Draft Report

केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय

भारत सरकार

Central Ground Water Board

Ministry of Water Resources, River Development and Ganga Rejuvenation

Government of India

Report on

AQUIFER MAPPING AND MANAGEMENT PLAN

Gauribidanur, Chikballapur District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region,Bengaluru

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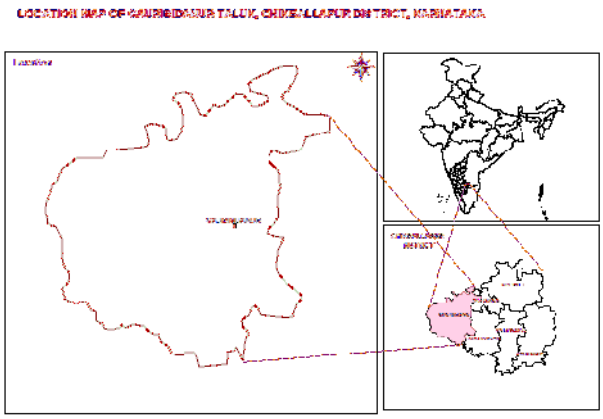
Government of India
Ministry of Water Resources, River Development
& Ganga Rejuvenation
Central Ground Water Board

GAURIBIDANUR TALUK AQUIFER MAPS AND MANAGEMENT PLAN, CHIKBALLAPUR DISTRICT, KARNATAKA



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January 2017

GAURIBIDANUR TALUK AQUIFER MAPS AND MANAGEMENT PLAN, CHIKBALLAPUR DISTRICT, KARNATAKA

CONTENTS

GAURIBIDANUR TALUK AQUIFER MAPS AND MANAGEMENT PLAN, CHIKBALLAPUR DISTRICT, KARNATAKA

1. SALIENT INFORMATION

Name of the taluk : **GAURIBIDANUR**
District : Chikballapur
State : Karnataka
Area : 893 sq.km.
Population :2,90,999 (2011)
Annual Normal Rainfall : 717 mm

1.1 Aquifer management study area

Aquifer mapping studies was carried out in Gauribidanur taluk, Chikballapur district of Karnataka, covering an area of 893 sq.kms under National Aquifer Mapping Project. Gauribidanur taluk of Chikballapur district is located between north latitude 130 25' and 130 47' & east longitude 770 22' and 770 43', and is covered in parts of Survey of India Toposheet Nos. 57 G/6, 57G/7, 57G/9 and 57 G/10. Gauribidanur taluk is bounded by Gudibanda and Chikballapur taluks in east Koratagere and Madhugiri taluks of Tumkur district in west, Doddaballapur taluk of Bangalore Rural district in the south and Hindupur taluk of Andhra Pradesh state in the north. The location map of Gauribidanur taluk of Chikballapur District is presented in Fig. 1.1.

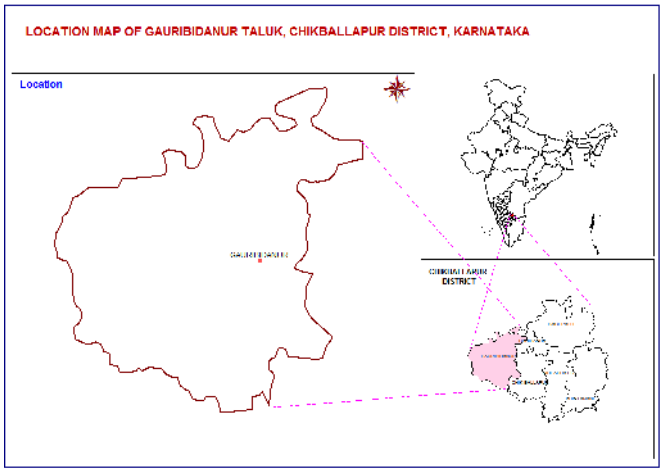

Fig. 1.1: Location Map of Gauribidanur taluk, Chikballapur district

1.2 Taluk administration

Gauribidanur taluk is divided into 6 Hoblies and Gauribidanur is the only one town, which is also the taluk headquarters. There are 220 inhabited and 19 uninhabited villages in

Gauribidanur taluk. The taluk is well connected by good network of roads. Bangalore - Mumbai railway line is the only railway line passing through the taluk.

1.3 Population

According to 2011 census, the population in Gauribidanur taluk is 2,90,999, comprising 1,47,049 males and 1,43,950 females. Out of the total population of 2,90,999, nearly 2,43,122 constitutes the rural population (83.54 %) and 47,877 is the urban population (16.46 %). The study area has an overall population density of 327 persons per sq.km. The decadal variation in population from 2001-2011 is 6.8 % in Gauribidanur taluk.

1.4 Hydrometeorology

Gauribidanur taluk enjoys semi-arid to arid climate. Dry and hot weather prevails during major part of the year. The area falls under Eastern dry agro-climatic zone of Karnataka state and is categorized as drought prone.

The climate of the study area is quite agreeable and free from extremes. The year is usually divided into four seasons: summer from March to May; rainy season or south-west monsoon season from June to September; post-monsoon season covering the months of October and November and dry or winter Season from December to February.

There is one rain gauge station located in Gauribidanur taluk (Table 1.1). The data in respect of this station from the year 1981 to 2010 is analysed. The data pertaining to this gauge is of long term nature and are well maintained. It is presumed that they are representative of the taluk and the same is used for analysis. Normal annual rainfall in Gauribidanur taluk for the period 1981 to 2010 is 717 mm.

Table1.1: Rain gauge and its location in Gauribidanur taluk

Sl.No	Station	Latitude	Longitude	Altitude (m amsl)
1	Gauribidanur	13°37’	77°31’	680

Statistical analysis

Computations were carried out for the 30 year blocks of 1981- 2010 on mean, standard deviation and coefficient of variation of pre-monsoon, monsoon, post-monsoon and annual rainfalls and are shown in Table 1.2.

The mean monthly rainfall at Gauribidanur station is ranging between 1mm during January to 163 mm during September. The CV percent for winter, pre-monsoon, monsoon and

post-monsoon season is 80, 35 & 66 percent respectively. Annual CV at this station works out to be 30 %.

Table 1.2: Statistical Analysis of Rainfall Data of Gauribidanur station, (Period 1981 to 2010)

Parameters	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec	**Annual**
NRF	1	6	10	26	61	70	84	108	163	134	48	6	717
CV(%)	442	282	178	114	80	74	73	68	48	82	133	172	30
% of ARF	0	1	1	4	9	10	12	15	23	19	7	1	100

Assessment of Drought

Rainfall data of Gauribidanur taluk has been analysed for 115 years using IMD method to assess the `drought conditions in Gauribidanur taluk. The results of the classification are listed in the Table 1.3. It is observed that the Gauribidanur taluk has experienced alternating from no drought to severe drought conditions over the years.

Table 1.3: Classification of drought and its recurrence (IMD, 1971)

% Deviation (Di)	>0	0 to -25	-25 to -50	< -50	Probability of drought occurrences
Category	No drought	Mild (Normal)	Moderate	Severe	
	Years				
Gauribidanur	54	38	20	3	Once in 5 years

The details of the drought assessment are discussed as herein under. Out of 115 years of analysis in Gauribidanur taluk, “No Drought” condition is observed during 54 years, “Mild Drought” condition 38 years, “Moderate Drought” condition experienced is 20 years. Further, it is observed that “Severe Drought” condition is experienced in 3 years i.e., during the years 1908, 1923 and 1945. Based on occurrence and frequency of past drought events, the probability of occurrence of various intensities of drought at the station has been studied. It has been observed that the frequency of occurrence of drought is once in 5 years in Gauribidanur taluk.

1.5 Agriculture & Irrigation

Agriculture is the main occupation in Gauribidanur taluk. The amount of rainfall and its distribution throughout the season contributes to the cropping pattern in the area.There are two agricultural seasons namely Khariff (June - October) and Rabi season (Mid October - Mid February). Major Khariff crops are paddy, maize, ragi, tur dal and vegetables (Table 1.4). Main crops of Rabi season are Ragi, Maize, horse gram, groundnut, and sunflower. Mango plantations are the major perennial crop grown in the area (table 1.4).

Table 1.4: Details of cropping pattern in Gauribidanur taluk 2013-2014 (ha)

Year	Paddy	Maize	Ragi	Tur dal	Horse Gram	Other pulses	Fruit trees	Vegetables	Groundnut	other oil seeds	Sugarcane
	Area under cultivation (in ha)										
2013-2014	284	29135	4215	770	350	1015	5725	1408	780	209	44

Table 1.5: Details of land use in Gauribidanur taluk 2013-2014 (ha)

Item Taluk	Year	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Gauribidan	2013-14	86727	4332	15985	7412	45449	1471

Source: District at a glance 2013-14, Govt. of Karnataka.

It is observed from table 1.5 that during the year 2013-14, percentage of gross cropped area of total geographical area was 54.10 % in Gauribidanur taluk. The land use map of Gauribidanur taluk is given in fig 1.2.

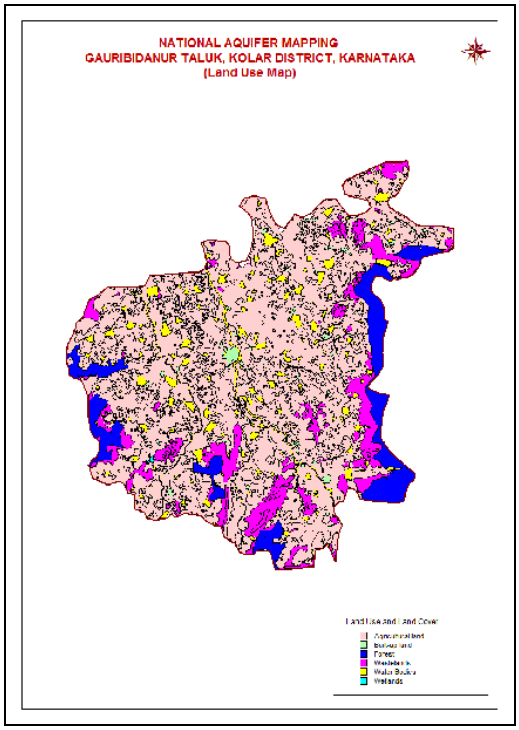

Fig 1.2: Land use map, Gauribidanur taluk

Table 1.6: Irrigation details in study area (ha)

Source	Area under irrigation
Canals	Nil
Tanks	Nil
Wells	Nil
Bore wells	11876
Lift Irrigation	Nil
Other Sources	Nil
Total	**11876**

Source: District at a glance Govt. of Karnataka 2013-14

1.6 Geomorphology, Physiography & Drainage

Geomorphologically, the taluk area is covered with uplands on Gneisses and Granites, which are ideal for agriculture. Physiography of the entire area is in southern maidan region, characterized by undulating landscape with broad valleys, where the elevation ranges from 700m to 1338 m amsl with good degree of slope. The eastern part of the taluk is covered by prominent hill ranges which are continuation of Nandidurga hill ranges running almost N-S direction and is the provenance for the sediment and drainage of Pennar. The remaining portion is having rolling topography undulating and gently sloping lands and valleys. The prominent hill ranges in the area is Devarbetta hill range with 1014 m amsl. The geomorphology of the taluk is given in fig 1.3.

In Gauribidanur taluk, there are no perennial rivers. There are few streams that rise in the hills and feed number of tanks. Theses tributaries are ephemeral. North Pennar drains the major part of the taluk and it rises on the Chennakesava betta, North West of Nandi hills and flows through Manchenahalli and Gauribidanur town and then enters Andhra Pradesh state. The drainage pattern of the area can be described as semi-dendritic to dendritic type **(**Fig 1.4). The drainage patterns are described as sub-rectangular due to marked influence of geologic structures and more or less similar lithological characters.

1.6 Soil

Four classes of soils are found in Gauribidanur taluk. They are clayey, clayey mixed, loamy skeletal and Rocky land. The soil map of the taluk is given below in fig 1.5.

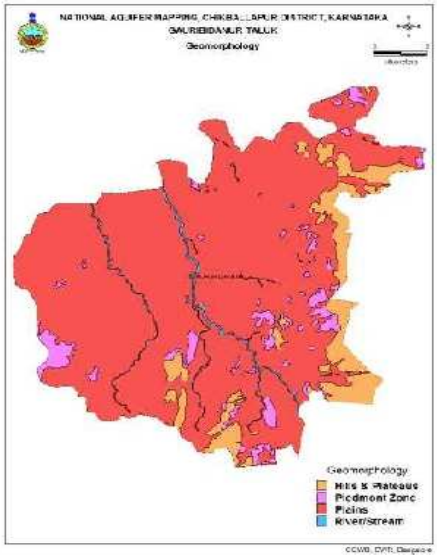

Fig. 1.3: Geomorphology Gauribidanur taluk

Fig. 1.4 Drainage, Gauribidanur taluk

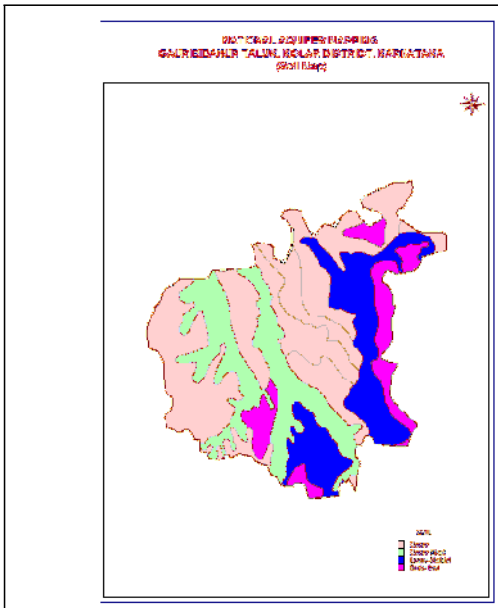

Fig 1.5: Soil map, Gauribidanur taluk

1.7 Ground water resource availability and extraction

(Aquifer wise up to 200 m depth, table 1.7)

Table 1.7: Ground water resource

	Total GW Resources (2011), (Ha m)			
Taluk	**Annual replenishable GW**	**Fresh In-storage GW resources**		**Total availability of fresh GW resources**
		Phreatic	**Fractured (Down to 200 m)**	**Dynamic + phreatic in-storage + fractured**
Gauribidanu	3975	0	1948	5922

1.8 Existing and future water demands

No scope for further Irrigation from ground water.

Domestic (Industrial sector) demand: 87 ha m (GWRE-2013)

1.9 Water level behaviour

(a) Depth to water level

Aquifer –I: In Gauribidanur taluk the phreatic aquifer is almost dry due to over exploitation

Aquifer - II

Pre-monsoon: 5.4 – 79.7 mbgl

Post-monsoon: 4.92 – 69.51 mbgl

DTW maps of pre monsoon (May 2014) and post monsoon (Nov 2014) of aquifer II are shown in fig 1.6 and 1.7 respectively

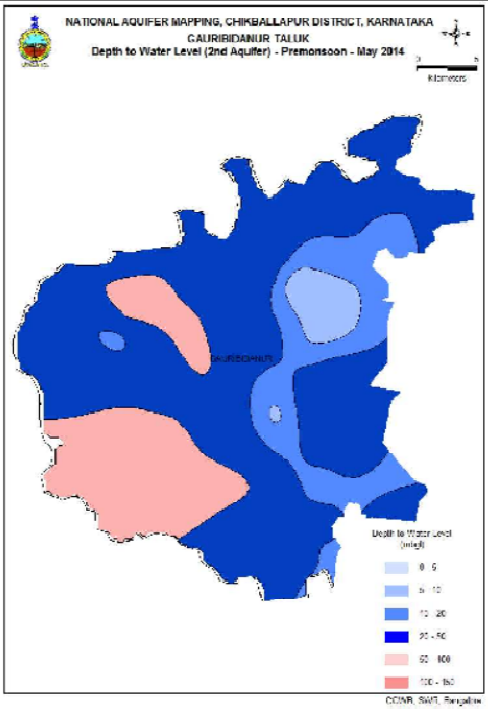

Fig 1.6: Depth to water level Pre-monsoon May2014 (Aq –II)

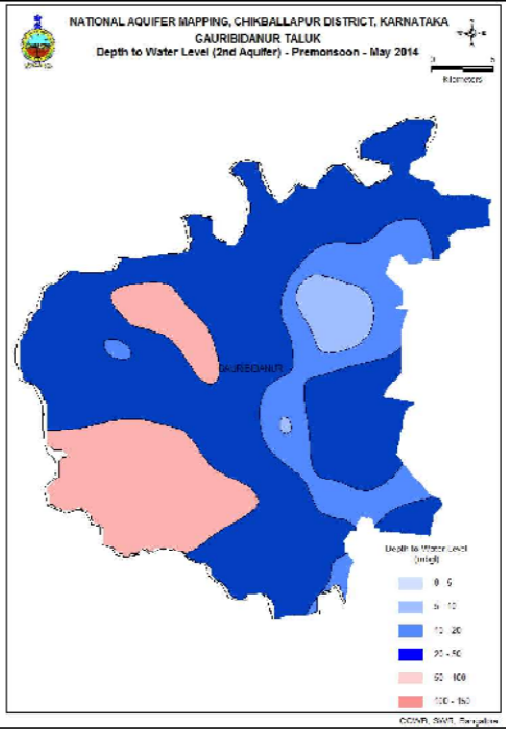

Fig 1.7: Depth to water level Post-monsoon Nov 2014 (Aq –II)

(b) Water level fluctuation

Aquifer-II

Seasonal Fluctuation: Rise ranges between 0.4 to 10.57m;
Fall ranges between 0.18 to 7.15m

The water level fluctuation and water table elevation maps are given below in fig 1.8 and 1.9 respectively.

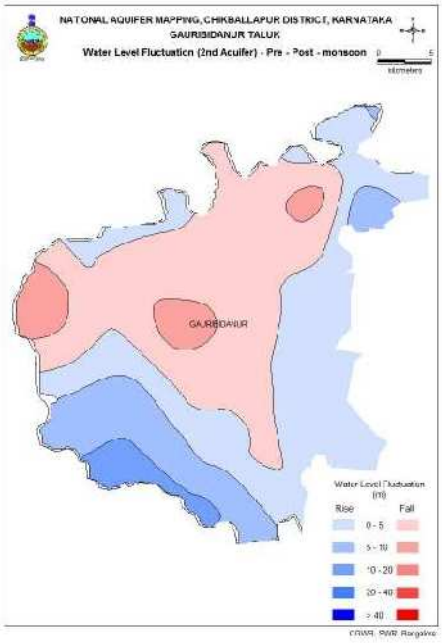

Fig 1.8: Water level fluctuation map (Aq – II)

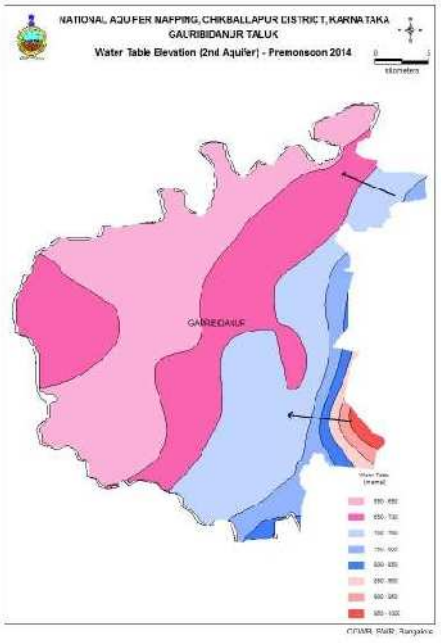

Fig1.9: Water table elevation map (Aq – II

2. AQUIFER DISPOSITION

2.1 Number of aquifers: In Gauribidanur taluk, there are mainly two types of aquifer systems;

i. **Aquifer-I (Phreatic aquifer) comprising** Weathered Gneiss / Schist

ii. Aquifer-II, (Fractured multi-aquifer system) comprising Fractured Gneiss / Schist

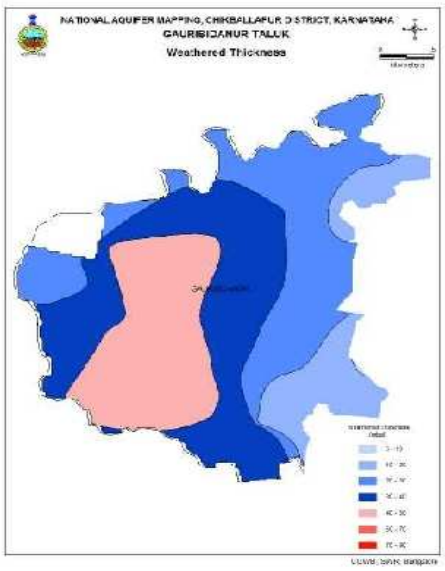

Fig 2.1: Weathered thickness (Aq–I)

2.2 3 D aquifer disposition and basic characteristics of each aquifer

(A) Aquifer disposition – Rockworks output

Based on the aquifer input data, various aquifer models viz., 3D aquifer models, 3D aquifer fence diagram, 3D fracture models, integrated 3D fracture models, aquifer sections have been prepared and presented in Figure 2.2 to 2.9.

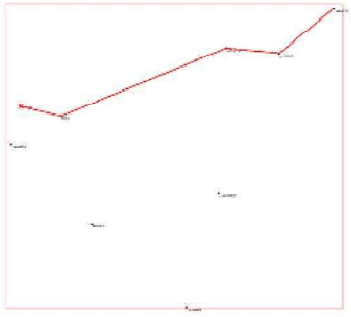

Fig.2.2: Cross - Section along EW

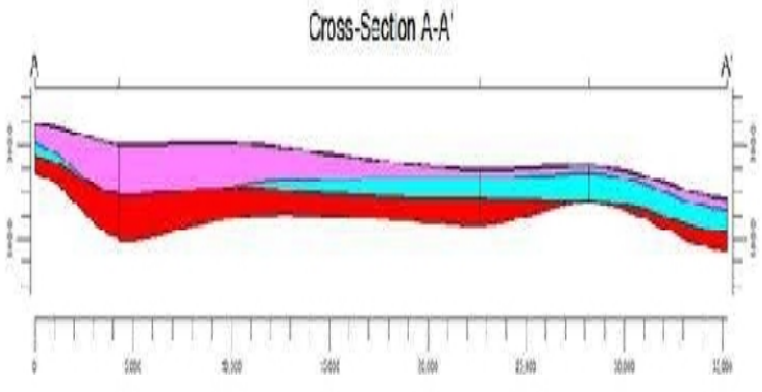

Fig 2.3: Aquifer disposition, Cross – section along EW,

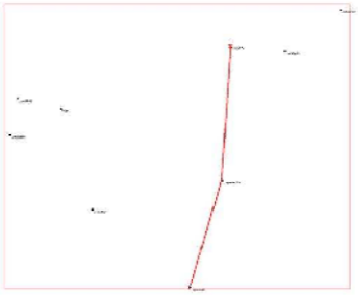

Fig. 2.4.: Cross - Section NS along N-S

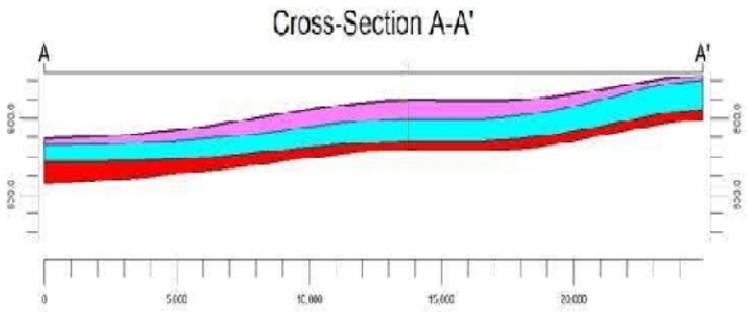

Fig.2.5: Aquifer disposition, Cross – section along NS

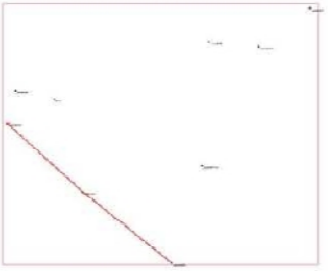

Fig.2.6: Cross - Section NW-SE.

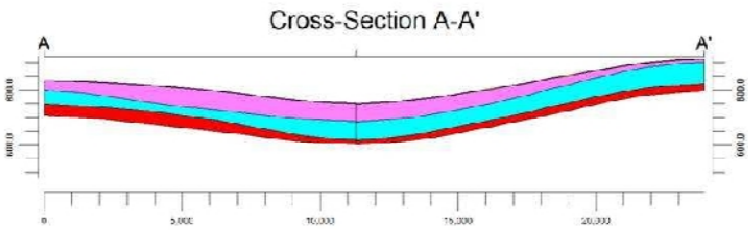

Fig.2.7: Aquifer disposition, Cross – section along NW-SE.

(B) Aquifer & Fracture occurrence - Rockworks output;

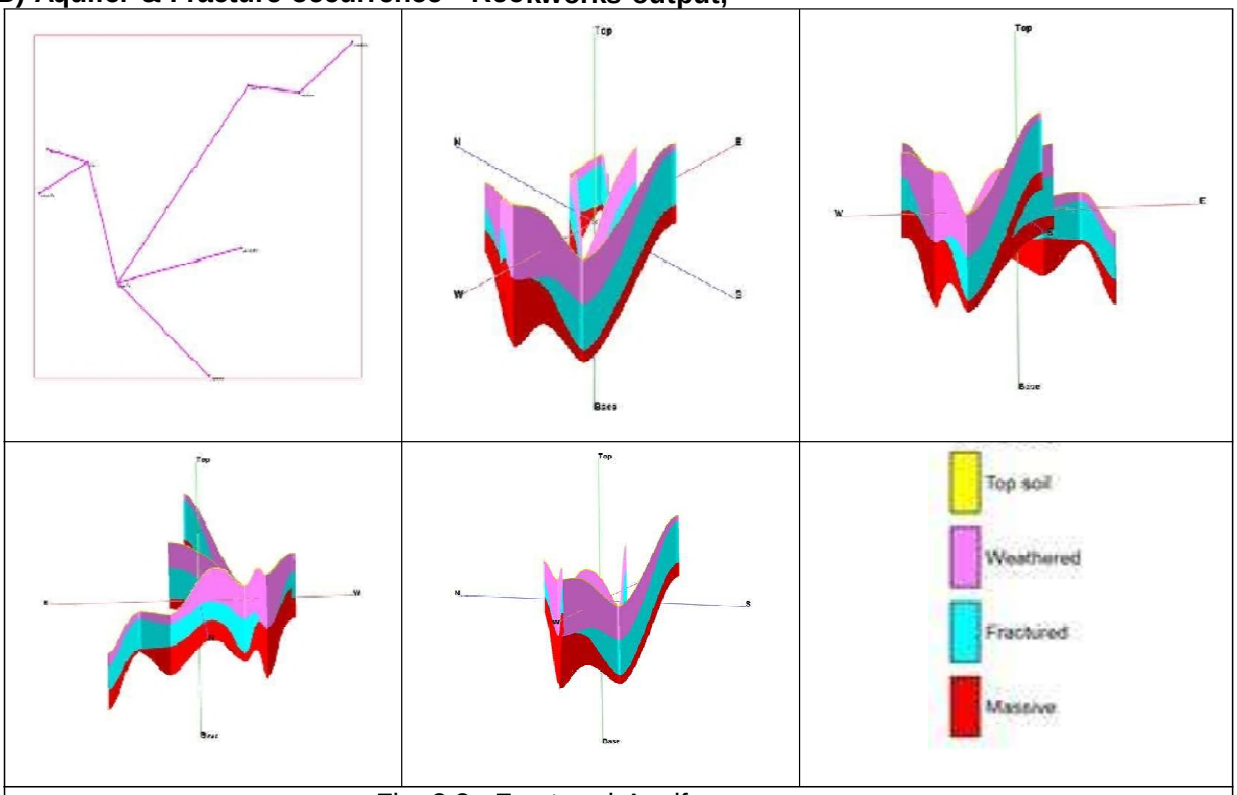

Fig. 2.8: Fractured Aquifer occurrence

(C) Fracture disposition

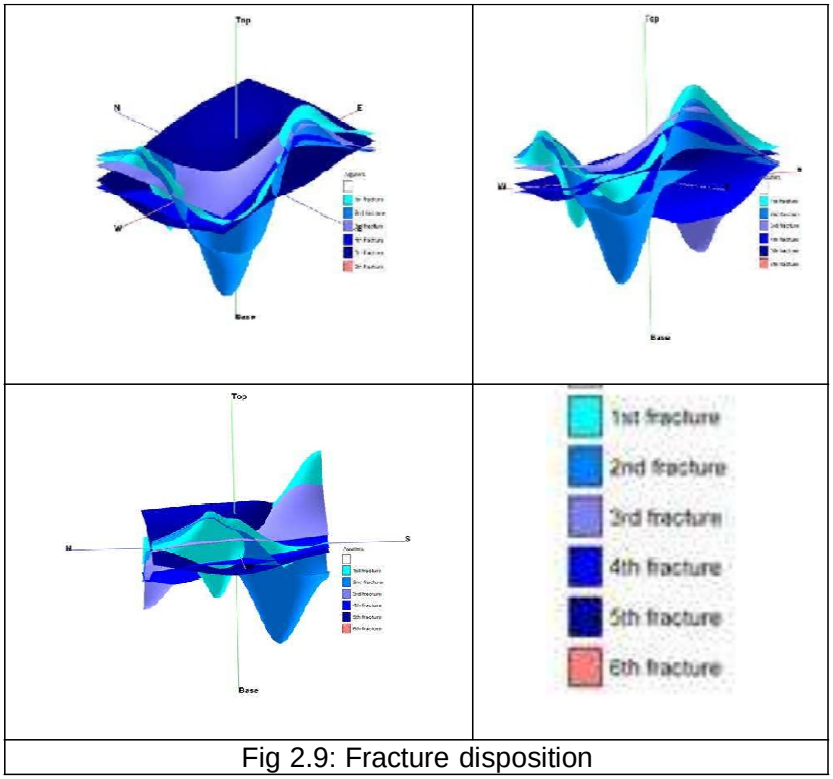

Fig 2.9: Fracture disposition

3. GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

3.1 Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2011)

Table 3.1: Present Dynamic Ground Water Resource (2011)

Taluk	Net annual GW availability, (ham)	Total draft for all uses, (ham)	Stage of GW development, %	Category
Gauribidanur	3975	7568	190	**Over Exploited**

(b) Present total Ground Water Resource (in ham).

Table 3.2 Present total Ground Water Resource (ham).

Taluk	Annual replenishable GW resources (ham)	Fresh In-storage GW resources (ham)		Total availability of GW resource (ham)
		Phreatic	Fractured	Dynamic + phreatic in-storage + fractured in-storage
Gauribidan	3975	0	1948	5922

(c) Present ground water availability and draft scenario (2011) in Gauribidanur taluk of Chikballapur district and expected improvement in Stage of Ground Water Development in future.

Table 3.3: Present ground water availability and draft scenario (2011)

TALUK	GW Availability (ham)	GW DRAFT (ham)	Net Balance	Stage of GW Development (%)	Expected Additional Recharge from non committed monsoon runoff available (ham)	Expected Increase in GW Availability (ham)	Expected Reduction in Stage of GW Development (%)	Expected Difference in Stage of GW Development (%)
Gauribidanur	3975	7040	-3065	190	859	1707	113	**7**

(d) Comparison of ground water availability and draft scenario in Gauribidanur taluk

Table 3.4: Comparison of ground water availability and draft scenario (2011)

Taluk	GW availability (Ham)	GW draft (ham)	Net Balance	Stage of GW development	GW availability (ham)	GW draft (in ham)	Net Balance	Stage of GW development	GW availability (ham)	GW draft (ham)	Net Balance	Stage of GW development
	2004				2009				2011			
Gauribidanur	5084	11014	- 5930	**216**	3973	7540	- 3567	**190**	3975	7040	- 3065	**190**

3.2 Chemical quality of ground water and contamination

During Aquifer Mapping Studies in Gauribidanur taluk, 17 key wells were established for Aquifer II which were all bore wells. In order to study the chemical quality of ground water one acidified and one normal representative water samples were collected from each of the key wells during pre-monsoon and were analyzed at Chemical Laboratory, C.G.W.B, S.W.R, Bangalore. Interpretation of Chemical Analysis results are mentioned as under:

Electrical conductivity

Aquifer- II : Out of 17 samples collected from bore wells representing Aq – II only, no sample indicates EC greater than the permissible limit of 2000 m/mhos/cm. Fig 3.1 illustrates electrical conductivity of water samples representing Aq- II, which indicates ground water in larger extent has EC value within the permissible limit. EC values of Aq- II ranges between 450 to 1560 m/mhos/cm at $25^{O}C$.

Fluoride: Fluoride concentration in ground water is of geogenic origin in areas underlain by younger granites/ gneisses containing minerals like Flurospar & fluroapatite

Aquifer – II: Out of 17 samples collected from bore wells representing Aq – II, 3 samples indicate fluoride greater than the permissible limit of 1.5 mg/l, which constitutes 18% of the samples collected. Fig 3.2 illustrates fluoride concentration and its spatial occurrence in water samples representing Aq- II. Ground water in southwest and northeast of taluk has fluoride greater than the permissible limit. Fluoride ranges between 0.4 to 1.7 mg/l (Gedre).

Fig 3.1: Electrical Conductivity Aq-II

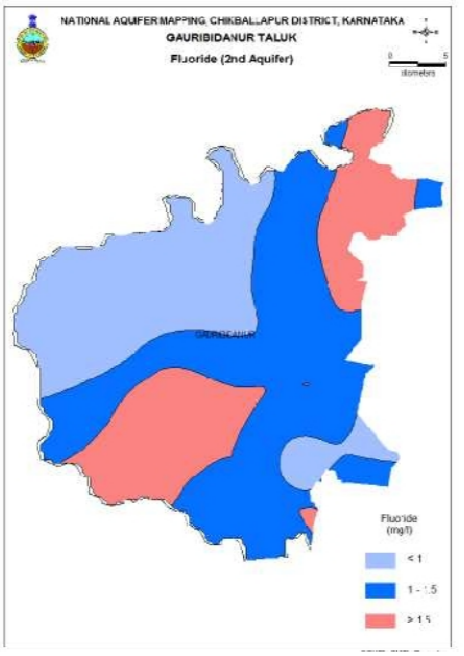

Fig 3.2: Fluoride distribution Aq-II

Nitrate: Aquifer II: Out of 17 samples collected from bore wells representing Aq – II, 1 sample indicates nitrate greater than the permissible limit of 45 mg/l, which constitutes 6% of the samples collected. Fig 3.3 illustrates nitrate concentration and its spatial occurrence in water samples representing Aq- II. Nitrate ranges between 6 to 50 mg/l (Halehalli village). Nitrate contamination is due to extensive use of fertilizers, hence, is anthropogenic in origin.

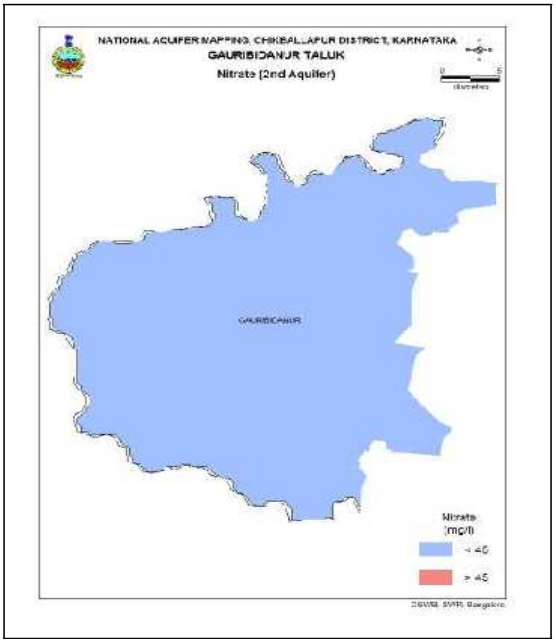

Fig. 3.3: Nitrate Aq-II

Arsenic: Arsenic concentration in water samples is much less than the permissible limit of 0.05mg/l.

Magnesium: Magnesium concentration in 8 water samples was found to be greater than the permissible limit of 30 mg/l, which constitutes 47% of samples.

In general, ground water quality in Gauribidanur taluk is good for drinking purpose except in some areas as depicted in above illustrated maps, where fluoride and nitrate are found to be greater than the permissible limit as per "Indian Standard Drinking Water Specification 2009". Ground water samples have also been tested and found suitable for agriculture & irrigation purposes.

4.GROUND WATER RESOURCE ENHANCEMENT

4.1 Aquifer wise space available for recharge and proposed interventions

Quantity of water available through non-committed surface runoff:

Table 4.1: Water available through non-committed surface runoff and AR structures feasible in Gauribidanur taluk.

Artificial Recharge Structures Proposed	Details
Non committed monsoon runoff available (Ham)	1340
Number of Check Dams	83
Number of Percolation Tanks	6
Number of Point Recharge structures	9
Tentative total cost of the project (Rs. in lakhs)	323.24
Excepted recharge (MCM)	8.59
Expected rise in water level (m)	0.5
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	3.76

4.2 Improvement in GW availability due to Recharge, Gauribidanur taluk. (Ham)

Table 4.2: Improvement in GW availability due to Recharge

Taluk	G W availability	Stage of GW dev %	Expected Additional Recharge from non committed monsoon runoff	Expected Increase in GW Availability	Expected Stage of GW Development after recharge (%)
Gauribidanur	3975	190	2566	6541	113

The map showing area feasible for artificial recharge of ground water is given in fig 4.1

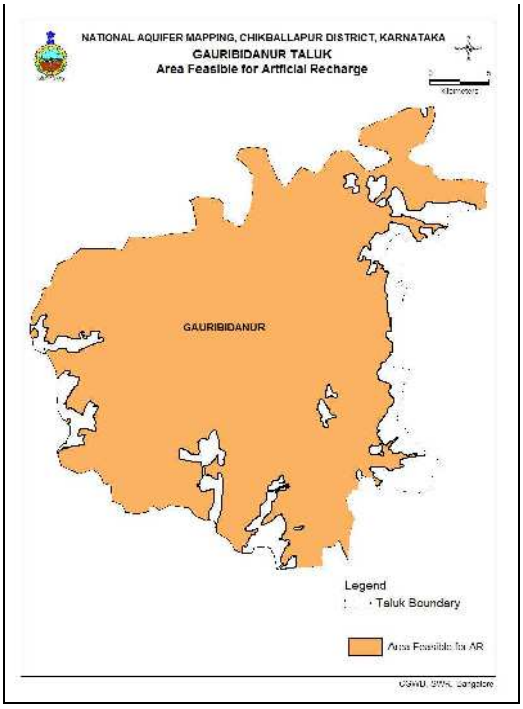

Fig 4.1: Area feasible for Artificial recharge and Management plan in Gauribidanur taluk

5. DEMAND SIDE INTERVENTIONS

5.1 Advanced irrigation practices

It is observed that bore well is the prevalent source for irrigation in the taluk. Thus, by adopting the below mentioned techniques will contribute in ground water resource enhancement in the long run.

Efficient irrigation practices like Drip irrigation & sprinkler needs to be adopted by the farmers in the existing 11876 ha of gross irrigated area.

Efficient irrigation techniques will contribute in saving ground water and thus will reduce the irrigation draft.

5.2 Change in cropping pattern

Not necessary as due to water scarcity, water intensive crops are not grown in the taluk. Cereals,

fruits, vegetables, pulses and oil seeds constitute major crops of the taluk. **Alternate water sources** Inter-basin transfer from west-flowing river Yettinahole project is considered for Gauribidanur taluk also. Transporting tertiary treated water from Bangalore city and filling MI tanks is also considered as an alternate water source for filling up the MI tanks.

5.3 Regulation and Control

Gauribidanur taluk has been categorized as **OVER EXPLOITED**, since the Stage of ground water development has reached **190%** (GE March 2011).

Ground water recharge component needs to be made mandatory in State Govt. Project related to further development of ground water, viz; Irrigation Projects or Public Water Supply Projects.

5.4 Other interventions proposed

Recharge already dry **phreatic aquifer (Aq-I)** in the taluk, through construction of artificial recharge structures, viz; sub-surface dams, check dams, step bunds & percolation tanks. The choice of recharge structures should be site specific and such structures need to be constructed in areas already identified as feasible for artificial recharge.

Periodical maintenance of artificial recharge structures should also be incorporated in the Recharge Plan.

Excess fluoride & nitrate concentration is found in ground water samples from Aq-II, as shown in the Figures given above & requires remedial measures viz.

- Dilution of nitrate rich ground water through artificial recharge & water conservation.
- Roof top rain water harvesting.
- Micro irrigation.