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

Malur Taluk, Kolar District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region,Bengaluru

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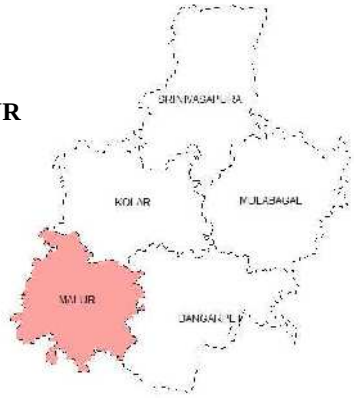
GOVERNMENT OF INDIA
Ministry of Water Resources, River Development
& Ganga Rejuvenation
CENTRAL GROUND WATER BOARD

MALUR TALUK AQUIFER MAPS AND MANAGEMENT PLANS, KOLAR DISTRICT, KARNATAKA

MALUR



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CENTRAL GROUND WATER BOARD
SOUTH WESTERN REGION
BANGALORE
DECEMBER 2016

MALUR TALUK AQUIFER MAPS AND MANAGEMENT PLANS,

KOLAR DISTRICT, KARNATAKA STATE

CONTENTS

AQUIFER MANAGEMENT PLAN OF MALUR TALUK, KOLAR DISTRICT, KARNATAKA STATE

1. SALIENT INFORMATION

Name of the taluk : **MALUR**
District : Kolar
State : Karnataka
Area : 646 sq.km.
Population : 2,36,920 (2011)
Annual Normal Rainfall : 693 mm

1.1 Aquifer management study area

Aquifer mapping studies was carried out in **Malur taluk**, Kolar district of Karnataka, covering an area of 646 sq.kms under **National Aquifer Mapping Project**. Malur taluk of Kolar district is located between north latitude $12^0$48'18" and 13^0 05'59' & east longitude $77^0$50' 26" and 78^0 $^{09'21"}$, and is covered in parts of Survey of India Toposheet Nos. 57 G/16,57 K/4, 57L/1, and 57H/13. Malur taluk is bounded by Kolar taluk on North, HoskoteTaluk in BangaloreRuralDistrict onwest, state of Tamil Nadu on South and Bangarpet taluk on Easterrnside. Location map of Malur taluk of Kolar District is presented in Figure-1.

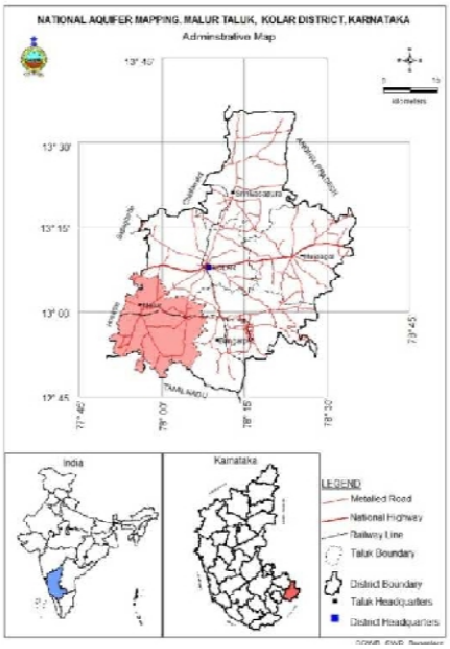


Fig1: Location Map of Malur taluk, Kolar district

Malur is divided into 4 Hoblies. Malur is only one town, which is also the taluk headquarters. There are 306 inhabited and 57 uninhabited villages in Malur taluk. The taluk is well connected by

good network of roads. It has an average elevation of 910 metres (2,990 ft). Malur is 46 kilometres (29 mi) from Bangalore City and is located on the Bangalore – Chennai trunk railway line. Though some passenger trains halt there, most of the express trains do not halt at Malur.

1.2 Population

According to 2011 census, the population in Malur taluk is 236920, comprising of 121083 males and 115837 females. Out of the total population of 236920, nearly 196870 constitute the rural population and 40050 is the urban population, which works out to 83 % (rural) and 17 % (urban) of the total population of taluk.The study area has an overall population density of 367 persons per sq.km. The decadal variation in population from 1991-2001 is 14.46 % in Malur taluk.

1.3 Hydrometeorology

Malur taluk enjoys semi-arid to arid climate. Dryness and hot weather prevails in 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 Malur taluk (Table 1). The data in respect of this station from the year 1981 to 2010 is analysed and presented in the following. The data pertaining to these gauges is of long term nature and are well maintained. It is presumed that they are representative of the taluks and the same is used for analysis. Normal annual rainfall in Malur taluk for the period 1981 to 2010 is 768 mm.

Table 1: Raingauges and its location in Malur taluk

Sl.No	Station	Latitude	Longitude	Altitude
1	Malur	13°00’	78°00’	902

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 and are shown in Table 2.

The mean monthly rainfall at Malur station is ranging between 2mm during January to 171mm during September. The CV percent for winter, pre-monsoon, monsoon and post monsoon season is 54, 32 & 45 percent respectively. Annual CV at this station works out to be 27 percent.

Table 2: Statistical Analysis of Rainfall Data of Eastern dry Agroclimatic Zone, Karnataka for the Period 1981 to 2010

Station	parameter	Jan	Feb	Mar	April	May	**Pre**	Jun	Jul	Aug	Sep	**Sw**	Oct	Nov	Dec	**NE**	**Annual**
Malur	NRF (mm)	2	3	14	38	89	**146**	66	69	96	171	**402**	157	49	15	**221**	**768**
	CV(%)	470	261	170	104	70	**54**	85	72	63	48	**32**	55	85	152	**45**	**27**
	% of ARF	0	0	2	5	12	**19**	9	9	12	22	**52**	20	6	2	**29**	**100**

Assessment of Drought

Rainfall data of Malur has been analysed for 114 years using IMD method to assess the drought condition in Malur taluk. The results of the classification are listed in the Table 3. It is observed that the Malur taluk has experienced alternating no drought to severe drought conditions over the years.

Table 3: Classification of drought and its recurrence (IMD, 1971)

% Deviation	>0	0 to -25	-25 to -50	< -50	Probability of drought occurrences
Category	No drought	Mild (Normal)	Moderate	Severe	
	Years				
Malur	53	40	19	2	Once in 5 years

The details of the drought assessment are discussed as herein under. Out of 114 years of analysis in Malur taluk, “No Drought” condition in the is experienced in 53 years, “Mild Drought” condition is 40 years and “Moderate Drought” condition experienced in 19 Further it is observed that “Severe Drought” condition is experienced in 2 years in Malur taluk ie., during the years 1920 and 1950. Based on occurrence and frequency of past drought events, the probability of occurrence of various intensities of drought at each station has been studied. It has been observed that the frequency of occurrence of drought is once in 5 years at Malur taluk.

1.4 Agriculture and Irrigation

Agriculture is the main occupation in Malur 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 Kharif (June – October) and Rabi season (Mid October – Mid February). Major Kharif crops are paddy, maize, ragi, tur, and vegetables. Main crops of Rabi season are Ragi, Maize, horse gram, groundnut, and sunflower. Sugarcane, fruits, are perennial crops grown in the area (Table 4a).

Table 4a: Details of Cropping pattern in Malur taluk 2013-14 (ha)

Year	Paddy	Maize	Ragi	Total Cereals & Minor Millets	Pulses	Oil Seeds	Total Fruits	Total Vegetables
2013-14	413	33	11365	11821	2552	400	2823	2780

It is observed that during the year 2013-14 percentage of gross cropped area of total geographical area was 44% in Malur taluk (Table 4b & map in fig 2).

Table 4b: Details of land use in Malur taluk 2013-14 (ha)

Taluk	Year	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once	Total sown area	Cultivable land excluding fallow land
Malur	2013-14	68116	1560	10165	9751	27807	1917	29724	13887

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

Table 5: Irrigation details in study area (ha)

Net Area Irrigated From	Malur Taluk
Canals	Nil
Tanks	Nil
Wells	Nil
Bore wells	4409
Lift Irrigation	Nil
Other Sources	Nil
Total	**4409**

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

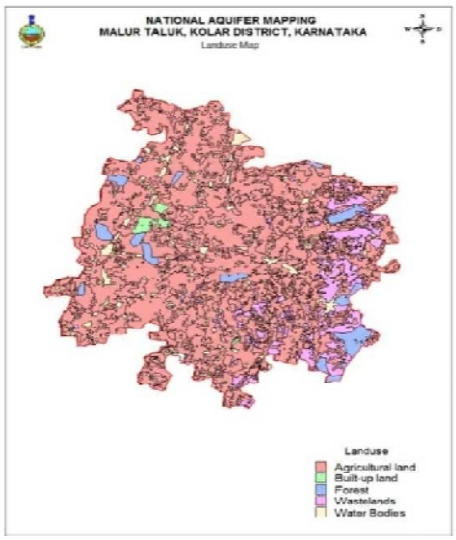


Fig 2: Landuse map of Malur taluk

1.5 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 Southern maidan region, characterized by undulating landscape with broad valleys, where the elevation ranges from 700 m to 1116 m amsl with good degree of slope. Malur taluk falls in the valley of Palar, which are undulating and well cultivated. Overall the topographic features in the area are formed by topographic divides between Palar, north and south Pennar catchments.

In Malur taluk there are no perennial rivers flowing. There are few streams that rise in the hills and feed number of tanks. Theses tributaries are ephemeral and flow only during monsoon season and dry up during summer.

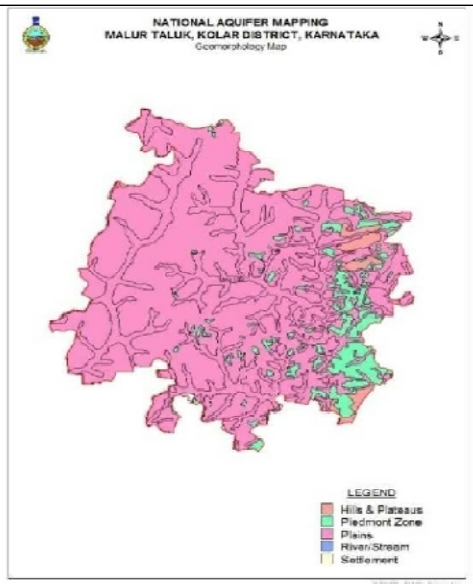


Fig 3 : Geomorphology, Malur taluk

Fig: 4 Drainage, Malur taluk

1.6 Soil

Five classes are clayey, clayey mixed, clayey skeletal, Loamy skeletal and Rocky land. Clayey soil in western side of study area, loamy skeletal soil in the eastern part, clayey mixed along the major drainage flowing in the taluk.

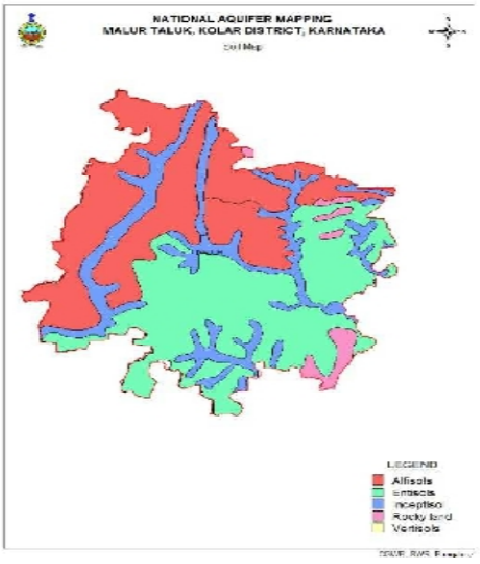


Fig 5: Soil map, Malur taluk

1.7 Ground water resource availability and extraction

Total GW Resources (2009), (Ha m; **Aquifer wise up to 200 m depth)**

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources		Total availability of fresh GW resources
		Phreatic	Fractured (Down to 200m)	Dynamic + phreatic in-storage + fractured
Malur	4093	15160	2075	17235

1.8 Existing and future water demands

No scope for further Irrigation from ground water**.**

1.9 Water level behaviour

(a) Depth to water level

Aquifer-I

Pre-monsoon: 2.04 – 9.15 mbgl

Post-monsoon:0.80 – 7.90mbgl

Aquifer-II

Pre-monsoon: 10.25 – 198.00mbgl

Post-monsoon: 4.90 – 62.40mbgl

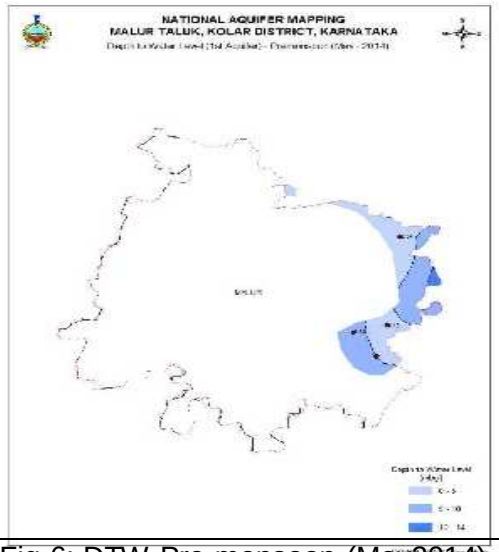


Fig 6: DTW Pre-monsoon (May2014), Aq- I

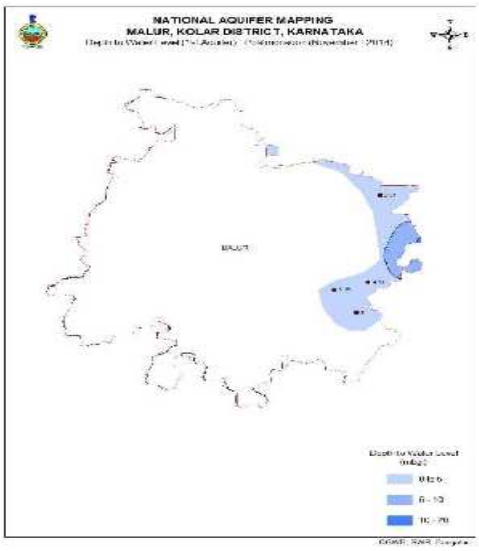


Fig 7: DTW Post-monsoon (Nov2014), Aq-II

(b) Water level fluctuation

Aquifer-I

Seasonal Fluctuation: Rise ranges between 1.20 to 2.40 m; Fall : Nil

Aquifer-II

Seasonal Fluctuation: Rise ranges between 0.90 to 8.20 m; Fall ranges between 0.00 to 7.10 m

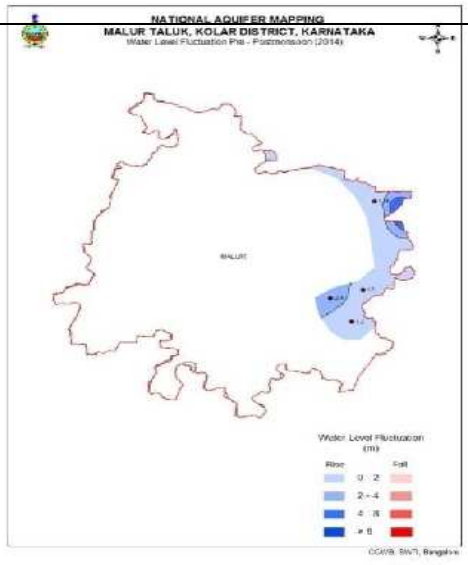


Fig 8: Water level fluctuation (Aq – I)

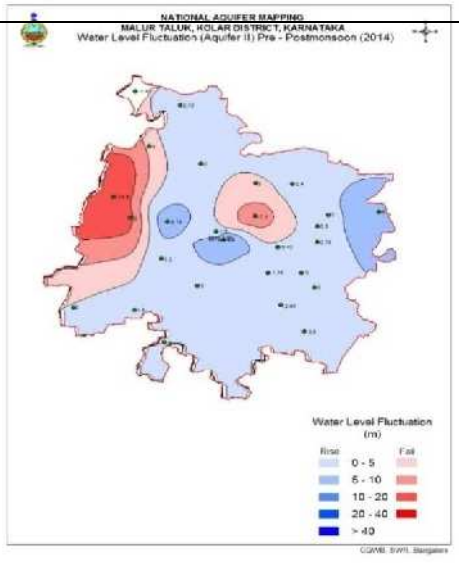


Fig 9: Water level fluctuation (Aq – II)

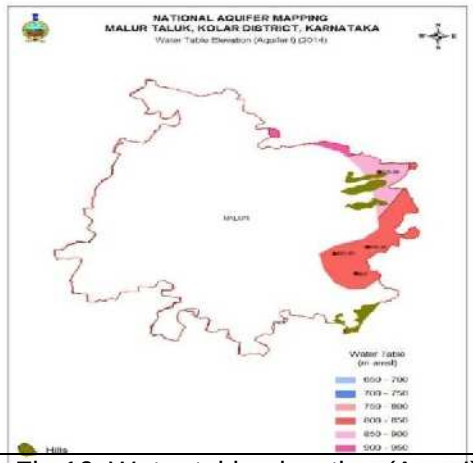


Fig 10: Water table elevation (Aq – I)

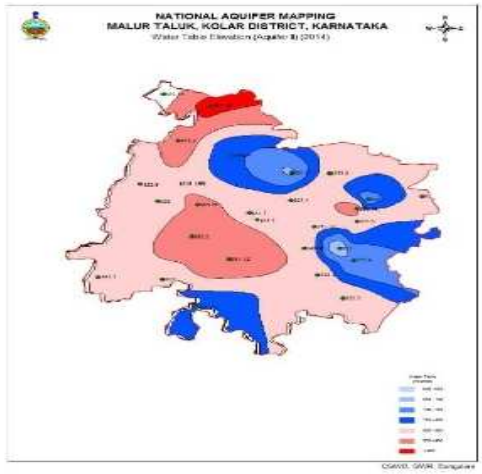


Fig 11: Water table elevation (Aq - II)

2.AQUIFER DISPOSITION

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

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

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

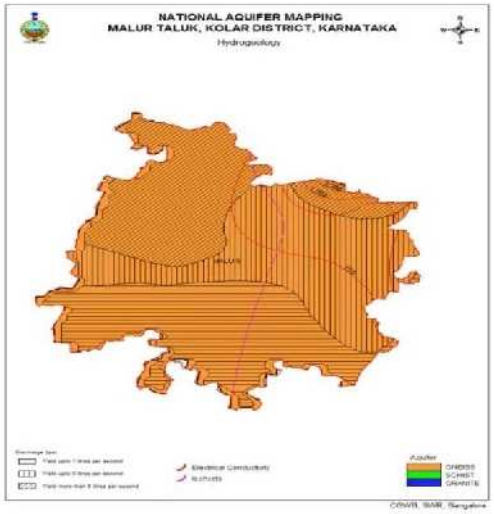


Fig 12: Hydrogeology of Malur taluk

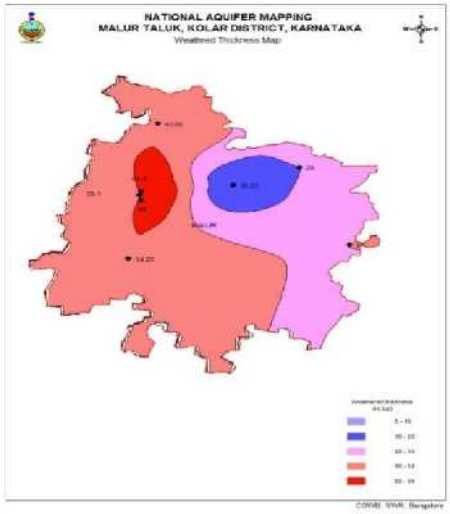


Fig 13: Weathered thickness (Aq – I)

2.2 3- D aquifer disposition and basic characteristics of each aquifer

(A) Aquifer disposition – Rockworks output

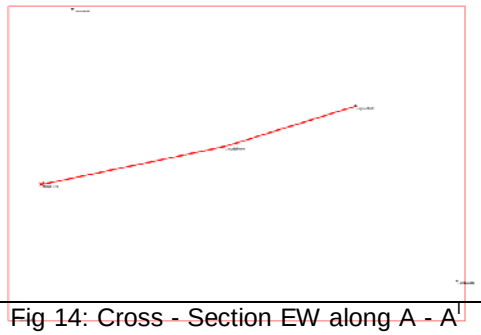


Fig 14: Cross - Section EW along A - A'

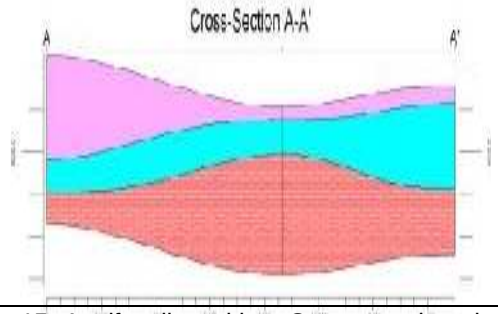


Fig 15: Aquifer disposition, Cross- section along EW

Rockworks output

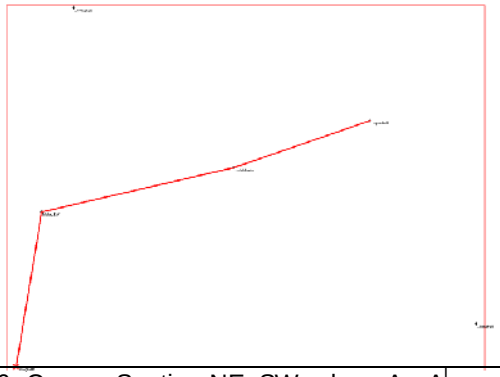


Fig16: Cross - Section NE–SW, along A - A'

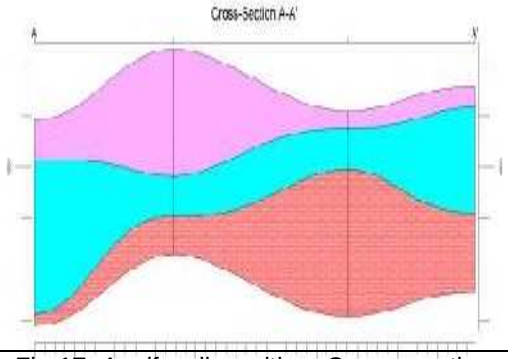


Fig 17: Aquifer disposition, Cross- section along NE–SW

Rockworks output

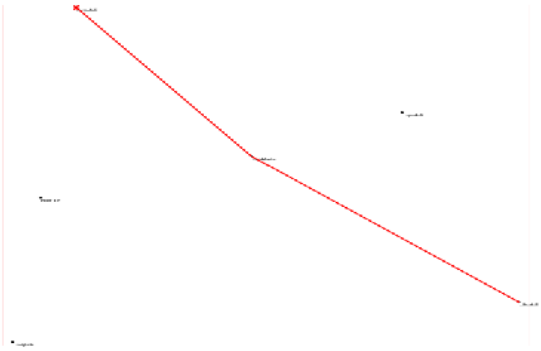


Fig 18: Cross - Section NW – SE, along A - A'

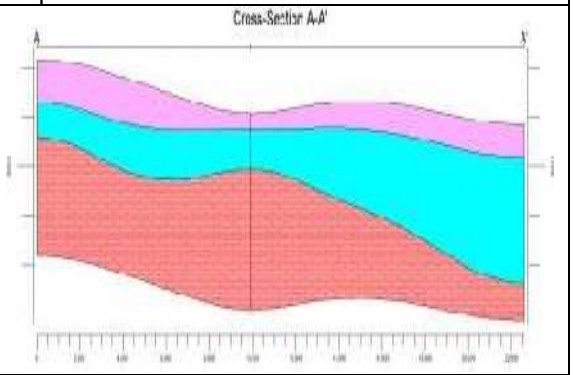


Fig 19: Aquifer disposition, Cross–section along NW–SE

Rockworks output

(B) Aquifer & Fracture occurrence - Rockworks output

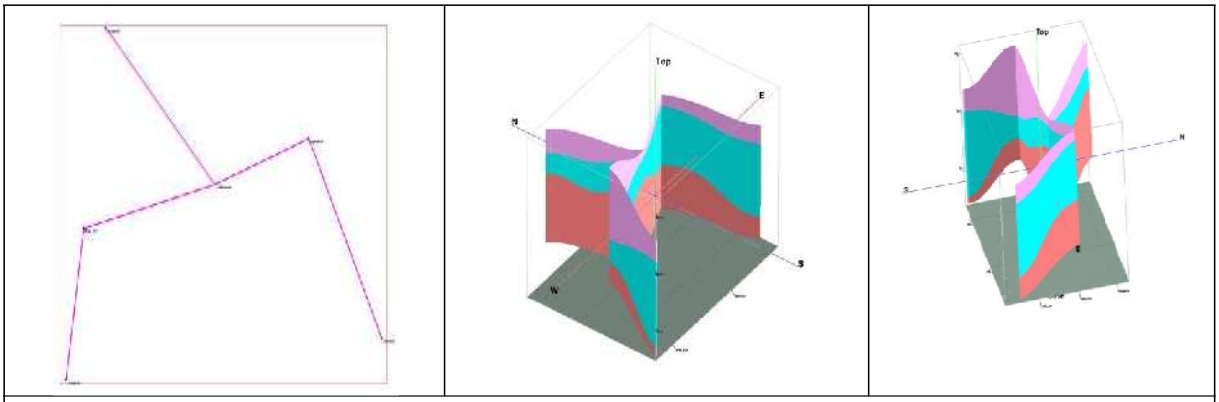


Fig 20: Fence diagrams along different sections

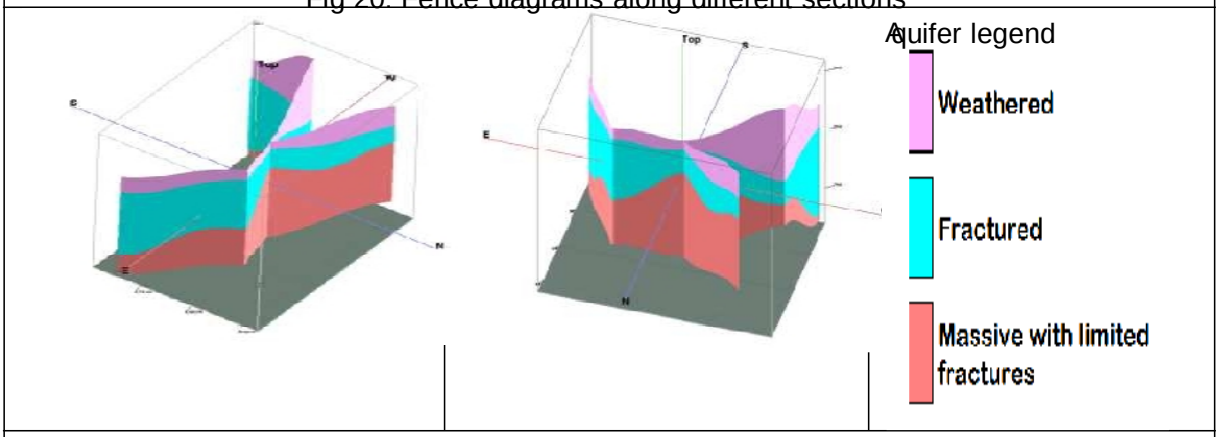
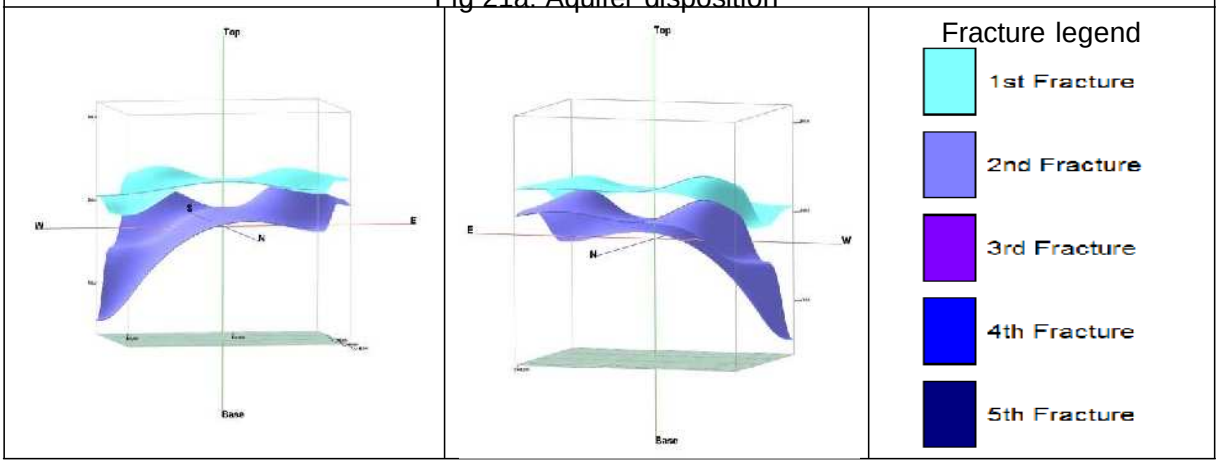


Fig 21a: Aquifer disposition



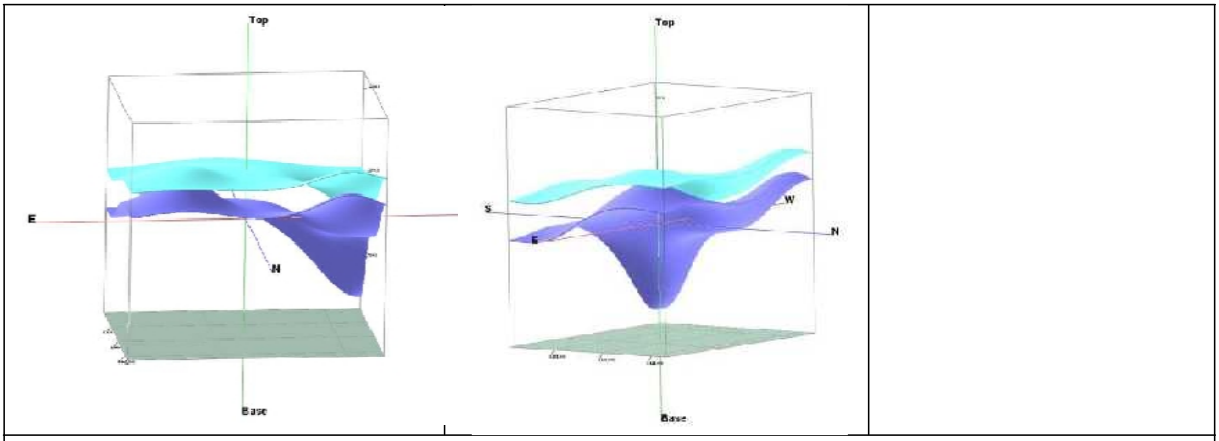


Fig 21b: Fracture disposition

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

3.1 Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2011)

Taluk	Net annual GW availability (in ham)	Total draft for all uses (in ham)	Stage of GW development, %	Category
Malur	4093	7323	179	**Over Exploited**

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

Taluk	Annual replenishable GW resources (in ham)	Fresh In-storage GW resources (in ham)		Total availability of GW resource (in ham)
		Phreatic	Fractured	Dynamic + phreatic in-storage + fractured in-storage
Malur	4093	15160	2075	17235

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

TALUK	GW Availability (in ham)	GW DRAFT (in ham)	Net Balance	Stage of GW Development (%)	Expected Additional Recharge from non committed monsoon runoff available (in ham)	Expected Increase in GW Availability (in ham)	Expected Reduction in Stage of GW Development (%)	Expected Difference in Stage of GW Development (%)
Malur	4093	7323	-3230	179	770	4863	151	**28**

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

Taluk	GW availability (in ham)	GW draft (in ham)	Net Balance	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Net Balance	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Net Balance	Stage of GW development
	2004				2009				2011			
Malur	4872	11629	- 6757	**239**	3844	7060	- 3216	**184**	4093	7323	- 3230	**179**

3.2 Chemical quality of ground water and contamination

During Aquifer Mapping Studies in Malur taluk, 22samples were collected, out of which 8 were dug wells, and 14 were bore wells representing Aquifer – I & II respectively. 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 from Chemical Analysis result are mentioned as under:

Electrical Conductivity:(a) Aquifer – I: Out of 8 samples collected from dug wells representing Aq – I, no samples indicate EC greater than the permissible limit of 2000 m/mhos/cm, which constitutes 0% of the samples collected. Fig.24 illustrates electrical conductivity of water samples representing Aq- I, which indicates ground water in larger extent has EC value within the permissible limit.EC values of Aq- I ranges between 580 to 1340 m/mhos/cm at 25^{o}C.

(b)Aquifer- II - Out of 14 samples collected from bore wells representing Aq – II, no sample indicate EC greater than the permissible limit of 2000 m/mhos/cm, which constitutes 0% of the samples collected. Fig. 25 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 540 to 1450 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 **(a) Aquifer – I:** Out of 8 samples collected from dug wells representing Aq – I, 1 sample indicate fluoride greater than the permissible limit of 1.5 mg/l, which constitutes 13% of the samples collected. Fig.26. illustrates fluoride concentration and its spatial occurrence in water samples representing Aq- I. Ground water in northeast of taluk have areas where fluoride is greater than the permissible limit. F ranges between 0.4 to 1.6 mg/l**.**

(b) Aquifer – II - Out of 14 samples collected from bore wells representing Aq – II, 2 samples indicate fluoride greater than the permissible limit of 1.5 mg/l, which constitutes 14% of the samples collected. Fig. 27 illustrates fluoride concentration and its spatial occurrence in water samples representing Aq- II. Ground water in southwest and northeast of taluk have fluoride greater than the permissible limit. Fluoride ranges between 0.40 to 1.6 mg/l (Jeyamanagala and Nelahallivillges**).**

It can be inferred that fluoride contamination is more prevalent in Aq – II.

Nitrate: (a) Aquifer – I: Out of 8 samples collected from dug wells representing Aq – I,3 samples indicate nitrate greater than the permissible limit of 45 mg/l, which constitutes 38% of the samples collected. Fig.28 illustrates nitrate concentration and its spatial occurrence in water samples representing Aq- I. Ground water in northeast, east and soute east of taluk have areas where nitrate is greater than the permissible limit. Nitrate ranges between 7 to 90 mg/l.(Shivapatana village)

(b) Aquifer – II - Out of 14 samples collected from bore wells representing Aq – II, 5 samples indicate nitrate greater than the permissible limit of 45 mg/l, which constitutes 36% of the samples collected. Fig. 29 illustrates nitrate concentration and its spatial occurrence in water samples representing Aq- II. Ground water in north, northwest, southeast and east of taluk have nitrate greater than the permissible limit. Nitrate ranges between 12 to 90 mg/l (Yeshwantapur village). Nitrate contamination is due to extensive use of fertilizers, hence is anthropogenic in origin. It can be inferred that nitrate contamination is more prevalent in Aq – II.

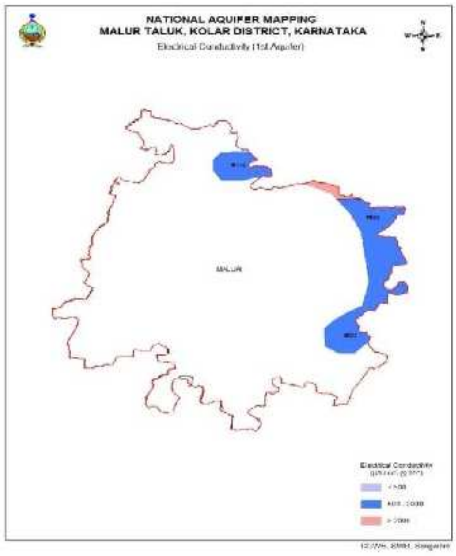


Fig 22: EC distribution, Aq-I

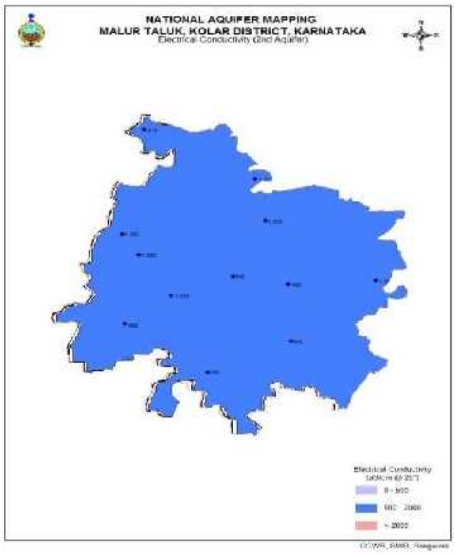


Fig 23: EC distribution, Aq-II

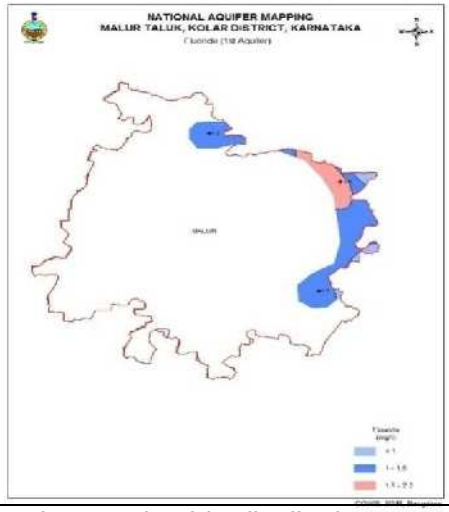


Fig 24 : Fluoride distribution, Aq-I

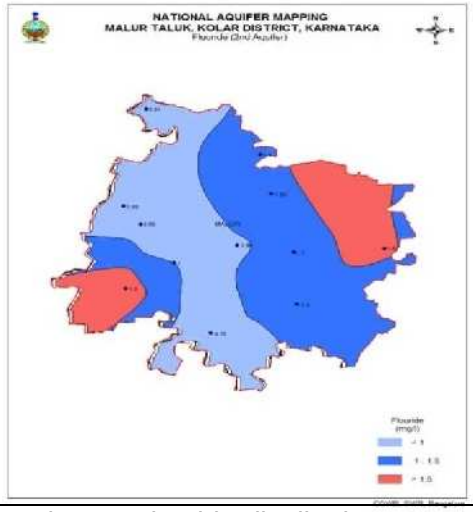


Fig 25 : Fluoride distribution, Aq-II

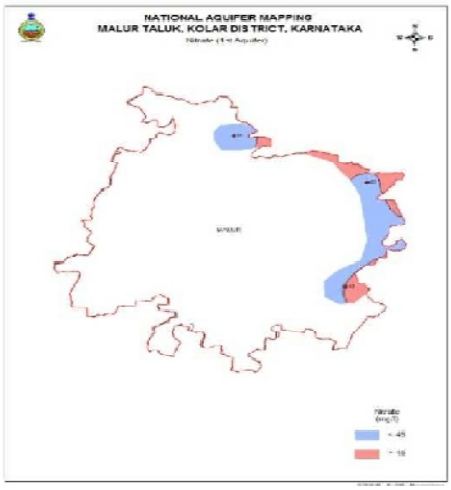


Fig 26 : Nitrate distribution, Aq-I

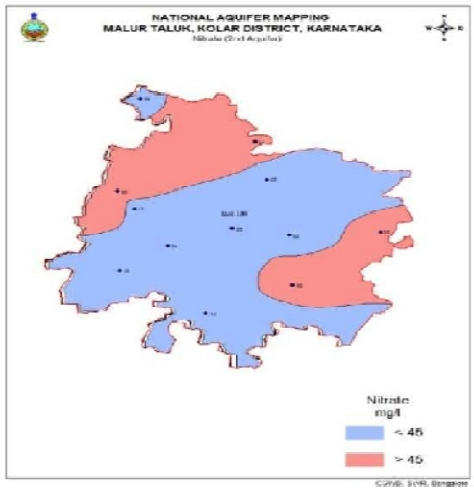


Fig 27 : Nitrate distribution, Aq-II

Magnesium: Magnesium concentration in 6 water samples was found to be greater than the permissible limit of 30 mg/l, which constitutes 33% of samples.

In general ground water quality in Malur taluk is good for drinking purpose except in some areas as depicted in above illustrated maps, where nitrate, fluoride and EC is 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:

Artificial Recharge Structures Proposed	**Malur Taluk**
Number of Check Dams	63
Number of Percolation Tanks	4
Number of Point Recharge structures	-
Tentative total cost of the project (Rs. in lakhs)	182.51
Excepted recharge (MCM)	10.33
Expected rise in water level (m)	0.5-6
Cost Benefit Ratio (Rupees/ cu.m. of waterharvested)	1.5

4.2 Improvement in GW availability due to Recharge, Malur taluk.

Taluk	GW availability	Stage of GW development %	Expected Additional Recharge from non committed monsoon runoff	Expected Increase in GW Availability	Expected Stage of GW Development after recharge (%)
Malur	4093	179	770	4863	151

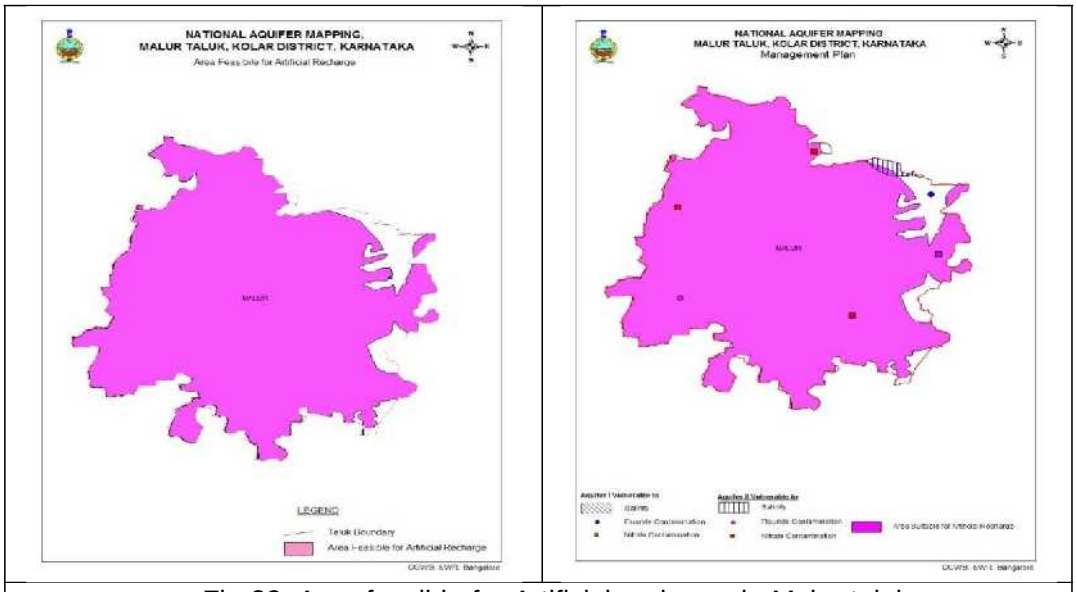


Fig 28: Area feasible for Artificial recharge in Malur taluk

5.0 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 gross irrigated area (Fig 29).

Irrigation draft is 6736 ham

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





Fig 29: Adoption of Efficient Irrigation Techniques

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.

5.3 Alternate water sources

Inter-basin transfer from west-flowing river Yettinahole project is considered for Malur taluk also. Under Yettinahole Project it is proposed to fill 35 Minor Irrigation tanks with 0.210 TMC of water.

Transporting tertiary treated water from Bangalore city and filling MI tanks, is also considered as an alternate water source.

5.4 Regulation and Control

Malur taluk has been categorized as **OVER EXPLOITED**, since the Stage of ground water development has reached 179**%** (GE March 2011). Hence, the taluk has already been **notified** for regulated groundwater development by **Karnataka Ground Water Authority.**

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.

5.5 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 Fig.30

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

Excess nitrate & fluoride concentration is found in ground water samples from Aq-I & Aq-II, as shown in Fig. & requires remedial measures viz.

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

Devarahalli, and Shivarpatnavillages where **Aq –I** is affected by excess nitrate concentration, needs to adopt the above mentioned remedial measures, where**Aq – II** is affected villages are Chikkatirupathi, Agrahara,Yeshwantapura,Rasindra and

,Nelahalli. The following villages where Aq –I is affected by excess fluoride concentration, needs to adopt the above mentioned remedial measures, Vegamadagu, Kamadatti, Keloli, Ananatapur, Chammareddihalli, Sriranagpura, Vammasandra, Gollahalli cross, Angondanahalli, Urkunte-Nittur, Mallapanahalli, Kurudumalle, Agra and Doddahattihalli.

- Villages where Aq – II is affected are Nelahalli and Jayamangala.

Heavy sand minig in Nangli watershed needs to be stopped to restore natural recharge to ground water.