TECHNICAL REPORTS: SERIES 'D'

CONSERVE WATER – SAVE LIFE

भारत सरकार

GOVERNMENT OF INDIA

जल संसाधन मंत्रालय

MINISTRY OF WATER RESOURCES

केंद्रीय भूजल बोर्ड

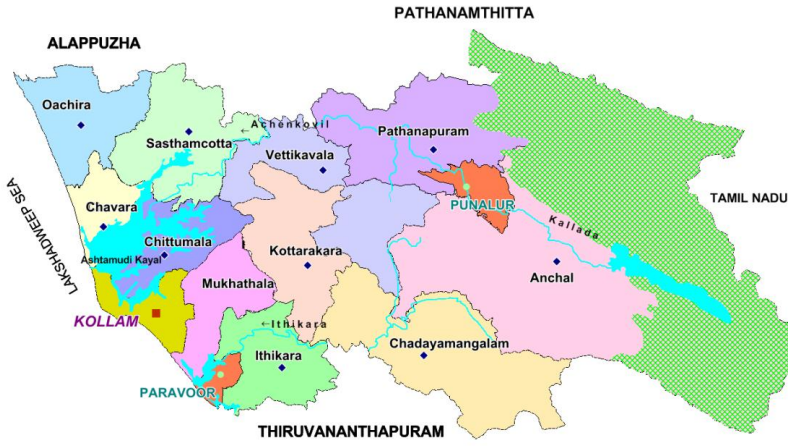
CENTRAL GROUND WATER BOARD

केरल क्षेत्र

KERALA REGION

भूजल सूचना पुस्तिका, कोल्लम जिल्ला, केरल राज्य

GROUND WATER INFORMATION BOOKLET OF KOLLAM DISTRICT, KERALA STATE



तिरुवनंतपुरम

Thiruvananthapuram

December 2013

GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION BOOKLET OF KOLLAM DISTRICT, KERALA

द्वारा

By
मिनी चंद्रन
वैज्ञानिक ग

Mini Chandran
Scientist C

KERALA REGION
KEDARAM, KESAVADASAPURAM
THIRUVANANTHAPURAM – 695 004
TEL: 0471-2442175
FAX: 0471-2442191

BHUJAL BHAVAN
NH-IV, FARIDABAD
HARYANA- 121 001
TEL: 0129-12419075
FAX: 0129-2142524

GROUND WATER INFORMATION BOOKLET OF KOLLAM DISTRICT, KERALA STATE

TABLE OF CONTENTS

KOLLAM DISTRICT AT A GLANCE

Sl.NO		
1.	**GENERAL INFORMATION**	
	i. Geographical Area (sq. km.)	2491
	ii. Administrative Divisions (as on 31.3.2010)	
	Number of Taluks	5
	Number of Blocks	11
	Number of Municipalities	3
	Corporation	1
	Number of Panchayats	73
	Number of Villages	104
	iii. Population (As per 2011Census)	2629703
	iv. Normal Annual Rainfall (mm)	2428
2.	**GEOMORPHOLOGY**	
	Major physiographic Units	Coastal plain(0-6 m agl) Midland (6-80 m agl) High land (>80 m agl)
	Major Drainages	Achenkovil Kallada Ithikara
3.	**LAND USE (Ha.) (as on 2009)**	
	a. Forest area	81438
	b. Net area sown	126372
	c. Total cropped area	161498
4.	**MAJOR SOIL TYPES**	Laterite, Brown Hydromorphic, Grayish Onattukara, Coastal Riverine alluvium and Forest Loam.
5.	**AREA UNDER PRINCIPAL CROPS (ha)**	Paddy – 3453 Banana – 2068 Cashew – 2858 Coconut – 56675 Tea – 1258 Plantation – 36121 Pepper – 8138 Rubber – 36111 Tapioca – 16933 Ginger - 390
6.	**IRRIGATION BY DIFFERENT SOURCES (ha) (as on 2009)**	
	Govt. and private wells	2104
	Govt. and privateTanks	108
	Govt. and private Canals	1233
	Minor irrigation	8
	Other sources	569
	Net Irrigated area	4023
7.	**NUMBER OF GROUNDWATER MONITORING WELLS (CGWB) (As on 31.3.2011)**	
	No. of Dug wells	47
	No of Piezometers	20

8.	**PREDOMINANT GEOLOGICAL FORMATIONS**	Recent alluvium, Sub-recent Laterite, Tertiary Sedimentary Formations, Archaean crystallines	
9.	**HYDROGEOLOGY**		
	Major Water bearing formation Pre-monsoon depth to water level (April 2011) Post-monsoon depth to water level (November 2011)	Recent alluvium, Sub-recent Laterite, Tertiary Sedimentary Formations, Archaean crystallines 1.67-25.40 m bgl 0.07-22.32 m bgl	
10.	**GROUNDWATER EXPLORATION BY CGWB (as on 31.3.2011)**		
	No. of wells drilled	40 EW in Hard Rock and 19 in Sedimentaries.	
	Depth range (m bgl)	114-301.89 in Hard Rock 30.1 - 416.00 in Sedimentaries	
	Discharge (lps)	0.61-23 in Hard rock 0.67-42.96 in Sedimentaries.	
11.	**GROUNDWATER QUALITY**		
	Quality of water	Generally good except in localized pockets in coastal area.	
12	**DYNAMIC GROUNDWATER RESOURCES (as in March 2009) Ha m**		
	Net annual ground water availability	40926.67	
	Annual Gross Ground Water draft	15711.15	
	Projected Demand for Domestic and industrial Uses upto 2025	13101.55	
	Stage of Ground Water Development (%)	38	
13	**AWARENESS AND TRAINING ACTIVITY**		
	Mass Awareness Program		
	Date	4.03.2008	
	Place	Kollam	
	No: of participants	220	
	Training Programmes	One Water Management Training Program	One Awareness raising training program
	Date	08.02.2002	March 2011
	Place	Anchal	Kollam
	No of participants	100	75
14.	**EFFORTS OF ARTIFICIAL RECHARGE& RAIN WATER HARVESTING**		
	Projects completed by CGWB (No., Amount spent and year)	One, Subsurface dyke at Sadanandapuram Amount spent : Rs 7,36,405/-(1998)	
	Projects under technical guidance of CGWB	NIL	
15.	**GROUNDWATER CONTROL AND REGULATION**		

	Number of OE Blocks.	NIL
	Number of Critical Blocks	NIL
	Number of Semi Critical Blocks	1
	Number of blocks notified	NIL
16.	**MAJOR GROUNDWATER PROBLEMS AND ISSUES**	◆ Saline water ingress is observed in the shallow alluvial aquifer in the western part of the district which is in hydraulic connection with the back water. ◆ Acute water scarcity is seen along the eastern hilly areas and also along Laterite hillocks ◆ Water logging along the western border of the district bordering the back water lagoons during the rainy season. Eg: Munroe Thuruthu. ◆ Groundwater pollution is reported from Chavara, Kundara and from Pozhikara area

GROUND WATER INFORMATION BOOKLET OF KOLLAM DISTRICT, KERALA

1.0 INTRODUCTION

Kollam (earlier known as Quilon), one of the famous trading towns of Kerala has a distinctive place in the mineral map of Kerala. It is located on the southwest part of Kerala State and extends from Lakshadweep Sea to the Western Ghats and is bordered by Trivandrum district on the South and Alleppey and Pathanamthitta districts in the North and Tirunelveli district of Tamil Nadu State in the East and Lakshadweep Sea in the west. It lies between North latitudes 8^0 45' and 9^0 07' and East longitudes 76^0 29' and 77^0 17'. It has a geographical area of 2491 sq km which is about 6.48% of the total geographical area of the State and falls in parts of Survey of India Toposheets 58C, D,G and H. Population of the district is 2629703 as per 2011 census, which is about 8.12% of the total population of the State. Of the total population, 1244815 are males and 1384888 are females. There was change of 1.72 percent in the population compared to population as per 2001. In the previous census of India 2001, Kollam District recorded increase of 7.38 percent to its population compared to 1991. The population density is 1056 persons per sq km.

1.1 Administration

Kollam district has a single revenue division with headquarters at Kollam. Pathanapuram, Kunnathur, Kottarakkara, Karunagapally and Kollam are the five Taluks in the district. The district is further subdivided into 11 development blocks, 73 Panchayaths and 104 villages. Paravoor , Punalur and Karunagapally are Municipal towns and Kollam has the status of a City Corporation.

1.2 Drainage & Irrigation

The district is drained by three west flowing rivers , viz *Achenkovil, Kallada* and *Ithikara*, originating in the eastern hilly region. These rivers together with their tributaries exhibit dendritic pattern of drainage.

The Ithikara basin has its elevation north of *Madathara* (271 m amsl) on the eastern side and slopes down to sea level west of Mayyanad. The Ithikara river originates from the *Madatharaikunnu* hills, south west of Kulathupuzha and drains into the Paravoor backwaters near Meenad. Ithikara river is a fourth order stream with a slope of 8.2 m/km. The length of the river is 56 km and the drainage area is 779 km^2.

The Kallada river basin has its highest elevation at *Karimalaikodkal* (1763 m amsl) on the eastern side and reaches almost sea level west of Karunagapally. The river originating from the Western Ghats drains into Ashtamudi backwaters near Kollam. The length of the river is 121 km and drainage area is 1996 km^2. Kallada river is a fifth order stream with a gradient of 12.6 m/km.

The Achenkovil river originates from the Western Ghats and covers a basin area of 1484 km^2 and the main channel length is 128 km. The River joins Pamba river at Veeyapuram and finally debouches into

the Vembanad lake. The Achankovil river is set in a well known shear zone demarcating the boundary between Kerala Khondalite Belt and charnockites of Southern Granulite terrain.

The district is blessed with the largest fresh water lake in the State namely the Sasthamkotta lake and is one of the resources which caters to the drinking water needs of Kollam district. The lake occupies 440 hectares and the catchment area of the lake is 1269 sq km. Other major lakes (Kayals) in the district are.

- Ashtamudi Kayal - 6424 ha
- Paravoor Kayal - 662 ha

The irrigation facilities in the district are limited. The major irrigation scheme is Kallada irrigation project and the target fixed for it was 61630 ha of land and 92806 ha of crops. There are also minor irrigation schemes through which 1500 ha of land is being irrigated. Among source of irrigation, ground water is the principal source of irrigation accounting for about 47% of the area under irrigation and the rest by lift and other methods of irrigation.

Source-wise data on irrigation in the district are given in **Table 1**

Table 1 : Source wise area under irrigation in Kollam District

Sl No.	Source	Net Area Irrigated	% area of Kollam district
1	Canal Irrigation	1229	1.21
2	Tank	278	4.31
3	Well Irrigation	4485	12.37
4	Other sources	852	5.49
	Total	**6844**	**23.38**

An index map showing location of block, boundary, drainage, location of EW, PZ and Groundwater monitoring wells (GWMW) are shown in **Figure 1**.

1.3 Land Use

The Kerala State Land Use Board has computed the area under various uses. The **Table 1a** represents the land under various categories.

Table 1a : Land use pattern in Kollam district

Sl No.	Category	Area in hectares	% of total area
1	Geographical area	249100	100
2	Built up land	6926	3
3	Agriculture land	139928	56
	Forest	84293	34
4	Water bodies	11816	5
5	Waste land	4784	2
6	Others	447	0.18

1.4 Work carried out by CGWB

Systematic hydrogeological work was carried out in 1959-60 and 1962-63. Further systematic surveys were done in 1970-71, 1974-75. Reappraisal survey was carried out during 1981. The SIDA assisted coastal Kerala Ground Water Project of CGWB carried out detailed hydrogeological studies with exploration in the entire district during the period 1983-88. Dr. E. Shaji and Mini Chandran, Sc C have carried out Ground water management studies of Kollam district during 2000- 2001 and 2007-08 respectively. The district report was compiled by Sri A. Subburaj (2002).

2.0 RAINFALL & CLIMATE

2.1 Rainfall

The district receives an annual average rainfall of about 2428 mm. The Southwest monsoon from June to September contributes nearly 55% of the total annual rainfall. The Northeast monsoon season from October to December contributes about 24% and the balance 21% is received during the month of January to May as pre-monsoon showers. Out of the total 119 rainy days, about 70 rainy days occur during the southwest monsoon season.

The monthly rainfall data for the period 2006-2011 is given in the **Table 2**.

2.2 Meteorological Parameters

Temperature

The temperature is more during the months of March to May and is less during December and January. The average mean monthly maximum temperature ranges from 29.9 to 36.4^{0}C and minimum temperature ranges from 19.4 to 23.8^{0}C.

Relative Humidity

The Relative humidity is higher during the monsoon period and all through the year it is higher during the morning hours.

Table 2: Monthly rainfall in Kollam district (Period 2006-2011)

Month	2006	2007	2008	2009	2010	2011
January	18	0	0	2.2	11.5	57
February	26	11.7	41.0	3.0	0.0	99
March	148	39.7	224.9	105.7	59.1	47
April	242	194.2	137.6	121.9	221.1	200
May	371	161.3	120.8	136.4	203.5	125
June	273	499.0	207.1	272.3	357.0	417
July	366	574.1	454.8	369.7	362.3	278
August	302	263.1	265.1	185.5	304.8	225
September	413	408.1	247.0	272.6	258.3	242
October	584	445	360.8	325.9	527.8	214
November	303	128.8	122.7	317.0	388.4	288
December	0	26.0	25.6	15.7	95.0	101.3
Total	**3046**	**2751**	**2207.4**	**2127.9**	**2788.8**	**2293.3**

Evaporation

Evaporation is more during summer months of January to April and it is low during the rainy months May to August. The maximum rate of 4.8 mm per day is recorded in March and the lowest rate of 2.6 mm is recorded during July.

Sunshine Hours

Sunshine ranges from 4.3 to 9.7 hours/day. Maximum sunshine is during the month of February. The months of June to August record the minimum sunshine due to the cloudy sky. Generally good sunshine hours are recorded in the months of November to May.

Wind

The wind speed ranges from 1.3 to 2.1 km/hour. The wind speed is high during the months of March to June and less during the months of September to December.

Potential Evapotranspiration (PET)

PET values are lower than the monthly rainfall during the month of May to October indicating water surplus for possible recharge into groundwater regime during these months. The monthly PET ranges from 119.3 to 177 mm.

3.0 GEOMORPHOLOGY AND SOIL TYPES

Physiographically, the district can be divided into three distinct units viz. the coastal plains, the midlands and the eastern highland regions. The coastal plains with an elevation ranging between 0-6 m amsl occur as narrow belt of alluvial deposits parallel to the coast. To the east of coastal belt is the midland region with altitude ranging from 6-80 m amsl. The midland area is characterised by rugged topography formed by small hillocks separated by deep cut valleys. The midland regions show a general slope towards the western coast. To its east is the high land region. Major parts of the catchment of river *Kallada* and *Ithikara* fall within this unit. This unit occupies the maximum area of the district. The Western Ghat fringes is bounded by 300 to 600 m contours. The highest elevation is noticed at *Karimalai* (1758 m amsl).

There are five major soil types encountered in the district. They are Lateritic soils, Brown Hydromorphic soils, Greyish Onattukara soils, Riverine and Coastal Alluvium and Forest Loam. Lateritic soil is the most predominant soil type of the district and it occurs in the midland and hilly areas and it is derived from laterites. Brown hydromorphic soil is confined to the valleys between undulating topography in the midlands and in the low lying areas of the coastal strip. They have been formed as a

result of transportation and sedimentation of materials from adjoining hill slopes. The alluvial soil is seen in the western coastal tract of the district. The coastal alluvium is characterized by secondary soils which are sandy and sterile with poor water holding capacity. Riverine alluvium is seen along the river beds. The width of the zone increases towards the southern part of the district. Greyish Onattukara soils are purely marine deposits extending to the interior and are generally coarse in texture. Forest loamy soils are found in the eastern hilly areas of the district and are characterized by a surface layer rich in organic matter.

4.0 GROUNDWATER SCENARIO

4.1. Hydrogeology

Ground water occurs in the porous granular formations such as alluvium, laterite, the Tertiary sediments and weathered and decomposed crystalline rocks as well as in the fissures, joints and fractures in the fresh crystalline rocks. The aquifers in the district can be grouped into four distinct geological formations in which they occur viz alluvial aquifers, laterite aquifers, Tertiary sedimentary rock aquifers and crystalline rock aquifers.

Crystalline Rocks

On the basis of depth of occurrence, the potential aquifers in the crystalline rocks can be classified into shallow phreatic aquifers and deep fractured aquifers.

Shallow Phreatic aquifers

The crystalline formations occurring in Kollam district are Khondalites, charnockites, granite gneisses and intrusives. The shallow aquifers of the crystalline rocks occur within a depth of 20 m in the district. They are made up of highly decomposed weathered zone and partly weathered and fractured rock occurring just below the weathered zone.

Wells in the Khondalitic terrain have depth varying from 5.0 to 20 m bgl and water levels varying between 4 to 20 m bgl during pre-monsoon and from 3 to 12.5 m bgl during post monsoon period. The yields of these wells are of the order 6 to 12 m^3/day. In the charnockites the wells have depth from 6 to 13m bgl and the depth to water level from 5 to 12.0 m bgl during pre-monsoon and from 3.0 to 9.0 m bgl during post monsoon. The yield of the wells range from 4 to 5 m^3/day. The wells piercing the charnockite are generally dry during summer months. The specific capacity of dug wells range from 1.50 to 82 lpm/m/dd.

Deeper Fractured Aquifers

The SIDA assisted Coastal Kerala Ground Water project explored the potentialities of the deep fractured rocks in the district. During the project 14 exploratory bore wells were drilled. Subsequently 15 bore wells were drilled by CGWB in the Field Season programs during the year 2007-08 in the hard rock terrain, the locations of which are cited in the hydrogeological map **(Figure 5)** of the district and the details are given in **Annexure 1a**.

The aquifer parameters of the wells drilled in the formations are given below

Formation	Depth (m bgl)	SWL (m bgl)	Discharge (lps)	Transmissivity (m^2/day)
Granite Biotite gneiss	114.71 to 301.89	0.20-65.37	0.61-23	0.83 to 80.6
Khondalites	175.67 to 200.5	9.1 to 18.24	0.85-11.0	0.43 to 52.835

An analysis of the yields of the 29 bore wells constructed indicate that 5% of them yield more than 20 lps, 19% yield between 10 to 20 lps and 57 % yield between 1 and 10 lps and 19% yield less than 1 lps. The yield of bore wells drilled in granite biotite gneiss is better compared to Khondlite group of rocks.

Tertiary Sediments

Ground water occurs under phreatic condition in the shallow zone and confined condition in the deeper zones in the Tertiary sedimentary rocks. The sedimentary formation of the area comprises of Alleppey beds, Vaikom beds, Quilon beds and Warkali beds. Of these four Tertiary formations, Vaikom and Warkalai beds contain the most potential aquifers.

Shallow aquifers

Ground water is developed by dug wells tapping the Tertiary sediments wherever these formations outcrop. The depth to water level in these formations ranges from 4.3 to 26.5 m bgl and the depth of the wells ranges from 6.0 to 28.5 m bgl. The yield of the wells ranges from 500 to 10000 lpd.

Deeper Aquifers

The sedimentary formations of the area comprise Alleppey beds, Vaikom beds, Quilon beds and Warkali beds. Of these the Warkali and Vaikom beds form the most potential aquifers. Five tube wells were constructed by CGWB during the SIDA project. The remaining 14 tube wells were constructed by CGWB prior to SIDA project. These wells were constructed to tap the aquifers in each of the geologic formations namely Vaikom, Quilon and Warkali beds. The details of these wells are given in **Annexure 1b**. Of the four formations tube wells have been constructed tapping Vaikom, Quilon and Warkali beds. Since no tube wells was constructed tapping the Alleppey beds the hydrogeological data and aquifer parameters for these beds are not available.

The *Vaikom* beds constitute the most potential aquifer systems in the Tertiary group. It is the most extensively developed aquifer in Kollam district. The piezometric head ranges from 19.22 m bgl at Vayyankara and 1.63 m bgl at Sooranad. The piezometric surface is around 18 m above msl in and around Poruvazhi- Pallickal area in Kollam district and it slowly reduces towards west and northwest. Around Kollam the piezometric surface is 5.0 m below mean sea level. The yield of the wells constructed tapping this formation ranges from 0.67 to 36 lps. The thickness of granular zones in the formation ranges from 6 to 65 m. The transmissivity value ranges from 6 m^2/day in the eastern area to 467 m^2/day at Mainagapally and 529 m^2/day at Sooranad. The storativity ranges from 2.5 x 10^{-9} to 4.1 x 10^{-3} indicating confined to semi confined conditions. The specific capacity of the wells ranges between 5.79 and 436 lpm/m. This aquifer is largely developed for the Kollam Town Water supply and nearby villages for rural water supply.

The hydrogeological data on *Quilon* aquifer are very limited as only one tube well was constructed by the project and one by CGWB tapping this formation. The type area of this formation is at Padappakara area of Kollam district. Compared to the underlying Vaikom beds the Quilon bed is not very promising. The thickness of granular zones tapped in this aquifer is between 6 and 10 m and is composed of fine sand. No tube wells were constructed tapping exclusively the Quilon aquifers like Warkali and Vaikom.

Warkali formation is the most extensively developed aquifer among the Tertiary sediments. They form semi confined to confined aquifers. The thickness of the granular zones varies from 5 and 40 m and the yields of the wells range from 3 to 13.7 lps. The transmissivity value ranges from 130 m^2/day to 710 m^2/day. It is minimum around Kollam and eastern parts and maximum at Karunagapalli and northern parts. The specific capacity of tube wells ranges between 22 and 562 lpm/m.

Laterites

The occurrence and movement of ground water in laterite are mainly controlled by the topography. Laterite forms potential aquifers along valleys and topographic lows where the thickness of saturated zone is more and can sustain large diameter open wells for domestic and irrigation use. The depth to water level in this formation ranges from 1.6 to 27.6 m bgl and the depth of the wells ranges between 5.6 to 28 mbgl. The yield of the well ranges from 0.5 to 6 m^3/day. The seasonal water level fluctuation in laterite range from 0.4 to 10.20 m. The laterite formations occurring along hill tops and slopes get desaturated on the onset of summer and water scarcity is experienced during summer in such area. The laterites along the recharge area of the sedimentary formation show a deep water level of the order of 15.00 to 28.0 m bgl as seen around Kumbalam, Kottiyam, Sasthamkotta, Poruvazhi and Sooranad.

Recent Alluvial Deposits

These constitue the most potential phreatic aquifer in the district and is extensively developed by dug wells and filter point wells for domestic and irrigation needs. The depth to water level in this formation ranges from 0.50 to 5.9 m which is 1 to 6 m above msl. The depth of the wells ranges from 2.76 to 10.6 m bgl. The yield of the shallow dug wells ranges from 15 to 50 m^3/day. The area around Iravipuram, Chavara, Karunagapally where the saturated thickness exceeds 5.0 m form promising area for filter point wells. The filter point wells are constructed to a maximum depth of 12.0 m bgl and the yield ranges from 20 to 60m^3/day. The seasonal water level fluctuation ranges from 0.5 to 4.34 m.

Water level

Block wise distribution of groundwater levels in the Ground Water Monitoring Wells of CGWB in the district during pre-monsoon (April 11) and post monsoon (Nov 11) are presented in **Tables 3 & 4** respectively. The pre-monsoon depth to water level ranges between 1.67 to 25.40 m bgl. The minimum depth to water level occurs in Ouachita block and the maximum occurs at Kumbalam (Chittumala block) and during post monsoon it ranges between 0.07 to 22.32 m bgl.

Table 3: Block wise distribution of ground water levels in Kollam District (April 2011)

Block	No. of wells analysed	Depth to water level, mbgl		No./ % of wells showing DTWL (m.bgl) in the range of				
		min	max	0-2	2-5	5-10	10-20	20-40
Anchal	10	2.04	12.73	0	2/20	7/70	1/10	0
Chadayamangalam	6	4.66	9.76	0	1/16.67	5/83.33	0	0
Chavara	3	1.78	2.80	2/75	1/25	0	0	0
Chittumala	2	8.51	25.40	0	0	1/50	0	1/50
Kottarakkara	3	3.92	6.92	0	1/33.33	2/66.67	0	0
Ithikara	1	14.46	14.46	0	0	0	1/100	0
Oachira	1	1.67	1.67	1/100	0	0	0	0
Pathanapuram	4	2.42	9.76	0	1/25	3/75.00	0	0
Mukhthala	1	9.97	9.97	0	0	1/100	0	0
Sasthamkotta	1	5.58	5.58	0	0	1/100	0	0
Vettikavala	2	4.90	7.42	0	1/50	1/50	0	0

Table 4: Block wise distribution of ground water levels in Kollam District (November 2011)

Block	No. of wells analysed	Depth to water level (m bgl)		No. % of wells showing DTWL (m.bgl) in the range of				
		min	max	0-2	2-5	5-10	10-20	20-40
Anchal	10	0.09	9.25	3/30	1/10	6/60	0	0
Chadayamangalam	6	4.54	8.41	0	1/16.67	5/83.33	0	0
Chavara	3	0.44	0.61	3/100	0	0	0	0
Chittumala	3	2.42	22.32	0	1/33.33	1/33.33	0	1/33.3
Ithikara	1	14.46	14.46	0	0	0	1/100	0
Kottarakkara	3	1.36	4.29	1/33.33	2/66.67	0	0	0
Oachira	1	0.48	0.48	1/100	0	0	0	0

Pathanapuram	4	1.76	6.37	1/20	2/40.00	2/40.00	0	0
Mukhathala	1	7.86	7.86	0	0	1/100	0	0
Sasthamkotta	2	3.52	7.84	0	0	1/50	0	0
Vettikavala	2	2.82	3.13	0	0	0	0	0

The decadal average water levels of observation wells in the district for the period from 2001-11 were analysed and is given in the **Table 5** . Average depth to water level in the range of 5-10 is observed in almost all blocks during the pre-monsoon period except Oachira and Chavara where shallow water levels (2.5 - 2.7m bgl) are observed. During Post monsoon shallow water levels are found in Pathanapuram block as well.

Table 5: Block wise Decadal Average Depth to water level (2001-2011)

Sl No.	Block Name	Depth to Water Level (m.bgl)	
		Pre monsoon	Post monsoon
1	Anchal	7.26	5.0
2	Chadayamangalam	8.43	6.77
3	Chavara	2.56	2.63
4	Chittumala	9.17	6.00
5	Ithikara	9.50	8.42
6	Kottarakkara	9.60	7.37
7	Oachira	2.74	0.65
8	Pathanapuram	7.21	4.88
9	Mukhathala	6.519	5.58
10	Sasthamkotta	8.02	7.19
11	Vettikavala	7.40	5.15

Average depth to water level in pre monsoon period (2001-2011) is shown in **Figure 3** and post monsoon period (2001-2011) in **Figure 4** and a generalized Hydrogeological map of the district is given in **Figure 5.**

Long term water level trend (2001-2011)

Trend analysis of groundwater level from 2001-2011 shows that a majority of blocks show a rising trend (0.56 to 33.58 cm/yr) and no significant decline is observed in any of the blocks (0.30 to 3.48 cm/yr).

4.2 Ground Water Resources

The dynamic groundwater resources of the district as in March 2009 have been computed as per the guidelines of the Ground Water Estimation Committee (GEC) Methodology 1997. As per the computation, the net groundwater availability is 40926.67 ha m**.** The resources available varied from 1567.93 Ha.m (Mukhathala) to 13306.31 Ha m (Anchal). The gross ground water draft for all uses in the district is of the order of 15711.15 Ha.m, leaving a balance of 23810.17 Ha.m for future irrigation development, after providing for 13101.55 Ha.m to cater to the domestic and industrial needs of the district up to the year 2025. The Stage of ground water development varies from 11.85% in Anchal

block to 88.96% in Anchalummoodu block. Based on the stage of ground water development and the long-term trend of ground water levels in observation wells, Anchalummoodu block has been categorized as 'Semi-Critical' and the remaining blocks are categorized as 'Safe'. Salient details of the computation are presented in **Table 6** and the details of categorization of blocks in the district are shown in **Figure 6**.

Table 6: Dynamic Ground Water Resource of Kollam District as in March 2009

Sl. No.	Assessment Unit/ District	Total Annual Ground Water Resources (Ha.m)	Provision for Natural Discharge (Ha.m)	Net Annual Ground Water Availability (Ha.m)	Existing Gross Ground Water Draft for All uses (Ha.m)	Net Ground Water Availability for Future Irrigation Development (Ha.m)	Stage of Ground Water Development (%)	Categorization for future GW development
1	Anchal	14784.79	1478.48	13306.31	1576.70	11603.34	11.85	Safe
2	Anchalummoodu	1483.13	148.31	1334.82	1187.39	39.47	88.96	Semi critical
3	Chadayamangalam	4144.32	414.43	3729.89	1469.66	2147.84	39.40	Safe
4	Chavara	2042.99	102.15	1940.84	941.08	916.53	48.49	Safe
5	Chittumala	1735.87	86.79	1649.08	882.05	702.83	53.49	Safe
6	Ithikkara	3275.63	327.56	2948.06	1534.52	1287.14	52.05	Safe
7	Karunagappally	1979.30	98.96	1880.33	997.19	561.57	53.03	Safe
8	Kottarakkara	2225.39	222.54	2002.85	1205.79	702.42	60.20	Safe
9	Mukhathala	1742.15	174.21	1567.93	1090.18	490.25	69.53	Safe
10	Oachira	1891.49	94.57	1796.92	879.11	842.73	48.92	Safe
11	Pathanapuram	4569.35	456.93	4112.41	1459.98	2544.28	35.50	Safe
12	Sasthamkotta	2261.18	113.06	2148.12	1115.19	944.14	51.91	Safe
13	Vettikkavala	2787.90	278.79	2509.11	1372.31	1027.63	54.69	Safe

4.3 Ground Water Quality

Groundwater, in general, is potable in the major part of the district, except along seacoast, backwaters and in areas polluted by industrial effluents. The quality is excellent in hilly tracts and most of the midland regions. Intermediate quality waters are found in the lower midland and coastal stretches. About 32% of GWMW samples show Electrical conductivity less than 100 µs/cm at 25^0C and about 37% show Electrical conductivity less than 250 µs/cm at 25^0C. Only in areas very near to the coast and tidal zones, the water samples having EC above 1000 µs/cm at 25^0C. Chloride in phreatic groundwater is below 60 mg/l in major part of the district. Higher values of chloride are observed as localized patches in the coastal plain in the close vicinity of the backwaters. The chloride content is observed in the range of 5.7 (Location: Ayur; Ayur block) to 298 mg/l (Location: Chavara;Chavara block). In the bore wells,

the quality of water is generally good, with EC is in the range of 50 to 250 µs/cm at 25^0C. Fluoride value is also within permissible limit.

The result of chemical analysis of GWMW samples collected from phreatic aquifers during April 2009 is given in **Annexure 2**.

4.4 Status of Groundwater Development

The shallow phreatic aquifers in alluvium are developed through dug wells and filter point wells. Filter point wells are more economical in the alluvium areas in comparison to dug wells. However, filter points can be constructed only in very restricted areas where the saturated sand thickness in the shallow zone exceeds 5 m.

Filter point wells are feasible in coastal areas especially along Chavara, Karunagapally and Oachira blocks and the yield from these wells ranges from 20 to 60m^3/day.

The yield of wells in laterite ranges from 0.5 to 6 m^3/day. The depth ranges of wells are 5.6 to 28 m bgl. Generally large diameter wells are constructed in laterite terrain.

Development of Vaikom aquifer is extensive in the district. The present draft from this aquifer is estimated to be less than 4 MCM leaving bright scope for future development. Maximum development has taken place in this aquifer catering to the dense coastal population. Many piezometers have been constructed in this aquifer by Central Ground Water Board to monitor the groundwater development. Vaikom aquifer caters to both drinking and industrial needs of the district.

The Quilon aquifer is comparatively less potential than that of underlying Vaikom aquifer. Hence this aquifer is not widely developed in the district.

The Warkali aquifers are the topmost potential aquifer in the Tertiary sediments. This aquifer has not been developed to the extent of those in Vaikom aquifers. Hence future development can be resorted to, from this aquifer to diminish the stress of development in Vaikom aquifers.

The depth of dug wells in the Tertiary formations ranges from 6-28.5 m bgl. The average yield of the wells ranges from 500 to 10000 lpd.

A total of 14 tube wells were drilled in the sedimentary area by CGWB prior to SIDA project and 5 during the SIDA Project. The depth of these wells ranges from 30 m at Pallickal to 416 m at Marudurkulangara. Discharge ranges from 0.75 lps at Poruvazhi to 56.9 lps at Mainagapalli.

In the fractured crystallines, the bore wells constructed to the depth ranging from 114.71 to 301.89 m. Yield ranges from 0.61 to 23 lps. The general potential zones are between 40 to 75 m. Below 100 m depth only in limited areas high yielding zones are encountered. CGWB drilled wells of 200 m depth

under Ground Water Exploration Programme. The yields of bore wells range from 50 lpm at Ezhukone, Kottarakara block to 1000 lpm at Valiyakavu, Pathanapuram Block. The data from exploratory drilling carried out by CGWB were analysed. The E-W trending lineaments followed by NE-SW lineaments are found to be potential in the district. The bore wells in the northern and north eastern parts of the district have comparatively higher discharges. High yields have been encountered during drilling in the wells constructed at Kulathupuzha(11 lps), Aryankavu(20 lps), Kottarakara(23 lps) , Valiakavu (16.66 lps), Anchal (25.20 lp), Thekkumala (12.60 lps), Ayiranallur (37.43 lps), Bharatipuram (15.48 lps) and Chithara (3.60 lps)

In recent years, due to fall in water level, the dug wells were deepened in many parts of the district for better yields. Common water lifting devices are centrifugal pumps and jet pumps for dug wells and submersible pumps and compressor for bore wells. Water is also being lifted by bucket and rope from dug wells for domestic purposes.

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1. Groundwater Development

The district is blessed with abundant groundwater resources in phreatic, semi-confined and confined conditions. Groundwater is mainly used for drinking and industrial purposes. The phreatic aquifer is tapped by dug wells and filter point wells generally fitted with 1.0 to 1.5 HP motors. The deeper confined Warkali and Vaikom aquifers are extensively developed through submersible or vertical turbine pumps for drinking water supply.

The ground water in the district is mostly developed through dug wells for domestic and agricultural purposes and to a limited extent for industrial and irrigation purposes. Recently the bore well culture has gained momentum. Ground water development should be coupled with management of rain water harvesting and surface water. There should be proper water budgeting in the district. The existing water resources and dug wells, ponds, tanks etc should be cleaned, protected and conserved. Artificial recharge schemes should be practiced in large scale along with rain water harvesting. Rainwater in situ collection can be practiced along the coastal region and artificial recharge to groundwater can be practiced in the midland regions.

Mass awareness programmes should be carried out at Panchayat level to create awareness among the people on the importance of conservation and protection of groundwater.

5.2 Water Conservation and Artificial Recharge

CGWB has implemented one artificial recharge scheme at Sadanandapuram in the Agricultural University campus. A subsurface dyke was constructed during the year 1998.

The structure constructed was a plastered brick wall over massive basement and it was kept 1.0 m below ground level to avoid water logging in the upstream side of the dyke. Three sets of piezometers were constructed on either side of the dyke for water level measurement.

Impact assessment study revealed that during the month of May immediately after the construction of the structure there was a rise of 0.22 to 0.88 m in water levels between the upstream and the downstream side. The reservoir area of the dyke got fully recharged by the first few showers and the same trend continued till the end of December.

Due to highly undulating nature of the topography and steep slopes, ground water discharge from the phreatic aquifer is quite high, during and after the monsoon. In order to retain the groundwater storage for utilization during the non monsoon months, the subsurface runoff should be checked. This can be achieved by construction of subsurface dykes in the upland regions and in the laterite valleys. The subsurface dyke constructed in the project at Sadanandapuram. Recharge structures like percolation tanks, check dams, contour bunding, trenching, pitting and terrace cultivation can be practiced in the upland regions. In coastal areas Artificial Recharge structures are not feasible since the water levels in these areas are in the range of 0.50 to 5.9 m which does not fulfil the condition for artificial recharge. Moreover during the monsoons the excess water is in the form of rejected recharge in alluvial aquifers. Hence the most feasible option for the solution of safe drinking water is rain water harvesting structures.

Anchal, Yeroor, Adayaman, Idamulakal, Karavaloor, Thenmala, Ariankavu, Chithara, Kilikollur Panchayaths are facing acute water scarcity during summer. The below mentioned remedial measures can be adopted to solve the water scarcity of the area

- Maintenance and desilting of the ponds
- Construction of check dams
- Conservation of Panchayath wells, ponds etc
- Encourage drip irrigation
- Implementation of rainwater harvesting and artificial recharge schemes

It will be ideal if the water management in the area be done on watershed basis, which will include construction of groundwater conservation structures to induce more recharge. Bore wells may be constructed along the potential fractures for irrigation and drinking water supply. Artificial recharge

schemes to be implemented in the blocks on priority basis. The proposed Artificial Recharge scheme is given in **Table 7** and is shown in **Figure 7**.

Table 7: Artificial Recharge Schemes proposed in Kollam District.

Sl No.	Name of block	Artificial Recharge Schemes				
		Percolation tank	Check dams	SSD*	Contour bunding / Terracing	Rooftop rain water harvesting
1	Vettikavala	3	3	2	1	
2	Pathanapuram	5	2	3	3	
3	Mukhathala	2	3	1	-	
4	Sasthamkotta	3	2	4	-	
5	Ithikara	-	-	-	-	4
6	Oachira	-	-	-	-	3
7	Kottarakkara	2	-	3	-	4
8	Kollam	-	-	-	-	3
9	Chavara	-	-	-	-	3
10	Chittumala	3	-	1	-	-
11	Chadayamangalam	2	1	-	-	-

*SSD: Subsurface dyke

6.0 GROUND WATER RELATED ISSUES AND PROBLEMS

The estimation of groundwater resources in for the year 2009 has indicated that groundwater development in the district is around 38%. However on, Anchalummoodu block is in ‘semicritica’l category. A considerable amount of groundwater is being developed from the midland area of the district from a number of wells for water supply and irrigation purposes. Saline water ingress is observed in the shallow alluvial aquifer in the western part of the district which is in hydraulic connection with the backwater. Water logging is generally seen in a limited area along the western border of the district bordering the backwater lagoons during rainy season. The foothill regions of the Western Ghats falling in Pathanapuram and Anchal blocks are facing acute water scarcity during summer months.

Groundwater pollution is reported from two areas of the district. One is reported from Chavara, and the other from Pozhikara. Chavara area has been polluted due to the effluents from the factory M/s Kerala Metals and Minerals Ltd. The groundwater in the nearby area shows low pH value 1.3 to 3.3 which is highly acidic and certain trace elements like Zn, Mn, and Fe are also reported above the permissible limit.

The tidal regulator at Pozhikara has created some environmental problems. The paddy fields in the Ithikara area have been affected, the nearly Paravoor Kayal has become more saline and the fresh water laterite aquifer became saline due to sea water ingress.

The 'Tsunami, which occurred during 2004 had affected the coastal areas of Alappad Panchayath. The groundwater of the area had become saline. The Reappraisal study during 2007-08 has shown that the wells affected quality wise during Tsunami have improved and the change was only a temporal phenomenon since the hydraulic gradient of the aquifer remained unaffected by the killer waves of Tsunami.

7.0 AWARENESS AND TRAINING ACTIVITY

Mass Awareness Programme (MAP) and Water Management Training Programme (WMTP) by CGWB

One Mass awareness programme was conducted during March 2008 at Kollam. Around 220 people participated in the Awareness Programme.

One WMTP programme was conducted at Anchal during 2002. About 100 participants attended the Training Programme. One awareness raising training program under Hydrology Project organized at Kollam during March 2010. About 75 participants attended the Training Programme.

8.0 AREAS NOTIFIED BY CGWA/SGWA

No block in Kollam district is notified by CGWA or SGWA at present.

9.0 RECOMMENDATIONS

- The groundwater potential in the alluvial terrain can be developed through various groundwater structures viz. dug wells, filter points and shallow tube wells. Dug wells ranging in depth from 4.0 to 7.0 m with diameter of 1.50 to 2.0 m is recommended. Filter point wells are feasible in areas around Chavara and Oachira blocks wherever the saturated sand thickness exceeds 5 m.
- Laterite aquifer in the northeastern parts of the district can be developed through open dug wells ranging in depth from 10 to 12 m with a diameter of 1.5 to 3.5 m. There is a big gap between dynamic phreatic groundwater resource available and utilized in the district. Accelerated groundwater development in the district would bring more area under irrigation since there is a lot of resource untapped.
- The Tertiary sediments can be developed through tube wells. There is scope for additional 55 tube wells in the district in the depth range of 100-150 m tapping the Warkali aquifer with a minimum granular thickness of 15 m.

- The deeper Vaikom aquifer in the Tertiary formation can be developed through tube wells and an additional 10 tube wells in the depth range of 150-300 m can be constructed.
- Development of groundwater will go a long way in providing assured irrigation and drinking water even to remote areas. Development of water resources needs a scientific management system coordinating the efforts of all concerned State and Central agencies for a speedy development of the district in the agricultural sector.
- The Panchayats suitable for constructing bore wells are Anchal, Erur, Alayaman, Idamulakkal, Thenmala, Ariyankavu, Chithara, Kadakkal, Nilamel, Veliyam, Vettikavala, and Pooyapalli. Proper site selection is needed to locate the base wells in lineaments to the better results can be obtained. Immediate attention is needed in the following panchayats for water supply schemes viz. Anchal, Erur, Alayaman, Ilamukal, Thenmala, Ariyankavu, Chithara, Kadakkal, Nilamel, Veliyam, Vettikavala and Kilikollur.
- The existing water resources like ponds, backwaters, rivers and panchayat wells should be cleaned and protected. All the wet lands of Kollam district should be protected from contamination and encroachment.
- Suitable artificial recharge schemes should be implemented for conserving surface runoff from rainfall. Rainwater harvesting schemes should be practiced in the coastal areas and artificial recharge schemes like sub-surface dyke, percolation tank, contour bunding etc. can be practiced in the mid land and high land regions of the district.
- Large scale rainwater harvesting may be considered to be taken up in the quality affected areas of Chavara and Pozhikara which may improve the quality of water through dilution over a period of time.
- Any development projects along or near the coast should be technically scrutinized and environmental impact assessment study should be made a pre requisite to assess the feasibility of the project.
- Farmers may be encouraged to adopt modern irrigation techniques like drip irrigation to have optimal use of the available resources and community irrigation schemes have to be encouraged.
- Necessary measures for regulating the exploitation of groundwater may be implemented in the semi critical block of Anchalummoodu.
- Mass awareness programmes and rainwater harvesting training should be conducted at Panchayath level to create awareness among people about the importance of this precious resource of groundwater

Figure 1: Index map of Kollam District, Kerala

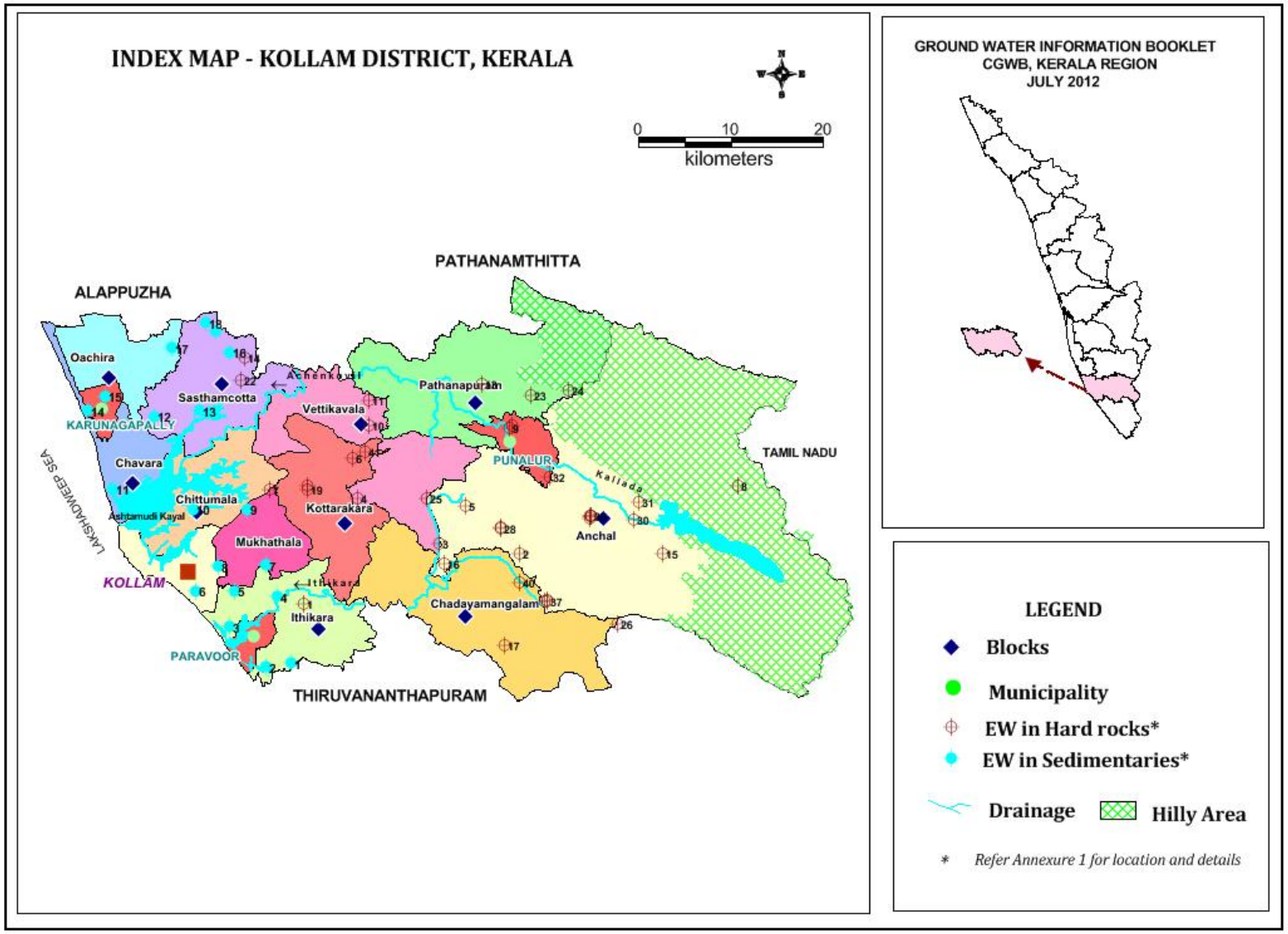


Figure 2: Depth to Decadal Average Water Level (Pre-monsoon April 2002-11)

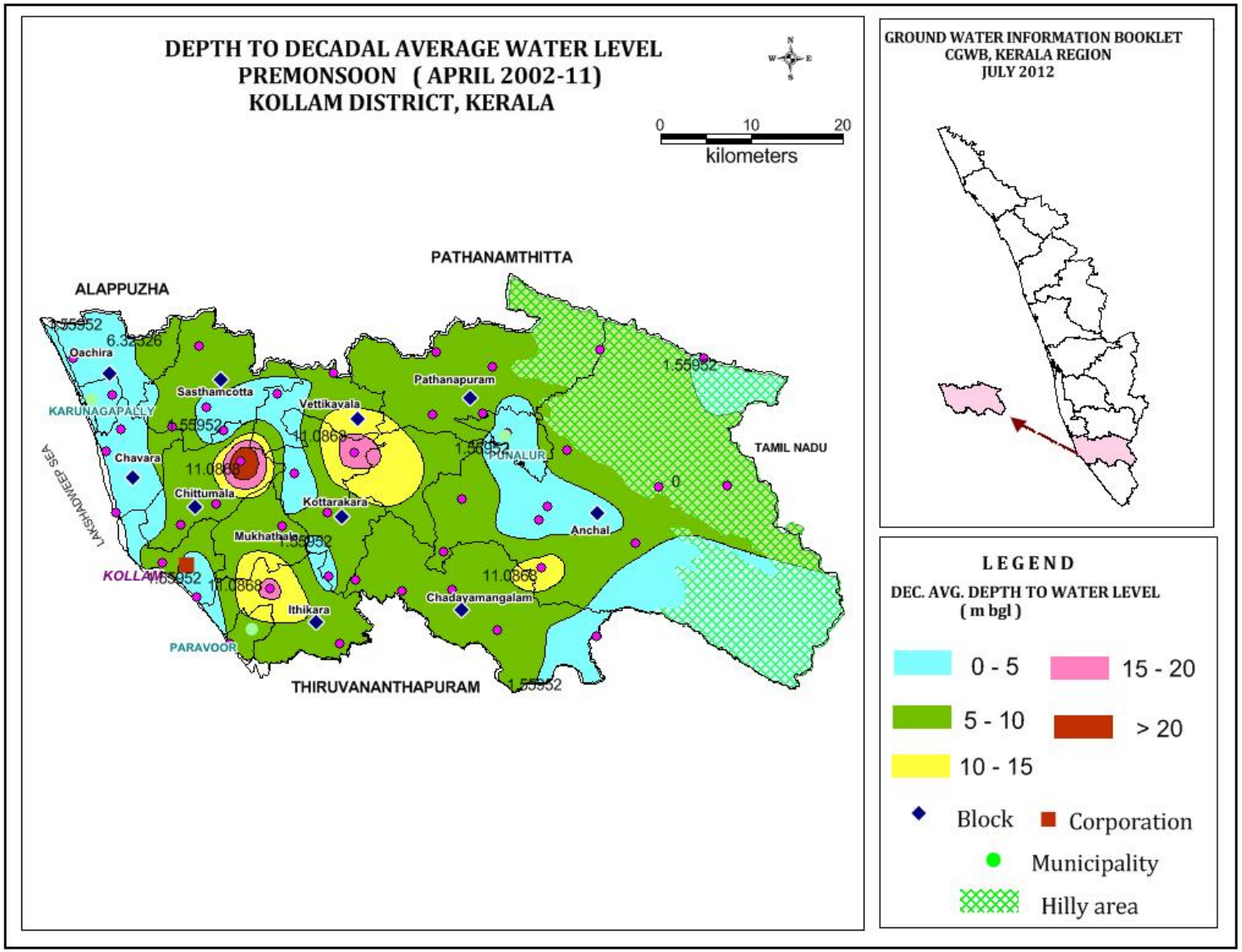


Figure 3: Depth to Decadal Average Water Level – Post monsoon-(Nov-2002-2011)

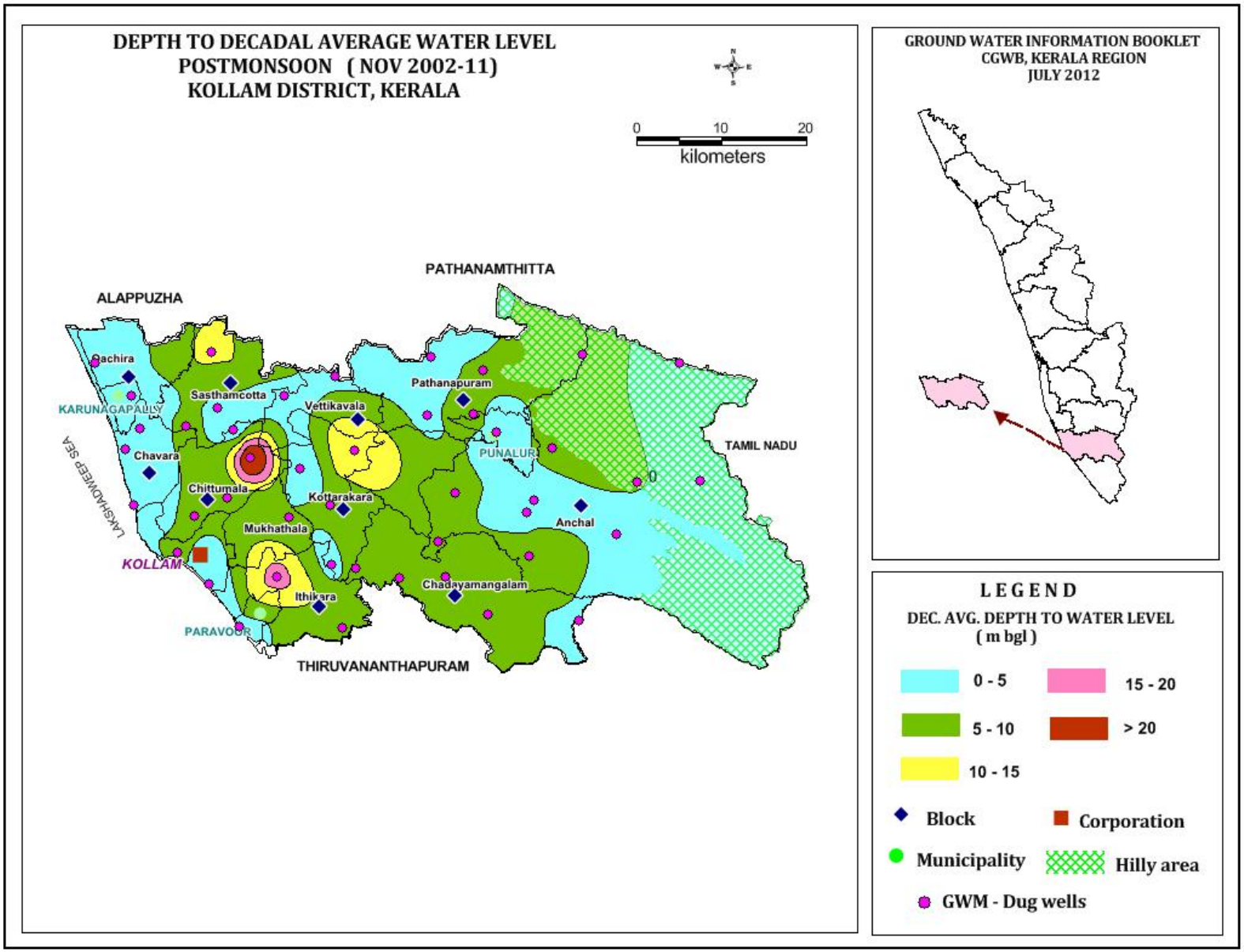


Figure 4: Hydrogeology of Kollam District, Kerala State

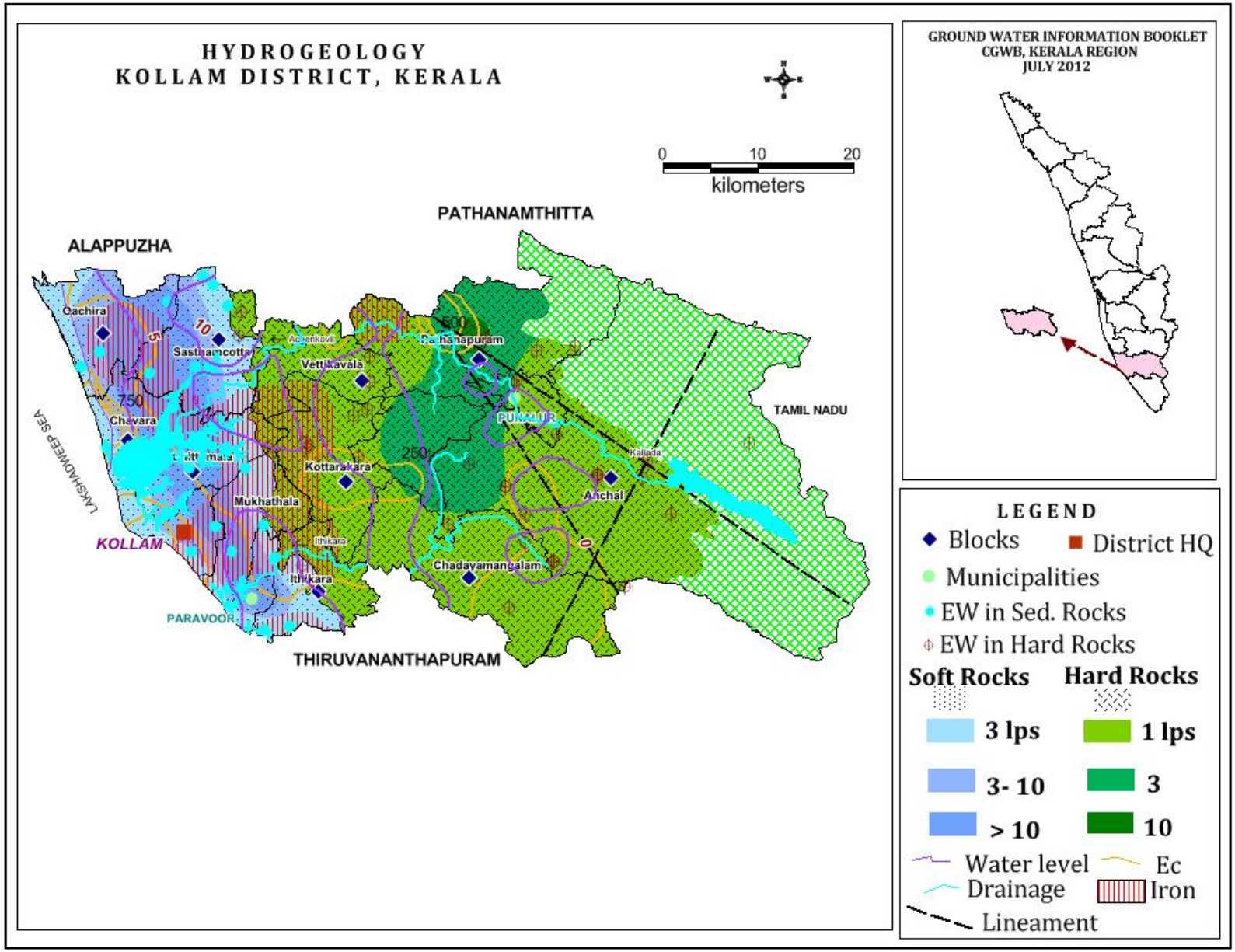


Figure 5: Categorization of Blocks in Kollam District

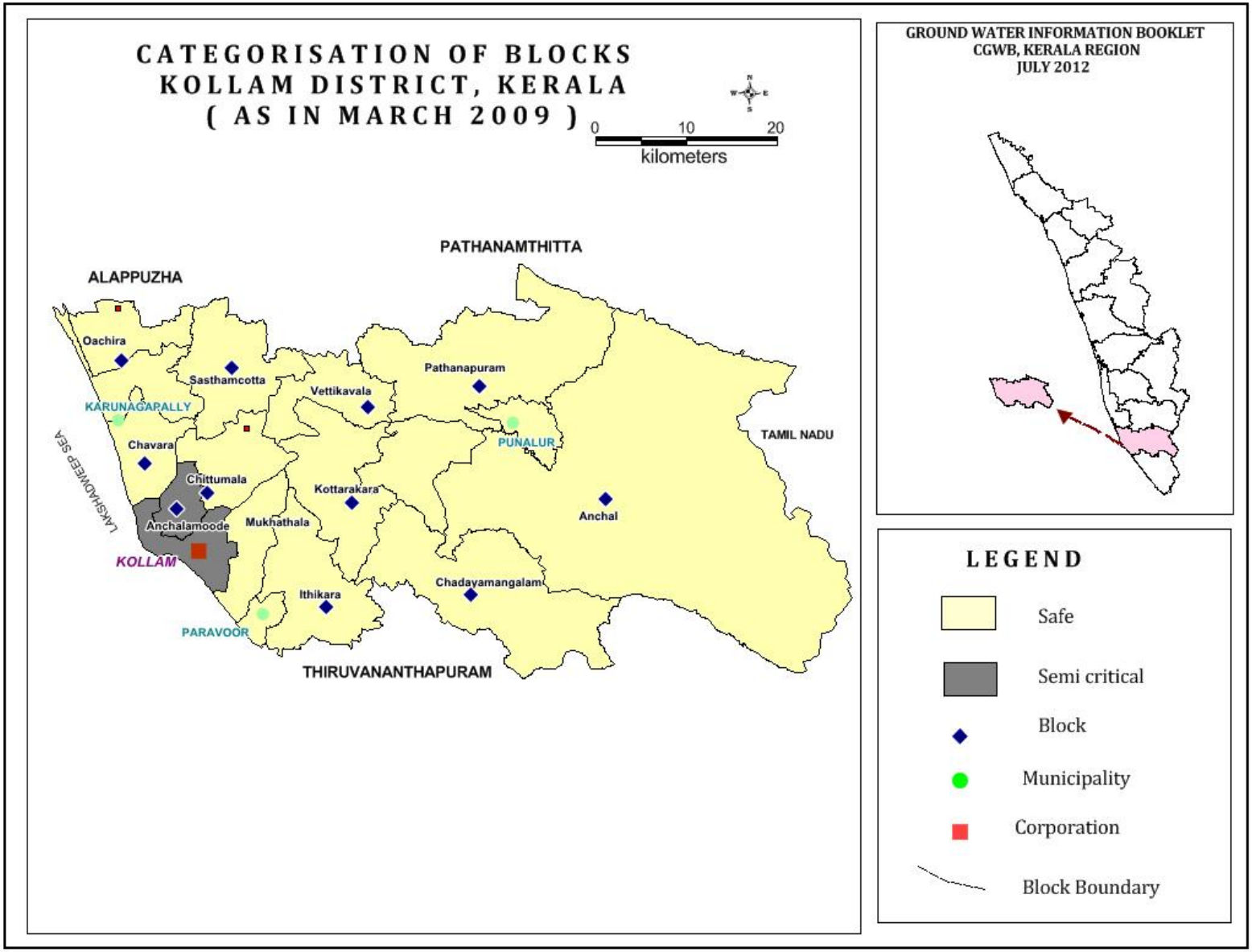
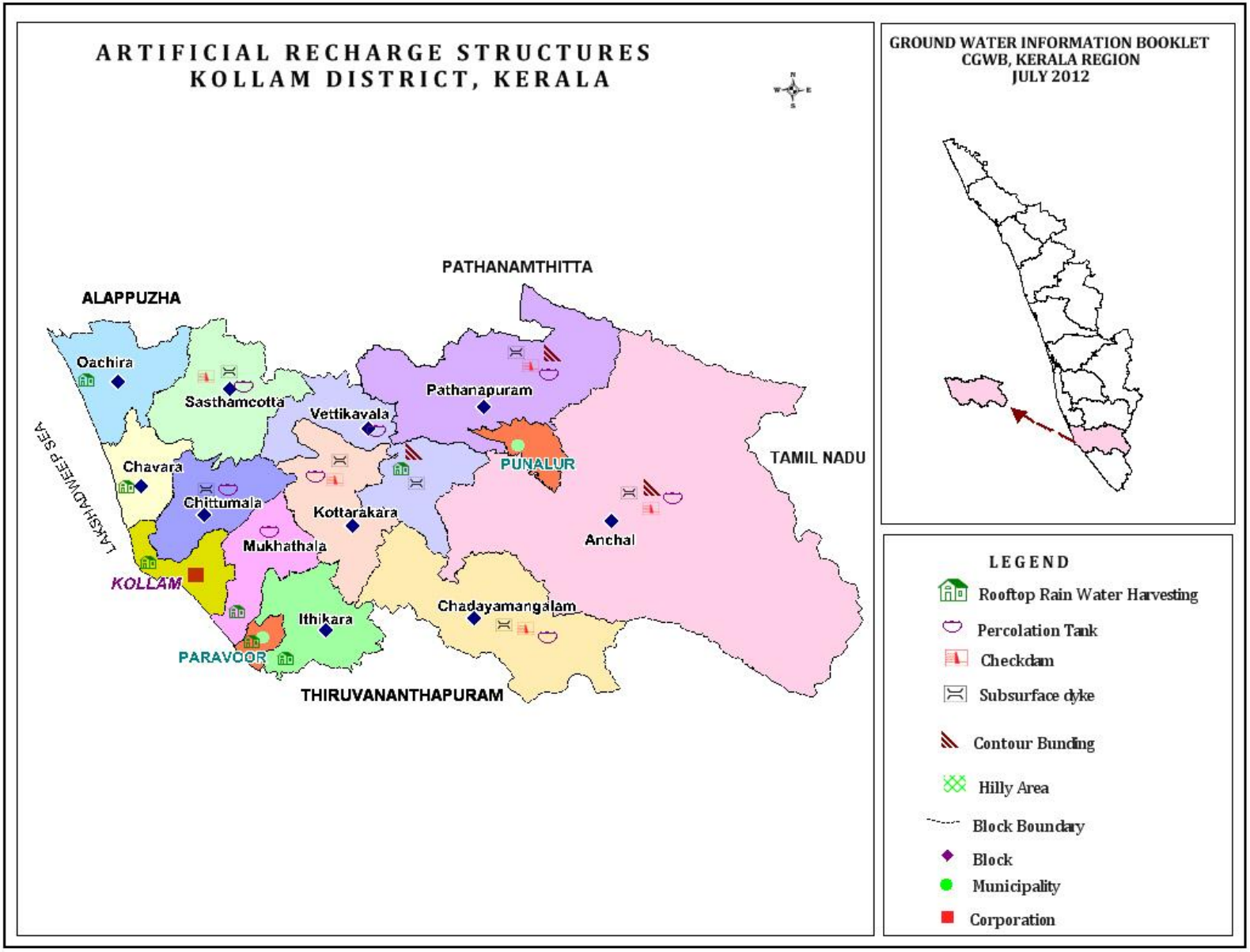


Figure 6: Artificial Recharge Structures proposed in Kollam District



Annexure 1a: Exploratory wells drilled in Hard rock area of Kollam District

Sl No	Location	Coordinates	lithology	Depth	Zones encountered	SWL	Dis lps	DD m	T (m2/day)
1	Karamkode	8^0 51' 20'' 76^0 43' 20''	Khondalite	200.5	-	18.24	-	-	-
2	Karukone	8^0 54' 15'' 76^0 56' 05''	Khondalite	200.53	35.00 75.00	9.10	0.31	-	0.43
3	Kampamkode	8^0 54' 50'' 76^0 51' 20''	Granite biotite gneiss	200.53	50.47 70.0 141.6	7.29	5.5	-	11
4	Nellikunnam	8^0 57' 30'' 76^0 46' 30''	Granite biotite gneiss	200.0	45.0 80.0	2.86	0.61		1.17
5	Tadikad	8^0 57' 05'' 76^0 52' 55''	Khondalite	175.67	50.47 80.61 118.71	12.05	4.5		4.5
6	Kottarakara	8^0 59' 50'' 76^0 46' 15''	Granite biotite gneiss	114.71	12.37 23.61	65.37	23		51
7	Kundara	8^0 58' 0'' 76^0 41' 20''	Garnet biotite gneiss	206.15	-	-	-	-	-
8	Ariankavu	8^0 58' 15'' 77^0 09' 00''	Granite biotite gneiss	129.95	58.0 80.0 90.0	2.05	20	-	80.6
9	Punaloor	9^0 01' 35'' 76^0 55' 30''	Granite biotite gneiss	200.53	-	-	-	-	
10	Mailom	9^0 01' 45'' 76^0 47' 10''	Granite biotite gneiss	300.06	111.0 210	4.28	0.9	-	-
11	Puvattur Padinjaru	9^0 03' 10'' 76^0 47' 10''	Granite biotite gneiss	200.53	-	-	-	-	-
12	Ambalattumbhagam	9^0 04' 20'' 76^0 4' 50''	Granite biotite gneiss	301.89	-	-	-	-	-
13	Kadakkamam	9^0 04' 10'' 76^0 53' 50''	Calc granulite	168.05	35.5 85	12.35	15.1	-	17
14	Idakkattu	9^0 05' 40'' 76^0 39' 50''	Granite biotite gneiss	200.53	45 90	1.30	2.5		3.0

					142				
15	Kulathupuzha	8^0 54’ 15’’ 77^0 04’ 30’’	Khondalite (Granite biotite gneiss)	115	37.80-40.80 56.10-59.10 65.20-71.30 95.70-98.80 111-115.0	1.05	11.04	9.10	52.835
16	Thottathara	8^0 53’ 42’’ 76^0 51’ 40’’	Khondalite (Granite biotite gneiss and quartzo feldspathic gneiss)	200	16.40-19.50 25.60-28.00 98.80-104.90 141.50-144.50	5.0	2.90	22.12	7.403
17	Kadakkal	8^0 48’ 54’’ 76^0 55’ 10’’	Khondalite (Granite biotite gneiss)	200	19.50-22.50 120.10-123.20 187.20-190.30	2.32	2.0	29.50	1.083
18	Kottukal	8^0 53’ 38’’ 76^0 84’ 41’’	Khondalite (Granite biotite gneiss)	200	28.60-31.70 62.20-65.20 150.60-153.70	21.06	1.50	15.70	2.26
19	Nellikunnam	8^0 57’ 58’’ 76^0 46’ 38’’	Granite biotite gneiss	166	7.0-9.0 46.90-50.0 83.50-86.60	0.20	1.30	36.0	0.83
20	Ezhukone	8^0 58’ 15’’ 76^0 43’ 32’’	Khondalite (Granite biotite gneiss)	123	13.40-16.40 19.50-22.50 43.90-46.90	3.0	0.85	10.54	0.644
21	Pattazhy	9^0 49’ 15’’ 76^0 48’ 20’’	Granite biotite gneiss with charnockites patches	200	19.5-22.50 25.6-28.60 53.0-56.10	4.52	1.20	22.93	1.16
22	Vazhathopu	9^0 04’ 20’’ $76^0$39’ 40’’	Charnockites	200		4.52			
23	Karavur	9^0 03’ 30’’ 76^0 56’ 45’’	Charnockites	200	19.5-22.50 25.6-28.60 53.0-56.10	1.21	4.0	22.93	1.16
24	Valiyakavu	9^0 03’ 45’’ 76^0 59’ 00’’	Granite biotite gneiss with charnockites patches	123	19.50-22.50 86.60-89.60 101.80-104.9	9.03	16.66	7.19	45.16
25	Mullumala, Kottarakara	-	Khondalite	200	10.50-13.50 132.30-135.50	6.16	4	22.15	-

26	JNV, Kottarakara	-	Khondalite	200	31-32	17.17	1	10	-
27	Tazhethukulakada	-	Khondalite	200	-	-	-	-	-
28	Chadayamangalam	-	Khondalite	200	-	-	-	-	-
29	Pathanapuram	-	Fractured Khondalite	200	22.50	8.10	1.0	12.0	-
30	Valakom	8° 57' 28" 76° 50' 36"	Khondalite	200	83.50-86.60,120.10-123.20	15.10	7.20	15.1	2.71
31	Arippa	8° 50' 10" 77° 01' 52"	Khondalite	200	98.80-101.80	8.00	3.60	21.5	0.659
32	Punalur	9° 01' 46" 76° 55' 37"	Khondalite	200	14.00-16.00	6.00	3.60	22.9	0.365
33	Anchal	8° 55' 46" 76° 54' 59"	Khondalite	147.6	40.80-43.90, 59.10-62.20, 141.50-147.60	13.75	25.20	9.25	28.47
34	Koovakkad	8° 56' 15" 77° 02' 50"	Khondalite/Hornblende Biotite Gneiss	200	Nil	8.00	Nil	Nil	Nil
35	Thekkumala	8° 57' 16" 77° 03' 08"	Khondalite (well abandoned due to caving)	68.7	34.70-37.80, 49.90-50, 53.00-56	0.30(agl)	12.60	Nil	Nil
36	Aiyranallur	8° 58' 46" 76° 57' 53"	Khondalite	184.3	22.50-25.60, 59.10-62.20, 138-141.50, 175.80, 178.10, 181.20-187.20	3.90	37.43	14.18	16.39
37	Bhartipuram	8° 56' 26" 77° 00' 17"	Khondalite	185.5	138.40-141.50	11.00	15.48	15.30	4.74
38	Chithara	8° 51' 31" 76° 57' 44"	Khondalite	200	80.50-83.50, 147.80-150.80, 175-178.10	1.50(agl)	7.20	28.45	11.6
39	Vizhuthara	8° 52' 35" 76° 56' 05"	Khondalite	200	114.00-117.00	15.40	3.60	16.35	0.878
40	Kottarakara	9° 00' 12" 76° 47' 00"	Khondalite	200	95.70-98.80, 129.30, 132.30	10.00	7.20	19.70	10.28

Annexure 1b: Details of wells drilled in Sedimentary area , Kollam District, Kerala

Sl No.	Year of construction	Location	Coordinates & Toposheet No.	Depth drilled (m bgl)	Depth constructed m bgl	Static Water Level m bgl	Aquifer tapped	Discharge lps
1	1972	Poodakulam	08^{0}47'30", 76^{0}42'30", 58D/9.	129.54	Nil	Nil	Slim Hole	
2	1985	Kalaikode	08^{0}47'40", 76^{0}41'05", 58 D/9.	159.11	152.45	12.63	Quilon+ Vaikom	13.86
3	1958	Mayyanad	08^{0}50'00", 76^{0}39'00", 58 D/9.	137.6	Nil	Nil	Vaikom	Abandoned well
4	1986	Ittikara	08^{0}51'45", 76^{0}41'45", 58 D/9.	76	53	15.73	Vaikom	-
5	1972	Pannimasseri	08^{0}52'05", 76^{0}39'15", 58D/9.	107.9	100.58	3.71	Vaikom	11.67
6	1986	Kollurvilla	08^{0}52'20", 76^{0}36'58", 58 D/9.	250	190	7.15	Vaikom	Not tested
7	1972	Kannanallore	08^{0}53'35", 76^{0}41'05", 58 D/9.	67.21	Nil	Slim Hole	Slim Hole	NA
8	1986	Tirumullavaram	08^{0}53'32", 76^{0}38'18", 58 D/9.	Pz -1 - 328.7 Pz-II - 40.7	Pz - 1- 300m, Pz - 2- 36.0m.	11.46 4.45	Warkali+ Vaikom	7.88 3.3
9	1972	Kottangara	08^{0}56'50", 76^{0}40'00", 58 D/9.	35.05	Nil	Slim Hole		NA

10	1972	Thrikkaruva	08^{0}56'50", 76^{0}36'50", 58 D/9.	189.89	184.29	8.60	Vaikom	42.96
11	1992	Chavara	08^{0}58'00", 76^{0}32'05", 58 D/9.	**I** 189.53, **II** 160.0, **III**101.45	185.0, 143.0, 48.0.	12.91 9.18 2.89	Warkali+ Quilon+ Vaikom	30 1.83 0.67
12	1972	Mainagappalli	09^{0}02'15", 76^{0}34'30", 58 C/12.	196.59	175	3.08	Vaikom	56.9
13	1993	Sasthamkotta	09^{0}02'49", 76^{0}37'10", 58 C/12.	178.92	Nil	Slim Hole	NA	NA
14	1990	Maradurkulangara	09^{0}02'35", 76^{0}30'37", 58 C/12.	l-416.00, ll-164.50	323.0, 150.0	5.1	Vaikom	26 25
15	1957	Karunagapalli	09^{0}03'25", 76^{0}31'40", 58 C/12	304	271	2.25	Warkali + Vaikom	NA
16	1987	Poruvazhi	09^{0}06'00", 76^{0}39'00", 58 C/12	47	32	7.62	Vaikom	0.75
17	1972	Sooranadu	09^{0}06'15", 76^{0}35'35", 58 C/12.	99.97	92.8	1.63	Vaikom	36.86
18	1987	Vayyankara	09^{0}08'15", 76^{0}37'45", 58 C/12	62.6	51.5	19.22	Vaikom	4.83
19	1988	Pallickal	09 08' 42" 76 39' 05" 58 C/12	30.1	28.5	8.12	Vaikom	NA

Annexure 2: Chemical Analysis data of GWMW samples collected from Kollam district during April 2009

Sl No.	Location	pH	Ec in µs/cm at 25° C	TH as $CaCO_3$	Ca	Mg	Cl	F	NO_3
				<----------Concentration in mg/L ---------->					
1	Achenkovil	8.3	416	94	21	10	70	0.49	1.6
2	Ailara	7.57	103	10	3.2	0.49	23	0.15	0.24
3	Akkal	-	120	10	3.2	0.49	14	0.14	16
4	Anchalummoodu	4.79	344	32	8	2.9	71	0.15	40
5	Ariyankavu	8.17	260	86	12	14	13	0.24	3.3
6	Avaneeswaram	7.37	64	14	4	0.97	4.3	0.28	2.6
7	Chadayamangalam	7.91	158	14	4.8	0.49	31	0.3	0.38
8	Channapetta	7.4	195	22	4	2.9	33	0.34	22
9	Chenkulam	8.02	90	8	1.6	0.97	13	0.07	8.6
10	Edamon	7.19	46	6	1.6	0.49	7.1	0.11	5
11	Iravipuram	7.85	349	82	27	3.4	36	0.17	10
12	Ithikkara	7.07	155	32	9.6	1.9	20	0.08	20
13	Kadakkal	4.37	495	64	16	5.8	70	1.1	135
14	Kadapuzha	8.73	167	52	14	4.4	13	0.32	8.9
15	Karunagapalli	8.05	273	84	27	3.9	30	0.16	5.8
16	Kottakayam	7.61	42	10	3.2	0.49	4.3	0.04	0.77
17	Kottarakkara	-	178	28	11	0	28	0.12	2.4
18	Kulakada	-	134	30	12	0	9.9	0.19	2.1
19	Kulathupuzha	7.7	246	20	4.8	1.9	43	0.05	47
20	Kunnada	7.34	80	14	4.8	0.49	11	0.5	6.5
21	Kutavettur	8.89	162	32	9.6	1.9	21	0.11	13
22	Madathara	7.58	114	14	4	0.97	21	0.3	12
23	Nallila	7.37	63	8	2.4	0.49	13	0.07	3.7
24	Oyur	7.29	72	12	4	0.49	8.5	0.12	10
25	Paripally	-	140	26	9.6	0.49	17	0.23	3.5

26	Pathanapuram	8.29	554	100	28	7.3	103	0.2	110
27	Pavitreswaram	7.7	114	8	2.4	0.49	24	0.19	16
28	Perinad	7.53	146	18	5.6	0.97	27	0.42	6.8
29	Pozhikara	8.09	382	78	16	9.2	64	0	1
30	Punalur I	-	105	20	6.4	0.97	14	0.1	0.92
31	Punalur II	-	117	28	6.4	2.9	14	0.25	0.54
32	Punnala	7.32	111	20	5.6	1.5	17	0.23	9.6
33	Quilon	6.76	95	26	8.8	0.97	13	0.34	6.1
34	Tadicaud	-	107	12	4	0.49	21	0.18	1.9
35	Thenmala	7.63	47	8	2.4	0.49	11	0.3	4.2
36	Ummannur	7.87	182	36	10	2.4	30	0.16	16
37	Vadakkumthala West	5.16	442	88	26	5.4	67	0.21	69
38	Vallikavu	-	138	40	13	1.9	20	0.14	9.3
39	Yeroor	8.39	327	50	14	3.9	33	0.49	2.9