Mayiladuthurai Districts. The capacity of the Barrage is 0.334 TMC or 9.457 Million Cum or KLD. The water stored in the barrage will be discharged through the North and South Rajan Channels which is unable to irrigate by Lower Anaicut Barrage.

The size of this proposed barrage is very small which 0.37% of Mettur Dam in Tamil Nadu. The primary purpose of this barrage is to divert the inflow through the channel to irrigate cultivable command areas and after meeting the demands the water will be stored to the capacity of 0.344 TMC to irrigate crops during lean seasons.

7.5.3 Dam Break Analysis for the Proposed Barrage

The dam breach analysis for this proposed barrage has been carried out by using the software **HEC – RAS (Hydrologic Engineering Centers River Analysis System)**.

7.5.3.1 HEC - RAS

HEC- RAS software has been developed by the **United States Army Corps of Engineers (USACE)**. This software models the hydraulics of water flow through natural rivers and other channels. It is designed to perform one-dimensional and two-dimensional hydraulic calculations for a full network of natural or constructed channels, overbank, floodplain areas, etc. The software allows simulating flow in natural or artificial channels to calculate the water level for performing flood studies and determine the areas that are likely to flood.

The software is comprised of a user interface, separate analysis components, data storage – management capabilities, and graphics and reporting facilities. It contains the following river analysis components:

- Steady flow water surface profile computations
- One-dimensional and/or two-dimensional unsteady flow simulation
- Quasi unsteady or fully unsteady flow movable boundary sediment transport computations, and
- Water quality analysis

A major element is that all four components use a common geometric data representation as well as common geometric and hydraulic computation routines.

Today's HEC-RAS software builds upon all of the engineering advances from previous generations of computer software. The software can be used for 1-D and 2-D flow simulations, steady flow or unsteady flow boundary conditions, sediment transport, and water quality modeling. It can account for subcritical, supercritical, and mixed flow regimes. The software can be used to perform flood studies, analyze backwater effects at roadway crossings (i.e., bridges and culverts), compute bridge scour, and perform dam or levee failure analysis, and a whole host of other complex river hydraulic analyses.

7.5.3.2 Inputs Required – HEC - RAS

The inputs for executing dam break analysis through HEC RAS for the proposed project are given below:

a) Projection file of the area
b) Digital elevation model of the project site
c) 2D flow areas
d) Storage areas
e) Details on dam/barrage
f) Unsteady flow data

7.5.3.3 Process of Dam Break Analysis

After setting the projection and creating RAS terrain for the proposed project, perimeter of the 2D flow area and the boundary of storage area are drawn in the downstream and upstream side of the barrage respectively. The barrage/dam which is undergoing breach is marked between the perimeter of 2D flow area and the storage area. The volume with respect to elevation in the storage area is set by the

software but it may be altered based on the capacity of barrage designed or data given by WRD.

Table No 7.2 Elevation– Volume from Terrain

S.No	Elevation(m)	Volume (1000 m^3)	S.No	Elevation(m)	Volume (1000 m^3)
1	9.44	0	14	12.616	1528.144
2	9.598	163.735	15	12.868	1788.214
3	9.776	190.977	16	13.105	2060.26
4	9.952	221.666	17	13.344	2366.606
5	10.121	255.212	18	13.579	2700.159
6	10.443	331.454	19	13.807	3054.486
7	10.753	421.744	20	14.248	3835.517
8	11.05	526.472	21	14.702	4769.654
9	11.332	644.858	22	15.16	5836.963
10	11.599	777.071	23	15.637	7073.964
11	11.853	924.301	24	16.17	8597.248
12	12.112	1100.031	25	16.726	10324.91
13	12.365	1300.219			

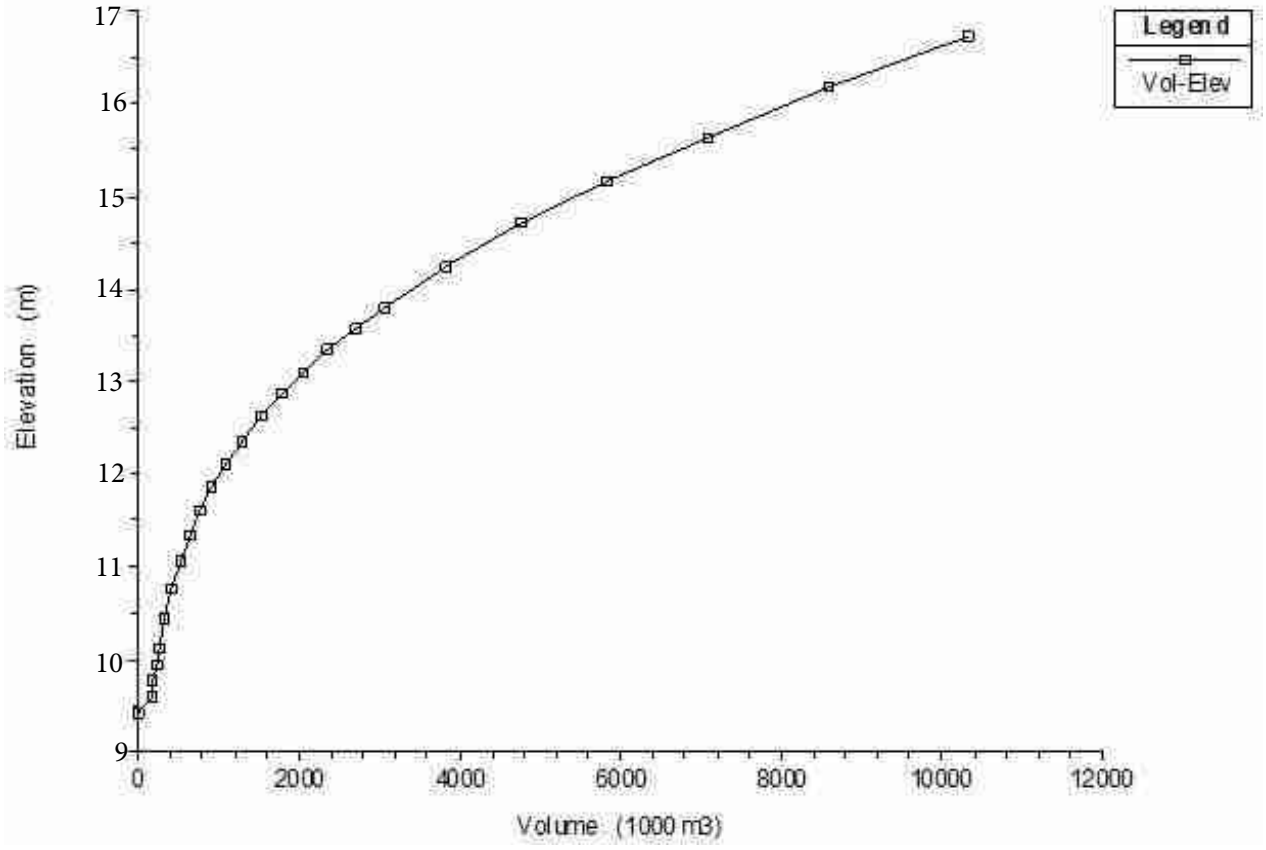


Fig No 7.1 Elevation – Volume relationship

After computing the elevation – volume curve, the barrage data is entered in the storage area and 2D area connection. The details of barrage entered are given below.

Table No 7.3 Details of proposed Barrage

1	Width of Weir	27.5m
2	Weir coefficient	2.18
3	Spillway approach height	3.05m or 3.55m
4	Design energy head	1.35m
5	Weir top elevation	18m
6	Deepest bed level of the Coleroon River	+8.44m
7	Highest bed level of the Coleroon River	+11.710m

Next, barrage breach parameters which are very essential for this analysis are entered in the storage area connection breach data. In this barrage, the longitudinal cut off wall below the raft foundation has been laid with the depth of 5.0m in upstream side and 9.0m in downstream side and they are connected by cross cut off wall. Hence the breach through seepage at the bottom of barrage will not occur in future. The details of breach data are given in below table.

Table No 7.4 Barrage breach data

1	Final breach bottom width	1000m
2	Final breach bottom elevation	8.44m
3	Weir coefficient for breach area	1.44
4	Breach formation time	1 hr
5	Starting WS elevation	14.9m
6	Failure mode	Overtopping

Later, unsteady flow data are given in the HEC RAS. In this area, the details of lateral inflow hydrograph have to be entered on time basis. The lateral inflow is the addition of water inflow to the reservoir through any streams, rivers or channels. As the proposed barrage is constructed across the Coleroon River, the inflow to the barrage from Lower Anicut is often during South West and North East season. The lateral inflow for the proposed project is taken as uniform discharge of 1000cum/hr for 24 hours. The maximum flood discharge in this river is given below.

Table No 7.5 Maximum Discharge in the Coleroon River

Year	Maximum Discharge in cu m^2/s
1924	10293
1961	11327
2005	9487

Table No 7.6 Lateral inflow Hydrograph for this analysis

Time	Later inflow	
	m^3/sec	cu ft/s
00:00	1000	35315
01:00	1000	35315
02:00	1000	35315
03:00	1000	35315
04:00	1000	35315
05:00	1000	35315
06:00	1000	35315
07:00	1000	35315
08:00	1000	35315
09:00	1000	35315
10:00	1000	35315
11:00	1000	35315
12:00	1000	35315
13:00	1000	35315
14:00	1000	35315
15:00	1000	35315
16:00	1000	35315
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23:00	1000	35315

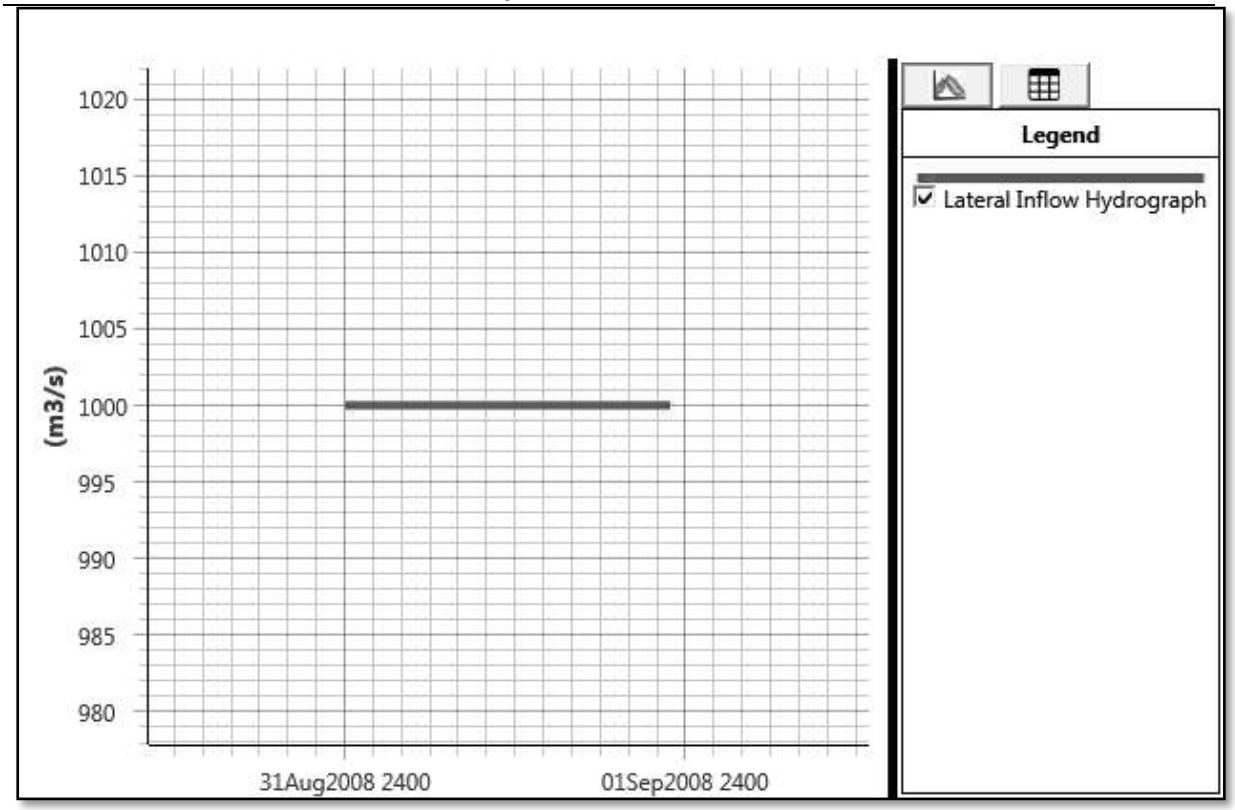


Fig No 7.2 Lateral Inflow Hydrograph

All the inputs required for breach analysis of proposed barrage are given in the software. By performing the unsteady flow simulation, the result of breach analysis is displayed in the RAS Mapper. It includes inundation area, depth of water and water surface elevation in the inundation area, velocity of flood during breach. The depth of water is analyzed by difference between water surface elevation and elevation of the 2D flow area. The results are available in the different base map of the area. The inundation area projected in the different maps such as Bing Satellite map, Google Hybrid map and ArcGIS World Street map with depth, velocity and WSE are given in below figures.

Fig Map 7.3 Image of Dam break analysis showing depth of flood water in the inundation area (Bing Satellite Map)

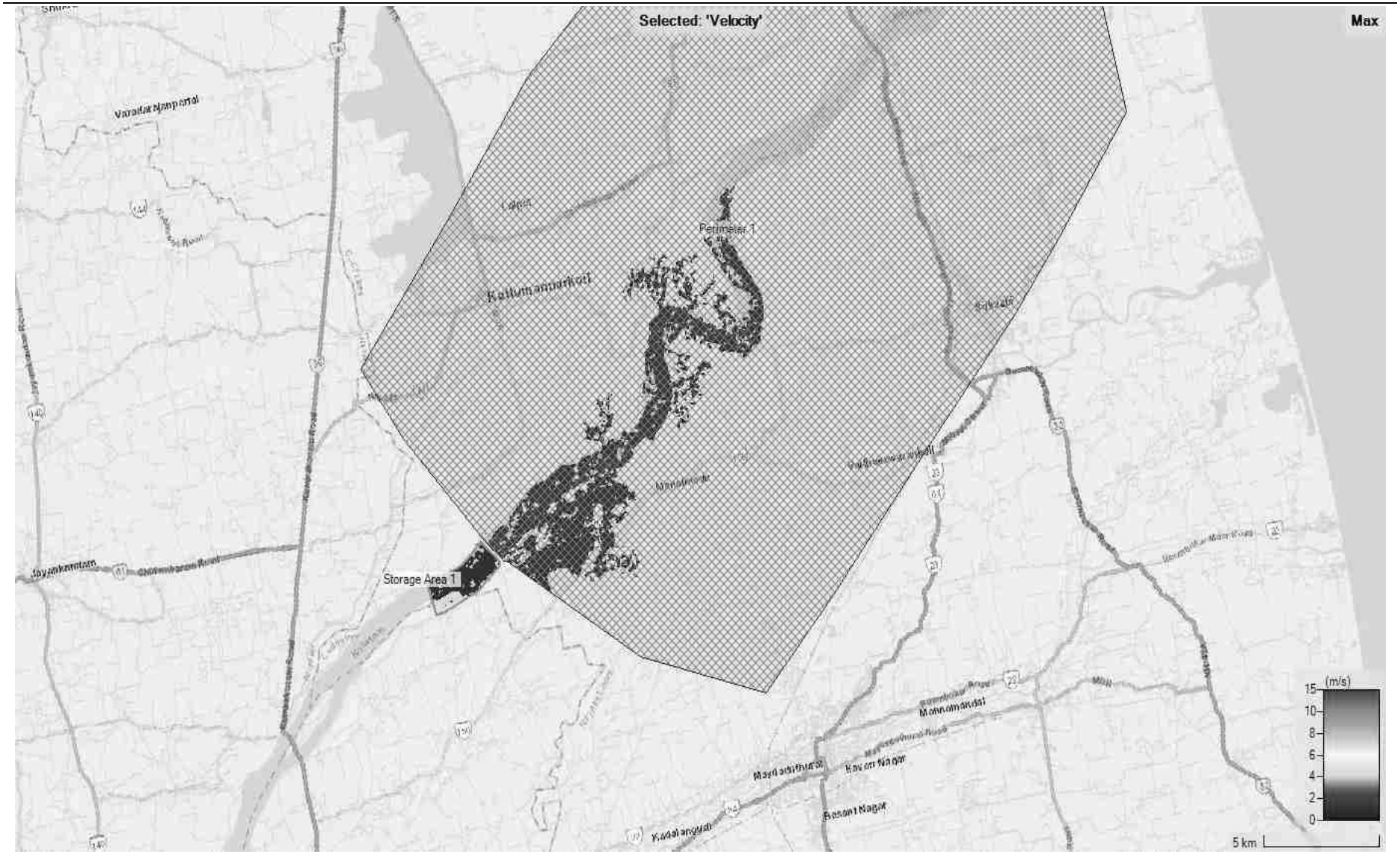


Fig Map 7.4 Image of dam break analysis over ArcGIS World Street Map showing velocity and spread of flood water during breach hours

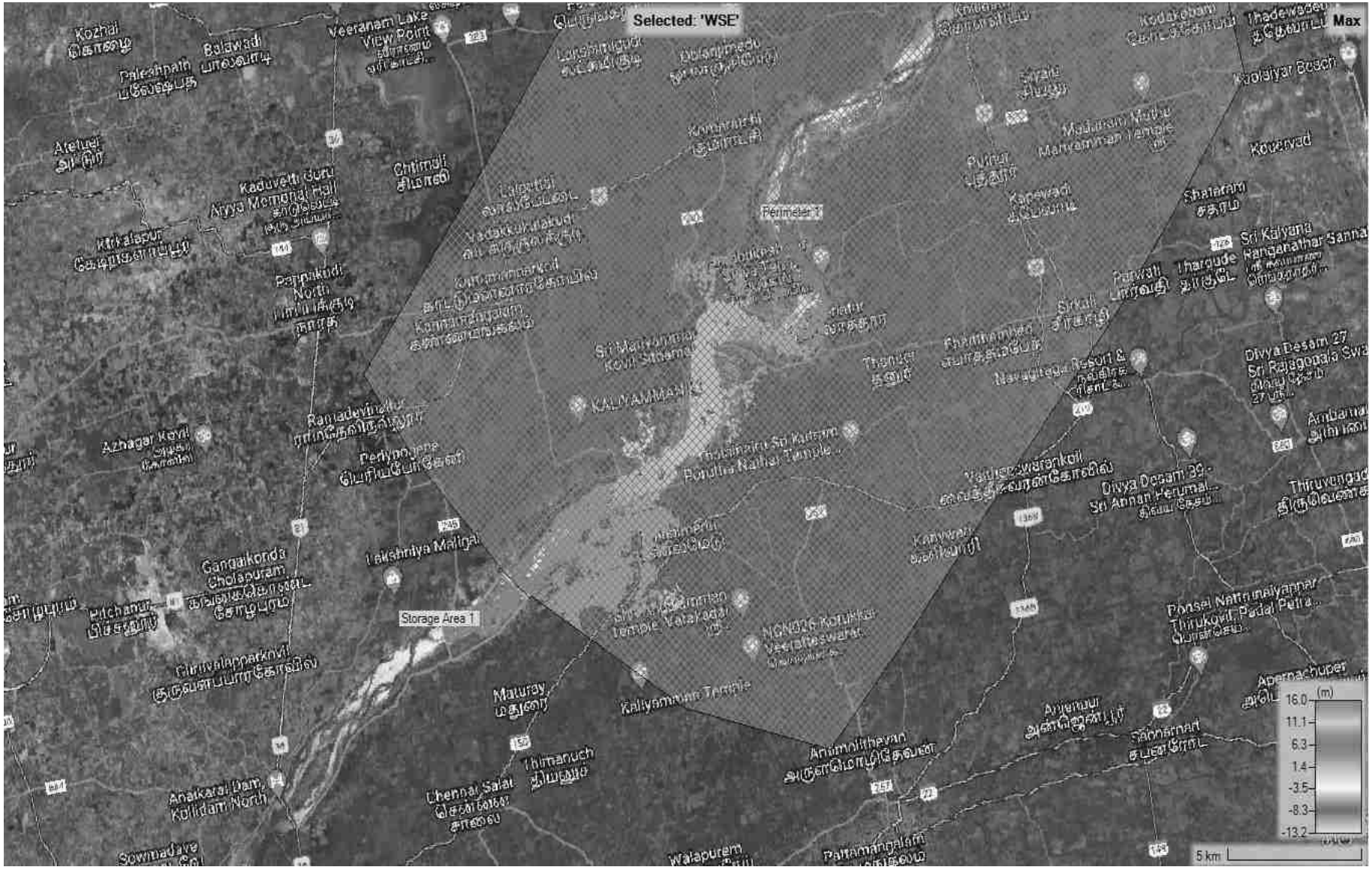


Fig Map 7.5 Image of dam break analysis showing elevation of water surface level over inundation area (Satellite Map)

7.5.3.4 Results

During breach hours, it is found that the storage water majorly flooded the area located in the right side of the Coleroon River upto lateral distance of 4km. There is no flood water in the area located in Cuddalore District. It shows that the elevation along right side bank may be lower than that of left side bank upto 6km downstream of the barrage. Beyond 6km, the water partially flooded on both side of the river upto lateral distance of 1.5km. The area of the major inundation area is approximately 15 km^2.

The depth of water in the inundation area is identified as only 2m above the ground surface level. As the river bed level in both upstream and downstream side are same as +9.5m and also the elevation of the area located near to river are higher than the river bed level, the velocity of flood water is less than 2m/s. The breach analysis were arrived based on the lateral inflow of 1000m^3/s. Even though the barrage is not present, if the flood level of Coleroon river is 11327m^3/s (Year 1961) the inundation area will be high upto sea shore. So the breach analysis were carried out with the average lateral inflow of 1000m^3/s. If the barrage is breached without any lateral inflow, the storage water will be flooded only within the river.

The stability of the Barrage has been designed well to withstand the flood for more than 100 years. If the barrage is broken unfortunately, the impact will be less; it will affect the crop cultivation without affecting any life of people and cattle. As the sill level of the barrage is lesser than elevation of surrounding area, the depth of inundation will be less than 2m.

7.6 Disaster Management Plan

7.6.1 Purpose

The failure of dam causes loss of life of people, cattle and damages crops and other properties in the downstream of barrage. The extent of loss is dependent on the extent of population and development in the downstream area. The Disaster Management Team should be readily available to identify the disaster earlier and to minimize its effects with proper emergency preparedness plan. The team provides timely warning to the population likely to be affected and alert key people who have to take respective actions in case of an emergency. Disaster preparedness can minimize loss of life and property by proper planning in advance. The planning of disaster management includes:

a) Advance knowledge of occurrence of floods and cyclones. The daily discharge from Mettur Dam, Salem during monsoons should be known earlier through WRD, Salem.

b) The map showing the area to be affected during failure of dam should be made available in office of WRD and in other related Departments.

c) Monitoring the stability of barrage and checking the rope of shutters, gear mechanism for lifting the shutters, DG set and electric lines continuously.

d) Review of provisions of anti-disaster shelters, adequacy of medical aid facilities and transportation, food etc.

e) An Emergency Management Contact Directory containing contact numbers of all nodal officials in disaster management at the national, state and District level of the Government, private, NGOs and the community will be prepared and maintained.

f) Know the Nodal Agencies for Disaster Early Warning Dissemination. The Central Water Commission (CWC) for issuing flood warnings in respect of the Cauvery, Palar, Thenpennai, Tamirabaruni, Bhavani Sagar, Ponnaiyar, Kosasthalaiyar and Araniyar Rivers.

7.6.2 Emergency Action Committee

The District Collector is the Chairperson of the District Disaster Management Authority (DDMA).

The District Disaster Management Authority, Cuddalore meets during August or September every year, under the Chairmanship of the Collector and detailed discussion takes place with the following officers regarding the precautionary measures to be taken to face the disaster and other activities to be taken in the event of any emergency during the monsoon season.

- District Panchayat Chairman – Co-Chairperson;
- Superintendent of Police – Member
- District Revenue Officer- Member Project
- Director (District Rural Development Authority)-Member
- Superintending Engineer (PWD) WRD – Member
- Superintending Engineer, TANGEDCO- Member
- Personal Assistant (General) to Collector – Member

On the basis of the points discussed during the prevention and preparedness meeting, an Action plan is prepared by all the departments for preventing, mitigating and responding to the disaster if any occur in the monsoon season. The Revenue Department will be the Nodal Department for controlling, monitoring and directing measures for organizing rescue, relief and rehabilitation in the District.

7.6.3 Roles and Responsibilities of Departments/Teams/Agencies involved in Disaster Management:

District Administration: The Revenue Department will be the Nodal Department for controlling, monitoring and directing measures for organizing rescue, relief and rehabilitation in the District. They will coordinate with WRD, PWD, Police Department, Fire & Rescue, Transport Department, NGO's, Health Department, TNEB, Municipal commissioner etc.

WRD: The Executive Engineer should visit the barrage regularly and inspect the working condition of each and every shutter practically during pre monsoon seasons. The shutters should be checked whether it is lifted within the minutes of time as per design. During monsoon season, the water flow in the river should be monitored by technical person of WRD such Junior Engineer, Assistant Engineer and by Technical Assistants. The District Disaster Meeting attended by Superintending Engineer, WRD should communicate minutes of meeting to Executive Engineer and all other officials, helpers etc to make alert during Dam Breach and flooding time.

Police Department: Next to Revenue Department, Police Department also will coordinate with all departments. They will help Medical Department, TNEB and Transport Department, Media and NGO's etc to do their duties on time. During evacuation, the properties and belongings of evacuees will be safeguarded by police.

Fire and Safety Department: The Fire services department during disaster has to evacuate the people affected due to dam failures and inundation. People trapped in house or any other place during flooding will be safely evacuated by this department and shifted to shelters.

Medical and Health Department: It is discussed in Emergency health preparedness Plan.

Media: The information regarding details and severity of flood will be given to media such as news channels, news paper printers and other important social media like

face book pages, Instagram etc. The remote areas will be informed by following ways:

- Community stations, FM Radio should be supplied with clear and accurate information.
- Mass messaging and use of mobile phone operators in information dissemination.
- Doordarshan and the local cable channels (TV channels & radio Channels including FM radio), Press Bulletin, Fax/Telephone, Social Media.
- Local means of raising alarms, for example church bells, sirens, loud hailers, loudspeakers, etc.

TNEB: Pre disaster, all the electric lines in the area likely to be affected shall be shut down to prevent the accidents due to electric shock. Lighting in the shelters, medical camp and other relief area shall be provided by TNEB.

Transportation: Transportation department should arrange the transportation facilities for shifting the evacuees to the shelters in consultation with police department.

NGO's: NGOs plays a vital role for successful implementation of relief works. Many NGO organizations are also helping to collect the donations and disburse them directly to the victims.

7.6.4 Efficient Communication System

An efficient communication system is essential to achieve a successful Emergency Preparedness Plan and this has to be finalized in consultation with local authorities and administrative setup. More often, the entire communication facility gets disrupted in a disaster situation. The wireless facility which is comparatively free from general encumbrances of the communication system shall be invariably a part of emergency preparedness plan. The respective department of police, who generally has this facility, must have standing instructions to convey disaster messages effectively in time. In addition, telephone facility should be available at dam site, vulnerable points and population centers. Vehicles equipped with sirens and public address system may also be kept ready for densely populated areas. Warning sirens may also be installed in the likely affected population to save warning time. Continuous monitoring of the Water levels and Rainfall is should be carried out in

upstream and Barrage site using automated recorders and transmission of data through V-sat.

7.6.5 Emergency Preparedness Plan and its implementation:

Once the Emergency is foreseen, the Emergency Action Plan may be put in operation by The Executive Engineer, WRD.

The Executive Engineer, WRD will alert the officers and workers of WRD with the emergency preparedness plan as discussed during District Disaster Management Authority (DDMA) Meeting. He will coordinate with all rescue teams and District Administration to combat the disaster.

- The announcement will be given to nearest villages through siren vehicle, drums, and vehicle fitted with loud speaker through Revenue Departments.
- Make transportation facilities in the disaster prone zone in consultation with transportation department and police department to shift the evacuees to shelter.
- Based on the Hazard area map, the people and cattle in the primarily affected area shall be shifted to shelters including prisoners, hospitalized people.
- The Police Department shall be allotted in the evacuated area to protect the belongings and properties of people.
- Adequate provision of food, drinking water and bathing, sanitation and essential health-care facilities for the evacuees in the camps/shelters.
- The people affected by the disaster shall be provided with sufficient clothing, blankets, etc. to ensure their safety and well-being.
- Medical camps will be formed to provide medical facilities for the evacuees in the shelters.
- Arrangements of extra beds and medical facilities in the nearby Government Hospitals.
- Making availability of more numbers of 108 ambulances in the disaster prone zone.
- Instructions regarding assignment of specific functions and responsibilities of various members of evacuation teams.

7.6.6 Emergency Health Preparedness

Failure of barrage may cause deaths, injuries, or illness in the affected community, exceeding the management capacities of local health services and requiring external assistance. It may disrupt the local health infrastructures such as hospitals, which will therefore not be able to respond to the emergency. Flooding causes adverse effects on the environment, increasing potential risk for communicable diseases that will increase morbidity, mortality.

Measures to Prevent Infectious Diseases during Disasters

1. Maintenance or restoration of safe water supply and temporary measures of rendering water safe for drinking and other essential uses.
2. Adequate food inspection especially, inspection of emergency kitchens and canteens
3. Regulation of sanitation in shelters and emergency camps.
4. Disposal of corpses and carcasses.
5. Maintenance or restoration of sanitation standards in the disposal of sewage and solid waste despite less or diminution of water – supply.
6. Control of pests, rodents and insects which carry disease, destroy food or become serious nuisances.
7. Requirements for Health relief:
    a) Disinfectants such as bleaching powder, chlorine liquid, Phenyl/cresol, Chloroscope for ensuring quantity of free chlorine and supplying safe potable and protected water.
    b) Mobile water tankers, drums and cans for transporting drinking water.

7.6.7 Animal Care

Animals both domestic as well as the wild are exposed to the effects of natural disasters. The department of Animal Husbandry devises appropriate measures to protect animals and finds means to shelter and feed them during disasters and their aftermath, through a community effort, to the extent possible.

7.6.8 Post Disaster Management

- Disaster affected households shall be provided with necessary tools, equipment and materials for repair, reconstruction and maintenance for safe use of their shelter.
- In the affected area, the risk of diseases and epidemics is high inadequate quantity and quality of water, poor environmental and sanitary conditions, decaying biological matter, water stagnation and inadequate shelter & food supplies. There should be adequate supply of medicines, disinfectants, fumigants, personal protective equipments, diagnostic kits, to check outbreak of epidemics. It should be ensured that the medicines have not reached expiry date.
- Sanitation services are crucial to prevent an outbreak of epidemics in post disaster phase.

7.7 Resettlement and Rehabilitation Action Plans

The proposed Barrage across Coleroon River of **The Executive Engineer,** Water Resource Department, Special Project Division, Kumbakonam – 612001 involves displacement of two houses located within river bank of upstream side of proposed barrage in Sarobhojijarapuram village. As it is government project, the resettlement of two houses will be done by Revenue Department of the District.

Both patta lands and poramboke lands are acquired within river banks for the storage of water in upstream of barrage. The total area of patta land acquired both in left bank and right of river is 84.72 Ha and the total area of poramboke land acquired both in left bank and right of river is 12.90 Ha. The Government has accorded administrative approval for the scheme and administrative sanction for land acquisition charges for Rs 31.3457 crore vide GO (Ms) No 48 dated 23.02.2018.

7.8 Command Area Development Plan (CADP)

Command Area Development plan is a Scheme to be implemented with the main objective of reducing the gap between irrigation potential created and that utilized. The proposed barrage is planned to construct across Coleroon River at RD 74/3 (12km downstream of Lower Anicut) to irrigate the cultivable command area of 9159 Ha in Cuddalore and Mayiladuthurai District. The command area in Cuddalore District is about 6601 Ha which covers 53 villages and in Mayiladuthurai District is about 2558 Ha which covers 35 villages.

The north rajan and south rajan channels were formed during the construction of Lower Anicut to discharge water from Lower Anicut to villages in downstream for irrigation and drinking water supply. The north rajan channel was formed left side of the Anicut Barrage whereas south rajan channel were formed right side of the barrage. The lengths of north rajan and south rajan channels and its tributaries are given below.

Table No7.7 Details of existing channels/canals for proposed barrage

S.No	Channels/Tributaries	Length in meters
1.	Northrajan channel	45460
2	Southrajan channel	54320
3.	Tributaries of Northrajan channel	200350
4.	Tributaries of Southrajan channel	219840
5.	Khanshahib canal	126000

The storage water from the proposed barrage also will be discharged through the Northrajan and Southrajan channel. The main channels and tributaries already exist well in the proposed command area to supply water for irrigation from the proposed barrage. No new canals are required to develop in the command area.

7.8.1 Command area development works

a) Land development

The land in the command area of both districts is plain without any undulations. Initially, the proposed command areas were partially irrigated by discharging water from the Lower Anicut. So the proposed command area was already developed by leveling to receive the irrigation water for cultivation of crops such as paddy and pulses. So the development of land is not required due to this project.

b) Field channels

Field channels will be developed by the farmers of respective agricultural land based on the type of crop cultivation. The paddy comes under Kharif crop which is cultivated during monsoon seasons and the pulses comes under Rabi crops which is cultivated during non monsoon seasons. So the field channels will be reformed from season to season by the farmers. The seminars on development of field channels will be conducted to village people under program of CADP.

Fig No 7.6 Field Channels in Paddy Cultivation

Fig No 7.7 Field Channels in Pulses Cultivation

c) Field drainage to prevent water logging

The command is very close to the sea coast in its lower portion. The premonsoon groundwater table is about 5 m below the ground level. The average post- monsoon water table is around 2 m below the ground level. Hence, any rise in the water table in the command area will have to be thoroughly watched after introduction of irrigation. However, to avoid the possibility of water logging in the command, a well drainage system is to be provided besides to resort to conjunctive use of surface and ground waters to enhance the irrigation intensity and also to bring down the groundwater level below the root zone of the crops.

d) Farm Roads

The existing road network to reach various parts of the command is sufficient. However, after introduction of irrigation, some new farm roads will be required to be constructed and old village roads will have to be realigned for better accessibility to the villages and agricultural fields.

e) Other facilities

The CADP program has to be conducted yearly once in villages of proposed command area to provide knowledge of efficient agricultural practices to farmers. It includes:

1. Crop rotations in different seasons.
2. Interplant system
3. Seeds used for cultivation
4. Update in new fertilizers (chemical and organic fertilizers)
5. Optimum dosage of fertilizers

6. Plant protection
7. Smart water management
8. Nutrients in soil during pre plowing and after harvesting
9. Modern machineries/ technologies in agricultural activities.
10. Labor productivity.
11. Scheme of bank loans for farmers.
12. Knowledge on site specific meteorology

It is also pertinent to develop other facilities concerning the health, education, protected drinking water supply, communications etc. for the general betterment of the living standards of the population of the command area.

7.9 Catchment Area Treatment Plan

7.9.1 Introduction

The study of erosion and sediment yield from catchment is of utmost importance as the deposition of sediment in reservoir reduces its capacity, thus affecting the water available for the designated use. The important factor that adds to the sediment load is due to grazing of animals. The removal of top fertile soil from catchment adversely affects the agricultural production.

The lack of proper vegetal cover is a factor, which causes degradation and thereby results in severe run off/soil erosion, resulting in premature siltation of the reservoir. Thus, a well-designed Catchment Area Treatment (CAT) Plan is essential to ameliorate the above including process of soil erosion. The catchment area treatment involves the understanding of the erosion characteristics of the terrain and identifying/ suggesting remedial measures to reduce the erosion rate.

7.9.2 Objectives of CATP

The main aim of the CAT is to rejuvenate various potential and degraded ecosystems in the catchment area.

- To facilitate the hydrological functioning of the catchment and to augment the quality of water of the river and its tributaries.
- Conservation of soil cover and to arrest the soil erosion, floods and siltation of the river and its tributaries and consequent reduction of siltation in the reservoir of the project.
- Mitigation of landslide landslip and rock falls.

- Soil conservation through biological and engineering measures to reduce sediment load in river and tributaries, thus improving the quality of water.
- Ecosystem conservation resulting from increased vegetative cover.
- Employment generation through community participation and conservation.

7.9.3 Catchment area

Cauvery is an Indian river flowing through the states of Karnataka and Tamil Nadu. The Cauvery River rises at Talakaveri on the Brahmagiri range in the Western Ghats, Kodagu district of the Karnataka state, at an elevation of 1341m above mean sea level and flows for about 800km before its outfall into the Bay of Bengal. The catchment area of Cauvery basin is estimated to be 81,155 km^2 (31,334 sq mi). The basin area of Cauvery is 42% in Karnataka State, 54% (34273 Sq.Km) in Tamil Nadu State (44016 Sq.Km) and 4% in Kerala State (2866 Sq.Km). The map of Cauvery basin is shown in Fig No.7.8 and River flow Diagram is shown in Fig No.7.9.

The Coleroon(Kollidam) is a river in south-eastern India. The Coreloon (Kollidam) is the northern distributary of the Cauvery River as it flows through the delta of Thanjavur. It splits from the main branch of the Cauvery River at the island of Srirangam and flows eastward into the Bay of Bengal. The distribution system in Coreloon (Kollidam) lies at the Lower Anaicut which is an island of river Coreloon (Kollidam).

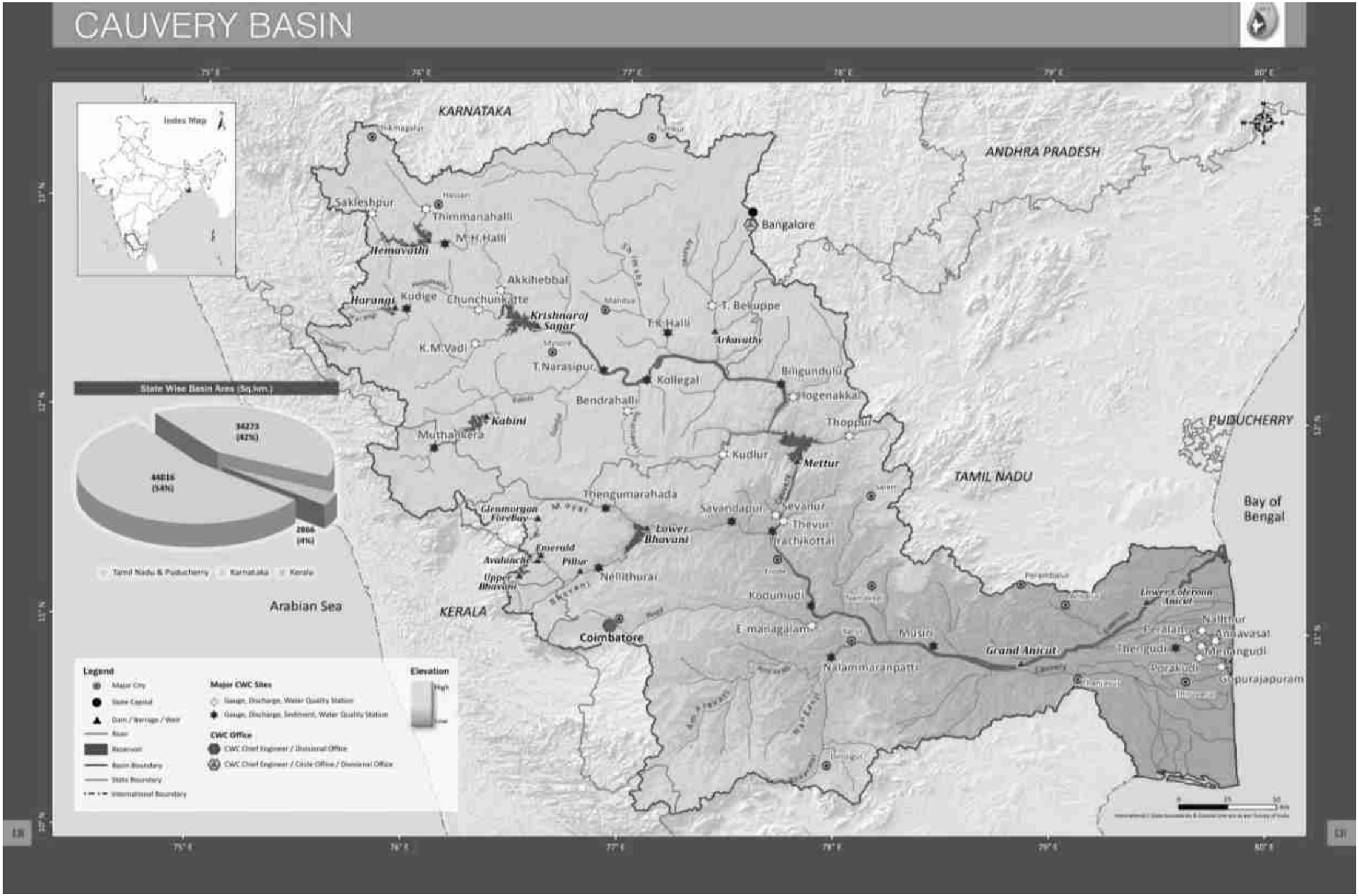


Fig 7.8 Image showing Cauvery River Basin

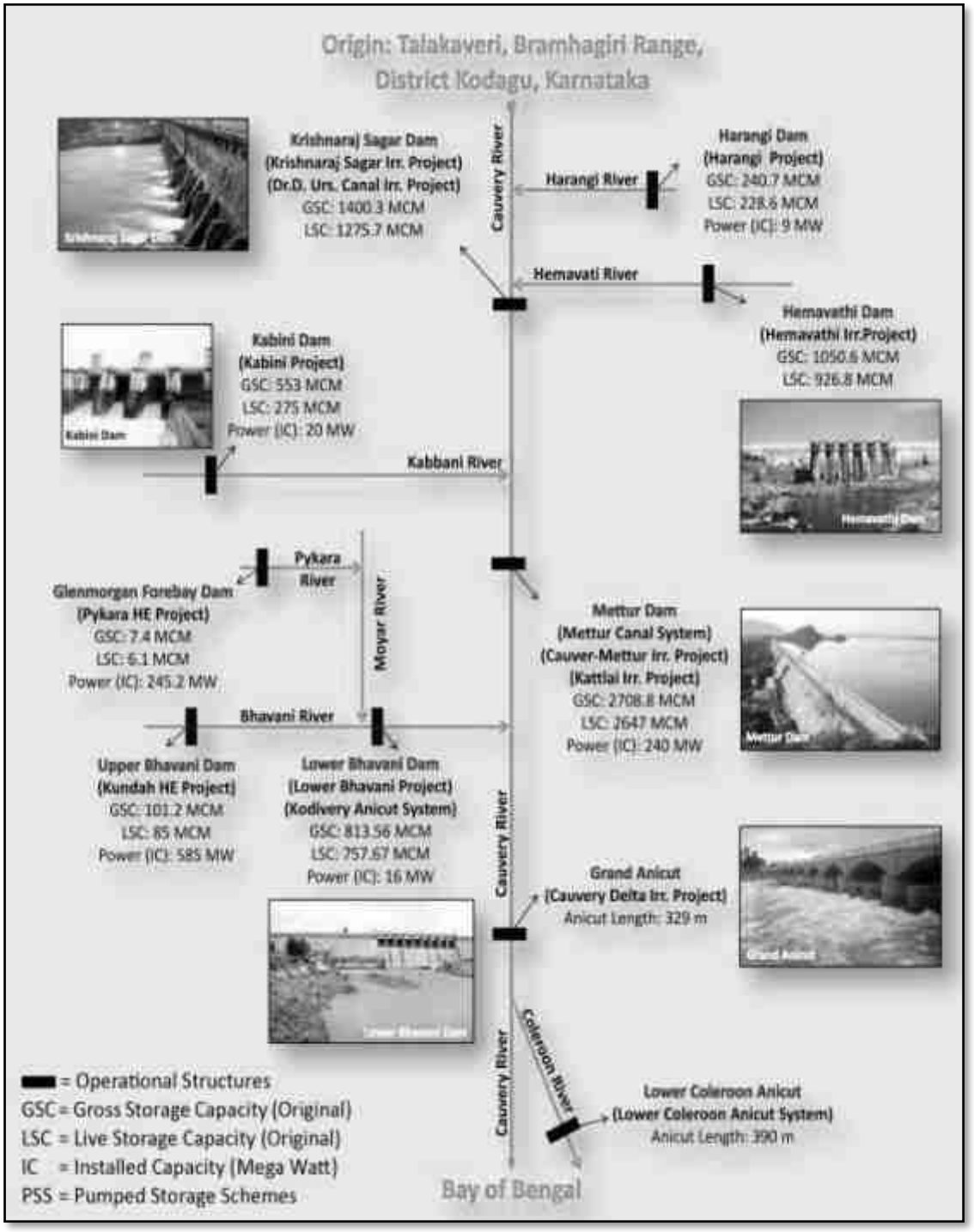


Fig No 7.9 River Flow diagram

7.9.4 Micro Watershed around the storage area:

A watershed is an area of land that drains or "sheds" water into a specific water body. Every body of water has a watershed. Watersheds drain rainfall and snowmelt into streams and rivers. These smaller bodies of water flow into larger ones, including lakes, bays, and oceans.

The details micro water shed around the proposed barrage were taken from Micro-Watershed Atlas of India.

Table No 7.8 Micro watershed Map No in Cuddalore District

S.No	Micro water shed Map No	Area
1	4B1B2a1	8736 Ha
2	4B1B2a2	
3	4B1B2a3	
4	4B1B2a4	
5	4B1B2a5	
6	4B1B2a6	
7	4B1B2a7	
8	4B1B1c5	

Table No 7.9 Micro watershed Map No in Thanjavur/Mayiladuthurai District

S.No	Micro water shed Map No	Area in Ha
1	4B1A8d8	19218 Ha
2	4B1A8d9	
3	4B1A8f1	
4	4B1A8f2	
5	4B1A8f3	
6	4B1A8f4	
7	4B1A8f5	
8	4B1A8f6	
9	4B1A8f7	
10	4B1A8f8	
11	4B1A8f9	

7.9.5 Slope of Sub water shed in the upstream of barrage

Slope has major influence on the loss of soil and water from the watershed and thereby influences the land use capability. The slope percentage determines the erosion susceptibility of the soil depending on its nature and class. This helps in classifying various lands suitability classes, which enables us to formulate suitable conservation measures for the prevention of soil erosion.

Table No 7.10 Slope Range Classification

Slope Class	Slope Range	Description
A	0-5%	Very Gentle Slope
B	5-8%	Gentle Slope
C	8-15%	Moderate Slope
D	15-30%	Moderately Steep Slope
E	30-70%	Steep Slope

From the slope map given in Fig No, it is seen that the slope of the sub water shed of proposed barrage comes under Slope class A. It shows that the area is almost flat or very gentle sloping. The slope range of the area is 0- 4.7%.

7.9.6 Soil type in Sub water shed

The sub watershed in the upstream of barrage is majorly covered with Vertisol type of soil. Vertisols are clay-rich soils that shrink and swell with changes in moisture content. During dry periods, the soil volume shrinks and deep wide cracks form. The soil volume then expands as it wets up. The depth of soil deposited will be 0.45m to 0.9m below ground level.

7.9.7 Land use of the Sub water shed

The area of the sub water shed is covered with plantation and by agricultural activity. The small bunds are formed along the boundary of agricultural field to irrigate the crops. So the erosion of soil in the sub water shed during monsoon season is less. The two main channels such as north rajan and south rajan are flowing adjacent to the River Coleroon on both sides. Eventhough the soil in the sub water shed get eroded during monsoon season, it will not get silted in the storage area, and it will be silted in the two channels.

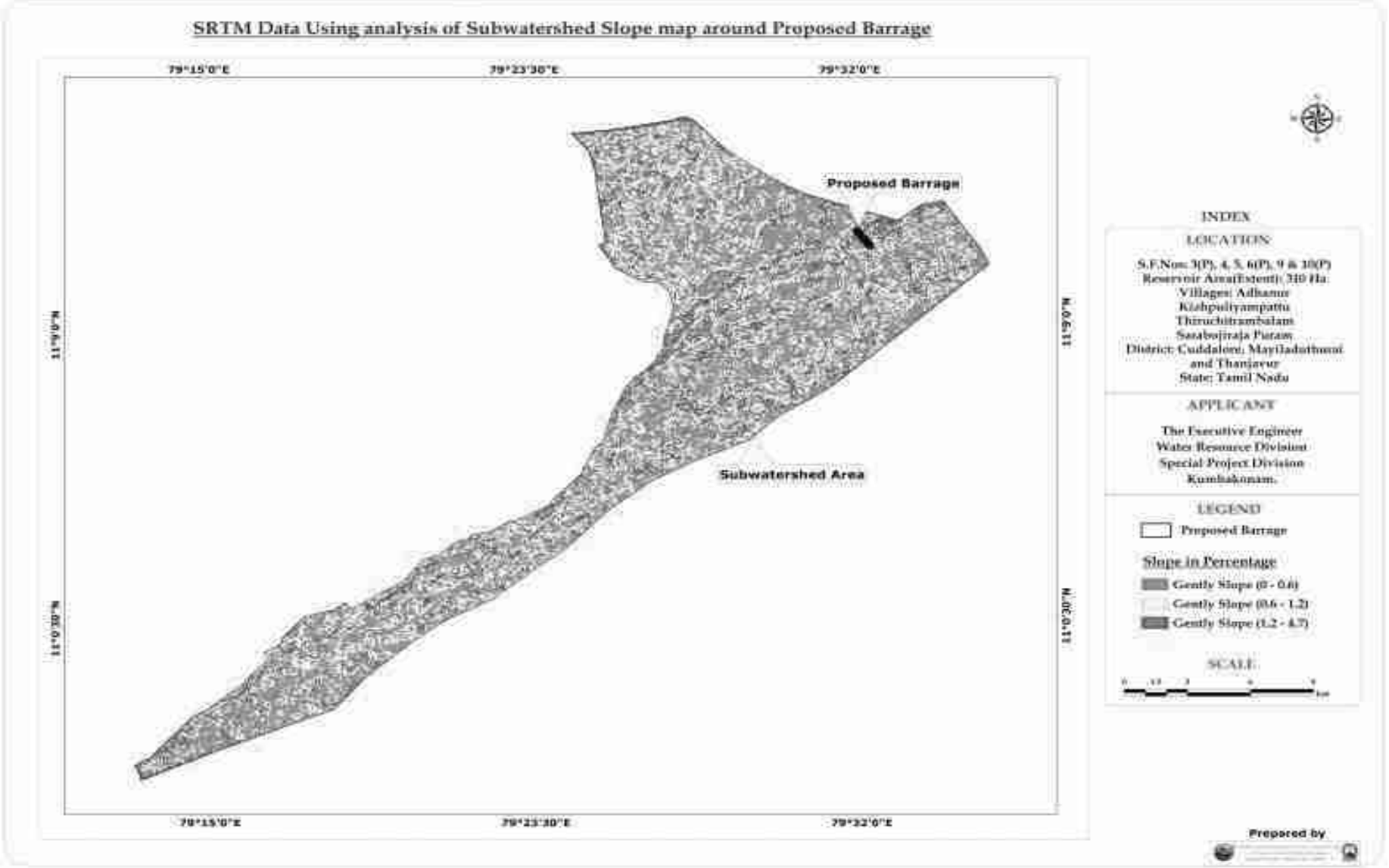


Fig 7.10 Image showing slope of nearest sub watershed of the proposed barrage in upstream side

7.9.8 Soil loss using Silt Yield Index (SYI) method

Methodology for the calculation of sediment yield index developed by All India Soil & Land Use Survey (Development of Agriculture, Govt. of India) was followed in this study.

7.9.8.1 Silt Yield Index

SYI = (Ai x Wi x Di) x 100/AW; Where I = 1 to n

Where

Ai = Area of ith (EIMU)
Wi = Weightage value of ith mapping unit
Di = Delivery ratio
n = No. of mapping units
Aw = Total area of sub-watershed

The SYI values for classification of various categories of erosion intensity rates were taken for the present study as follows:

	Priority Category	SYI Values
1.	Very High	>1300
2.	High	1200-1299
3.	Medium	1100-1199
4.	Low	1000-1099
5.	Very low	<1000

7.9.8.2 Delivery Ratio

The delivery ratio was calculated for each composite erosion intensity unit. The delivery ratio suggests the percentage of eroded material that finally finds entry into the reservoir or river/stream. Total area of different erosion intensity classes in each watershed was then calculated. The SYI values for classification of various categories of erosion intensity rates were taken for the present study as follows: The delivery ratio is generally governed by the type of material, soil erosion, relief length ratio, cover conditions, distance from the nearest stream, etc. However, in the present study the delivery ration to the erosion intensity units were assigned upon their distance from the nearest stream.

Table No 7.11 Delivery Ratio Criteria Adopted

Nearest Stream	Delivery ratio
0-0.9 km	1.00
1.0 – 2.0 km	0.95
2.1 – 5.0 km	0.90
5.1 – 15.0 km	0.80
15.1 – 30.0 km	0.70

7.9.8.3 Weightages for the Mapping unit

The weightages for Land use, Slope & Soil were summed to get the Erosion Intensity Classes.

Table No 7.12 Erosion Intensity & Weightages

Erosion Intensity based on slope Range	Sum of weightages
Very Severe – Steep slope	12 to 14
Severe – Moderately Steep slope	9 to 11
Moderate - Moderate slope	6 to 8
Slight- Gentle Slope	4 to 5
Negligible – Very Gentle SLope	0 to 3

7.9.9 Sediment Yield Index for Sub water shed in upstream of barrage in Cuddalore District

Land use – Cultivation
Slope Intensity – Very Gentle slope
Soil depth – Deep
Erosion – Negligible (0 to 3)
Weightage/DR unit – 3/1

SYI = A x W x D x 100/AW
A = 8736 Ha
W = 3
D = 1.0

Gross silt yield = 8736 x 3 x 1
= 26208

Silt yield index = 26208 x 100/8736
= 300

7.9.10 Sediment Yield Index for Sub water shed in upstream of barrage in Thanjavur District

Land use – Cultivation
Slope Intensity – Very Gentle slope
Soil depth – Deep
Erosion – Negligible (0 to 3)
Weightage/DR unit – 3/1

SYI = A x W x D x 100/AW

A = 8736 Ha

W = 3

D = 1.0

Gross silt yield = 19218 x 3 x 1

= 57654

Silt yield index = 57654 x 100/19218

= 300

Table 7.13: SYI & Priority for Sub-watersheds Treatment

Sub water shed	Area (Ha)	SYI	Priority
Cuddalore District	8736	300<1000	Very low
Thanjavur	19218	300<1000	Very low

From the above table, both the sub water shed will be given less priority for the treatment of catchment area. As the land use of the sub water shed area is agriculture, suggestion for catchment area treatment will be given based on agricultural activities.

7.9.11 Biological Measures

a) Strip cropping

Strip cropping is a method of farming which involves cultivating a field partitioned into long, narrow strips which are alternated in a crop rotation system. It is used when a slope is too steep or when there is no alternative method of preventing soil erosion.

Fig No 7.11 Strip cropping to control soil erosion

b) Contour Cropping

Contour cropping is a conservation farming method that is used on slopes to control soil losses due to water erosion. Contour cropping involves planting crops across the slope instead up and down the slope. Use of contour cropping involves protects the valuable topsoil by reducing the velocity of runoff water and inducing more filtration. Contour Cropping is most effecting on slopes between 2-10%.

Fig No 7.12 Contour cropping to reduce soil erosion

c) Pasture Cropping

Pasture cropping is the cultivation of forage crops with no-tillage technique. Forage crop is crop of cultivated plants or plant parts, other than separated grain, produced to be grazed or harvested for use as feed for animals. Potential environmental benefits of this system are varied, and include increasing soil cover, reducing erosive processes, improving soil structure and organic matter, increasing infiltration and water retention.

Fig No 7.13 Pasture cropping - no tillage – Control soil erosion

d) Grass land forming

Grass land protects soil from wind and water erosion. It provides high quality, relatively inexpensive feed for livestock. It helps to maintain soil fertility because it encourages higher levels of soil organic matter than row crops.

Fig No 7.14 Grass land farming

e) Mulching

Mulch is any material that is spread or laid over the surface of the soil as s covering. It is used to minimize rain splash, reduce evaporation, control weeds, reduce temperature of soil in hot climates and moderates the temperature to a level conductive to microbial activity. it also helps in breaking the energy of raindrops, prevent splash and dissipation of soil structure, obstruct the flow of runoff to reduce their velocity and prevent sheet and rill erosion. They also help in improving the filtration capacity by maintain a conductive soil structure at the top surface of land.

Fig No 7.15 Mulching

f) Wood lands

Woodland can help to purify our air and water, reduce flood risks and decontaminate soils in post-industrial areas. Riparian woodlands (on river banks) are an excellent example: the woodland filters water from the soil in nearby fields, removing nutrients and other pollutants before it reaches the river.

Fig No 7.16 Plantation of trees in Poramboke land to control soil erosion

7.9.12 Engineering Measures

Mechanical practices are engineering measures used to control erosion from sloping land surfaces and thus land surface modification is done for retention and slope disposal if runoff water. The objectives are given below:

1. To increase the time of stay of runoff water to increase the infiltration time for water
2. To decrease the effect of land slope on runoff velocity by intercepting the slope at several points so that the velocity is less than the critical velocity.
3. To protect the soil from erosion caused by the runoff water.

a) Contour bunds

The contour bunds are recommended for areas with permeable soils and land slope less than 6%.

The main functions of contour bunds are:

1. It reduces the length of slope which in turn reduces the soil erosion.
2. The water is impounded for some time and gets recharged into the soil which helps in crop cultivation.

Fig No 7.17 Contour bunding

b) Terracing and Check dams

Terracing and Check dams of land are required only for the area having slope greater than 10%. The slope of the sub watershed in the upstream side of proposed barrage is less than 4%.

CHAPTER – 8: PROJECT BENEFITS

The proposed barrage project provides many benefits to people living around the site and farmers in the cultivable command area of Cuddalore and Mayiladuthurai District.

8.1 Benefits of project during construction phase

During construction phase more than 300 people are employed for executing barrage across Coleroon River at RD 74/3 mile. More than 150 people are employed from the nearby surrounding villages. The construction of barrage is long term project which provides employment for more than 4 years.

It provides employment for all categories of people such as skilled, semi skilled and unskilled. Due to this project, the income of people in the nearby villages is increased which are invested in buying tractors and other agricultural equipment. Even though the construction work is completed, they can make income through agricultural activities by using those modern agricultural equipments.

Depending on this construction activity and people working in the site, the village people has earned money by starting tea shop, mini hotels, petti shops, mechanic shed etc. Also many houses in the village are rented by officials of WRD and contractors. These are the indirect employment of this project.

Industrial activity will help in improving the socio–economic benefits in areas like employment, communication and infrastructure development etc.

8.2 Benefits of project during operational phase

The purpose of proposed barrage of 0.334 TMC capacities is to stabilize the cultivable command area of 6601 Ha in Cuddalore District and of 2558 Ha in Mayiladuthurai District. There is Lower Anicut dam located 11km away in upstream side of the proposed barrage. This dam also supply irrigation water to Ariyalur, Thanjavur, Cuddalore and Mayiladuthurai District but it is unable to supply sufficient irrigation water to Cuddalore and Mayiladuthurai District due to water pressure of this dam.

So the proposed low head diversion dam diverts the required water with high water pressure for stabilizing the ayacuts in Cuddalore and Mayiladuthurai District and after meeting the demands, the remaining water will be drained into the Coleroon River. Due to water storage in the proposed barrage, water saved in Lower Anicut could be

taken into Veeranam tank through the Vadavar channel as a supplementation and there by this scheme becomes a BOON for New Veeranam scheme that has already been proposed for Chennai drinking water supply scheme.

Due to this scheme, the water level in the adjoining wells and tube wells in the percolation area adjacent to the proposed water spread area of the barrage and in the existing ayacut of North and South Rajan channel will be considerably increased due to ground water recharge. The stored water will be useful for the existing infiltration wells of TWAD board intended for drinking water supply schemes.

From the District Diagnostic Report of Cuddalore District, it is found that the area of paddy cultivation has been decreased year by year due to insufficient irrigation water. Due to the proposed project, the area of paddy cultivation will be increased from 1730 Ha to 6009 Ha. Subsequently, tonnage of paddy production will be increased from 8529 MT to 29624MT which is 3.5 times of present production quantity. The other benefits of this project are given below points.

- The proposed project overcome the food shortage existing in India and eradicates the hunger and poverty.

- The raising of water level along the water storage area and supply of water in the cultivable command area engage the farmers in agricultural activity throughout the year. Thereby income of farmers will be increased from the present condition and living standard of the people will also be increased.

- The scarcity of drinking water in those areas if any will also be rectified by the proposed project.

- Nowadays the suicide of farmers is happening all over India as sufficient water is not available for the irrigation of cultivable land. So this type of suicide can be prevented through this project.

8.2.1 Benefits under CER Activity

Under Corporate Environmental Responsibility (CER) plan, the Executive Engineer, the project proponent of the proposed barrage will provide required facilities to the nearest villages by using 0.25 to 2% of the project cost. The percentage of CER cost based on project cost and type of project is given in below table.

Table No: 8.1 Percentage of CER cost based on project cost and type of project.

S.No	Capital investment / Additional capital investment (in Rs)	Green field project - % of the capital investment	Brown field project - % of the capital investment
1	≤ 100 crores	2.0%	1.0%
2	>100 crores to ≤500 crores	1.5%	0.75%
3	>500 crores to ≤1000 crores	1.0%	0.50%
4	>1000 crores to ≤10000 crores	0.5%	0.25%
5	>10000 crores	0.25%	0.125%

The total cost for the proposed barrage is 465.43 crores and this project comes under Brown field project. As per the above table, 0.75% (3.69 crores) of the project cost will be spent for doing required facilities in nearby villages under CER activity. Keeping in view of the above, the provisions for the Corporate Environmental Responsibility is given below as PWD doing this project for benefit of villages to supply water to enhance agricultural activities, we are proposed in this project benifite for local agriculture people and growth of agriculture activity, so no need for CER activity.

Table No: 8.2 CER activity and cost allocated for CER activity

CER Activity	CER Cost @ 0.75% of Project Cost (Rs. In Lakhs)
1. Providing Drinking water supply to the affected villages, developing more cropping lands by keeping water supply as per demand for two districts Cuddalore and Myiladuthurai	5.0

CHAPTER – 9: ENVIRONMENTAL COST BENEFIT ANALYSIS

The project proponent is agreed to spend 7.4 Crores under CER activity which is beneficial for development of villages covered in the Districts of Cuddalore, Mayiladuthurai and Thanjavur.

The irrigation of 9159 Ha of ayacuts in Cuddalore and Mayiladuthurai Districts through the proposed barrage will increase the agricultural yield which may cause for increase in GDP in those Districts.

The cost of proposed project is 465.43 crores, the expected benefit to the agricultural based industries shall be substantial than the investment. Further desiliting of sand in the water storage area covering extent of 341.46 Ha in Cuddalore District, 40.54 Ha in Thanjavur District and 1.3 Ha in Mayiladuthurai District may create revenue yield of 3000 crores for Government. The total quantities of sand proposed to be desilted in three districts are 13,257,100 m^3.

The proposed project is an excellent revenue model to both Government and society.

CHAPTER - 10: ENVIRONMENTAL MANAGEMENT PLAN

The **Environment Management Plan (EMP)** is required to ensure sustainable development in the study area. Hence it needs to be a comprehensive plan for which the industry, Government, Regulating agencies likes Pollution Control Board working in the region and more importantly the population of the area need to extend their co-operation and contribution.

It has been evaluated that the project area will not be affected significantly due to industrial activity. Mitigation measures at the source level and an overall Management Plan at the site level are elicited so as to improve the surrounding environment.

10.1 ENVIRONMENTAL MANAGEMENT PLAN DURING CONSTRUCTION PHASE

10.1.1 Air Environment

The fugitive dust will be generated due to the various construction activities. The transportation of trucks on the exposed site and unloading of the raw materials (Sand and aggregate) in the site generate fugitive dust. The sprinkling of water on the exposed ground and moisturizing the raw materials before unloading will reduce the emission of fugitive dust. The cement bags will be stacked and covered with tarpaulin so the suspension of cement particles in the air will be controlled. The boundary of the site will be covered with curtains to prevent the escape of dust from the site to adjacent lands. All the labors will be provided with dust protection mask.

10.1.2 Water Environment

During the construction activity no effluent will be generated. The water requirements for the construction activity will be sourced PWD/WRD wells in the nearest villages. The surface water in the River Coleroon will not be used for the construction activity. All the maintenance work of machineries and tippers, excavators will be done at the mechanic shop. The painting work and any other coating work of barrage will be done with tarpaulin placed at the river/channel bed level. It will prevent the infiltration of chemicals into the ground during rainy seasons. The municipal waste water generated during construction phase will be treated by temporarily built septic tank and soak pit along the river banks. The surface water will be diverted from construction zone and coffer dam will be used to prevent the seepage of ground and surface into the foundation work. The construction work in the channels will be carried out during non monsoon season only.

10.1.3 Noise Environment

Noise will be generated due to movement of trucks and handling of equipment and machineries and also from the labors working in the site. All the transporting vehicles and machineries, equipment will be maintained periodically to control unnecessary noise generation. The curtains provided around the site will suppress the noise in addition. The concave mirrors will be set up at the corners as to avoid the unnecessary horns from the trucks and also to prevent accidents. Speed of trucks entering or leaving the site will be limited to moderate speed to prevent undue noise from empty vehicles. Adequate silencers will be provided in all the diesel engines of vehicles. The labors worked at the high noise prone zone will be provided ear plugs.

10.1.4 Soil Environment

The soil excavated during the substructure work of the barrage will be stacked separately and used for the green belt development during operation phase and also used for standardization of both bunds of Coleroon River. The excavated material which has the high bulk density will be used for the road formation over the bund. The painting work of the barrage will be carried with tarpaulin laid on the bed to protect the soil properties. All the raw materials used for the construction activities will not be stacked directly on the site/ground.

10.1.5 Solid Waste Management

The solid waste generated will be segregated into recyclable and non recyclable. The recyclable and reuse materials like plastic, steels, bottles will be sold to authorized recyclers and non recyclable materials such as surkhi, broken concrete will be used for road formation within the project site. The management of municipal solid wastes is mentioned in Clause 4.6.2 of Chapter 4.

10.1.6 Ecology and Biodiversity

The loss of plants during the site clearance will be counted and double the times of plant will be planted during the operation phases. The migrated faunas during the construction phase will again find the habitation in the green belt developed during operational phase.

10.1.7 Socio Economic

Good maintenance practices will be adopted for machinery and equipment, which will help to avert potential noise problems. Appropriate air pollution control measure will be taken so as to minimize the environmental impact within the core zone. An

emergency preparedness plan will be prepared in advance, to deal with fire fighting, evacuation and local communication. For the safety of workers, personal protective appliances like hand gloves, helmets, safety shoes, goggles, aprons, nose masks and ear protecting devices has been provided which meet 'BIS' (Bureau of Indian Standards).

10.2 ENVIRONMENTAL MANAGEMENT PLAN DURING OPERATIONAL PHASE

10.2.1 Air Environment

The water stored in the upstream of barrage and supply of water for the irrigation purposes will lead to climate change and increase the humidity in the particular area. If the project has more advantages there must be at least few disadvantages. However the proposed project will not cause major impact on climate change. To overcome the impacts due to outdoor humidity, the mitigation measures are given in Clause 4.1.2.1 in Chapter 4.

10.2.2 Water Environment

The water sample of Coleroon River water has been analyzed and found as good. At the same time, the quality of ground water in the villages around storage area and in CCA was found fairly well and in some places it was found bad. The infiltration of water from storage area and from the channels during supply will improve the ground water quality and make it potable for drinking purposes.

The quality of storage water should be analyzed monthly once to identify if any sewage from village is mixing with the storage water. Sometimes animal's dead are thrown away in the water body which cause odor and pollution in water. Minimum 10 samples should be taken from the storage area on both sides of the bank. The storage area should be under surveillance to prevent the storage water from pollution by means of sewage or any effluents.

The ground water around the barrage and in the command area should be analyzed during pre monsoon season, monsoon season and post monsoon season to identify changes in ground water quality and to find ground water quality in which season is suitable for drinking purposes.

10.2.3 Noise Environment

During operational phase, the noise generated during discharge of water between sill level and shutters will be controlled by greenbelt development on both sides of river banks. The WRD staff will be provided separate room to get relief from noise for sometimes.

10.2.4 Soil Environment

All the repair work and maintenance work of machineries of barrage will be carried out by spreading water proof tarpaulin on the river/channel bed and other soil surfaces. The used/spent oil will be stored in MS drums and sold to authorized recyclers for reuse. The soil erosion along the river banks will be controlled by developing green belt.

The quality of soil shows that whether the command area receives sufficient irrigation water or not. The soil quality in the command area should be analyzed during operational phase to find the area which get sufficient water and the area which does not get sufficient water.

10.2.5 Solid Waste Management

During maintenance work in operational phase, no solid waste will be generated. Nearly 5 persons will be employed at the barrage for monitoring and operation of barrage. So, the generation of municipal solid waste will also be less.

10.2.6 Ecology and Biodiversity

1000 numbers of one year taller sapling will be planted along the river banks, village roads and along the channels for maintaining the sustainable environment. The survival and growth of the plant will be monitored daily. The plantation attenuating noise will be planted near the barrage. The green belt development will provide the habitant for many living things such as birds, squirrel, insects etc.

After one year of operation of barrage, the production rate of paddy cultivation in the command area of both districts should be accounted. It will help WRD to find the optimum level of irrigation for the proposed command area.

10.2.7 Socio Economic

The WRD staffs should be engaged in the barrage all days to monitor the storage of water in the barrage and movement of vehicles over the bridge. Danger boards should be placed around the barrage to not to swim in the water body and not to take photographs near the parapet wall. During flood season, before discharge river water into the river and channels, the announcement has to be made to alert the public people. The dam break analysis and disaster management is given details in Chapter 7.

10.3 Environmental Policy of the Executive Engineer, WRD

The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonam is committed to construct and operate the barrage with strong environment conscience ensuring sustainable development, safe workplaces and health of workers and community. Environmental Policy of EE, WRD is followed.

10.4 Environment Management Cell

It is important to have a permanent organizational set up for implement of environmental management plan. Conscious of this, the Executive Engineer will create Environmental Management Cell to coordinate the activities concerned with the WRD and implementation of the environmental mitigation measures during construction and operation phases of the proposed barrage.

The Executive Engineer will be responsible for the implementation of mitigation measures during construction and operation phases of the proposed barrage. Environmental Management Cell (EMC) will be headed by Executive Engineer supported by adequate number of personnel and third party(Environment Consultant) having sufficient educational and professional qualification and experience to discharge responsibilities related to environmental management including statutory compliance, pollution prevention, environmental monitoring, preventive maintenance of pollution control equipment and green belt development as well as maintenance. Environment Management Cell (EMC) will look after the environment related matters during the operation phase of the barrage. Environment Management Cell (EMC) will also look into any infringement/ deviation/ violation of the environmental or forest norms/ conditions.

10.4.1 Duties of Environment Management Cell

- Monitoring Ambient air quality
- Noise monitoring
- Green belt development
- Soil sampling and testing
- Water sampling and testing
- Monitoring of storm water drains
- Management of municipal solid waste management
- Management of sewage waste
- Monitor and mitigate infringement/ deviation/ violation of the environmental or forest norms/ conditions

The organization set-up of the Environmental Management Cell (EMC) is presented in Figure 10.1.

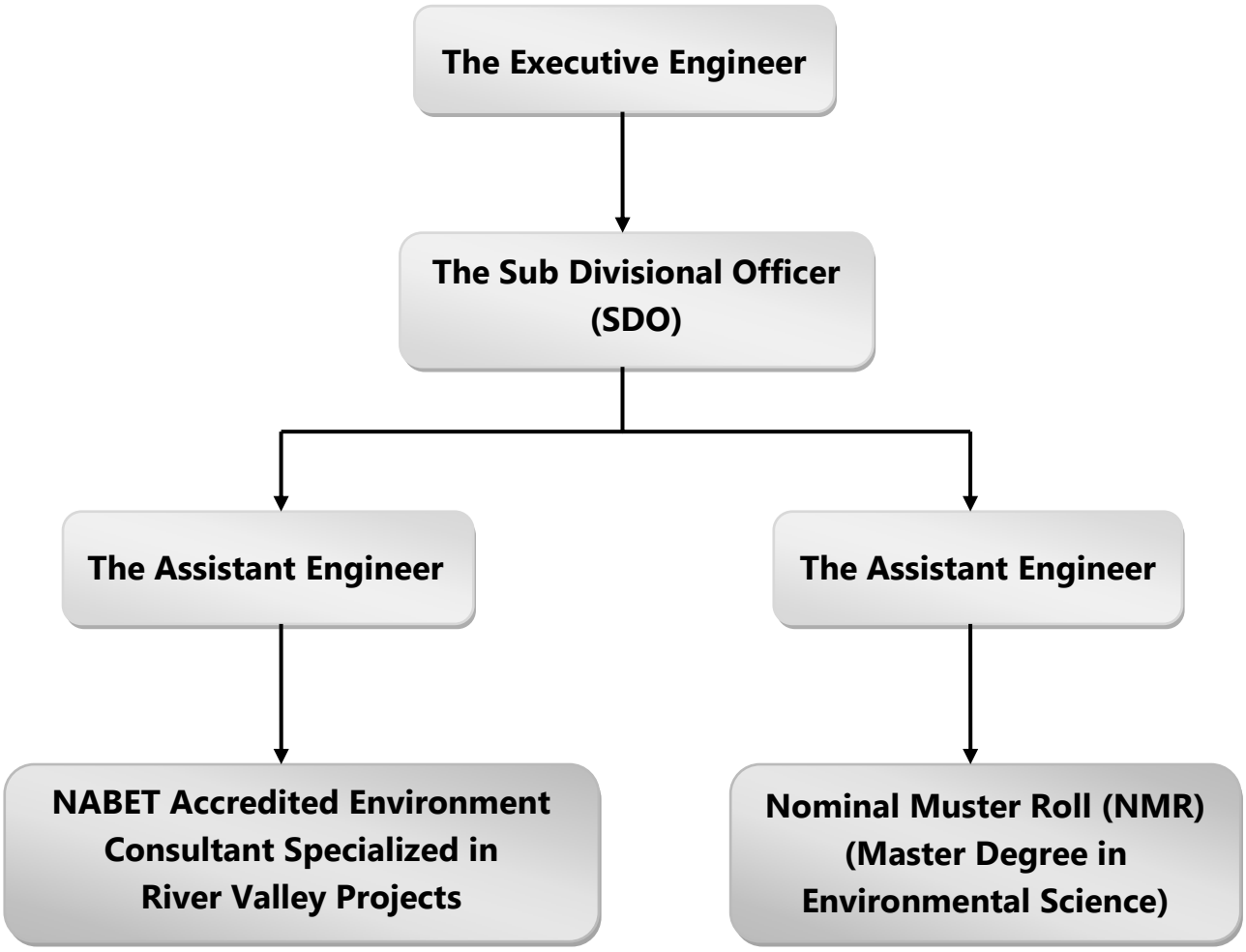


Fig No 10.1. Chart of Environment Management Cell

10.4.2 Reporting System

Proper reporting of implementation of mitigation measures plays important role in effective environmental management. The reporting is always from descending order, the lowest to higher level officer. The Environment Consultant of the EMC will monitor ambient air quality, noise level and green belt, sampling of water, soil with the help of NMR and submits all the reports of monitoring and lab reports to the Assistant Engineer, WRD. The Assistant Engineer will supervise the NMR and Environment Consultant and verify the reports submitted by consultant and audit all the condition in the Environmental clearance given by MOEF&CC shall be complied or not. If any condition given in the EC is not complied, the Assistant Engineer will make the necessary arrangement such as heath check up labors, Solar lights along the street, conducting mock drills, etc to comply all the NCs of Environmental

Clearance. He will also work out the cost of implementation and convey the detailed report to the Sub Divisional Officer. The Sub Divisional Officer will arrange the meeting with the Executive Engineer by calling all members in EMC. In that meeting all the NC of EC condition will be discussed and the steps will be taken to comply the EC condition not to violate the environment norms and to maintain sustainable environment.

10.5 Description of the administrative aspects of ensuring that mitigative measures are implemented and their effectiveness monitored, after approval of the EIA

In order to maintain the environmental quality within the standards, regular monitoring network to maintain environmental quality will be implemented.

Table 10.1: EMP Budget during Construction Phase

S. No	Description	Capital Cost in Rs.	Recurring Cost/year in Rs
1	Safety kits - Rs.1000/Labor	3,00,000	2,00,000
2	Environmental Monitoring	-	1,25,000
3	Water sprinkling on the exposed ground, unpaved road	Hiring tractor mounted with water tank	3,00,000
4	Disposal of Bio Sludge generated from Septic Tank	-	1,00,000
5	Management of Municipal Solid Waste (Biodegradable and Non Biodegradable)	-	1,00,000
6.	Display board with Environmental Conditions	1,00,000	20,000
7.	First aid facility in the site	1,00,000	1,00,000
8.	Health check up of workers	3,00,000	3,00,000
9.	Greenbelt development along the banks – 500 tree saplings	1,00,000	25,000
10	Installation of safety sign boards	1,00,000	20,000
11	Monitoring of safety through Safety Engineer	-	3,00,000
12	Fire extinguisher, sand buckets	10,000	10,000
Total		**Rs. 10,10,000/-**	**Rs.16,00,000**

Table 10.2: EMP Budget during Operational Phase

S. No	Description	Capital Cost in Rs.	Recurring Cost/year in Rs
1	Environmental Monitoring	-	2,50,000
2	Display board with Environmental Conditions	1,00,000	20,000
3	First aid facility at the barrage	50,000	50,000
4	Greenbelt development along the banks, Channels and village roads– 1000 tree saplings	2,00,000	50,000
5	Installation of danger board mentioning not to swim in water storage area and not to take selfie near parapet wall, storage area.	1,00,000	20,000
6	Fire extinguisher, sand buckets	10,000	10,000
Total		**Rs. 4,60,000/-**	**Rs.4,00,000**

CHAPTER – 11: SUMMARY AND CONCLUSIONS

11.0 INTRODUCTION

The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonam – 612001 (Government of Tamil Nadu) has proposed to construct Barrage with 84 vents across the River Coleroon at RD 74/3 mile in Adhanur and Kumaramangalam Villages to irrigate the cultivable command area of 9159 Ha in Cuddalore and Mayiladuthurai Districts.

Initially, the Executive Engineer of WRD has applied under Category B2 for obtaining environmental clearance of proposed irrigation project vide online proposal no. SIA/TN/RIV/406095/2022 dated 18.11.2022.

During the 358th SEAC meeting held on 24.02.2023, the committee observed that the construction work of barrage has been started earlier before getting Environmental Clearance and declared that the proposed project comes under violation category as per EIA Notification, 2006.

Thereby the SEAC recommended SEIAA to issue sector specific standard Terms of Reference (TOR) under violation category with public hearing for conducting Environmental Impact Assessment study along with ecological damage assessment plan, preparation of remediation plan, preparation of natural and community resource augmentation plan.

During 604th SEIAA meeting held on 23.03.2023, the authority accept the recommendation of SEAC and issued TOR under violation category vide Lr.No.SEIAA-TN/F.No.9677/Violation/ToR-1400/2022 dated 23.03.2023.

11.1 SCOPE OF THE PROJECT

The scope of the proposed project is construction and operation of barrage across the River Coleroon between Adhanur and Kumarangalam Villages in Cuddaore and Mayiladuthurai District to irrigate 9159 Ha of proposed command areas after obtaining environmental clearance from SEAC/SEIAA, TN.

The proposed project requires Draft EIA report for conducting public hearing and Final EIA Report for obtaining EC from as per Lr.No.SEIAA-TN/F.No.9677/Violation/ToR-1400/2022 dated 23.03.2023.

11.2. PROJECT DESCRIPTION

Table 11.1 Project Details

Project Details	
Proponent	**The Executive Engineer,** Water Resource Department, Special Project Division, Kumbakonam – 612001 (Government of Tamil Nadu)
Site Location	Across the River Coleroon at RD 74/3 mile, 12km downstream of Lower Anicut between Adhanur and Kumaramangalam Villages in Cuddalore and Mayiladuthurai District.
Geographical Co-ordinates	Left bank - 11˚11'45"N and 79˚32'04"E Right bank - 11˚11'14"N and 79˚32'29"E
Toposheet No.	58M/12
Elevation of river bed level	+9.5m above MSL
Capacity of barrage	0.334 TMC
Length of the barrage	1064.40
Cultivable command areas	9159 Ha 6601 Ha in Cuddalore District – 53 Villages 2558 Ha in Mayiladuthurai District – 35 Villages
Discharge of water	Through North Rajan channel for Cuddalore District Through South Rajan Channel for Mayiladuthurai District
Desilting in Storage area	Total area of Desilting – 382.0 Ha Cuddalore District – 341.46.0 Ha out of 382.0 Ha
Method of Desilting	Mechanized method by using Hydraulic excavators and tippers combination
Period of Lease	1 year
River bed level	+9.500m above MSL
Sill level	+10.00m above MSL
Depth of Desilting	0.5m below sill level upto scour vent or river bed level
Geological resources	30,110,379 m^3 between Lower Anicut and Proposed barrage (820.77.70 Ha)
Mineable reserves	Cuddalore District – 85,75,310 m^3

Shoal height	Cuddalore District – 3.825m Thanjavur District – 6.590m
Project Cost	Rs. 465.43 Crores
EMP Cost (Capital)	Constructional phase – Rs.10,10,000 Operational phase – Rs.4,60,000
Environment Recurring Cost	Constructional phase – Rs.16,00,000 Operational phase – Rs.4,00,000
CER Cost	RS. 7.46 Crores
Accessibility	
Nearest Habitation	Adhanur – 100m – N Kumaramangalam – 240m - S
Nearest Roadway	NH 81- connecting Coimbatore to Chidambaram 6.2km - N SH 150-Connecting Kattrupattacheri to Vaitheshwaran kovil – 2.6km – S MDR – Arulmozhidevan village to Ramadevinallur – 1.6km - NW Village road – Eyyalur to Adhanur – 60m N River bank road adjacent to project site
Nearest Railway station	Mayiladuthurai Railway Station-14.0Km-SE
Nearest Airport	Trichy International Airport-100km-SW
Environmental Sensitiveness	
Interstate Boundary	TamilNadu - Andha Pradesh Interstate boundary 197km - NW
Coastal Zone	Bay of Bengal – 34km- E. Hence the area does not attract the C.R.Z. Notification, 1991.
Reserve Forest	There is no Reserve forest and Protected forest located within 10km radius of project site. Periyavalayam R.F – 13.6 km - NW Vethiyarvettu R.F – 14.0km – NW Karuppurkodai R.F(within river bed) – 13.7km – SW Koovathur R.F – 19.0km – NW Melur Devanur R.F - 21.3km – NW Sooriyamanal R.F – 22km – NW Siluvaicheri R.F – 24.5km – NW Within Command areas:

<table>
<tr><td></td><td>Pichavaram R.F Extension</td></tr>
<tr><td>Wildlife sanctuary</td><td>Nil within 25km radius. The Proposed project site does not attract the Wildlife (Protection) Act, 1972.
Karaivetti Bird Sanctuary – 57 km-SW</td></tr>
<tr><td>Water bodies</td><td>The site itself is a Water body (Coleroon River).
1. Veeranam Lake-6.3 km-N</td></tr>
<tr><td>Habitations</td><td>
<table>
<tr><th>Name of Village</th><th>Direction</th><th>Distance from project site (Approx.)</th><th>Population</th></tr>
<tr><td>Adhanur</td><td>N</td><td>0.11</td><td>927</td></tr>
<tr><td>Kizhpuliyampattu</td><td>W</td><td>1</td><td>773</td></tr>
<tr><td>Tiruchitrambalam</td><td>S</td><td>1.5</td><td>6371</td></tr>
<tr><td>Sarabojiraja puram</td><td>SW</td><td>0.38</td><td>4782</td></tr>
</table>
</td></tr>
<tr><td>Defense Installations</td><td>Nil within 10km radius</td></tr>
<tr><td>Critically Polluted area</td><td>Nil within 10km radius</td></tr>
<tr><td colspan="2">Resources Requirement</td></tr>
<tr><td>Water Requirement</td><td>Construction phase of barrage – 12 KLD
Desilting in Cuddalore District – 8 KLD</td></tr>
<tr><td>Man Power</td><td>Construction phase of barrage – 300 people
Operational phase of barrage – 30 people
Desilting in Cuddalore District – 44 people</td></tr>
</table>

11.3. Details of barrage and other structures proposed to be constructed:

a) Barrage

The barrage has been designed for a design discharge of 4, 55,726 cusecs. The barrage is designed with raft foundation. The Barrage consists of

- Surplus Regulator
- Scour Vent.
- Upstream Protection works
- Downstream Protection works
- Barrage Shutters
- Operating Platform

b) Two lane bridges over the barrage

A two lane bridge has been proposed to be constructed along with the barrage for the purpose of inspection and to connect the villages on both banks of river the Coleroon. The width of the bridge including carriage way and both sides foot path is 12m and the total length of the bridge is 1064.40m with 84 Nos. of span.

c) Head sluice for North Rajan Channel

A quantity of 745 Cusecs of water has been proposed to be discharged from this barrage into North Rajan channel towards the stabilization of the existing ayacuts. For this purpose a head sluice has been proposed at the left flank of the barrage in the left bank of Coleroon.

Fig No 11.1 Head sluice of north rajan channel

d) Head sluice for South Rajan Channel

A quantity of 640 Cusecs of water has been proposed to be discharged from this barrage into South Rajan channel towards the stabilization of the existing ayacuts. For this purpose a head sluice has been proposed at the right flank of the barrage in the right bank of Coleroon.

Fig No 11.2 Head sluice of south rajan channel

e) Formation of Channel for Narimudukku Drain

The Narimudukku drain is diverted from upstream of proposed barrage to the downstream through existing south rajan channel by constructing baffle wall at the center of channel.

Fig No 11.3 Diversion of Narimudukku Drain into existing south rajan channel by constructing baffle wall at the centre of channel

f) Two Lane Bridge over North Rajan Channel

A two lane bridge has been proposed to be constructed across the North Rajan Channel to connect the villages in left bank of River the Coleroon. The overall width of the road is 15.775m and the width of the carriageway is 12.00m.

g) Two Lane Bridge over South Rajan and Narimudukku Drain

A two lane bridge is proposed to be constructed across Narimudukku drain and South Rajan Canal at the diversion location of Narimudukku Drain to connect the villages in right banks of River the Coleroon.

h) Syphon Aqueduct

A Syphon aqueduct is proposed to construct across the South Rajan Channel for a designed discharge of about 2500 Cusecs. The Syphon Aqueduct is designed for 4 Nos of vent having size of 3.05 x 2.40m.

i) Reconstruction of Kondappan Cauvery infall Regulator

It is proposed to construct a new Regulator at the point where the Kondappan Cauvery Regulator exists to drain a total discharge of about 3500 cusecs from Narimudukku Drain and Kondappan Cauvery Drain into Coleroon River. The Regulator design consists of 9 vent way of size of 2.70m x 2.00m.

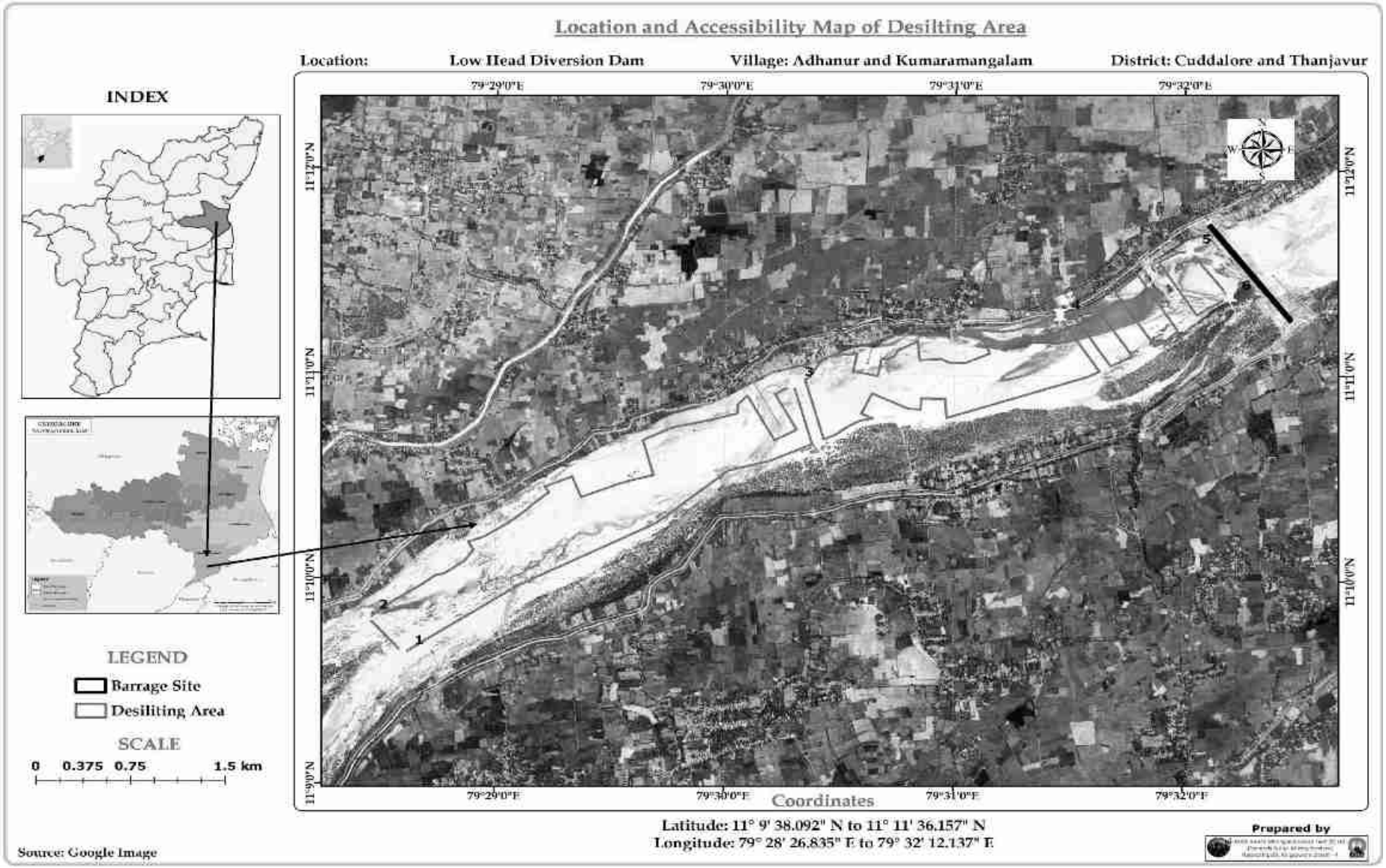


Fig No.11.4 Location of proposed barrage site

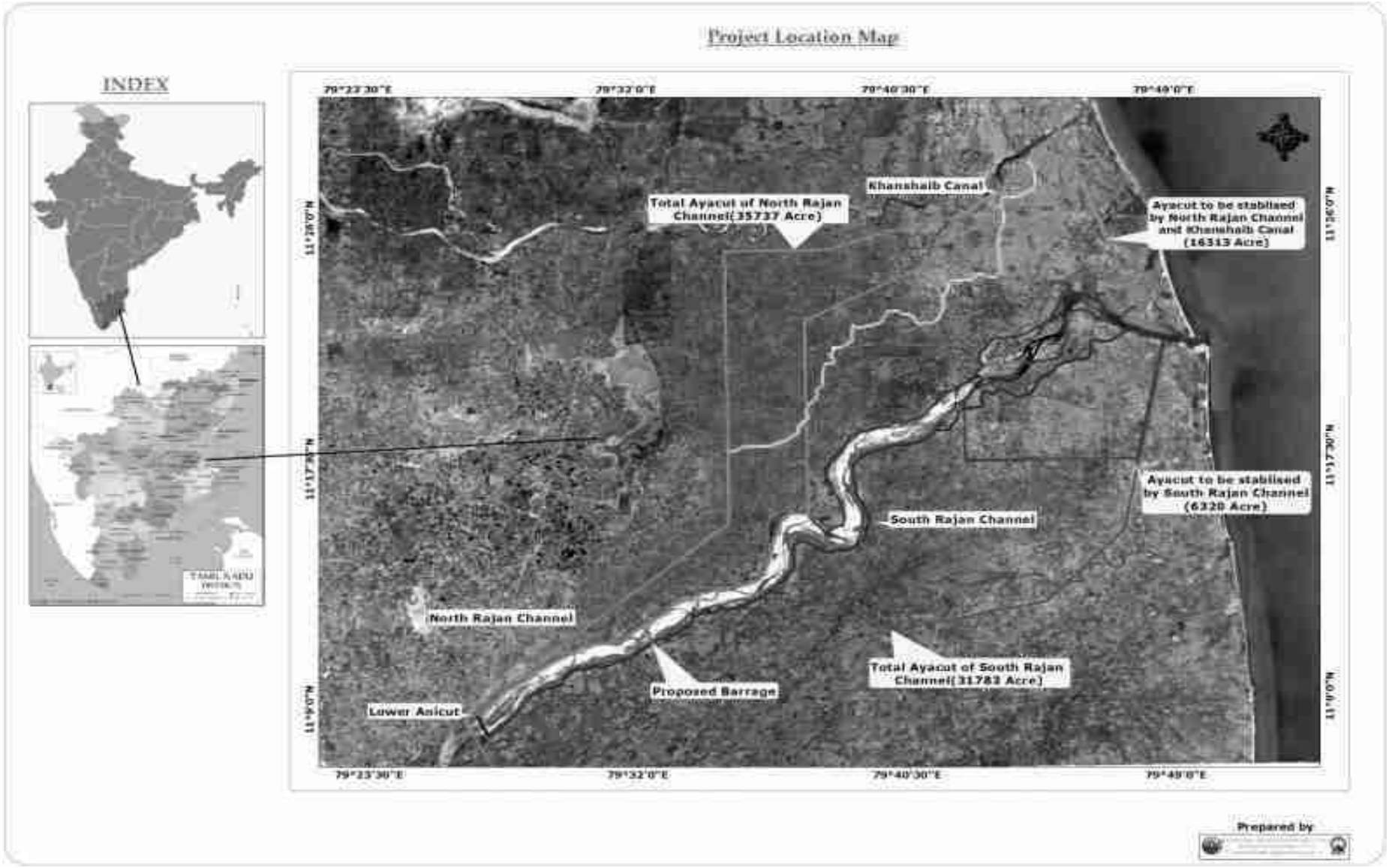


Fig No.11.5 Location of proposed command areas

11.4 Description of the environment

11.4.1 Base line environmental study

Collection of base line data is an integral part of the preparation of environmental impact assessment reports. The baseline monitoring study has been carried out during June 1st 2022 - May 31st, 2023 i.e, Monsoon – June 1st, 2022 to September 30th 2022, Post Monsoon – October 1st, 2022 to February 28th, 2023 and Pre Monsoon – March 1st, 2023 to May 31st, 2023to assess the existing environmental scenario in the area. For the purpose of EIA studies, Project site was considered as the core zone and area outside the site lease boundary up to 10km radius from the project site and in command areas was considered as buffer zone.

Table 11.2 Baseline Data

Particulars	Details		Standards
Meteorology (June 1st, 2022 – May 31st, 2023)			
Rainfall (Avg.)	Monsoon Period	317.3mm	--
	Post Monsoon Period	793.6mm	
	Pre Monsoon Period	818.6mm	
Temperature	Monsoon Period	25°C - 37°C	--
	Post Monsoon Period	21°C - 33°C	
	Pre Monsoon Period	23°C - 38°C	
Wind speed	0.6 to 1.1 m/s for 3 seasons		--
Wind Direction	From N, NE		--
Ambient Air Quality (NAAQS)			
PM_{10}	Monsoon Period	42.6 - 70.5 µg/m^3	100 µg/m^3
	Post Monsoon Period	40.4 - 67.3 µg/m^3	
	Pre Monsoon Period	44.2 - 72.5 µg/m^3	
$PM_{2.5}$	Monsoon Period	17.6 - 35.2 µg/m^3	60 µg/m^3
	Post Monsoon Period	16.5 - 32.6 µg/m^3	
	Pre Monsoon Period	19.8 - 37.1 µg/m^3	
SO_2	Monsoon Period	4.2 - 15.2 µg/m^3	80 µg/m^3
	Post Monsoon Period	4.1 - 14.1 µg/m^3	
	Pre Monsoon Period	6.4 - 17.1 µg/m^3	
NO_x	Monsoon Period	6.3 - 22.8 µg/m^3	80 µg/m^3
	Post Monsoon Period	5.9 - 19.8 µg/m^3	
	Pre Monsoon Period	8.1 - 24.7 µg/m^3	

Noise Level (CPCB Standard)			
Day time (6:00 am-10:00 pm)	Monsoon Period		**Industrial Area** Day Time - 75 dB (A) **Residential Area** Day Time – 55 dB (A)
	Core zone	41.8 - 43.5 dB (A)	
	Buffer zone	37.4 - 48.1 dB (A)	
	Post Monsoon Period		
	Core zone	40.6 - 41.7 dB (A)	
	Buffer zone	39.5 - 46.2 dB (A)	
	Pre Monsoon Period		
	Core zone	42.7 - 45.3 dB (A)	
	Buffer zone	39.6 - 50.1 dB (A)	
Night time (10:00 pm-6:00 am)	Monsoon Period		**Industrial Area** Night Time – 70 dB(A) **Residential Area** Night Time – 45 dB (A)
	Core zone	38.2 - 41.3 dB (A)	
	Buffer zone	36.1- 42.6 dB (A)	
	Post Monsoon Period		
	Core zone	37.3 - 40.5 dB (A)	
	Buffer zone	38.4 - 42.9 dB (A)	
	Pre Monsoon Period		
	Core zone	40.4 - 42.6 dB (A)	
	Buffer zone	35.4 - 43.7 dB (A)	
Water Quality IS 10500:2012 (Desirable limits)			
Ground Water			
pH	Monsoon Period	6.90 - 8.31	6.5 to 8.5
	Post Monsoon Period	6.55 - 8.12	
	Pre Monsoon Period	7.06 - 8.50	
TDS	Monsoon Period	250 - 3006 mg/l	500 mg/l
	Post Monsoon Period	236 - 2950 mg/l	
	Pre Monsoon Period	301 - 3158 mg/l	
Electrical conductivity at 25˚C (Micromhos/cm)	Monsoon Period	403 - 5094	-
	Post Monsoon Period	395 - 4522	
	Pre Monsoon Period	415 - 5124	
Total Hardness as $CaCO_3$	Monsoon Period	57 - 857 mg/l	200 mg/l
	Post Monsoon Period	45 - 864 mg/l	
	Pre Monsoon Period	82 - 864 mg/l	
Total suspended solids	Monsoon Period	1 -18 mg/l	-
	Post Monsoon Period	1 - 12 mg/l	
	Pre Monsoon Period	1 - 14 mg/l	
Chlorides Cl	Monsoon Period	19 - 973 mg/l	250 mg/l

	Post Monsoon Period	26 - 1052 mg/l	
	Pre Monsoon Period	10 - 912 mg/l	
Total iron Fe	Monsoon Period	0.03 - 3 mg/l	0.3 mg/l
	Post Monsoon Period	0.03 - 3 mg/l	
	Pre Monsoon Period	0.03 - 3 mg/l	
Sulfates SO_4	Monsoon Period	4 - 67 mg/l	200 mg/l
	Post Monsoon Period	8 - 62 mg/l	
	Pre Monsoon Period	8 - 75 mg/l	
Surface Water			
pH	Monsoon Period	7.14 - 8.13	6.5 to 8.5
	Post Monsoon Period	7.25 - 8.33	
	Pre Monsoon Period	7.20 - 8.19	
TDS	Monsoon Period	296 - 796 mg/l	500 mg/l
	Post Monsoon Period	328 - 462 mg/l	
	Pre Monsoon Period	315 - 495 mg/l	
Electrical conductivity at 25˚C	Monsoon Period	496 - 1342	-
	Post Monsoon Period	498 - 732	
	Pre Monsoon Period	554 - 823	
Total Hardness as $CaCO_3$	Monsoon Period	95 - 249 mg/l	200 mg/l
	Post Monsoon Period	108 - 254 mg/l	
	Pre Monsoon Period	105 - 495 mg/l	
Total suspended solids	Monsoon Period	1 - 2 mg/l	-
	Post Monsoon Period	1 - 2 mg/l	
	Pre Monsoon Period	1 - 2 mg/l	
Chlorides Cl	Monsoon Period	67 - 210 mg/l	250 mg/l
	Post Monsoon Period	72 - 223 mg/l	
	Pre Monsoon Period	59 - 208 mg/l	
Total iron Fe	Monsoon Period	0 - 0.08 mg/l	0.3 mg/l
	Post Monsoon Period	0 - 0.08 mg/l	
	Pre Monsoon Period	0 - 0.08 mg/l	
Sulfates SO_4	Monsoon Period	4 - 26 mg/l	200 mg/l
	Post Monsoon Period	8 - 28 mg/l	
	Pre Monsoon Period	5 - 29 mg/l	
Soil Quality			
pH	Monsoon Period	6.33 - 8.49	Neutral in nature
	Post Monsoon Period	6.50 - 8.72	
	Pre Monsoon Period	7.03 - 9.07	

Bulk density	Monsoon Period	1.0 - 1.62 g/cc	Favorable physical condition for plant growth.
	Post Monsoon Period	1.0 - 1.58 g/cc	
	Pre Monsoon Period	1.0 - 1.45 g/cc	
Hydro Geology			
Water Table	Monsoon Period	1 - 13.7m bgl	
	Post Monsoon Period	1.5 – 14.0m bgl	
	Pre Monsoon Period	2 – 15m bgl	

11.5 Anticipated Environmental Impacts and Its Mitigation Measures

11.5.1 Air Environment

a) Impacts during Construction Phase

- The transportation of raw materials to project site through the earthen and gravel road, unloading of construction materials, excavation of earth and loading of earth into tippers, stacking of cements and aggregates will generate fugitive dust and affects the habitations located in the predominant wind directions.
- Workers with long term exposure to fine particulate dust are at risk of pneumoconiosis, emphysema, bronchitis, silicosis and fibrosis.
- The generated dust gets deposited in the water body and it affects aquatic organisms which will disturb the ecosystem.
- The usage of DG sets in the site and continuous operation of diesel operated vehicles may increase global warming

Mitigation Measures

- Covering of truck carrying raw material to the project site to control the dust emission from truck. Sprinkling of water in the gravel and earthen road during the movement of trucks for the suppression of dust.
- Covering of raw materials stored in the project site with tarpaulin to prevent dust emission due to wind movement in the site specific. Covering of the project site using dust control curtains at the boundary of project site to prevent the escape of dust to the adjacent agricultural lands and villages.
- Regular maintenance of tippers and other equipments for the controlled gaseous emission of CO, SO_x and NO_x. Provision of PPE such as mask and ear plugs to the labors worked to dust prone zone.

- The Retrofit Emission Control Device will be fitted with all DG set to control the emission of particulate matter and carbon. The ambient air quality will be monitored three months once to adopt the environmental management plan effectively to comply the air quality with NAAQS.

b) Impacts during Operational phase

- The storage of water in the barrage and the discharge of water in the open atmosphere will cause evaporation of water. When more water evaporates in an area, the humidity in the particular area will be high. Humidity holds particles in the air close to the ground, increasing and sustaining the levels of air pollution in the atmosphere.

- High humidity can have an adverse effect on the human body.

Mitigation Measures

- It is suggested to use the stack in sufficient height for all the industries and DG sets in houses to exhaust the flue gases to the outside air.

- If there is any mud road or non paved road, the road should be properly compacted with bull dozers to control the emission from road during any transportation.

- To overcome the effects of humidity, any people who are working continuously should take break and hydrate often. Moreover finding air conditioners or ceiling or table fan during break is better to reduce the stress level due to humidity.

11.5.2 Noise Environment

a) Impacts during Construction Phase

Noise pollution poses a major health risk to the workers. The sources of noise in the proposed barrage is operation of excavators, cranes, movement of tippers and other construction works such fitting of scaffolding and shutters etc.

The noise generated by the construction activity will be dissipated within the core zone. This is because of distance involved and other topographical features adding to the noise attenuation. From the results, it can be seen that the ambient noise levels (day time and night time) at all the locations are within permissible limits prescribed by CPCB. At present there is no construction activity carried out. However, the expected noise levels are not likely to have any effect. Precaution will be made to keep down the noise exposure level of 85 dB (A) to the operating personnel for 8 hrs duration.

Mitigation Measures

- Use of personal protective devices i.e., earmuffs and earplugs by workers, who are working in high noise generating areas.
- Limiting time exposure of workers to excessive noise.
- Proper and regular maintenance of vehicles, machinery and other equipments.
- The noise generated by the machinery will be reduced by proper lubrication of the machinery and other equipments.
- Speed of trucks entering or leaving the site will be limited to moderate speed to prevent undue noise from empty vehicles.
- Providing proper noise proof enclosure for the workers separated from the noise source and noise prone equipment
- Provision of Quiet areas, where employees can get relief from workplace noise.
- Regular medical check–up and proper training to personnel to create awareness about adverse noise level effects.

b) Impacts during Operational phase

During operation phase, the storage of water will not generate major noise level. The discharge of water between sill level and shutters generate noise. It may affect the staffs working in the barrage and normal life of people in the nearest habitations.

Mitigation Measures

During operational phase, the noise generated during discharge of water between sill level and shutters will be controlled by greenbelt development on both sides of river banks.

11.5.3 Water Environment

a) Impacts on Ground water during construction phase

The stacking of raw materials such as cement and other building materials such as paints, resins, retarders, hardeners, mould releasing agents etc on the open land affects the soil quality and it indirectly affects the ground water quality when the surface water infiltrates into the ground along with surface materials. The spillages of materials in the construction place will affect both surface and ground water and soil qualities.

Mitigation Measures

All the raw materials should be stacked over the impervious layer and it should be covered with rain proof materials along the bank of river. During construction activities, only the required materials have to be shifted to working place (river bed) and it should be placed over impervious layer to protect the ground water quality. Tarpaulin has to be placed over the river bed and other ground surface to carry the spillages.

b) Impacts on Ground water during operational phase

The storage of water in the barrage and discharge of water through north rajan and south rajan channel increase the ground water table in the villages around the storage area and in the command areas. The ground water recharge due to seepage from the channel increase the quality of ground water by diluting the concentration of Total dissolved solids. **(Positive impact)**

c) Impacts on Surface water during constructional phase

The water required for construction of barrage and other structures has been withdrawn from bore well and no river water was used for any purposes during construction work. The flow of river water was diverted without affecting any aquatic organism during construction of each pier and each segment of raft foundation. Hence Coleroon River water resources and its quality has not been affected by this project.

The bridge over the north rajan and south rajan channel will be constructed during summer season when the flow of channel water is nil.

The diversion of Narimudukku drain into the south rajan channel will supports the agricultural activity between diversion point and Syphon Aqueduct along the channel. **(No Negative impact).**

d) Impacts on Surface water during operational phase

There are no surface water bodies such as lakes and ponds found within cultivable command area of Cuddalore and Mayiladuthurai Districts. Due to water storage in the proposed barrage, water saved in Lower Anicut could be taken into Veeranam tank through the Vadavar channel as a supplementation and there by this scheme becomes a BOON for New Veeranam scheme that has already been proposed for Chennai drinking water supply scheme.

Recommendations

The north rajan channel with the length of 55.1 km and south rajan channel with length of 54.1km has to be desilted every year before discharge the river water into each channel. Bushes which are obstacles to water flow and garbage which will cause water pollution has to be cleared periodically.

11.5.4 Soil Environment

a) Impacts during Construction Phase

The storage of construction materials directly on the soil surface will affect the soil quality in that particular area and during rainy season, the leachate from storage affect the soil quality in the surrounding areas. During foundation work, the excavated sand was dumped in the deepest bed level of Coleroon River and the excavated silt, gravel and clay were dumped along the river bank. It will be used for strengthening of river banks in upstream side of proposed barrage.

Mitigation Measure

- All the construction materials should be stored on impervious layer and it should be covered with rain proof materials.
- The dumping of sand over the deepest bed level should be properly levelled and the silt, gravel and clay properly stacked without affecting the flow of river water.
- Part of mineral rich soil has to be used for green belt development in the earmarked site.

b) Impacts during Operational Phase

Irrigation provides soil moisture for good plant growth throughout the growing season. The proposed project provides sufficient water for irrigation which leaches out salts present in soil. Irrigation of sufficient water plays an important role in the soil bacteria community which supports growth of crops. During operational phase, the proposed project has **positive impact on the soil environment.**

Recommendation

In the operation phase, the maintenance works involves white wash, painting of barrage, bridges, infall regulators, syphon aqueduct, baffle walls, lubrication of gearing shutters etc. During these works, the spillages will affect the quality of soil. So, it is suggested to use water proof tarpaulin on the soil surface during such works to protect the soil environment from spillages. The waste oil generated from DG sets and during

maintenance of other equipment should be stored in MS drums and collected by the authorized recyclers for recycling and reuse.

11.5.5 Biological Environment

a) Impacts during Construction Phase

There are no notified endangered species in the area, which may be affected due to the construction activities; therefore the biological environment will not have significant impact due to construction activity. The impact on the biological environment due to amount of dust generation is minimized by well-developed green belt in and around project site and covering of the project site using dust control curtains.

b) Impacts during Operational phase

During operation phase, the water stored in the barrage provides habitation for fishes and other aquatic organisms. Due to this project, the production of paddy crop shall be increased from 8529MT to 29624MT. The project proponent is proposed to plant 1000 No of tree saplings along River banks, Village roads and along the both channels

11.5.6 Land Environment

a) Impacts during Construction Phase

The proposed low head diversion dam(barrage) store the water of 0.334 TMC and divert the water through north rajan and south rajan channel for irrigating proposed CCA of 9159 Ha and the excess water will automatically drain into the Coleroon River by surplus over the sluice of barrage. The land use of river water body will remain river; only the part of water will be stored and diverted for irrigation purposes.

b) Impacts during Operational phase

In the cultivable command area, due to insufficient irrigation water, most of the lands are seen without agricultural activity. During the operational phase of barrage, those lands will be cultivated with paddy, pulses and with other regional crops. Hence land use of CCA will remain agricultural land but all the land gives greenery looks.

There will be no negative impact on land environment due to this project.

11.5.7 Socio Economic Environment

a) Impact during construction phase

The proposed barrage project provides job opportunities of 300 people in construction phase. Out of 300 people, 150 people from the surrounding village have been benefited.

Until the completion of this project, preference will be given to the local population for employment in all categories including semi-skilled and unskilled. For executing this project, both the patta and poramboke land in both the bank river has been acquired. The details are given below.

Table No 11.3 Land Acquisition Summaries

Sl. No	Description	Patta in Ha.	Poramboke in Ha.
1	Left Bank	41.435	48.825
2	Right Bank	61.64	1.115
Total		**103.075**	**49.94**

Mitigation Measures

The Government has accorded Administrative approval for the scheme and administrative sanction for land acquisition charges for Rs 31.3457 crore vide GO (Ms) No 48 dated 23.02.2018.

b) Impacts during Operational phase

During discharge of water through north and south rajan channels to proposed cultivable command area, the paddy and pulse cultivation will be increased dramatically. The fish culture activity and improved agricultural activity improves the economic and living standard of the people living along the barrage and in CCA. The increase in production of paddy and pulses may help to eradicate the poverty and starvation throughout the country. The impact of barrage is inundation of nearest agricultural land if the dam is broken unfortunately.

Mitigation Measures

- The barrage and head sluice of north and south rajan should be maintained yearly once. The rope of shutters, gear mechanism for lifting the shutter should be checked.
- The desilting of barrage below the level (+9.50m) should be avoided to maintain the stability of foundation.
- The WRD staffs should be engaged in the barrage all days to monitor the storage of water in the barrage and movement of vehicles over the bridge.
- Danger boards should be placed around the barrage to not to swim in the water body and not to take photographs near the parapet wall.

- During flood season, before discharge river water into the river and channels, the announcement has to be made to alert the public people.
- The sewage of village should not be discharged into the water body.
- The stability of Kumaramangalam Water intake located at 140m away from proposed barrage should be inspected periodically.

11.6 Occupational Health Measures

Table No 11.4 Plan and fund allocations towards occupational health & safety of the workers

Frequency of Health Examination	Total Workers	Fund allocated for Health Check up
Six months once	300	6.0 Lakhs

11.7 Justification for selecting the location

- The North Rajan and South Rajan Channel are located adjacent to the proposed barrage. So the channels will be easily connected to the proposed barrage to divert water for irrigation purposes.
- There is no transportation bridge located within the storage area of proposed barrage.
- Road facility is available on both left and right banks of proposed barrage. So the raw materials will be easily transported to project site for construction activity.
- Initially, the barrage was proposed to construct at RD mile 74/4 in which Kondappan Cauvery Drain is located upstream of the proposed barrage. The Kondappan Cauvery Drain bed level is (+8.505m) much lower than the crest level fixed for the proposed regulator (i.e., +10.000m). It was found that this will lead to cause stagnation of water to a depth of 1.495m in upstream side of the proposed regulator. So it was planned to construct proposed barrage at RD mile 74/3.
- Two major water supply intakes and more than five minor water supply intakes are located storage area of proposed barrage. So the water stored in the barrage will regularly supply water to existing villages.
- The stretch of the river is straight in this location.
- As the elevation of proposed sill level is less than the surrounding area, the storage of water in the barrage will not submerge the surrounding lands.

- The length of the river from the proposed barrage to sea shore is 45km and the proposed barrage is not last barrage in this river. The Government of Tamil Nadu has proposed to construct two more barrages in the downstream of proposed project. From analysis all the aspects, RD 74/3 is the suitable place to construct this proposed barrage.

11.8 Benefits of project

11.8.1 Construction phase

During construction phase more than 300 people are employed for executing barrage across Coleroon River at RD 74/3 mile. More than 150 people are employed from the nearby surrounding villages. The construction of barrage is long term project which provides employment for more than 4 years.

It provides employment for all categories of people such as skilled, semi skilled and unskilled. Due to this project, the income of people in the nearby villages is increased which are invested in buying tractors and other agricultural equipment. Even though the construction work is completed, they can make income through agricultural activities by using those modern agricultural equipments.

Depending on this construction activity and people working in the site, the village people has earned money by starting tea shop, mini hotels, petti shops, mechanic shed etc. Also many houses in the village are rented by officials of WRD and contractors. These are the indirect employment of this project.

11.8.2 Operational phase

The proposed low head diversion dam diverts the required water with high water pressure for stabilizing the ayacuts in Cuddalore and Mayiladuthurai District and after meeting the demands, the remaining water will be drained into the Coleroon River. Due to water storage in the proposed barrage, water saved in Lower Anicut could be taken into Veeranam tank through the Vadavar channel as a supplementation and there by this scheme becomes a BOON for New Veeranam scheme that has already been proposed for Chennai drinking water supply scheme.

Due to this scheme, the water level in the adjoining wells and tube wells in the percolation area adjacent to the proposed water spread area of the barrage and in the existing ayacut of North and South Rajan channel will be considerably increased due to ground water recharge.

Due to the proposed project, the area of paddy cultivation will be increased from 1730 Ha to 6009 Ha. Subsequently, tonnage of paddy production will be increased from 8529MT to 29624MT which is 3.5 times of present production quantity.

11.8.3 Benefits under CER Activity

Under Corporate Environmental Responsibility (CER) plan, the Executive Engineer, the project proponent of the proposed barrage will provide required facilities to the nearest villages by using 0.25 to 2% of the project cost.

11.9 Environmental Management Plan

The **Environment Management Plan (EMP)** is required to ensure sustainable development in the study area. Hence it needs to be a comprehensive plan for which the industry, Government, Regulating agencies likes Pollution Control Board working in the region and more importantly the population of the area need to extend their co-operation and contribution.

It has been evaluated that the project area will not be affected significantly due to industrial activity. Mitigation measures at the source level and an overall Management Plan at the site level are elicited so as to improve the surrounding environment.

11.9.1 Environment Management Cell

It is important to have a permanent organizational set up for implement of environmental management plan. Conscious of this, the Executive Engineer will create Environmental Management Cell to coordinate the activities concerned with the WRD and implementation of the environmental mitigation measures during construction and operation phases of the proposed barrage.

The Executive Engineer will be responsible for the implementation of mitigation measures during construction and operation phases of the proposed barrage. Environmental Management Cell (EMC) will be headed by Executive Engineer supported by adequate number of personnel and third party(Environment Consultant) having sufficient educational and professional qualification and experience to discharge responsibilities related to environmental management including statutory compliance, pollution prevention, environmental monitoring, preventive maintenance of pollution control equipment and green belt development as well as maintenance. Environment Management Cell (EMC) will look after the environment related matters during the operation phase of the barrage. Environment Management Cell (EMC) will also look into any infringement/ deviation/ violation of the environmental or forest norms/ conditions.

The organization set-up of the Environmental Management Cell (EMC) is presented in Figure 11.6.

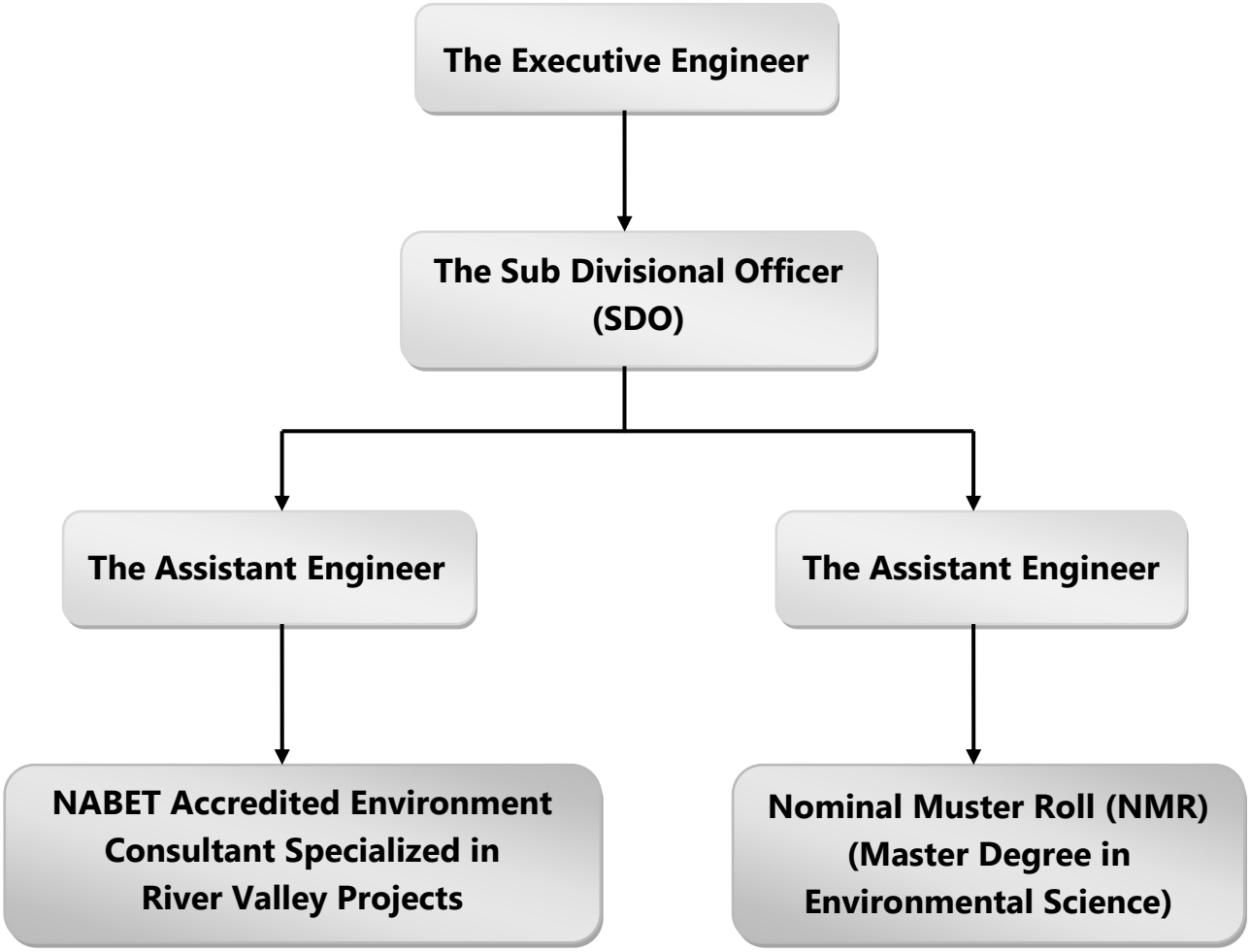


Fig No 11.6 Chart of Environment Management Cell

Table No 11.5 EMP Budget during Construction Phase

S. No	Description	Capital Cost in Rs.	Recurring Cost/year in Rs
1	Safety kits - Rs.1000/Labor	3,00,000	2,00,000
2	Environmental Monitoring	-	1,25,000
3	Water sprinkling on the exposed ground, unpaved road	Hiring tractor mounted with water tank	3,00,000
4	Disposal of Bio Sludge generated from Septic Tank	-	1,00,000
5	Management of Municipal Solid Waste (Biodegradable and Non Biodegradable)	-	1,00,000
6.	Display board with Environmental Conditions	1,00,000	20,000
7.	First aid facility in the site	1,00,000	1,00,000
8.	Health check up of workers	3,00,000	3,00,000
9.	Greenbelt development along the banks – 500 tree saplings	1,00,000	25,000
10	Installation of safety sign boards	1,00,000	20,000
11	Monitoring of safety through Safety Engineer	-	3,00,000
12	Fire extinguisher, sand buckets	10,000	10,000
Total		**Rs. 10,10,000/-**	**Rs.16,00,000**

Table No 11.6 EMP Budget during Operational Phase

S. No	Description	Capital Cost in Rs.	Recurring Cost/year in Rs
1	Environmental Monitoring	-	2,50,000
2	Display board with Environmental Conditions	1,00,000	20,000
3	First aid facility at the barrage	50,000	50,000
4	Greenbelt development along the banks, Channels and village roads– 1000 tree saplings	2,00,000	50,000
5	Installation of danger board mentioning not to swim in water storage area and not to take selfie near parapet wall, storage area.	1,00,000	20,000
6	Fire extinguisher, sand buckets	10,000	10,000
Total		**Rs. 4,60,000/-**	**Rs.4,00,000**

11.10 Environmental Monitoring Program

Environmental Monitoring program will be conducted for various environmental components as per conditions stipulated in Environmental Clearance Letter issued by MOEF&CC & Consent to Operate issued by TNPCB.

Table 11.7 Post Project Environmental Monitoring Program (Construction phase)

S. No	Environment Attributes	Location	Monitoring		Remarks
			Duration	Frequency	
1	Meteorology and Air Quality	Continuous monitoring weather station in core zone/ nearest IMD station	24 hours	Monthly Once	Wind speed, direction, Temperature,Relative humidity and Rainfall.
2	Air Pollution Monitoring – $PM_{2.5}$, PM_{10}, SO_2 and NO_x	5 locations (One station in the core zone and at least one in nearby residential area, one in the upwind, one station on the downwind direction and one in cross wind direction).	8 hours	Once in six months	Fine Dust Sampler and Respirable Dust Sampler
3	Water Pollution Monitoring	No Effluent generation during the construction phase. Set of grab samples during pre and post monsoon nearby ground and surface water in the vicinity.	–	Once in six months	Physico–chemical, micro-biological characteristics
4	Hydrogeology	Water level in open wells in buffer zone around 1km at specific wells	-	During Foundation Work and desilting work	Water level monitoring devices will be used.
5	Noise	Project site Boundary, high noise generating areas within the site due to heavy machineries and at the nearest residential area	24 hours	Monthly Once	Sound level meter
6	Soil	Core Zone and Buffer zone (Grab samples)	–	Once in six months	Physical and Chemical characteristics
7	Loss of flora and fauna	Project site	During Site Clearance	During Site Clearance	Visual inspection
8.	Vibration Test	Project site	-	When the blasting involved during foundation work	Ground vibration test

Table 11.8 Post Project Environmental Monitoring Program (Construction phase)

S. No	Environment Attributes	Location	Monitoring		Remarks
			Duration	Frequency	
1	Meteorology and Air Quality	Continuous monitoring weather station in core zone and in CCA/nearest IMD station	24 hours	Monthly Once	Wind speed, direction, Temperature, Relative humidity and Rainfall.
2	Air Pollution Monitoring – $PM_{2.5}$, PM_{10}, SO_2 and NO_x, CO, SPM	Ambient Air Quality Monitoring 8 locations (Two stations in two villages located in left and right of storage area, 3 random locations in CCA of Cuddalore Districts and 2 random locations in CCA of Mayiladuthurai Districts.	8 hours	Once in six months	Fine Dust Sampler and Respirable Dust Sampler
3	Water Pollution Monitoring	1. Collection of surface water sample in storage area 2. Collection of ground water sample in left and right side of storage area 3. Collection of ground water sample in cultivable command areas.	–	Once in six months	Physico–chemical, micro-biological characteristics
4	Hydrogeology	1. Left and right side of storage area 2. Cultivable command area	-	Once in six months	Ground water levels in MSL
5	Soil	Both agricultural and non agricultural land in core zone and in CCA(Grab samples)	–	Once in six months	Physical and Chemical characteristics
6	Greenbelt development	Project site, village roads, river banks, along the channels	-	Daily	Watering and care taking of plants
7	Agricultural activity	Cultivable command area	-	Yearly once	Both pulses and paddy

11.11 Ecological Damage Assessment, Remediation Plan, Natural Resource Augmentation and Community Resource Augmentation

Environmental Compensation for the construction activity carried out during violation period is computed as follows:

Environmental Compensation, EC = PI × N × R × S × LF

Where

PI = 41 for Orange Category Industry
N = 1419 days
R = Rs.100 (Minimum)
S = 1.0 for cumulatively Small Scale Unit
LF = 1.0 for population less than 1.0 million

EC = 41 x 1419 x 100 x 1.0 x 1.0

EC = Rs. 58,17,900

Table No 11.9 Cost Estimated for Remediation Plan

S.No	Description	Cost
1	Land Reclamation	Rs.11,80,000
2	Cost for medical checkup (300 Workers)	Rs. 3,00,000
3	Cost for Plantation along river banks (500 Saplings) and leaving of fingerlings into water body	Rs. 1,20,000
4	Cost for medical checkup (100 Village people)	Rs. 50,000
5	Plantation along village road, public places (500 Saplings)	Rs. 1,00,000
	Total Cost	**Rs.17,50,000**

Table No 11.10 Natural and Community Resource Augmentation Plan

S. No	Activities	Financial Proposal
Natural Resource Augmentation Plan		
1	Rejuvenation of tributaries of north rajan and south rajan channels in command area	Rs.10,00,000
2	Provision of solar panels arrangements to the nearest houses on both sides of barrage Total number of houses - 20 No.s Solar panel setting/house - Rs.30,000	Rs. 6,00,000
3	Seminars, workshops, panel discussion, brainstorming sessions on topics of strategic importance to agriculture sector in the nearest villages.	Rs. 4,00,000
Total		**Rs.20,00,000**
Community Resource Augmentation Plan		
1	Construction of public toilets in Adhanur and Kumaramangalam villages	Rs.21,00,000
	Total	**Rs 21,00,000**

Total Cost (Remediation Plan + NRAP+CRAP) = Rs. 58,50,000

11.12 Conclusion

As discussed, it is safe to say that the project is not likely to cause significant impact on the ecology and environment of the area, as adequate preventive measures will be adopted to contain the pollutants within permissible limits. The total operation shall be carried out with ease & minimum risk of the workers. The proposed project will definitely increase the agricultural activity around the barrage and in command areas which improve the economic condition of village people and government. The proposed Environmental Management Plan will keep the area in a safe environment with negligible impact on the environment.

CHAPTER - 12: DISCLOSURE OF CONSULTANTS ENGAGED

AADHI BOOMI MINING AND ENVIRO TECH (P) LTD, a QCI/NABET Accredited EIA Consultant Organization having it's Registered Office at Salem and Branch at Porur, Chennai were promoted by a team of professional Geologists\ Mining\ Environment\ Civil\ Mechanical\ Chemical Engineers\Scientists. The company has vast experience in various disciplines including Exploration and mining of minerals and was incorporated in 2002 in the name of Suriya Mining Services providing expert advice and solutions for clients' requirement in the field of Mineral prospecting, Exploration, Mining, Geo-technical, Techno economic Feasibility reports\evaluation, Mineral Engineering, Environment Impact Assessment (EIA), Environment Management Plan (EMP), Environment Monitoring and related liaison jobs like Environment Clearance, Wild life and Forest clearance from DEIAA/SEIAA/NBWL/CRZ, MoEF& CC etc of all accredited sectors.

12.1 SCOPE

- EIA & EMP for all accredited sectors and Monitoring as per SPCB/CPCB/MoEF & CC
- Environment/ Wild life/ CRZ/ Forest Clearance
- Social Impact Analysis (SIA) and Eco-Biodiversity studies for Mine Closure Plan
- Remote Sensing & GIS including Satellite data processing, ASTER, DEM etc for application in Forest, Agriculture, Disaster, Mineral Exploration, Environment Modelling, Town planning etc
- Geological Surveying, Mapping, Exploration and Project Management
- Geophysical, Geochemical & Geotechnical studies to locate concealed deposit\ formation including structural studies
- Noise and Vibration studies as per DGMS\MoEF & CC to design controlled blasting where inhabitations are located within 300m
- Mine Design and costing, selection of Machineries and Project Evaluation
- Statutory Mine Plans & Sections, Mining Plan and other mandatory projects
- Design and development of Mineral Beneficiation Plant including mineral separation studies.

12.2 INFRASTRUCTURE

- Our Human resources are well expertise in all functional areas as per Ver. 3 of NABET\QCI. Our Hi Tech ISO certified Office and Lab are accredited by NABL and MoEFCC.

- And have latest field Investigation devices like Respirable and Fine Dust Samplers, Digital Seismograph, DDR3 Resistivity Meter, Echo sounder, DGPS, Total Station, Water level monitoring meters, GPS 62S, Sound Level Meter etc.

12.3 DISCLOSURE OF CONSULTANT FOR EIA STUDY

The Applicants, **The Executive Engineer,** Water Resource Department, Special Project Division, Kumbakonam – 612001 (Government of Tamil Nadu) has appointed **AADHI BOOMI MINING AND ENVIRO TECH PRIVATE LTD**, having its office at 3/216, K.S.V Nagar, Narasothipatti, Alagapuram, Salem – 636 004, Tamil Nadu, for preparation of EIA/EMP report for obtaining Environment Clearance from SEIAA/SEAC, Tamil Nadu.

AADHI BOOMI MINING AND ENVIRO TECH PRIVATE LTD has MOU with **EKDANT ENVIRO SERVICES (P) LTD** laboratory at Chennai and has own Laboratory named **ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY, accredited by NABL** for sampling and testing of air, water, noise and soil samples. Ekdant Enviro Services are recognized by the Ministry of Environment and Forests, Government of India under the relevant provision of Environment (Protection) Act 1986 and Accredited by NABL and NABET, Quality Council of India, New Delhi.

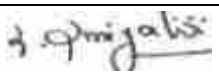
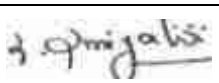
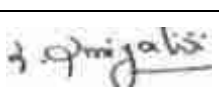
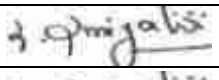
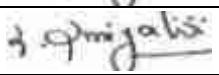
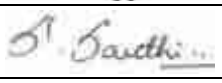
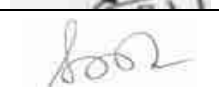
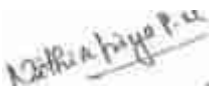
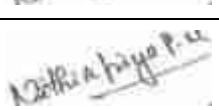
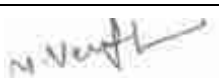
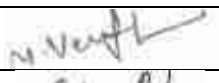
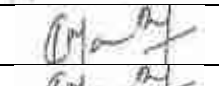
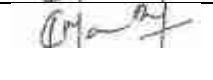
S. No.	Study	Consultants/LAB
1	Generation of Base Line Data	Aadhi Boomi Mining & Enviro Tech P Ltd, Salem
2	Remote Sensing and Land use/Land cover Studies	Aadhi Boomi Mining & Enviro Tech P Ltd, Salem
3	Preparation of EIA and EMP Report	Aadhi Boomi Mining & Enviro Tech P Ltd, Salem
4	Ecological Damage Assessment, Remediation Plan, Natural Resource Augmentation and Community Resource Augmentation	Aadhi Boomi Mining & Enviro Tech P Ltd, Salem

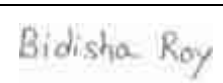
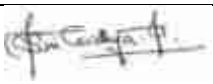
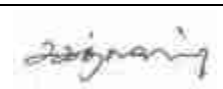
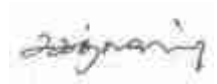
12.4 DECLARATION OF EXPERTS INVOLVED IN THE EIA REPORT PREPARATION

Names of the EIA coordinator, Functional Area Experts and other Team Members engaged and nature of consultancy rendered is provided in NABET Annexure –VII of EIA report. The multidisciplinary team comprises of Environmental Engineers, Geologists and Geographers who involved in preparation of Environmental Impact Assessment Report and Environment Management Plan for various functions like Air

quality, Water quality, Noise levels, Soil Conservation, Hydro geology, Ecology and bio-diversity, Land use and Socio–Economics.

Table 12.1: Declaration of Experts

S.No	Name of the Expert	Category	Functional Areas	Signature
In-House Experts				
1.	Mr.S.Suriyakumar	A	EIA Co-ordinator	
		A	Solid and Hazardous Waste SHW*- HW* only	
		A	Risk Assessment and Hazard Management (RH)	
		A	Land Use (LU)	
		A	Soil Conservation (SC)	
2.	Mrs. S. Santhi	B	Land Use (LU)	
		B	Socio Economics (SE)	
3.	Mr.K.Thirumeni	B	EIA Co-ordinator - Building and Construction	
		B	EIA Co-ordinator - Highways	
		B	Land use (LU)	
4.	R.R Prakash Babu	B	Air Pollution, Monitoring, Prevention and Control (AP)	
		B	Noise and Vibration (NV)	
5.	Dr. Nithia Priya P.M	B	Air Pollution, Monitoring, Prevention and Control (AP)	
		B	Water Pollution Monitoring, Prevention and Control (WP)	
6.	Mr. M. Venkatesh Prabhu	B	Meteorology, Air Quality Modelling & Prediction (AQ)	
		B	Noise and Vibration (NV)	
7.	Mr. K. Manuraj	B	Geology (GEO)	
			Hydrogeology (HG)	

8.	V. Sudha	B	Ecology and Biodiversity	
Empanelled Experts				
9.	Dr. Nallathambi Varadarajan	A	Geology (Geo)	
		A	Hydrology, ground water and water conservation (HG)	
10.	Bidisha Roy	B	Meteorology, Air Quality Modelling & Prediction (AQ)	
Team Member Involved in Report Preparation				
11.	Mrs. S. Sri Vidhya	Team Member	Water Pollution Monitoring, Prevention and Control (WP) under FAE - Dr. Nithia Priya P.M	
			Meteorology, Air Quality Modelling & Prediction (AQ) under FAE - Mr. M. Venkatesh Prabhu	
12.	Mr. S. Sagath Srikrishnan	Team Member	Solid hazardous Waste (SHW) under FAE Mr. Suriyakumar. S	
			Water Pollution Monitoring, Prevention and Control (WP) under FAE - Dr. Nithia Priya P.M	
13.	Mrs. A. Nagadevi	Team Member	Water Pollution Monitoring, Prevention and Control (WP) under FAE - Dr. Nithia Priya P.M	
			Ecology and Biodiversity (EB) under FAE – V. Sudha	
14.	Mr. A. Jagadeesh Kumar	Team Member	Noise and vibration under FAE - Mr. M. Venkatesh Prabhu	
			Meteorology, Air Quality Modelling & Prediction (AQ) under FAE - Mr. M. Venkatesh Prabhu	

CHAPTER 13 - ECOLOGICAL DAMAGE ASSESSMENT, REMEDIATION PLAN, NATURAL RESOURCE AUGMENTATION AND COMMUNITY RESOURCE AUGMENTATION

13.0 Introduction

The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonam – 612001 (Government of Tamil Nadu) has proposed to construct Barrage with 84 vents across the River Coleroon at RD 74/3 mile in Adhanur and Kumaramangalam Villages to irrigate the cultivable command area of 9159 Ha in Cuddalore and Mayiladuthurai Districts.

Initially, the Executive Engineer of WRD has applied under Category B2 for obtaining environmental clearance of proposed irrigation project vide online proposal no. SIA/TN/RIV/406095/2022 dated 18.11.2022.

During the 358th SEAC meeting held on 24.02.2023, the committee observed that the Executive Engineer, WRD has started the construction work of barrage before getting Environmental Clearance and declared that the proposed project comes under violation category as per EIA Notification, 2006. Thereby the SEAC recommended SEIAA to issue sector specific standard Terms of Reference (TOR) under violation category with public hearing for conducting Environmental Impact Assessment study and for ecological damage assessment plan, preparation of remediation plan, preparation of natural and community resource augmentation plan.

During 604th SEIAA meeting held on 23.03.2023, the authority accept the recommendation of SEAC and issued TOR under violation category vide Lr.No.SEIAA-TN/F.No.9677/Violation/ToR-1400/2022 dated 23.03.2023. The ecological damage caused by the Executive Engineer was assessed as per Central Pollution Control Board guidelines.

13.1 CPCB Guidelines for environmental compensation for violation cases

During the violation Period, impacts of construction activity on the Environmental Components viz. Air, Water, Land, Biological and Socio-economic Environment are assessed based on the Norms specified by the Central Pollution Control Board (CPCB) to implement "Polluter Pays" Principle and to levy Environmental Compensation for Restoration of Environmental Damages.

The Environmental Compensation shall be based on the following formula:

EC = PI x N x R x S x LF

EC is Environmental Compensation in Rupees
PI = Pollution Index of Industrial Sector
N = Number of days of violation took place
R = A factor in Rupees for EC
S = Factor for Scale of Operation
LF = Location Factor.

13.1.1 Environmental compensation for Irrigation project of the Executive Engineer

The construction work of the proposed project was started on 04.05.2019 and the work has been stopped on 23.03.2023 based on the recommendation of SEAC during 358th SEAC meeting. The number of days working during the violation period is calculated as 1419 days. The construction of barrage comes under the Orange category. The pollution index for the orange category project is 41 to 59 as per CPCP guidelines. As the irrigation project is proposed for increase the agricultural activity in Cuddalore and Mayiladuthurai District, the cost of environmental compensation per day is taken as Rs.100, the pollution index is taken as 41 and the factor of scale is taken as 1.0. The Adhanur and Kumaramangalam village is located left and right side bank of the proposed barrage. The population of each village is less than 1.0 million, thereby by location factor is taken as 1.0.

Environmental Compensation for the construction activity carried out during violation period is computed as follows:

Environmental Compensation, EC = PI × N × R × S × LF

Where

PI = 41 for Orange Category Industry
N = 1419 days
R = Rs.100 (Minimum)
S = 1.0 for cumulatively Small Scale Unit
LF = 1.0 for population less than 1.0 million

EC = 41 x 1419 x 100 x 1.0 x 1.0

EC = Rs. 58,17,900

13.2 Impacts of Construction activities on Environmental Components

13.2.1 Impact on Land Environment

During construction activity, land was damaged by not adopting environment management plan. While carrying out site visit, the raw material such as steel rod, concrete blocks and other construction material such as scaffolding, paint can, resins and shutters used for concrete work were placed over the open land which leads to soil pollution. The earth excavated during foundation work of barrage, head sluice and infall regulators were not dumped properly in the project site. The construction wastes were also not placed in particular earmarked place instead it is scattered in the bank of river near to barrage. All the above activity caused damage of land and affects the aesthetic view of land environment.

Fig 13.1 Showing improper dumping of earth and scattering of construction materials, wastes

13.2.1.1 Remediation Plan

To restore the land use of the area, all the excavated earth should be dumped along both the banks of river for strengthening the banks along the upstream of proposed barrage. The construction materials on the open land shall be cleared and placed over the impervious layer or it should be placed within the garages. The waste materials such as steel roads, plastic cans, card boards, barrels and electric wires shall be properly segregated in containers and all the wastes shall be sold to authorized recyclers.

The land damaged during construction activities should be leveled using dozers. After the construction of barrage, the green belt shall be developed at the entrance of both sides of barrage. The estimated time period for the above work is approximately 14 days. The machineries and labors engaged for the work is given below.

Total workers required per day	= 50Nos
Wages per labor per day	= Rs.1000
Wages for 50 labors per day	= Rs.50,000
Diesel required per day	= 200 liters
Cost of fuel per day	= Rs.20,000
Construction of garages with impervious layer	= Rs.2,00,000

The estimated cost for reclamation of land is **Rs. 11,80,000**

13.2.2 Air Environment

The increase in pollution in Air environment causes so many health issues to workers and village people. The construction activity was carried out without any environment management plan such as water sprinkling system along unpaved mud roads, covering truck by tarpaulin while transportation of materials, usage of curtains around construction site and provision of PPE to workers. It is needed to estimate the fugitive emission during the violation period to identify the level of impact on air environment. The fugitive emission has been arrived by AERMOD software with the inputs of meteorological data, location and quantity of sand and aggregates unloaded in the project site, transportation along the unpaved road and distance of the nearest habitations.

Formula to find the emission rate during unloading of sand:

$$E = 1.76h^{1/2}\{(100-m)\ (m)^{-1}\}^{0.2}\{(s)\ (100-s)^{-1}\}^{2}u^{0.8}\ (cy)^{0.1}$$

Formula to find the emission rate during unloading of coarse aggregates:

$$E = 0.023\ [\{100-m\}\ sh\ \{m\ (100-s)^{-1}\}]^{2}\ (u^{3}cy)^{0.1}$$

Formula to find the emission rate during movement of vehicles in the unpaved roads:

$$E = [\{(100-m)\ (m)^{-1}\}^{0.35}\ \{(us)\ (100-s)^{-1}\}]^{0.7}\{0.5 + 0.1(f + 0.42v)\}\ 10^{-3}$$

Table 13.1 INCREMENTAL RISE IN CONCENTRATION (GLCs) OF PM10 (AP) ON UNLOADING & TRANSPORTATION ACTION

Locations	Locations Code	Background value in µg/m^3	Incremental GLC in µg/m^3	Total Predicted GLC in µg/m^3
Project site	AQ1 - Centre	48	39.91	87.91
Receptor -01	AQ2- Adhanur village	48	3.11	51.11
Receptor -02	AQ2- Kumaramangalam village	48	10.58	58.58
Receptor -03	AQ3- Ayangudi village	48	3.28	51.28
Receptor - 04	AQ4 – Kesingan village	48	4.16	52.16
National Ambient Air Quality Standards (NAAQS)				100

The above table 13.2 shows that the incremental GLC due to construction activity during violation period is 39.91µg/m^3. The total predicted GLC was 87.91µg/m^3 which is slightly high due to lack of environmental management plan but it was within the NAAQS.

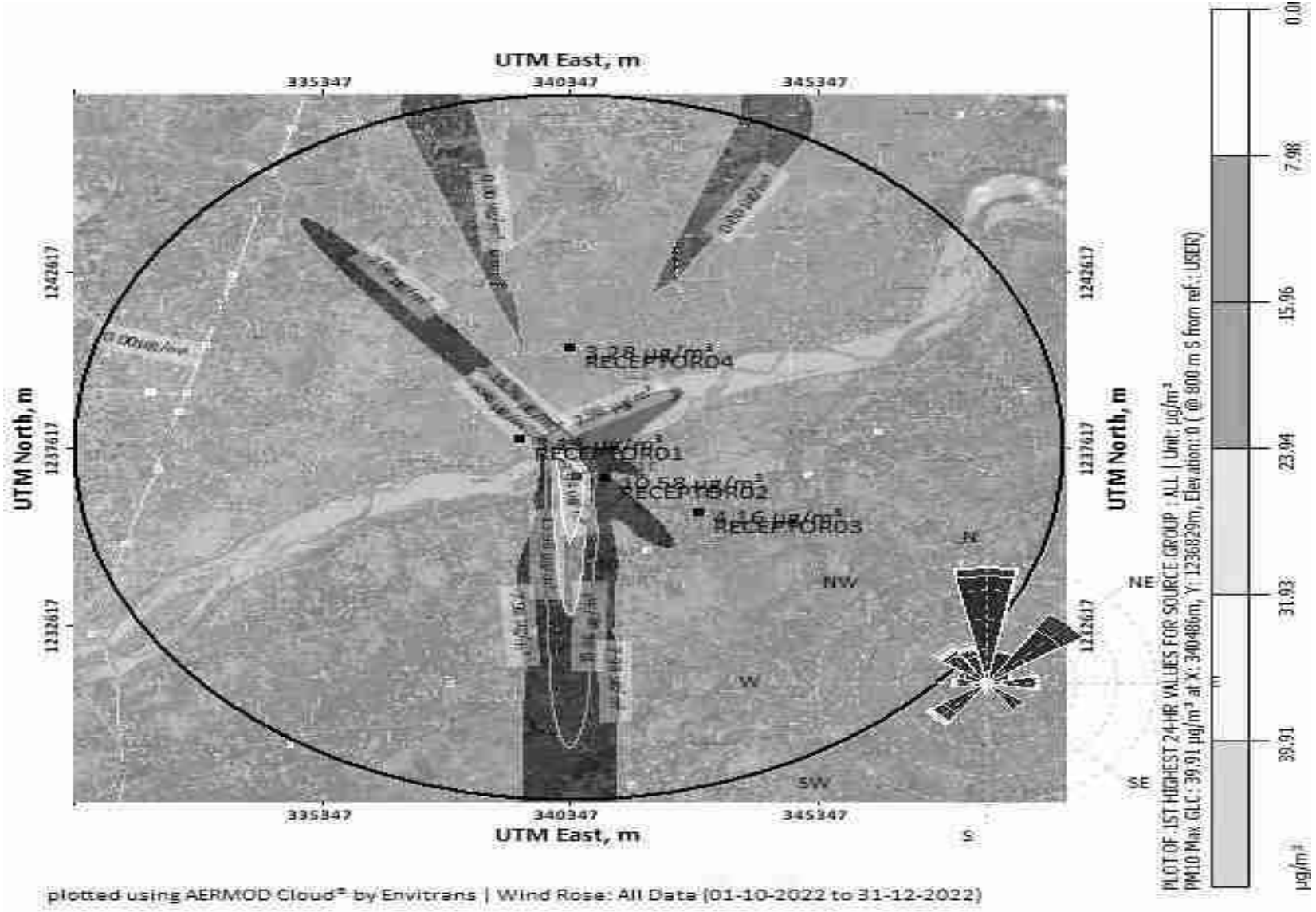


Fig No 13.2 Isopleths of PM10 is 39.91 µg/m3 occurred near the project site during violation period due to i) unloading and ii) transportation of materials over the unpaved road

13.2.2.1 Impact due to Air Pollution

- The dust generated from the construction activity deposited on the flora in and around the project site and affected its rate of growth.
- Those dust also deposited on the nearest structures like temple, schools and residential houses.
- Other effect of fugitive emission during construction activity was causing health issues to the workers.

13.2.2.2 Remediation Plan

- The dust gets deposited on the structures and flora was washed out during monsoon season.
- The health check will be carried out for all labors worked during violation period.
- The Green belt will be developed around the bank of rivers to prevent the escape of dust.

The cost for remediation plan is estimated below

Total man power during violation period	= 300 No's
Cost of health checkup for a person	= Rs.1000
Total cost for medical checkup (Workers)	**= Rs.3,00,000**

13.2.3 Water Environment

The construction of barrage has been carried out across the Coleroon River. During construction activity, the river water has been diverted and coffer dam were used in the foundation work. Moreover, the construction activity in the south rajan channel was carried out only during non monsoon season. The required numbers of toilet facilities with septic tank has been built along both sides of river banks; no sewage was let into the river water body. Hence the quality of surface water was not disturbed through any activities. The water required for construction activities and domestic purposes were obtained from Proponent own bore well and from authorized water vendors. River water was not utilized for any purposes. The water extracted from bore well will be recharged

during every year rainy seasons. The municipal solid wastes also were properly disposed during violation periods. In future the storage of water in the proposed barrage will improve agricultural activity in the surrounding areas and in command areas. This will be a positive impact.

13.2.4 Ecology and Biodiversity

13.2.4.1 Impact Assessment on Biological Environment

There is no reserved forest found within 10km radius. The construction activity has been carried out only within the project site (Government Poramboke land). It did not affect any lands in adjacent to project site. On the right bank of river, it was seen that the agricultural activity has been carried without any disturbance due to construction work. As per the EIA Notification 2006, 33% of project land has to be allocated for green belt development. Since the project area is water body, the green belt is planned to develop along the river banks. However the project proponent has not carried out any plantation along the banks of river. The plantation of trees provides the habitation for fauna like reptiles, birds and mammals and it maintains ecological balance. The well grown trees absorb the gas emitted by vehicles, human beings and release oxygen. So it control temperature rise and climate change due to construction activity. The greenbelt along the river banks act as barrier as it control noise and air pollution.

The improper dumping of excavated earth in the project site affects the growth of flora. The diversion of Narimudukku drain into the south rajan channel and diversion of river water during barrage construction may affect the ecology of aquatic fauna. Some of the eggs of fish and other aquatic fauna have not hatched at right time due to diversion.

13.2.4.2 Remediation Plan

The proponent has to plant the sapling along the river banks after the banks are strengthened by using excavated earth. After the completion of work, the project proponent has to leave native fingerling into the water bodies with the help of Fisheries Department.

The cost of one sapling with fencing, watch and ward	= Rs 200
No of saplings planned to plant (river banks)	= 500 No
Cost of fingerlings	= Rs.20,000
Total cost for Plantation and leaving of fingerlings	**= Rs. 1,20,000**

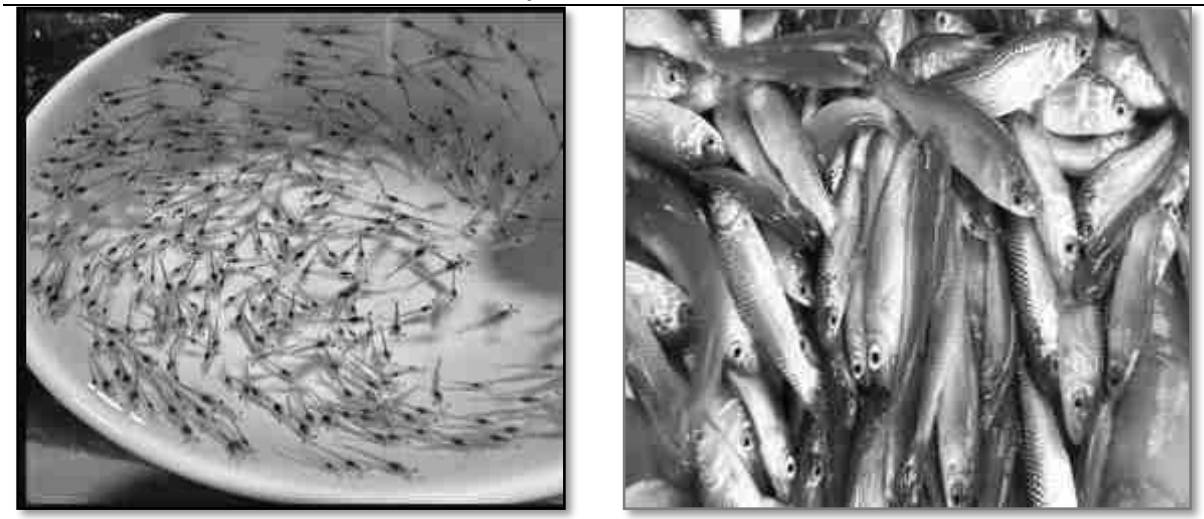


Fig No 13.3 Fingerlings of Catla and Prawn (Native types of fish)

13.2.5 Socio economic environment

13.2.5.1 Impacts on Socio economic environment

The industrial development in the area has both positive and negative impacts. The positive impacts are providing employment to the local village people. Thereby living standard of the village people will be increased. Likewise this construction of barrage provided employment to more than 150 village people. Depending on this project so many people earned money by keeping hotels, tea shops and mechanical sheds etc. The negative impacts are noise and air pollution, resettlements and rehabilitations, impacts on adjacent agricultural lands, disturbance for people using river bank. The people in the nearby villages may be affected health wise due to non implementation of proper environment management plan during violation period. However no death has encounter in project site and in nearest village during violation period due to construction activity. The WRD has acquired patta land of 84.72 Ha and poramboke land of 12.90 Ha for executing the proposed project. However, the Government has accorded administrative approval for the scheme and administrative sanction for land acquisition charges for Rs 31.3457 crore vide GO (Ms) No 48 dated 23.02.2018.

13.2.5.2 Remediation plan

Health check up random of random village people	= 100 No's
Cost of medical checkup for a person	= Rs.500
Total cost for medical checkup (Village people)	**= Rs.50,000**
Plantation along village road, public places (500 Nos)	**= Rs.1,00,000**

Table 13.2 Cost Estimated for Remediation Plan

S.No	Description	Cost
1	Land Reclamation	Rs.11,80,000
2	Cost for medical checkup (300 Workers)	Rs. 3,00,000
3	Cost for Plantation along river banks (500 Saplings) and leaving of fingerlings into water body	Rs. 1,20,000
4	Cost for medical checkup (100 Village people)	Rs. 50,000
5	Plantation along village road, public places (500 Saplings)	Rs. 1,00,000
	Total Cost	**Rs.17,50,000**

Table 13.3 Natural and Community Resource Augmentation Plan

S. No	Activities	Financial Proposal
Natural Resource Augmentation Plan		
1	Rejuvenation of tributaries of north rajan and south rajan channels in command area	Rs.10,00,000
2	Provision of solar panels arrangements to the nearest houses on both sides of barrage Total number of houses - 20 No.s Solar panel setting/house - Rs.30,000	Rs. 6,00,000
3	Seminars, workshops, panel discussion, brainstorming sessions on topics of strategic importance to agriculture sector in the nearest villages.	Rs. 4,00,000
Total		**Rs.20,00,000**
Community Resource Augmentation Plan		
1	Construction of public toilets in Adhanur and Kumaramangalam villages	Rs.21,00,000
	Total	**Rs 21,00,000**

Total Cost (Remediation Plan + NRAP+CRAP) = Rs. 58,50,000

After the acceptance of estimated cost of Rs. 58,50,000 by SEAC during EC appraisal meeting, the proponent will take bank guarantee of Rs. 58,50,000 for Remediation plan, NRAP and CRAP.

THIRU. DEEPAK S. BILGI, I.F.S.
MEMBER SECRETARY

STATE LEVEL ENVIRONMENT IMPACT ASSESSMENT AUTHORITY-TAMILNADU
3rd Floor, Panagal Maaligai,
No.1, Jeenis Road, Saidapet,
Chennai - 600 015.
Phone No. 044-24359973
Fax No. 044-24359975

TERMS OF REFERENCE (ToR)

Letter No.SEIAA-TN/F.No.9677/Violation/ToR-1400/2022 dated:23.03.2023

To

The Executive Engineer,
Water Resource Department,
Special Project Division,
Kumbakonam - 612001.

Sir,

Sub: SEIAA-TN –Terms of Reference (ToR) under Violation category with public hearing for the Proposed irrigation project by construction of barrage with head sluices across the River Coleroon (12 km downstream of Lower Anicut) at RD 74/3 Mile in Adhanur Village, Kattumannarkoil Taluk, Cuddalore District with Cultural Command Area - 6601 Ha (53Nos.Villages) and Kumara Mangalam Village, *Mayiladuthurai* Taluk & District with Cultural Command Area - 2558 Ha (35 Nos.Villages) with total Cultural Command Area - 9159 Ha (< 10,000 Ha) for Ayacut development through North and South Rajan canals by The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonam District under Schedule 1(e) "River Valley/Irrigation projects" of Category "B1"– Terms of Reference (ToR) under Violation category with public hearing issued for the preparation of EIA report, EMP report, & Chapter 13 - Ecological Damage Assessment, Remediation Plan, Natural Resource Augmentation and Community Resource Augmentation – Regarding.

Ref: 1. Online Application No. SIA/TN/RIV/406095/2022) dt: 18.11.2022

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2. Your application Received dated: 27.12.2022
3. Minutes of the 358th SEAC Meeting held on 24.02.2023
4. Minutes of the 604th SEIAA meeting held on 23.03.2023

The project proponent, The Executive Engineer submitted application for the proposed irrigation project by construction of barrage with head sluices across the River Coleroon (12 km downstream of Lower Anicut) at RD 74/3 Mile in Adhanur Village, Kattumannarkoil Taluk, Cuddalore District with Cultural Command Area - 6601 Ha (53Nos.Villages) and Kumara Mangalam Village, *Mayiladuthurai* Taluk & District with Cultural Command Area - 2558 Ha (35 Nos.Villages) with total Cultural Command Area - 9159 Ha (< 10,000 Ha) for Ayacut development through North and South Rajan canals by The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonam District, Tamil Nadu under Schedule 1(c) "River Valley/Irrigation projects".

Discussion by SEAC and Remarks:-

Proposed irrigation project by construction of barrage with head sluices across the River Coleroon (12 km downstream of Lower Anicut) at RD 74/3 Mile in Adhanur Village, Kattumannarkoil Taluk, Cuddalore District with Cultural Command Area - 6601 Ha (53Nos.Villages) and Kumara Mangalam Village, *Mayiladuthurai* Taluk & District with Cultural Command Area - 2558 Ha (35 Nos.Villages) with total Cultural Command Area - 9159 Ha (< 10,000 Ha) for Ayacut development through North and South Rajan canals by The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonam District - For Environmental Clearance.
(SIA/TN/RIV/406095/2022) dt: 18.11.2022).

The proposal was placed in the 358th SEAC Meeting held on 24.02.2023. The details of the minutes are available in the website (parivesh.nic. in).

The SEAC noted the following:

1. The Proponent, The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonam District has applied for Environmental Clearance for the proposed irrigation project by construction of barrage with head sluices across the River Coleroon (12 km downstream of Lower Anicut) at RD 74/3 Mile in Adhanur Village,

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Kattumannarkoil Taluk, Cuddalore District with Cultural Command Area - 6601 Ha (53Nos.Villages) and Kumaramangalam Village, *Mayiladuthurai* Taluk & District with Cultural Command Area - 2558 Ha (35 Nos. of Villages) with total Cultural Command Area - 9159 Ha (< 10,000 Ha) for Ayacut development through North and South Rajan canals.

2. The project/activity is covered under category "B1" of Item 1(c) "River Valley/Irrigation projects" of the schedule to the EIA Notification,2006.
3. MoEF&CC, Office Memorandum Dt:12.11.2020.

****

During the meeting the SEAC noted that, the project activity was started without prior Environmental Clearance and the SEAC decided to **recommend grant of sector specific standard Terms of Reference (ToR) under violation category with public hearing** for conducting Environment Impact Assessment Study for River Valley Projects in 3 parts for the project, for assessment of Ecological damage, remediation plan and natural & community resource augmentation plan to be prepared as an independent chapter in the Environment Impact Assessment report by the Accredited consultant and also with collection and analysis of data for the assessment of ecological damage, preparation of remediation plan and natural & community resource augmentation plan to be done by an Environmental laboratory duly notified under the Environment (Protection) Act, 1986, accredited by NABET or a laboratory of council of Scientific and Industrial research Institutions working in the field of Environment in addition to the following ToRs. Further, this issuance of ToR under violation does not warrant grant of EC and the grant of EC is subject to the outcome of the court case filed before the Hon'ble High Court of Madras (Madurai Bench) vide *W.P.(MD) No. 11757 of 2021 titled Fatima Vs Union of India challenging the SoP for violation proposals dated 07th July 2021*:

1. The pp shall furnish 30 Years Coleroon river flow data.
2. The pp shall furnish drainage pattern around 10 km of the project site & the Cultural Command Area along with details of wells, infiltration area, surface water sources with capacity, Ground water level etc for a period of 10 Years.
3. Details and current status of Land acquisition for Govt. and Private lands with Survey

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No. & Village.

4. Details on the operating, expired, abandoned quarries located within 5 km radially around the proposed construction of barrage.
5. Details on the seismicity of the region where the construction is carried out.
6. Details of impact on pulse & paddy production before & after proposed construction of barrage.
7. Details of drinking water sources downside of barrage and the implications of barrage on them.
8. Detailed residual moisture impact study.
9. Details & Impact study on the proposed desilting & Dredging activity associated with proposed construction of barrage.
10. Details on Disaster Management pertaining to proposed barrage.

Remarks of SEIAA:

The proposal was placed in the 604th Authority meeting held on 23.03.2023. The authority after detailed discussion accepts the recommendation of SEAC in its meeting dated 24.02.2023 and decided to issue ToR (Under Violation category) with public hearing, subject to following ToRS in addition to sector specific Standard ToR and specific additional ToRs recommended by SEAC. Further, this ToR (Under Violation category) with public hearing granted will not entail EC to the proponent as the case W.P (MD). No. 11757 of 2021 of 2021 is pending before Hon'ble Madurai Bench of the High Court of Madras and will be subject to final orders of the Hon'ble Madurai Bench of the High Court of Madras in the matter W.P(MD). No. 11757 of 2021.

1. Details of impact on migratory fish movement and habitat of wild life near the sedimentation area.
2. Impact of changes due to sedimentation and the effect on water quality due to interferences.
3. Possible acoustic and noise pollution and their impact on river fauna.
4. Impact due reduced capacity of stored dissolved oxygen.
5. New technologies to overcome hazard on riverine system.

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SEIAA-TN

PART-I

1(c): STANDARD TERMS OF REFERENCE FOR CONDUCTING ENVIRONMENT IMPACT ASSESSMENT STUDY FOR RIVER VALLEY PROJECTS AND INFORMATION TO BE INCLUDED IN EIA/EMP REPORT

(1) Scope of EIA Study:

The EIA Report should identify the relevant environmental concerns and focus on potential impacts that may change due to the construction of proposed project. Based on the baseline data collected for three

(3) seasons (Pre-monsoon, Monsoon and Winter seasons), the status of the existing environment in the area and capacity to bear the impact on this should be analysed. Based on this analysis, the mitigation measures for minimizing the impact shall be suggested in the EIA/EMP study.

(2) Details of the Project and Site

General introduction about the proposed project.

Details of Project and site giving L-Sections of all U/S and D/S Projects with all relevant maps and figures. Connect such information as to establish the total length of interference of Natural River and the committed unrestricted release from the site of Dam/Barrage into the main river.

A map of boundary of the project site giving details of protected areas in the vicinity of 25 km of project location.

Location details on a map of the project area with contours indicating main project features. The project layout shall be superimposed on a contour map of ground elevation showing main project features (viz. location of dam, Head works, main canal, branch canals, quarrying etc.) shall be depicted in a scaled map.

Layout details and map of the project along with contours with project components clearly marked with proper scale maps of at least 1:50,000 scale and printed at least on A3 scale for clarity.

Existence of National Park, Sanctuary, Biosphere Reserve etc. in the study area, if any, should be detailed and presented on a map with distinct distances from the project components.

Drainage pattern and map of the river catchment up to the proposed project site.

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Delineation of critically degraded areas in the directly draining catchment on the basis of Silt Yield Index as per the methodology of Soil and Land use Survey of India.

Soil characteristics and map of the project area.

Geological and Seismo-tectonic details and maps of the area surrounding the proposed project site showing location of dam site and canal sites.

Remote Sensing studies, interpretation of satellite imagery, topographic sheets along with ground verification shall be used to develop the land use/land cover pattern of the study using overlaying mapping techniques viz. Geographic Information System (GIS), False Color Composite (FCC) generated from satellite data of project area.

Land details including forests, private and other land.

Demarcation of snow fed and rain fed areas for a realistic estimate of the water availability.

(3) Description of Environment and Baseline Data

To know the present status of environment in the area, baseline data with respect to environmental components air, water, noise, soil, land and biology & biodiversity (flora & fauna), wildlife, socioeconomic status etc. should be collected within 10 km radius of the main components of the project/site i.e. dam site and power house site. The air quality and noise are to be monitored at such locations which are environmentally & ecologically more sensitive in the study area. The baseline studies should be collected for 1 season (Preferably Monsoon season). Flora-Fauna in the catchment and command area should be documented. The study area should comprise of the following:

Catchment area up to the dam/barrage

site. Submergence Area.

Project area or the direct impact area should comprise of area within 10 km radius of the main project components like dam, canals etc.

Downstream upto 10 km from the tip of the reservoir.

(4) Details of the Methodology

The methodology followed for collection of base line data along with details of number of samples and their locations in the map should be included. Study area should be demarcated properly on the appropriate scale map. Sampling sites should be depicted on map for each parameter with proper legends. For Forest Classification, Champion and Seth (1968) methodology should be followed.

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(5) Methodology for Collection of Biodiversity Data

The number of sampling locations should be adequate to get a reasonable idea of the diversity and other attributes of flora and fauna. The guiding principles should be the size of the study area (larger area should have larger number of sampling locations) and inherent diversity at the location, as known from secondary sources (e.g. eastern Himalayan and low altitude sites should have a larger number of sampling locations owing to higher diversity).

The entire area should be divided in grids of 5kmX5km preferably on a GIS domain. There after 25% of the grids should be randomly selected for sampling of which half should be in the directly affected area (grids including project components such as reservoir, dam, powerhouse, tunnel, canal etc.) and the remaining in the rest of the area (areas of influence in 10 km radius form project components). At such chosen location, the size and number of sampling units (e.g. quadrates in case of flora/transects in case of fauna) must be decided by species area curves and the details of the same (graphs and cumulative number of species in a tabulated form) should be provided in the EIA report. Some of the grids on the edges may not be completely overlapping with the study area boundaries. However these should be counted and considered for selecting 25% of the grids. The number of grids to be surveyed may come out as a decimal number (i.e. it has an integral and a fractional part) which should be rounded to the next whole number,

The conventional sampling is likely to miss the presence of rare, endangered and threatened (r.e.t.) species since they often occur in low densities and in case of faunal species are usually secretive in behaviour. Reaching the conclusion about the absence of such species in the study area based on such methodology is misleading. It is very important to document the status of such species owing to their high conservation value. Hence likely presence of such species should be ascertained from secondary sources by a proper literature survey for the said area including referring to field guides which are now available for many taxonomic groups in India. Even literature from studies/surveys in the larger landscapes which include the study area for the concerned project must be referred to, since most species from adjoining catchments is likely to be present in the catchments in question. In fact such literature form the entire state can be referred to. Once a listing of possible r.e.t. species form the said area is developed, species specific

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methodologies should be adopted to ascertain their presence in the study area which would be far more conclusive as compared to the conventional sampling. If the need be, modern methods like camera trapping can be resorted to, particularly for areas in the eastern Himalayas and for secretive/nocturnal species. A detailed listing of the literature referred to, for developing lists of r.e.t. species should be provided in the EIA reports.

The R.E.T. species referred to in this point should include species listed in Schedule I and II of Wildlife (Protection) Act, 1972 and those listed in the red data books (BSI, ZSI and IUCN).

(6) Components of the EIA Study

Various aspects to be studied and provided in the EIA/EMP report are as follows:

A. Physical and Chemical Environment

Geological & Geophysical AspectsandSeismo- Tectonics:

Physical geography, Topography, Regional Geological aspects and structure of the Catchment.

Tectonics, seismicity and history of past earthquakes in the area. A site specific study of the earthquake parameters will be done. The results of the site specific earthquake design shall be sent for approval of the NCSDP (National Committee of Seismic Design Parameters, Central water Commission, New Delhi for large dams.

Landslide zone or area prone to landslide existing in the study area should be examined. Presence of important economic mineral deposit, if any.

Justification for location & execution of the project in relation to structural components (dam / barrage height).

Impact of project on geological environment.

Meteorology, Air and Noise:

Meteorology (viz. Temperature, Relative humidity, wind speed/direction etc.) to be collected from nearest IMD station.

Ambient Air Quality with parameters viz. Suspended Particulate Matter (SPM), Respirable Suspended Particulate Matter (RSPM) i.e. suspended particulate materials < 10 microns, Sulphur dioxide (SO2) and Oxides of Nitrogen (NOX) in the study area at 5-6 Locations.

Existing Noise Levels and traffic density in the study area at 5-6 Locations.

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Soil Characteristics:

Soil classification, physical parameters (viz., texture, Porosity, Bulk Density and water holding capacity) and chemical parameters (viz. pH, electrical conductivity, magnesium, calcium, total alkalinity, chlorides, sodium, potassium, organic carbon, available potassium, available phosphorus, SAR, nitrogen and salinity, etc.) at @ one sample/ha of command area.

Remote Sensing and GIS Studies:

Generation of thematic maps viz, slope map, drainage map, soil map, land use and land cover map, etc. Based on these, thematic maps, an erosion intensity map should be prepared.

New configuration map to be given in the EIA Report.

Water Quality

History of the ground water table fluctuation in the study area.

Water Quality for both surface water and ground water for [i] Physical parameters (pH, Temperature, Electrical Conductivity, TSS); [ii] Chemical parameters (Alkalinity, Hardness, BOD, COD, NO3, PO4, Cl, So4, Na, K, Ca, Mg, Silica, Oil & grease, phenolic compounds, residual sodium carbonate); [iii] Bacteriological parameter (MPN, Total coliform); and [iv] Heavy Metals (Pb, As, Hg, Cd, Cr-6, Total Cr, Cu, Zn, Fe) at minimum10 Locations, however, the sampling numbers should be increased depending on the command area.

Delineation of sub and micro watersheds, their locations and extent based on the Soil and Land Use Survey of India (SLUSOI), Department of Agriculture, Government of India. Erosion levels in each micro-watershed and prioritization of micro-watershed through Silt Yield Index (SYI) method of SLUSOI.

B. Water Environment & Hydrology

Hydro-Meteorology of the project viz. precipitation (snowfall, rainfall), temperature, relative humidity, etc. Hydro-meteorological studies in the catchment area should be established along-with real time telemetry and data acquisition system for inflows monitoring.

Run off, discharge, water availability for the project, sedimentation rate, etc. Basin Characteristics.

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Catastrophic events like cloud bursts and flash floods, if any, should be documented.

For estimation of Sedimentation Rate, direct sampling of river flow is to be done during the EIA study. The study should be conducted for minimum one year. Actual silt flow rate to be expressed in ha-m km-2 year-1.

Set-up a G&D monitoring station and a few rain gauge stations in the catchment area for collecting data during the investigation.

Flow series, 10 daily with 90%, 75% and 50% dependable years discharges.

Environmental flow release should be 20% of the average of the 4 lean months of 90% dependable year during the lean season and 30% of Monsoon flow during monsoon season. For remaining months, the flow shall be decided by the Committee based on the hydrology and available discharge.

A site specific study on minimum environment flow should be carried out.

C. Biological Environment

Flora

Characterization of forest types (as per Champion and Seth method) in the study area and extent of each forest type as per the Forest Working Plan.

General vegetation profile and floral diversity covering all groups of flora including Bryophytes, Pteridophytes, Lichens and Orchids. A species wise list may be provided.

Assessment of plant species with respect to dominance, density, frequency, abundance, diversity index, similarity index, importance value index [IVI], Shannon Weiner Index etc. of the species to be provided. Methodology used for calculating various diversity indices along with details of locations of quadrats, size of quadrats etc. to be reported within the study area in different ecosystems.

Existence of National Park, Sanctuary, Biosphere Reserve etc in the study area, if any, should be detailed.

Economically important species like medicinal plants, timber, fuel wood etc. Details of endemic species found in the project area.

Flora under RET categories should be documented using International Union for the Conservation of Nature and Natural Resources (IUCN) criteria and Botanical Survey of India's Red Data list along with economic significance. Species diversity curve for RET species should be given.

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Fauna

Fauna study and inventorisation should be carried out for all groups of animals including reptiles and nocturnal animals in the study area. Their present status along with Schedule of the species.

Information (authenticated) on Avi-fauna and wild life in the study area. Status of avifauna their resident/migratory/ passage migrants etc.

Documentation of butterflies, if any, found in the area. Details of endemic species found in the project area.

RET species- voucher specimens should be collected along with GPS readings to facilitate rehabilitation. RET faunal species to be classified as per IUCN Red Data list and as per different schedule of Indian Wildlife (Protection) Act, 1972.

Existence of barriers and corridors, if any, for wild animals.

Compensatory afforestation to compensate the green belt area that will be removed, if any, as part of the proposed project development and loss of biodiversity.

For categorization of sub-catchments into various erosion classes and for the consequent CAT plan, the entire catchment (Indian Portion) is to be considered and not only the directly the draining catchment.

D. Aquatic Ecology

Documentation of aquatic fauna like macro-invertebrates, zooplankton, phytoplanktons, benthos etc.

Fish and fisheries, their migration and breeding grounds.

Fish diversity, composition and maximum length & weight of the measured populations to be studied for estimation of environmental flow.

Conservation status of aquatic fauna.

E. Irrigation and Cropping Pattern

Cropping pattern and Horticultural practices in the study area.

Collection of primary data on agricultural activity, crop and their productivity and irrigation facilities component.

Component of pressurized/drip irrigation and micro

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irrigation. Details of Conjunctive use of water for irrigation.

F. Socio-Economic

Collection of Baseline data on human settlements, health status of the community and existing infrastructure facilities for social welfare including sources of livelihood, job opportunities and safety and security of workers and surrounding population.

Collection of information with respect to social awareness about the developmental activity in the area and social welfare measures existing and proposed by project proponent.

Collection of information on sensitive habitat of historical, cultural and religious and ecological importance.

The Socio-economic survey/profile within 10 Km of the study area for Demographic profile; Economic Structure; Development Profile; Agricultural Practices; Infrastructure, education facilities; health and sanitation facilities; available communication network etc.

Documentation of Demographic, Ethnographic, Economic structure and development profile of the area

Information on Agricultural practices, Cultural and aesthetic sites, Infrastructure facilities etc

Information on the dependence of the local people on minor forest produce and their cattle grazing rights in the forest land.

List of all the Project Affected Families with their names, education, land holdings, other properties, occupation, source of income, land and other properties to be acquired, etc.

In addition to Socio-economic aspects of the study area, a separate chapter on socio-cultural aspects based upon study on Ethnography of the area should be provided.

7. Impact Prediction and Mitigation Measures

The adverse impact due to the proposed project should be assessed and effective mitigation steps to abate these impacts should be described.

Air Environment

Changes in ambient and ground level concentrations due to total emissions from point, line and area sources

Effect on soils, material, vegetation and human health

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Impact of emissions from DG sets used for power during the construction, if any, on air environment. Pollution due to fuel combustions in equipments & vehicles

Fugitive emissions from various sources. Impact on micro climate.

Water Environment

Changes in surface & ground water quality.

Steps to develop pisci-culture and recreational facilities. Changes in hydraulic regime and down stream flow. Water pollution due to disposal of sewage.

Water pollution from labour colony/camps and washing equipment.

Land Environment

Adverse impact on land stability, catchment of soil erosion, reservoir sedimentation and spring flow (if any) [a] due to considerable road construction/widening activity [b] interference of reservoir with the inflowing streams [c] blasting for excavation of canals and some other structures

Changes in land use/land cover and drainage pattern. Immigration of labour population.

Quarrying operation and muck disposal.

Changes in land quality including effects of waste disposal River bank and their stability

Impact due to submergence.

Biological Environment

Impact on forests, flora, fauna including wildlife, migratory avi-fauna, rare and endangered species, medicinal plants etc.

Pressure on existing natural resources

Deforestation and disturbance to wildlife, habitat fragmentation and wild animal's migratory corridors

Compensatory afforestation-Identification of suitable native tree species for compensatory afforestation & green belt.

Impact on fish migration and habitat degradation due to decreased flow of water Impact on breeding and nesting grounds of animals and fish

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Socio-economic Aspects

Impact on local community including demographic profile. Impact on socio-economic status.

Impact on economic status.

Impact on human health due to water / vector borne disease. Impact on increases traffic.

Impact on Holy Places and Tourism.

Impacts of blasting activity during project construction which generally destabilize the land mass and lead to landslides, damage to properties and drying up of natural springs and cause noise pollution, will be studied. Proper record shall be maintained of the base line information in the post project period.

Positive as well as negative impacts likely to be accrued due to the project are to be listed.

(8) Environment Impact Analysis

Environmental Impact Analysis due to the project on the above mentioned components should be carried out for construction and operation phases using qualitative or quantitative methods.

(9) Environment Management Plan (EMP)

Environmental Management Plan aimed at minimizing the negative impacts of the project should be given in detail. The mitigation measures are to be presented for all the likely adverse impacts on the environment. The following suggestive mitigating plans should be included:

Catchment Area Treatment (CAT) Plan should be prepared micro-watershed wise. Identification of area for treatment based upon Remote Sensing & GIS methodology and Silt Yield Index (SYI) method of SLUSOI coupled with ground survey. Areas/watersheds falling under 'very severe' and 'severe' erosion categories are required to be treated. Both biological and engineering measures should be proposed in consultation with State Forest Department. Year-wise schedule of work and monetary allocation should be provided. CAT plan is to be completed prior to reservoir impoundment. Mitigations measures to check shifting cultivation in the catchment area with provision for alternative and better agricultural practices should be included.

Command Area Development (CAD) Plan giving details of implementation schedule

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with a sample CAD plan.

Compensatory Afforestation in lieu of the forest land required for the project needs to be proposed. Choice of plants should be made in consultation with State Forest Department including native and RET species, if any.

Biodiversity and Wild Life Conservation & Management Plan for conservation and preservation of endemic, rare and endangered species of flora and fauna to be prepared in consultation with State Forest Department.

Resettlement and Rehabilitation (R&R) Plan need to be prepared with due consultation with Project Affected Families (PAFs). The provision of the d R&R plan should be according to the National Resettlement and Rehabilitation Policy (NRRP-2007) as well as State Resettlement and Rehabilitation Policy. Detailed budgetary estimates are to be provided. Resettlements sites should be identified.

Plan for Green Belt Development along theperiphery of reservoir, colonies, approach road, canals etc. to be prepared in consultation with the State Forest Department. Local plant species suitable for greenbelt development should be selected.

Reservoir Rim Treatment Plan for stabilization of land slide/land slip zones if any, around the reservoir periphery to be prepared. Suitable engineering and biological measures for treatment of the identified slip zones to be provided with physical and financial schedule.

Plan for Land Restoration and Landscaping of project sites.

Fisheries Conservation & Management Plan-Fish fauna inhabiting the affected stretch of river, a specific fisheries management plan should be prepared for river and reservoir.

Muck Disposal Plan- suitable sites for dumping of excavated material should be identified in

consultation with the State Pollution Control Board and Forest Department. All Muck disposal sites

should be minimum 30 m away from the HFL of river. Plan for rehabilitation of muck disposal sites

should also be given. The L- section/ cross section of muck disposal sites and approach roads to be

given. Financial out lay for this may be given separately.

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Plan for Restoration of quarry sites and landscaping of colony areas, working areas, roads, etc.

Study of Design Earthquake Parameters: A site specific study of earthquake parameters should be done. The results of the site specific earth quake design parameters should be approval by National Committee of Seismic Design Parameters, Central Water Commission (NCSDP), New Delhi.

Dam Break Analysis and Disaster Management Plan: The outputs of Dam Break Model should be illustrated with appropriate graphs and maps clearly bringing out the impact of Dam break scenario. Provision for early warning systems should be provided.

Water and Air Quality & Noise Management Plans to be implemented during construction and post-construction periods.

Mitigating measures for impacts due to Blasting on the structures in the vicinity.

Ground Water Management Plan.

Public Health Delivery Plan including the provisions for drinking water facility for the local community.

Labour Management Plan for their Health and Safety.

Sanitation and Solid Waste Management Plan for domestic waste from colonies and labour camps etc.

Local Area Development Plan to be formulated in consultation with the Revenue Officials and Village Panchayats. Local skill development schemes should be given. Details of various activities to be undertaken along with its financial out lay should be provided.

Environmental safeguards during construction activities including Road Construction.

Energy Conservation Measures.

Environmental Monitoring Programme with physical & financial details covering all the aspects of EMP. A summary of cost estimate for all the plans, cost for implementing all Environmental Management Plans including the cost for implementing environmental monitoring programme should be given. Provision for an Environmental Management Cell should be made.

In the EMP, also include a sample CAD plan for a distributary outlet command. Such a plan is to show the alignment of irrigation and drainage channels. The components of the OFD works to be undertaken may be clearly mentioned along with a time schedule for their

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completion vis-à-vis the progress of irrigation development.

In addition to the above, the following shall be furnished:-

The Executive summary of the EIA/EMP report in about 8-10 pages should be prepared incorporating the information on following points:

1) Project name and location (Village, District, State, Industrial Estate (if applicable).
2) Products and capacities. If expansion proposal then existing products with capacities and reference to earlier EC.
3) Requirement of land, raw material, water, power, fuel, with source of supply (Quantitative)
4) Process description in brief, specifically indicating the gaseous emission, liquid effluent and solid and hazardous wastes.
5) Measures for mitigating the impact on the environment and mode of discharge or disposal.
6) Capital cost of the project, estimated time of completion.
7) Site selected for the project - Nature of land - Agricultural (single/double crop), barren, Govt/ private land, status of is acquisition, nearby (in 2-3 km.) water body, population, with in 10km other industries, forest , eco-sensitive zones, accessibility, (note - in case of industrial estate this information may not be necessary)
8) Baseline environmental data - air quality, surface and ground water quality, soil characteristic, flora and fauna, socio-economic condition of the nearby population
9) Identification of hazards in handling, processing and storage of hazardous material and safety system provided to mitigate the risk.
10) Likely impact of the project on air, water, land, flora-fauna and nearby population
11) Emergency preparedness plan in case of natural or in plant emergencies
12) Issues raised during public hearing (if applicable) and response given
13) CSR plan with proposed expenditure.
14) Occupational Health Measures
15) Post project monitoring plan

Besides the above, the below mentioned **general points** should also be followed:-

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a. A note confirming compliance of the TOR, with cross referencing of the relevant sections / pages of the EIA report should be provided.

b. All documents may be properly referenced with index, page numbers and continuous page numbering.

c. Copy of permission related to Port facility, Desalination plant, wind mill /solar power plant from competent Authority.

d. Where data are presented in the report especially in tables, the period in which the data were collected and the sources should be indicated.

e. While preparing the EIA report, the instructions for the proponents and instructions for the consultants issued by MoEF vide O.M. No. J-11013/41/2006-IA.II (I) dated 4th August, 2009, which are available on the website of this Ministry should also be followed.

f. The consultants involved in the preparation of EIA/EMP report after accreditation with Quality Council of India (QCI)/National Accreditation Board of Education and Training (NABET) would need to include a certificate in this regard in the EIA/EMP reports prepared by them and data provided by other organization/Laboratories including their status of approvals etc. In this regard circular no F. No.J - 11013/77/2004-IA-II(I) dated 2nd December 2009,18th March 2010, 28th May 2010, 28thJune 2010,31st December 2010 & 30th September 2011 posted on the Ministry's website http://www.moef.nic.in/ may be referred.

- After preparing the EIA (as per the generic structure prescribed in Appendix-III of the EIA Notification, 2006) covering the above mentioned points, the proponent willtake further necessary action for obtaining environmental clearance in accordance with the procedure prescribed under the EIA Notification, 2006.
- The final EIA report shall be submitted to the SEIAA, Tamil Nadu for obtaining Environmental Clearance.

The TORs prescribed shall be **valid for a period of three years** from the date of issue, for submission of the EIA/EMP report as per OMNo.J-11013/41/2006-IA-II(I)(part) dated 29th August, 2017.

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Copy to:

1.The Additional Chief Secretary to Government, Environment & Forests Dept, Govt. of Tamil Nadu, Fort St. George, Chennai - 9.

2.The Chairman, Central Pollution Control Board, PariveshBhavan, CBD Cum-Office Complex, East Arjun Nagar, New Delhi - 110032.

3.The Member Secretary, Tamil Nadu Pollution Control Board, 76, MountSalai, Guindy, Chennai-600 032.

4.The APCCF (C), Regional Office, Ministry of Environment & Forest (SZ), 34, HEPC Building, 1st & 2nd Floor, Cathedral Garden Road, Nungambakkam, Chennai - 34.

5.Monitoring Cell, I A Division, Ministry of Environment & Forests, ParyavaranBhavan, CGO Complex, New Delhi - 110003.

6. The Commissioner, Cuddalore Municipality.

7.Stock File.

Enclosure

CHECKLIST

To be filled in by the project proponent with supporting documents. Furnish reply to each question listed below.

Name of the project:

Project location:

Stage at which the project execution stands:

Part - A – Applicable for Pre-construction:

1. Have the constructions of STP, Solid Waste Management facility, E-waste management facility, DG sets, etc., been made in the earmarked area only?
2. Have statutory clearances and approvals been obtained?
   a) Chief Controller of Explosives,
   b) Fire and Rescue Services Department,
   c) Civil Aviation Department,
   d) Forest Conservation Act, 1980 and Wild Life (Protection) Act, 1972,
   e) State / Central Ground Water Authority,
   f) Coastal Regulatory Zone Authority, Bio-Diversity Act, 2002, Wetland Authority Act & Rules, other statutory and other authorities as applicable to the project been obtained by project proponent from the concerned competent authorities?
3. Have trees been cut? If yes, has the compensation plantation been done, in the ratio of 1: 10?
4. Have the Plastic wastes been segregated and disposed as per the provisions of Plastic Waste (Management & Handling) Rules 2016?
5. Has a separate environmental management cell formed with suitable qualified personnel?

Part - B –Pre construction phase:

1. Has the approval of the competent authority been obtained for structural safety of the buildings during earthquake, adequacy of fire fighting equipments, etc as per National

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Building Code including protection measures from lightning etc before commencement of the work?

2. Have all required sanitary and hygienic measures for the workers were in place before starting construction activities and the same have been maintained throughout the construction phase?
3. Are the designs of buildings in conformity with the Seismic Zone Classifications?
4. Has the construction of the structures been undertaken as per the plans approved by the concerned local authorities/local administration?
5. Has any construction activity of any kind been taken up in the OSR area?
6. Has the Consent of the local body concerned been obtained for using the treated sewage in the OSR area for gardening purpose?
7. Are the height and coverage of the constructions in accordance with the existing FSI/FAR norms as per Coastal Regulation Zone Notification, 2011?
8. Is the basement of the building above the maximum flood level documented by the Water Resource Department, PWD, Government of Tamil Nadu in consultation with the CMDA?
9. Are the pipelines marked with different colors with the following details?
    i. Location of STP, compost system, underground sewer line.
    ii. Pipe Line conveying the treated effluent for green belt development.
    iii. Pipe Line conveying the treated effluent for toilet flushing
    iv. Water supply pipeline
    v. Gas supply pipe line, if proposed
    vi. Telephone cable
    vii. Power cable
    viii. Strom water drains, and
    ix. Rain water harvesting system.,
10. Has a First Aid Room been provided in the project site during the entire construction and operation phases of the project?
11. Has the structural design of the proposed building been vetted by premier academic institutions like Anna University, IIT Madras, etc?
12. Is there any threat to the biodiversity due to the proposed development?

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13. Has the present land use surrounding the project site got disturbed at any point of time?
14. Has the existing land use been altered due to the project and is it in consistent with the surroundings?
15. Has the green belt area been planted with indigenous native trees, in adequate numbers and areas?
16. Have the natural vegetation listed particularly the tress, been removed during the construction phase? Was there disturbance to the aquatic eco-system within and outside the area?
17. Did the construction activities of the site adhere to all environmental and ecological standards and safeguards?
18. Have the rain water harvesting system (storage + recharge pits) been designed as per the Rain water harvesting and conservation manual of CPWD?
19. Has the land earmarked for OSR been identified, earmarked in coordination with CMDA adjacent to the entry or exit and it has been fenced?
20. Does storm water generated within the premises find access to any water bodies directly/indirectly?
21. Are proper Fire fighting plan and disaster management plan in place?
22. Does the building spoil the green views and aesthetics of surroundings and does it provide enough clean air space?
23. Are the DG Sets and STP located away from the boundary of the project site to ensure minimal disturbance to the neighbours?

Part - C – Construction phase:

24. Have all the labourers engaged for construction been screened for health and adequately treated before and during their employment on the work at the site?
25. Were Personnel working in dusty areas given protective respiratory devices and provided with adequate training and information on safety and health aspects? Have Occupational health surveillance program of the workers been undertaken periodically to observe any contradictions due to exposure to dust?
26. Have Periodical medical examination of the workers engaged in the project been carried out and records maintained?
27. Water Supply:

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i) If water requirement during construction phase was met from ground water source, then approval of the PWD Department of water resources is necessary. Was it obtained?

ii) Was provision made for the housing labour within the site with all necessary infrastructures and facilities such as fuel for cooking, mobile toilets, mobile STP, safe drinking water, medical health care, crèche etc?

iii) Was adequate drinking water and sanitary facilities provided for construction workers at the site? Was the treatment and disposal of waste water through dispersion trench after treatment through septic tank? The MSW generated disposed through Local Body?

iv) Was water demand during construction reduced by use of pre-mixed concrete, curing agents and other best practices prevalent?

v) Are the fixtures for showers, toilet flushing and drinking water of low flow type by adopting the use of aerators / pressure reducing devises / sensor based control?

28. Solid Waste Management:

i) Was the solid waste in the form of excavated earth excluding the top soil generated from the project activity scientifically utilized for construction of approach roads and peripheral roads?

29. Top Soil Management:

i) Was the top soil excavated during construction activities stored for use in horticulture/ landscape development within the project site?

30. Did disposal of construction debris during construction phase affect the neighboring communities and was it disposed off only in approved sites, with the approval of Competent Authority with necessary precautions for general safety and health aspects of the people? Was the construction and demolition waste managed as per Construction & Demolition Waste Management Rules, 2016?

31. Did Construction spoils, including bituminous materials and other hazardous materials, watercourses? Was the dump sites for such materials secured so that they should not leach into the adjacent land/ lake/ stream etc?

32. Diesel Generator sets:

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i) For the diesel generator used during construction phase, was the air and noise emission in conformity to the standards prescribed in the Rules under the Environment (Protection) Act, 1986, and the Rules framed thereon?

ii) Was the diesel required for operating stand by DG sets stored in underground tanks fulfilling the safety norms? Was clearance from Chief Controller of Explosives was taken?

iii) Are the acoustic enclosures installed at all noise generating equipments such as DG sets, air conditioning systems, cooling water tower, etc?

33. Air & Noise Pollution Control:

i) Were vehicles hired for bringing construction materials to the site in good condition and conformed to air and noise emission standards, prescribed by TNPCB/CPCB? Were the vehicles operated only during non-peak hours?

ii) Ambient air and noise levels should conform to residential standards prescribed by the TNPCB, both during day and night. Was the Incremental pollution loads on the ambient air and noise quality closely monitored during the construction phase? Was any pollution abatement measures implemented?

iii) Traffic congestion near the entry and exit points from the roads adjoining the proposed project site shall be avoided. Is parking fully internalized and no public space utilized? Is Parking plan as per CMDA norms?

iv) Do the buildings have adequate distance between them to allow free movement of fresh air and passage of natural light, air and ventilation?

34. Building material:

i) Were Fly-ash blocks used as building material in the construction as per the provision of Fly ash Notification of September, 1999 and amended as on 27th August, 2003 and Notification No. S.O. 2807 (E) dated: 03.11.2009?

ii) Was Ready-mix concrete used in building construction and necessary cube-tests conducted to ascertain their quality?

iii) Is the use of glass reduced up to 40% to reduce the electricity consumption and load on air conditioning?

35. Storm Water Drainage:

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Is Storm water management around the site and on site established by following the guidelines laid down by the storm water manual?

36. Are the following Energy Conservation Measures been implemented?
    i) Roof should meet prescriptive requirement as per Energy Conservation Building Code by using appropriate thermal insulation material, to fulfill the requirement.
    ii) Opaque wall should meet prescribed requirement as per Energy Conservation Building Code which is mandatory for all air conditioned spaces by use of appropriate thermal insulation material to fulfill the requirement.
    iii) All norms of Energy Conservation Building Code (ECBC) and National Building Code, 2005 as energy conservation have to be adopted Solar lights shall be provided for illumination of common areas.
    iv) Application of solar energy should be incorporated for illumination of common areas, lighting for gardens and street lighting. A hybrids system or fully solar system for a portion of the apartments shall be provided.
    v) A report on the energy conservation measures conforming to energy conservation norms prescribed by the Bureau of Energy Efficiency shall be prepared incorporating details about building materials & technology; R & U factors etc and submitted to the SEIAA in three month's time.
    vi) Energy conservation measures like installation of CFLs/TFLs for lighting the areas outside the building should be integral part of the project design and should be in place before project commissioning.

37. Fire Safety:
    i) Are adequate fire protection equipments and rescue arrangements in place as per the prescribed standards?
    ii) Is proper and free approach road for fire-fighting vehicles upto the buildings and for rescue operations in the event of emergency in place?

38. Green Belt Development:
    i) Has the Project Proponent planted tree species with large potential for carbon capture in the proposed green belt area based on the recommendation of the Forest department well before the project is completed?

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39. Sewage Treatment Plant:
    i) Is the Sewage Treatment Plant (STP) installed certified by an independent expert/ reputed Academic institutions for its adequacy?
40. Rain Water Harvesting:
    i) Is roof rain water collected from the covered roof of the buildings, etc harvested so as to ensure the maximum beneficiation of rain water harvesting by constructing adequate sumps so that 100% of the harvested water is reused?
    ii) Is Rain water harvesting for surface run-off implemented as per plan? Before recharging the surface run off, is pre-treatment planned with screens, settlers etc done to remove suspended matter, oil and grease, etc? Are adequate number of bore wells / percolation pits/ as provided?
    iii) Is the roof rain water collected and stored in the sumps proposed to be treated before water is put to any beneficial use?
41. Building Safety:
    i) Is lightning arrester properly designed and installed at top of the building and where ever is necessary?

Part – D Operation Phase

1. Has the "Consent to Operate" been obtained from the Tamil Nadu Pollution Control Board before the start of the operation of the project?
2. Is the Proponent responsible for the maintenance of common facilities including greening, rain water harvesting, sewage treatment and disposal, solid waste disposal and environmental monitoring including terrace gardening for a period of 3 years?
3. Is the ground water level and its quality monitored and recorded regularly in consultation with Ground Water Authority?
4. Is treated effluent emanating from STP recycled / reused to the maximum extent possible? Does the treated sewage conform to the norms and standards for bathing quality laid down by CPCB irrespective of any use? Are necessary measures in place to mitigate the odour and mosquito problem from STP?
5. Is the STP continuously operated by providing stand by DG set in case of power failure?

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6. Is the treated sewage used for green belt development/ avenue plantation without causing pollution?
7. Are adequate measures being taken to prevent odour emanating from solid waste processing plant and STP?
8. Is regular monitoring done regarding operation and maintenance of STP, reuse and disposal of untreated sewage and effluent, swimming pool, Solid waste Management?
9. Have any CSR / CER activities been carried out?
10. Is organic waste convertor proposed for managing the municipal solid waste (Organic components) in place? If yes, is care taken to operate and maintain the OWC such a way that there is no problem to the nearby residents?
11. Is the Municipal solid waste generated collected, segregated and disposed as per Solid Waste Management Rules, 2016
12. Is the e - waste generated collected and disposed to a nearby authorized e-waste centre as per E- waste (Management& Handling), Rules 2016?
13. Is the height of stack of DG sets equal to the height needed as per CPCB norms?
14. Is the noise level maintained as per MoEF/CPCB/TNPCB guidelines/norms both during day and night time?
15. Is spent oil from D.G sets stored in HDPE drums in an isolated covered facility and disposed as per the Hazardous& other Wastes (Management & Transboundary Movement) Rules 2016?
16. Is the storm water drain provided at the project site maintained without choking or without causing stagnation? Is the storm water properly disposed off in the natural drainage / channels without disrupting the adjacent public?
17. Are the used CFLs and TFLs properly collected and disposed off/sent for recycling as per the prevailing guidelines/rules of the regulatory authority to avoid mercury contamination?

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SEIAA-TN

Annexure II - 33 years River Flow Data

WATER RESOURCES DEPATMENT

COLEROON BASIN SUB DIVISION
LOWER ANICUT

COLEROON BASIN DIVISION
CHIDAMBARAM

LOWER ANICUT TOTAL MONTHLY WATER SURPLUS FROM JANUARY 1990 TO DECEMBER 2022

SL.NO	YEAR	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL IN CUSECS	TOTAL IN Mcft	TOTAL IN TMC
1	1990	2000		100		120					16111	9247		27578	2382.74	2.38
2	1991								80492	11192	41333	703464	1196	837677	72375.29	72.38
3	1992								64797	55188	19156	650675	66030	855846	73945.09	73.95
4	1993						11121				16038	713988	447352	1188499	102686.31	102.69
5	1994	3458	5664			3979	4605	9504	235211		64708	575287	8646	911062	78715.76	78.72
6	1995	8422				20446	7830	1827			20422	47056		106003	9158.66	9.16
7	1996					3119	5162	4239			9673	34178	320296	376667	32544.03	32.54
8	1997		13104		226	2484	2898				1103	265766	393959	679540	58712.26	58.71
9	1998									13668	3216	246285	326876	590045	50979.89	50.98
10	1999					14020					9779			23799	2056.23	2.06
11	2000	2160									424256	75879	137589	639884	55285.98	55.29
12	2001	6264									19876	18299	17132	61571	5319.73	5.32
13	2002		42103								2739			44842	3874.35	3.87
14	2003													0	0.00	0.00
15	2004										29148	175949		205097	17720.38	17.72
16	2005									74559	1275547	1853668	840386	4044160	349415.42	349.42
17	2006								85523		3221	122544	3252	214540	18536.26	18.54
18	2007							59563	488927		113048	151920	348591	1162049	100401.03	100.40
19	2008										692404	402302	227740	1322446	114259.33	114.26
20	2009											210250	65800	276050	23850.72	23.85
21	2010										2014	11137	191214	204365	17657.14	17.66
22	2011				25467	12027	6282				28773	191667	52681	316897	27379.90	27.38
23	2012	5368									41274	7064		53706	4640.20	4.64
24	2013								215414					215414	18611.77	18.61
25	2014										26211	1704	1312	29227	2525.21	2.53

SL.NO	YEAR	January	February	March	April	May	June	July	August	September	October	November	December	TOTAL IN CUSECS	TOTAL IN Mcft	TOTAL IN TMC
26	2015											68122	136340	204462	17665.52	17.67
27	2016													0	0.00	0.00
28	2017											778	17181	17959	1551.66	1.55
29	2018							99178	1501328	28601	6915	2087		1638109	141532.62	141.53
30	2019									126523	74021	68027	132688	401259	34668.78	34.67
31	2020												98040	98040	8470.66	8.47
32	2021	88150	2466								3325	824598	208824	1127363	97404.16	97.40
33	2022	10516						449699	2236306	1145425	1311901	356931	165765	5676543	490453.32	490.45
	33 YEARS OVER ALL TOTAL														2034780.39	2034.78

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Core Zone Site Address : Village : Adhanur District : Cuddalore State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°11'42.0" N Sample Longitude : 79°31'55.4" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.66
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	759
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.6
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	460
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	462
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	133
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	45
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	124
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	9
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	2
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	76
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	150
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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NABL TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	150
21	Sulphate as SO_4	mg/l	IS 3025:P.24:1986:R.2019	9
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.06
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.004
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	54
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	12
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.6
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	8
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	BDL(DL:0.01)
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	1
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

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Verified by
(CS. Anilandeshwari)

Authorize by
(CS. Suriyakumar)

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------ End of the Report ------

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NABL TC-9497

TEST REPORT

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Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Eyyalur District : Cuddalore State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°11'20.8" N Sample Longitude : 79° 31'00.9" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.35
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	695
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.5
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	440
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	442
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	222
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	78
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	218
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	4
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	1
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	190
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	150
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	150
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	8
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.06
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.005
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	42
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	7
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.8
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	8
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	0.004
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.08
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

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(S Akilandeshwari)

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End of the Report

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)	Report No. : ABM-TR-916(a)
Issued To: The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom.	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Kanjankollai-I District : Caddalore State : Tamil Nadu	Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°10'12.2" N Sample Longitude : 79°28'37.4" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.80
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	540
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.5
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	352
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	354
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	168
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	56
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	155
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	13
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	3
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	152
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	80
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	80
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	6
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.05
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.003
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	22
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	4
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	7.0
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	4
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	BDL([DL:0.001]
30.	Nitrite as NO_3	mg/l	IS 3025 P.34: 2019	0.06
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

V.Kavi
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(V.Kalaivani)

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(S. Akilandeshwari)

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End of the Report

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Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Kanjankollai-II District : Cuddalore State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 22.11.2022 Sample latitude : 11°9'55.5" N Sample Longitude : 79° 28'23.5" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.60
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	534
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.5
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	348
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	350
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	155
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	48
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	133
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	22
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	5
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	78
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	80
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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NABL TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	80
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	6
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.05
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.003
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	16
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	4
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.9
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	4
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	BDL(DL:0.001)
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.06
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V.Kalaivani)

Verified by
CS.Akilandeshwari

Authorize by
CS.Suriyakumar)

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY
End of the Report
SALEM

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Kulothunganallur District : Ariyalur State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°9'51.10" N Sample Longitude : 79° 27'46.19" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.72
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	620
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	370
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	372
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	209
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	56
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	13
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	154
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	100
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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NABL TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	100
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	7
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.06
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.004
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	38
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	5
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.8
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	4
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrate as NO_2	mg/l	IS 3025 P.34: 2019	BDL(DL:0.001)
30.	Nitrite as NO_3	mg/l	IS 3025 P.34: 2019	0.07
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V. Kavivani)

Verified by
(S. Akilandeshwari)

Authorize by
(S. Suriyakumar)

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY ★ SALEM

End of the Report

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Vembukudi District : Ariyalur State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°9'52.97" N Sample Longitude : 79° 26'37.48" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.03
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	540
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.2
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	350
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	352
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	244
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	64
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	178
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	66
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	16
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	166
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	80
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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NABL TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	80
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	6
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.05
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.003
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	22
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	4
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.8
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	4
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	BDL(DL:0.001)
30.	Nitrite as NO_3	mg/l	IS 3025 P.34: 2019	0.06
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(C.V. Kalaivani)

Verified by
(S. Akilandeshwari)

Authorize by
(S. Suriyakumar)

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Vanathirayankuppam District : Ariyalur State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°10'46.2" N Sample Longitude : 79° 26'51.3" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.20
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	428
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.3
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	1
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	282
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	283
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	133
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	43
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	120
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	13
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	3
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	72
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	50
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	50
21	Sulphate as SO_4	mg/l	IS 3025:P.24:1986:R.2019	4
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.04
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	BDL(DL:0.001)
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	9
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	3
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.7
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	4
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	BDL(DL:0.001)
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.03
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V. Kavitha)

Verified by
(S. Akilandeshwari)

Authorize by
(S. Suriyakumar)

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TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Periyapogene District : Cuddalore State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°13'55.8" N Sample Longitude : 79° 30'29.4" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.13
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	455
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.4
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	1
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	300
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	301
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	191
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	64
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	178
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	13
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	3
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	165
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	50
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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NABL TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	50
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	5
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.04
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	BDL(DL:0.001)
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	10
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	3
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.6
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	4
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	BDL(DL:0.001)
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.03
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V. Kalaivani)

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(S. Akilandeshwari)

Authorize by
(S. Suriyakumar)

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY ★ SALEM

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ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY

(Unit of Aadhi Boomi Mining and Enviro Tech Pvt Ltd)

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Kandamangalam District : Cuddalore State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°15'02.2" N Sample Longitude : 79° 31'30.9" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.17
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	724
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.3
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	490
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	492
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	364
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	113
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	315
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	49
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	11
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	230
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	150
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	150
21	Sulphate as SO_4	mg/l	IS 3025:P.24:1986:R.2019	8
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.06
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.004
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	48
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	8
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.6
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	8
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	0.002
30.	Nitrite as NO_3	mg/l	IS 3025 P.34: 2019	1
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V. Kalaivani)

Verified by
(S. Akilandeshwari)

Authorize by
(S. Surivakumar)

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY
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NABL
TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Veerananthapuram District : Cuddalore State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°15'9.31" N Sample Longitude : 79° 30'52.50" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.43
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	717
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.3
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	450
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	452
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	377
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	111
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	306
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	71
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	17
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	226
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	150
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	150
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	8
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.06
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.003
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	43
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	7
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.6
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	8
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	0.003
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	1
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(Y. Kalaivani)

Verified by
(S. Akilandeshwari)

Authorize by
(S. Suriyakumar)

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Omampuliyur District : Cuddalore State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°13'06.9" N Sample Longitude : 79°33'34.5" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.43
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	682
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.2
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	420
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	422
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	249
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	80
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	222
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	27
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	7
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	192
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	100
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	100
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	8
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.05
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.005
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	41
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	7
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	7.5
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	8
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	0.003
30.	Nitrite as NO_3	mg/l	IS 3025 P.34: 2019	1
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by (V. Kalaivani)

Verified by (S. Akilandeshwari)

Authorize by (S. Suriyakumar)

------ End Of the Report ------

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Kumaramangalam District : Mayiladuthurai State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°11'14.99" N Sample Longitude : 79° 32'33.97" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.76
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	559
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.6
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	354
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	356
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	164
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	48
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	133
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	31
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	8
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	78
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	80
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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NABL TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	80
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	6
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.05
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.007
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	23
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	4
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	8.2
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	4
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	BDL(DL:0.001)
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.09
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

V.Kalaivani
Prepared by
(V.Kalaivani)

Verified by
(S.Akilandeshwari)

Authorize by
(S.Suriyakumar)

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TEST REPORT

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Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Nattarmangalam District : Cuddalore State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°11'42.5" N Sample Longitude : 79° 31'55.3" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.24
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	734
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.6
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	464
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	466
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	266
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	88
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	244
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	22
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	5
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	198
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	150
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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NABL TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	150
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	9
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.07
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.006
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	49
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	8
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	7.6
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	8
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	BDL(DL;0.001)
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.09
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V. Kalaivani)

Verified by
(S. Akilandeshwari)

Authorize by
(S. Suriyakumar)

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY ★ SALEM

End of the Report

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ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-A916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Thiruchitrabalam District : Mayiladuthurai State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°10'15.8" N Sample Longitude : 79°31'40.2" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.87
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	636
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.6
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	400
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	402
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	244
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	75
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	208
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	36
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	9
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	182
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	100
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	100
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	8
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.06
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.005
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	38
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	7
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	7.4
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	4
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	BDL(DL:0.001)
30.	Nitrite as NO_3	mg/l	IS 3025 P.34: 2019	0.08
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V. Vekatgivani)

Verified by
(S. Akilandeshwari)

Authorize by
(S. Suriyakumar)

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End of the Report

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Vettamangalam District : Thanjavur State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°10'28.9" N Sample Longitude : 79° 31'15.4" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.94
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	671
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.7
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	430
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	432
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	253
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	78
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	217
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	36
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	9
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	180
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	100
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	100
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	8
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.06
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.004
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	40
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	7
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.7
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	8
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	0.003
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.09
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V. Kalaivani)

Verified by
CS. Akilandeshwari)

Authorize by
CS. Suriyakumar

End of the Report

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY SALEM

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ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 22.11.2022 Page : 1 of 1

Sample Name	: Ground Water	Received On	: 22.11.2022
Sample Description	: Colourless Liquid	Commenced On	: 22.11.2022
Sample Drawn By/ Date	: By hand/22.11.2022	Completed On	: 22.11.2022
Sample method	: ABMEAL/QSP/21	Sample latitude	: 11°09'55.6" N
Sample Plan	: ABMEAL/QSP/22	Sample Longitude	: 79° 31'04.5" E
Sample Mark	: Buffer Zone		
Site Address	: Village : Kulasekaranallur District : Thanjavur State : Tamil Nadu.		

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.50
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	1137
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.8
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	698
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	700
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	182
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	51
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	142
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	40
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	10
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	82
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	200
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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NABL TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	200
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	16
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.08
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.007
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	85
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	30
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	5.8
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	14
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	0.004
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.08
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V. Kalaivani)

Verified by
(S. Akilandeshwari)

Authorize by
(S. Suriyakumar)

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY * SALEM

End of the Report

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Kamachipuram District : Thanjavur State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°09'28.6" N Sample Longitude : 79° 30'44.1" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.77
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	1042
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.9
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	632
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	634
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	244
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	61
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	169
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	75
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	18
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	148
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	200
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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NABL TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	200
21	Sulphate as SO_4	mg/l	IS 3025:P.24:1986:R.2019	12
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.08
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.007
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	68
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	22
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	5.9
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	14
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	0.005
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	2
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V. Balaji Varuni)

Verified by
(S. Akilandeshwari)

Authorize by
(S. Srivakumar)

ANALYTICAL LABORATORY
ABM ENVIRONMENTAL AND
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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Kallaiyopur District : Thanjavur State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°09'26.7" N Sample Longitude : 79° 30'37.8" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.81
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	1253
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.1
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	750
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	752
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	293
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	64
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	178
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	115
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	28
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	165
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	220
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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QCI NABL TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	200
21	Sulphate as SO_4	mg/l	IS 3025:P.24:1986:R.2019	21
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.08
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.007
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	101
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	42
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	5.5
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	16
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	0.005
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	2
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

V. Raji
Prepared by
(V. Kalaivani)

Verified by
(S. Akilandeshwari)

Authorize by
(S. Suriyakumar)

------- End of the Report -------

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ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Ozhugacheri District : Thanjavur State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°08'13.9" N Sample Longitude : 79° 27'54.3" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.56
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	660
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.3
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	388
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	390
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	266
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	83
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	230
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	36
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	9
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	200
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	100
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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NABL TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	100
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	6
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.06
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.003
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	40
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	7
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.2
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	8
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	BDL(DL:0.001)
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.08
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V. Kalaivani)

Verified by
(S. Aadilandeshwari)

Authorize by
(S. Suriyakumar)

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Ground Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Kuruchi District : Thanjavur State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°06'58.4" N Sample Longitude : 79° 28'37.4" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	8.13
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	462
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.5
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	1
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	294
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	295
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	138
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	39
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	107
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	31
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	8
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	150
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	50
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	50
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	4
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.03
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	**BDL(DL:0.001)**
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	10
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	3
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	7.2
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	4
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	**BDL(DL:0.001)**
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.03
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(Cr. Kalaivani)

Verified by
(S. Akilandeshwari)

Authorize by
(S. Suriyakumar)

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY ★ SALEM

End of the Report

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1

Sample Name	: Ground Water	Received On	: 22.11.2022
Sample Description	: Colourless Liquid	Commenced On	: 22.11.2022
Sample Drawn By/ Date	: By hand/22.11.2022	Completed On	: 25.11.2022
Sample method	: ABMEAL/QSP/21	Sample latitude	: 11°08'34.2" N
Sample Plan	: ABMEAL/QSP/22	Sample Longitude	: 79° 30'58.2" E
Sample Mark	: Buffer Zone		
Site Address	: Village : Irumoolai District : Thanjavur State : Tamil Nadu.		

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.84
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	699
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.1
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	436
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	438
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	289
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	78
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	218
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	71
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	17
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	140
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	100
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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NABL TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	100
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	7
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.07
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.004
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	42
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	7
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.6
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	8
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	0.002
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.06
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V. Kaarivanni)

Verified by
CS. Akilandeshwari

Authorize by
CS. Surivakumaran

End of the Report

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a1)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Surface Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Core Zone Site Address : Village : Adhanur District : Cuddalore State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°11'41.05" N Sample Longitude : 79° 32'4.47" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.14
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	576
3.	Turbidity	NTU	IS 3025:P.10: 2023	BDL(DL:0.1)
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.3
5.	Taste	-	IS 3025:P.07: 2017	Nil
6.	Colour	HU	IS 3025:P.04: 2021	Nil
7.	Odour	-	IS 3025:P.05: 2018	Nil
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	360
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	362
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	184
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	55
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	151
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	33
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	8
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	152
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	80
19.	Carbonate	mg/l	IS 3025:P.51: 2023	BDL(DL:1)

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NABL TC-9497

20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	80
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	7
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.06
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.003
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	16
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	5
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.8
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	4
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	BDL(DL:0.001)
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.07
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V. Malaivani)

Verified by
(S. Arivandeshwari)

Authorize by
(S. Suriyakumar)

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY * SALEM
End of the Report

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a1)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Surface Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Keelpuliyampattu District : Cuddalore State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°11'27.92" N Sample Longitude : 79° 31'50.40" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.56
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	612
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.6
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	384
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	386
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	198
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	68
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	186
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	12
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	3
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	165
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	50
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	50
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	5
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.05
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.003
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	35
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	4
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.8
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	4
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	**BDL(DL:0.001)**
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.04
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

V-kalaiyani
Prepared by
(V.kalaiyani)

Verified by
CS.Akilandeshwari

Authorize by
CS.Suriyakumar

-------- End of the Report --------

ANALYTICAL LABORATORY SALEM

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a1)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Surface Water Sample Description : Colourless Liquid Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Achalpuram District : Cuddalore State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 22.11.2022 Completed On : 25.11.2022 Sample latitude : 11°10'59.2" N Sample Longitude : 79° 30'17.4" E

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.36
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	1342
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.7
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	796
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	798
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	249
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	76
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	209
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	40
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	10
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	190
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	80
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	80
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	26
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.08
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.004
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	120
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	44
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	5.2
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	16
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	0.005
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	2
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by
(V. Kalaivani)

Verified by
(S. Akilandeshwari)

Authorize by
(S. Suri Yakumar)

------- End of the Report -------

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY ★ SALEM

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a1)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom.	Report Date : 26.11.2022 Page : 1 of 1

Sample Name	: Surface Water	Received On	: 22.11.2022
Sample Description	: Colourless Liquid	Commenced On	: 22.11.2022
Sample Drawn By/ Date	: By hand/22.11.2022	Completed On	: 25.11.2022
Sample method	: ABMEAL/QSP/21	Sample latitude	: 11°10'48.8" N
Sample Plan	: ABMEAL/QSP/22	Sample Longitude	: 79°29'32.6" E
Sample Mark	: Buffer Zone		
Site Address	: Village : Sirukattur District : Cuddalore State : Tamil Nadu.		

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.58
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	686
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.8
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	2
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	422
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	424
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	232
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	66
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	182
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	50
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	12
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	210
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	100
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	100
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	10
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	0.08
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	0.004
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	46
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	8
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	7.6
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	8
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	0.003
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	1
31.	Oil & Grease	mg/l	IS 3025 P:39: 2021	<0.4

Prepared by
CV.Kalaivani

Verified by
CS.Akilandeshwari

Authorize by
CS.Suriyakumar

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End of the Report

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-916(a1)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1

Sample Name	: Surface Water	Received On	: 22.11.2022
Sample Description	: Colourless Liquid	Commenced On	: 22.11.2022
Sample Drawn By/ Date	: By hand/22.11.2022	Completed On	: 25.11.2022
Sample method	: ABMEAL/QSP/21	Sample latitude	: 11°09'27.2" N
Sample Plan	: ABMEAL/QSP/22	Sample Longitude	: 79° 30'38.4" E
Sample Mark	: Buffer Zone		
Site Address	: Village : Kallaiyopur District : Thanjavur State : Tamil Nadu.		

S.NO	PARAMETERS	UNITS	METHODS	RESULTS
1.	pH	-	IS 3025:P.11:2022	7.65
2.	Electrical Conductivity (EC)	mg/l	IS 3025:P.14: 2013	496
3.	Turbidity	NTU	IS 3025:P.10: 2023	**BDL(DL:0.1)**
4.	Temperature	°C	IS 3025:P.09:1984: 2017	25.5
5.	Taste	-	IS 3025:P.07: 2017	NIL
6.	Colour	HU	IS 3025:P.04: 2021	NIL
7.	Odour	-	IS 3025:P.05: 2018	NIL
8.	Total Suspended Solids (TSS)	mg/l	IS 3025:P.17: 2022	1
9.	Total Dissolved Solids (TDS)	mg/l	IS 3025:P.16: 2023	296
10.	Total Solids	mg/l	IS 3025:P.15:1984:R.2017	297
11.	Total Hardness as $CaCO_3$	mg/l	IS 3025:P.21:2009:R.2019	133
12.	Calcium as Ca	mg/l	IS 3025:P.40:1991:R.2019	46
13.	Calcium Hardness	mg/l	IS 3025:P.40:1991:R.2019	129
14.	Magnesium Hardness	mg/l	IS 3025:P.46:1994:R.2019	4
15.	Magnesium as Mg	mg/l	IS 3025:P.46:1994:R.2023	1
16.	Chloride as Cl^-	mg/l	IS 3025:P.32:1988:R.2019	82
17.	Acidity as $CaCO_3$	mg/l	IS 3025:P.22:1986:R.2019	-
18.	Total Alkalinity as $CaCO_3$	mg/l	IS 3025:P.23: 2023	50
19.	Carbonate	mg/l	IS 3025:P.51: 2023	**BDL(DL:1)**

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20.	Bicarbonate	mg/l	IS 3025:P.51: 2023	50
21	Sulphate as SO_4^-	mg/l	IS 3025:P.24:1986:R.2019	4
22.	Iron as Fe	mg/l	IS 3025:P.53:2003:R.2019	BDL(DL:0.01)
23.	Hexavalent Chromium as Cr^{+6}	mg/l	IS 3025:P.52:2003:R.2019	BDL(DL:0.001)
24	Sodium as Na	mg/l	IS 3025:P.45:.2019	9
25.	Potassium as K	mg/l	IS 3025:P.45:.2019	2
26.	Dissolved Oxygen (DO)	mg/l	IS 3025:P.38:1989:R.2019	6.8
27.	Chemical Oxygen Demand as COD	mg/l	IS 3025:P.51: 2023	4
28.	Biological Oxygen Demand as BOD	mg/l	IS 3025:P.44: 2023	<2
29.	Nitrite as NO_2	mg/l	IS 3025 P.34: 2019	BDL(DL:0.001)
30.	Nitrate as NO_3	mg/l	IS 3025 P.34: 2019	0.02
31.	Oil & Grease	mg/l	IS 3025 P.39: 2021	<0.4

Prepared by (V.Kalaivani)

Verified by (CS.Akilandeshwari)

Authorize by CS.Suriyakumar

-------- *End of the Report* --------

AND ANALYTICAL ... SALEM

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-917(b)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom.	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Soil Sample Description : Black Soil Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Vembakudi District : Ariyalur State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 23.11.2022 Completed On : 25.11.2022 Sample latitude : 11^0 10'13.42" N Sample Longitude : $79^0$27'15.12" E

S.No	Parameters		Test Methods	Units	Results
1.	pH		IS: 2720 (P-26):1987	-	7.35
2.	Electrical Conductivity		IS :14767 : 2000	µs/cm	241
3.	Moisture		IS:2720 (P-2):1972	%	4.12
4.	Bulk density		ABMEAL/CH/SO/SOP/18	g/cc	1.02
5.	Water holding capacity		IS :14765 : 2000	%	75
6.	Texture	Sand	IS:10317:1982	%	52
		Silt			28
		Clay			20
					"LOAM"
7.	Organic Matter		IS:2720 (P-22):1972	%	2.12
8.	Calcium		ABMEAL/CH/SO/SOP/12	%	0.001
9.	Magnesium		ABMEAL/CH/SO/SOP/13	%	**BDL(DL:0.1)**
10.	Chloride		ABMEAL/CH/SO/SOP/14	%	0.003
11.	Sodium		ABMEAL/CH/SO/SOP/08	%	0.02
12.	Potassium		ABMEAL/CH/SO/SOP/06	%	0.005
13.	Phosphorus		IS : 6092 (Part - 3) : 2004	%	0.04
14.	TKN		IS:14684:1999(RA-2005)	%	0.01

BDL = Below Detectable Limit : DL: Detection Limit

Prepared by (V. Kalaivani)

Verified by (S. Alailandeshwari)

Authorized Signatory (S. Suriyakumar)

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY SALEM

End of the Report

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TEST REPORT

Sample Ref No: ABM-TRF-260(A)	Report No. : ABM-TR-917(b)
Issued To: The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom.	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Soil Sample Description : Brown Soil Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Rajendrasoghagan District : Ariyalur State : Tamil Nadu.	Received On : 22.11.2022 Commenced On : 23.11.2022 Completed On : 25.11.2022 Sample latitude : 11° 15'13.3" N Sample Longitude : 79°33'21.8" E

S.No	Parameters		Test Methods	Units	Results
1.	pH		IS: 2720 (P-26):1987	-	9.06
2.	Electrical Conductivity		IS :14767 : 2000	µs/cm	70
3.	Moisture		IS:2720 (P-2):1972	%	0.52
4.	Bulk density		ABMEAL/CH/SO/SOP/18	g/cc	1.09
5.	Water holding capacity		IS :14765 : 2000	%	48
6.	Texture	Sand	IS:10317:1982	%	25
		Silt			54
		Clay			21
					Silt Loam
7.	Organic Matter		IS:2720 (P-22):1972	%	1.06
8.	Calcium		ABMEAL/CH/SO/SOP/12	%	0.001
9.	Magnesium		ABMEAL/CH/SO/SOP/13	%	**BDL(DL:0.1)**
10.	Chloride		ABMEAL/CH/SO/SOP/14	%	0.004
11.	Sodium		ABMEAL/CH/SO/SOP/08	%	0.007
12.	Potassium		ABMEAL/CH/SO/SOP/06	%	0.003
13.	Phosphorus		IS : 6092 (Part - 3) : 2004	%	0.005
14.	TKN		IS:14684:1999(RA-2005)	%	0.004

BDL = Below Detectable Limit : DL: Detection Limit

Prepared By	Verified by	Authorized Signatory
(V. Kalaivani)	(S. Akilandeshwari)	(S. Suriyakumar)

------- End of the Report -------

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TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-917(b)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom.	Report Date : 26.11.2022 Page : 1 of 1

Sample Name : Soil Sample Description : Brown Soil Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Core Zone Site Address : Village : Adhanur District : Cuddalore State : Tamil Nadu.	Received On : 22.11.2022 Commenced On : 23.11.2022 Completed On : 25.11.2022 Sample latitude : 11°11'15.17" N Sample Longitude : 79°32'28.36" E

S.No	Parameters		Test Methods	Units	Results
1.	pH		IS: 2720 (P-26):1987	-	8.20
2.	Electrical Conductivity		IS :14767 : 2000	µs/cm	84
3.	Moisture		IS:2720 (P-2):1972	%	1.07
4.	Bulk density		ABMEAL/CH/SO/SOP/18	g/cc	1.08
5.	Water holding capacity		IS :14765 : 2000	%	58
6.	Texture	Sand	IS:10317:1982	%	48
		Silt			28
		Clay			24
					"SANDY CLAY LOAM"
7.	Organic Matter		IS:2720 (P-22):1972	%	1.41
8.	Calcium		ABMEAL/CH/SO/SOP/12	%	0.001
9.	Magnesium		ABMEAL/CH/SO/SOP/13	%	**BDL(DL:0.1)**
10.	Chloride		ABMEAL/CH/SO/SOP/14	%	0.001
11.	Sodium		ABMEAL/CH/SO/SOP/08	%	0.02
12.	Potassium		ABMEAL/CH/SO/SOP/06	%	0.003
13.	Phosphorus		IS : 6092 (Part - 3) : 2004	%	0.002
14.	TKN		IS:14684:1999(RA-2005)	%	0.007

BDL = Below Detectable Limit : DL: Detection Limit

Prepared by	Verified by	Authorized Signatory
(V.kalaivani)	(S.Akilandeshwari)	(S.Suriyakumar)

------- *End of the Report* -------

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ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-917(b)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom.	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Soil Sample Description : Brown Soil Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Rajendrasoghagan District : Ariyalur State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 23.11.2022 Completed On : 25.11.2022 Sample latitude : 11°15'13.3" N Sample Longitude : 79°33'21.8" E

S.No	Parameters		Test Methods	Units	Results
1.	pH		IS: 2720 (P-26):1987	-	9.06
2.	Electrical Conductivity		IS :14767 : 2000	µs/cm	70
3.	Moisture		IS:2720 (P-2):1972	%	0.52
4.	Bulk density		ABMEAL/CH/SO/SOP/18	g/cc	1.09
5.	Water holding capacity		IS :14765 : 2000	%	48
6.	Texture	Sand	IS:10317:1982	%	25
		Silt			54
		Clay			21
					Silt Loam
7.	Organic Matter		IS:2720 (P-22):1972	%	1.06
8.	Calcium		ABMEAL/CH/SO/SOP/12	%	0.001
9.	Magnesium		ABMEAL/CH/SO/SOP/13	%	**BDL(DL:0.1)**
10.	Chloride		ABMEAL/CH/SO/SOP/14	%	0.004
11.	Sodium		ABMEAL/CH/SO/SOP/08	%	0.007
12.	Potassium		ABMEAL/CH/SO/SOP/06	%	0.003
13.	Phosphorus		IS : 6092 (Part - 3) : 2004	%	0.005
14.	TKN		IS:14684:1999(RA-2005)	%	0.004

BDL = Below Detectable Limit : DL: Detection Limit

Prepared by (V. Kalaivani)

Verified by V. Kalaivani

Authorized Signatory (S. Surivakumar)

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)	Report No. : ABM-TR-917(b)
Issued To: The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom.	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Soil Sample Description : Brown Soil Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Kallaiyopur District : Thanjavur State : Tamil Nadu.	Received On : 22.11.2022 Commenced On : 23.11.2022 Completed On : 25.11.2022 Sample latitude : 11°09'27.2" N Sample Longitude : 79°30'38.4" E

S.No	Parameters		Test Methods	Units	Results
1.	pH		IS: 2720 (P-26):1987	-	8.60
2.	Electrical Conductivity		IS :14767 : 2000	µs/cm	450
3.	Moisture		IS:2720 (P-2):1972	%	2.42
4.	Bulk density		ABMEAL/CH/SO/SOP/18	g/cc	1.03
5.	Water holding capacity		IS :14765 : 2000	%	58
6.	Texture	Sand	IS:10317:1982	%	44
		Silt			52
		Clay			4
					"Silt Loam"
7.	Organic Matter		IS:2720 (P-22):1972	%	1.6
8.	Calcium		ABMEAL/CH/SO/SOP/12	%	0.001
9.	Magnesium		ABMEAL/CH/SO/SOP/13	%	**BDL(DL:0.1)**
10.	Chloride		ABMEAL/CH/SO/SOP/14	%	0.01
11.	Sodium		ABMEAL/CH/SO/SOP/08	%	0.008
12.	Potassium		ABMEAL/CH/SO/SOP/06	%	0.005
13.	Phosphorus		IS : 6092 (Part - 3) : 2004	%	0.04
14.	TKN		IS:14684:1999(RA-2005)	%	0.02

BDL = Below Detectable Limit : DL: Detection Limit

Prepared by (V. Ilangaiyaran)

Verified by

Authorized Signatory (CS. Surivakumar)

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY ★ SALEM

------- End of the Report -------

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-917(b)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom.	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : Soil Sample Description : Brown Soil Sample Drawn By/ Date : By hand/22.11.2022 Sample method : ABMEAL/QSP/21 Sample Plan : ABMEAL/QSP/22 Sample Mark : Buffer Zone Site Address : Village : Sarabojirajapuram District : Thanjavur State : Tamil Nadu.		Received On : 22.11.2022 Commenced On : 23.11.2022 Completed On : 25.11.2022 Sample latitude : 11°10'16.0" N Sample Longitude : 79°31'41.3" E

S.No	Parameters		Test Methods	Units	Results
1.	pH		IS: 2720 (P-26):1987	-	8.64
2.	Electrical Conductivity		IS :14767 : 2000	µs/cm	157
3.	Moisture		IS:2720 (P-2):1972	%	3.12
4.	Bulk density		ABMEAL/CH/SO/SOP/18	g/cc	1
5.	Water holding capacity		IS :14765 : 2000	%	68
6.	Texture	Sand	IS:10317:1982	%	53.84
		Silt			42.32
		Clay			3.84
					Sandy Loam
7.	Organic Matter		IS:2720 (P-22):1972	%	0.74
8.	Calcium		ABMEAL/CH/SO/SOP/12	%	0.001
9.	Magnesium		ABMEAL/CH/SO/SOP/13	%	**BDL(DL:0.1)**
10.	Chloride		ABMEAL/CH/SO/SOP/14	%	0.003
11.	Sodium		ABMEAL/CH/SO/SOP/08	%	0.03
12.	Potassium		ABMEAL/CH/SO/SOP/06	%	0.002
13.	Phosphorus		IS : 6092 (Part - 3) : 2004	%	0.005
14.	TKN		IS:14684:1999(RA-2005)	%	0.007

BDL = Below Detectable Limit : DL: Detection Limit

Prepared by (C. Kalaivanan)

Verified by (S. Akilandeshwari)

Authorized Signatory (S. Suriyakumar)

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TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-919(d)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : NOISE Monitoring date : 21.11.2022 Site Address : Village : Periyapogene District : Cuddalore State : Tamil Nadu.		Data Received On : 22.11.2022

S.NO	PARAMETERS	TEST METOD	UNIT	LOCATION	RESULT
1	NOISE	IS:9989-1981	dB(A)	Buffer Zone	43.4

BDL = Below Detectable Limit ; DL = Detection Limit

Prepared by
(V. Elangovan)

Verified by
(V. Elangovan)

Authorized Signatory
(S. Suriyakumar)

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY ★ SALEM

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TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-919(d)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : NOISE Monitoring date : 21.11.2022 Site Address : Village : Palavaykandan District : Cuddalore State : Tamil Nadu.		Data Received On : 22.11.2022

S.NO	PARAMETERS	TEST METOD	UNIT	LOCATION	RESULT
1	NOISE	IS:9989-1981	dB(A)	Buffer Zone	45.1

BDL = Below Detectable Limit ; DL = Detection Limit

Prepared by
CV Kalaivanan

Verified by
CV Kalaivanan

Authorized Signatory
CS Suriyakumar

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY * SALEM

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TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-919(d)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : NOISE Monitoring date : 21.11.2022 Site Address : Village : Pandanallur District : Thanjavur State : Tamil Nadu.		Data Received On : 22.11.2022

S.NO	PARAMETERS	TEST METOD	UNIT	LOCATION	RESULT
1	NOISE	IS:9989-1981	dB(A)	Buffer Zone	44.8

BDL = Below Detectable Limit ; DL = Detection Limit

Prepared by
(Vilagaivani)

Verified by
(Vilagaivani)

Authorized Signatory
(S. Suriyakumar)

For ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY
SALEM

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TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-919(d)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : NOISE Monitoring date : 21.11.2022 Site Address : Village : Thiruchitrambalam. District : Mayiladuthurai State : Tamil Nadu.		Data Received On : 22.11.2022

S.NO	PARAMETERS	TEST METOD	UNIT	LOCATION	RESULT
1	NOISE	IS:9989-1981	dB(A)	Buffer Zone	46.5

BDL = Below Detectable Limit ; DL = Detection Limit

V. kalg

Prepared by
(V. kalaivani)

Verified by
(V. kalaivani)

Authorized Signatory
(S. suriyakumar)

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY ★ SALEM

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TEST REPORT

Sample Ref No: ABM-TRF-260(A)	Report No. : ABM-TR-919(d)
Issued To: The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : NOISE Monitoring date : 21.11.2022 Site Address : Village : Manalmedu. District : Mayiladuthurai State : Tamil Nadu.	Data Received On : 22.11.2022

S.NO	PARAMETERS	TEST METOD	UNIT	LOCATION	RESULT
1	NOISE	IS:9989-1981	dB(A)	Buffer Zone	48.1

BDL = Below Detectable Limit ; DL = Detection Limit

Prepared by (V.Kalaivani)

Verified by (V.Kalaivani)

Authorized Signatory (S.Suriyakumar)

---------- End of the Report ----------

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY SALEM

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TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-919(d)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26.11.2022 Page : 1 of 1
Sample Name : NOISE Monitoring date : 21.11.2022 Site Address : Village : Nattarmangalam District : Cuddalore. State : Tamil Nadu.		Data Received On : 22.11.2022

S.NO	PARAMETERS	TEST METOD	UNIT	LOCATION	RESULT
1	NOISE	IS:9989-1981	dB(A)	Buffer Zone	47.5

BDL = Below Detectable Limit ; DL = Detection Limit

Prepared by
(Vijayavani)

Verified by
(S. Alcilandeshwari)

Authorized Signatory
(S. Suriyakumar)

End of the Report

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY ★ SALEM

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NABL TC-9497

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TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-919(d)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom .	Report Date : 26 .11.2022 Page : 1 of 1
Sample Name : NOISE Monitoring date : 21.11.2022 Site Address : Village : Adanur District : Cuddalore. State : Tamil Nadu.		Data Received On : 22.11.2022

S.NO	PARAMETERS	TEST METOD	UNIT	LOCATION	RESULT
1				N	41.8
2				W	43.5
5	NOISE	IS:9989-1981	dB(A)	Core zone	42.5

BDL = Below Detectable Limit ; DL = Detection Limit

Prepared by	Verified by	Authorized Signatory
(V.kalaivani)	(C.S.Atilandeshwari)	(C.S.Suriyakumar)

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NABL TC-9497

TEST REPORT

Sample Ref No: ABM-TRF-260(A)		Report No. : ABM-TR-918(C)
Issued To:	The Executive Engineer, Water Resource Department, Special Project Division, Kumbakonom.	Report Date : 26.11.2022 Page : 1 of 1

Sample Description	: AMBIENT AIR	Received On	: 22.11.2022
Sampling Method	: IS 5182(Part-14):2000	Commenced On	: 22.11.2022
Date of Sampling	: 21.11.2022	Completed On	: 25.11.2022
Sample Mark	: Core Zone	Sample latitude	: 11° 11'44.30" N
Sample Drawn By/ Date	: By hand/22.11.2022	Sample Longitude	: 79° 32'6.91" E
Sampling Method	: ABMEAL/QSP/22		
Ambient Temperature	: 29°C		
Relative Humidity	: 68%		
Site Address	: Village : Adhanur District : Cuddalore State : Tamil Nadu..		

S.NO	PARAMETERS	PROTOCOL	UNIT	RESULT
1	Particulate Matter ($PM_{2.5}$)	IS 5182 (Part 24): 2019	$\mu g/m^3$	**48**
2	Respirable Particulate Matter (PM_{10})	IS 5182 (Part 23): 2006	$\mu g/m^3$	**26**
3	Sulphur Dioxide (SO_2)	IS 5182 (Part 2): 2006	$\mu g/m^3$	**12**
4	Nitrogen Dioxide (NO_2)	IS 5182(Part 6) : 2006	$\mu g/m^3$	**17**
5	Ozone(O_3)	IS 5182(Part 9): 1974	$\mu g/m^3$	**34**
6	Ammonia(NH_3)	IS 5182 (Part 25): 2018	$\mu g/m^3$	**29**
7	Nickel(Ni)	IS 5182 (Part 26) : 2020	ng/m^3	**BDL(DL:0.1)**
8	Lead(Pb)	IS 5180(Part22): 2004	$\mu g/m^3$	**BDL(DL:0.1)**

BDL = Below Detectable Limit ; DL = Detection Limit

Prepared by
(V. Kalaivani)

Verified by
(V. Kalaivani)

Authorized Signatory
(S. Suriyakumar)

ABM ENVIRONMENTAL AND ANALYTICAL LABORATORY SALEM

End of the Report

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