

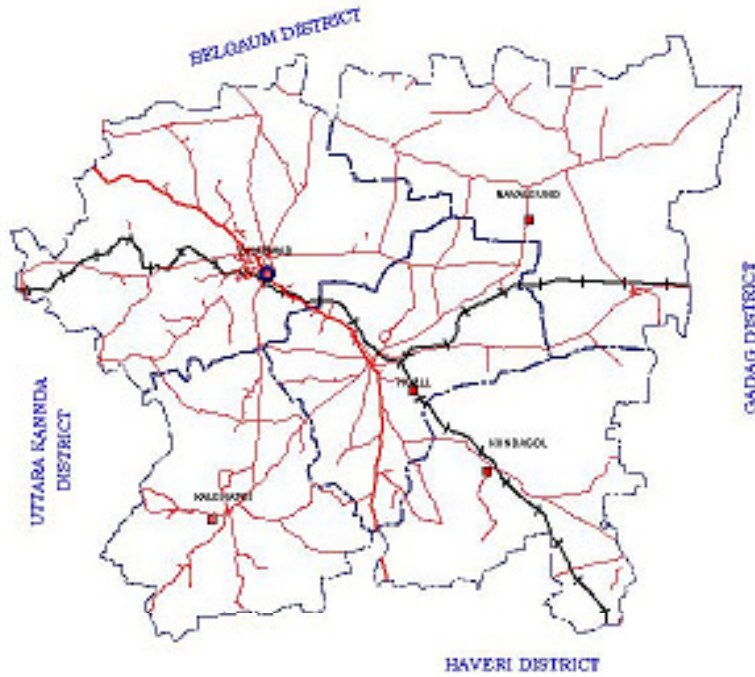


स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल  
CONSERVE WATER - SAVE LIFE



GOVERNMENT OF INDIA  
MINISTRY OF WATER RESOURCES  
CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION BOOKLET  
DHARWAD DISTRICT, KARNATAKA



SOUTH WESTERN REGION  
BANGALORE  
DECEMBER 2008

## **FOREWORD**

Ground water contributes to about eighty percent of the drinking water requirements in the rural areas, fifty percent of the urban water requirements and more than fifty percent of the irrigation requirements of the nation. Central Ground Water Board has decided to bring out district level ground water information booklets highlighting the ground water scenario, its resource potential, quality aspects, recharge – discharge relationship, etc., for all the districts of the country. As part of this, Central Ground Water Board, South Western Region, Bangalore, is preparing such booklets for all the 27 districts of Karnataka state, of which six of the districts fall under farmers' distress category.

The **Dharwad** district Ground Water Information Booklet has been prepared based on the information available and data collected from various state and central government organisations by several hydro-scientists of Central Ground Water Board with utmost care and dedication. This booklet has been prepared by **Shri M.Muthukkannan, Scientist-D**, under the guidance of Dr. K. Md. Najeeb, Superintending Hydrogeologist, Central Ground Water Board, South Western Region, Bangalore. The figures were prepared by S/Sri. H.P.Jayaprakash, Scientist-C and K.Rajarajan, Assistant Hydrogeologist. The efforts of Report processing section in finalising and bringing out the report in this format are commendable.

I take this opportunity to congratulate them for the diligent and careful compilation and observation in the form of this booklet, which will certainly serve as a guiding document for further work and help the planners, administrators, hydrogeologists and engineers to plan the water resources management in a better way in the district.

**(T.M.HUNSE)**  
**Regional Director**

## 1.0 INTRODUCTION

The district Dharwad with an area of 4273 sq. km (427329Ha) lies in the northern part of Karnataka state between 15°02'00" to 15°48'00" north latitude and 74° 43' 30" to 75° 33'25" east longitudes as depicted in **Fig.1**. Eastern region fall under Malaprabha river (Krishna basin 87%) sub-basin and the "Kali"river (west-flowing river) basin in the west, the rivers are ephemeral. The Bennihalla river (Krishna basin) and the Bedthi nadi & Shalmala Nadi (west flowing rivers) are main watersheds (**Fig-2**) in the district.

The district is well connected by national (NH-4), state highways and the rail. The Dharwad-Hubli, the twincity is a major city, Dharwad is the home to the Karnataka University and the University of Agricultural Sciences .The district comprises five taluks, 5 municipalities and 127-gram panchayats comprising 372 villages. The population of the district is 1604253; include about 685191 work forces with 16.65% growth of population (census-2001). Agriculture is the main occupation in the district using both surface water and groundwater resources practicing flood irrigation method. The major crops grown are Jower, paddy, wheat and maize.

The scientific investigations carried out by CGWB through hydrogeological, geophysical, groundwater salinity studies and drilling of test bore wells to ascertain the groundwater resources scenario in terms of quality & quantity have been brought out in this volume.

## 2.0 RAINFALL & CLIMATE

The rainfall in the district occur from southwest monsoon extends from June to September and ranges from 998.2 to 594.30 mm. An average of 59 rainy days registered during 1901 to 1970, with the rainfall contribution of about 64.9 % from SW monsoon and by NE monsoon 35.1%. The yearly normal rainfall of 772.00mm recorded during 1971-2000 and is about 600mm in the NE region of the dist.

The area experiences tropical climate/semiarid climate with a distinct seasons (1) summer (2) rainy season and (3) the winter. The relative humidity is generally high as over 80% in the monsoon season and less in non-monsoon periods. In April month the whirlwinds are common.

## 3.0 GEOMORPHOLOGY & SOIL TYPE

The study area falls in the western-ghat section (sahyadris) of the peninsula within the rugged foothills. An undulating central Pediplain and the eastern maidan is the prominent feature. It situated at an altitude of 753 m (N-W Dharwad Tk) to 558 mamsl.

The lateritic brownish sandy soil occurs in the western region with 19.62-to 3.6-cm/hour rate of infiltration characteristic. The black cotton soil (BCS) in the eastern part having 2.0 to 5.0 metres thickness, are high humus and low phosphate content, with normal pH-value and very low infiltration characteristic. The Loamy to kankary soil are seen along the banks of river/stream courses.

## 4.0 GROUND WATER SCENARIO

### 4.1 Hydrogeology

Main rock formations in the area are the Gneissic-granites and Schists, the secondary structures like joints, fissures and faults present in them (**Fig.3**) act as a porous media-the Aquifer. The lateritic layer overlying in moderate thickness and alluvium occurs along the riverbanks in less than 3.00 metres thickness acts as an aquifer locally. Ground water in the aquifer generally occurs under unconfined/phreatic and semi-confined conditions. The unconfined condition prevails within the depth range of 17.00 to 40.00 mbgl. 32 exploratory borewells have been drilled at select places within the depth range of 150 to 200 mbgl reveals the presence of fractured zones; they are occasionally saturated between 20.00 and 150 mbgl depths. Generally, the schistose formation has deeper ground water potential zones. The top porous part in the water table aquifer constitutes approximately 3% of volume of formation. The specific capacity of dugwells in the district ranges from 6.90 to 65.03 m<sup>3</sup>/m/dd and the aquifer transmissivity estimated in the order of 1.07 to 113.69 m<sup>2</sup>/day. While the transmissivity of the deeper aquifers estimated in the order of 11 to 40 m<sup>2</sup>/day and that of yield ranges from 2 to 5 lps. The specific capacity of exploratory borewells falls in the range of 32 to 65 lpm/m/d.

#### Water levels

The decadal mean depth to groundwater level (DTW) record reveals shallower water level in the west-central stretch of the district especially in Dharwad and Kalghatgi taluks as depicted in the Hydrogeological map, fig-3. where as the deeper level recorded in the south-south-eastern parts. The general levels recorded in the range of 6.00 to 9.0 mbgl in May-2006 (**Fig-4**) and is recorded between 4.50 and 7.00 mbgl during November-2006 (**Fig-5**). The water level is deeper as between 10 to 20 mbgl in major part of Kundgol, parts of Navalgund and bordering Dharwad, Hubli taluks.

The water level trend for the month May for the period of 1997 to 2007 shows a general fall of 0.5 to 1.5 m, with a few isolated pockets at rising (+ fluctuation) trend in the order of 1.0 to 5.0 m. A general declining trend recorded in November month ie post monsoon period and a appreciable rise of about 1.00m/year noticed in few patches of western hilly region.

Generally the water table contour fall along the regional topography as it flows towards the major river courses depicting a gentle water table gradient. The contour traced also exhibits the ground water divide along the watershed boundaries (Malaprabha and Kali rivers). The ground water flow seems to be converged down to the deeper level in the eastern region. The water table traced show in the altitude range of < 515.15 to 686.26 above mean sea level (amsl) and < 514.85 to 682.70 amsl respectively during post-monsoon and Pre-monsoon period of 2005.

## 4.2 GROUND WATER RESOURCES

The main known source of groundwater in the district is recharge by annual precipitation (rainfall). The ground water potential reveals the annual resource as 31961.81 Ham for the year 2004, as a replenishable /dynamic resource, as indicated in table (A) below. The annual groundwater drawl in Dharwad-taluk accounts for 3441.18 ham and minimum of 937.38 Ham in Kundgol taluk as detailed in table (B). Due to the prevailing socio-economical condition and an uneven distribution of potential aquifers about 2610.35 ham have been used for drinking and 9551.88 Ham both for industrial purpose and irrigation purpose with a total draft of 11059.94 ham during the year 2004 as shown in **Table 1(A)** and **Table 1(B)**.

**Table-1(A)**

Sl. No	Taluk	Recharge from rainfall during monsoon season (ham)	Recharge from Other sources during monsoon season (ham)	Recharge from rainfall during non-monsoon season (ham)	Recharge from Other sources during non-monsoon season (ham)	Gross ground water vailability (ham)
1	DHARWAD	7407.58	453.04	1024.86	402.68	9288.17
2	HUBLI	3803.07	189.12	584.09	199.40	4775.67
3	KALGHATGI	5099.76	125.53	535.11	273.39	6033.80
4	KUNDAGOL	2594.12	303.52	548.55	117.47	3563.66
5	KUNDAGOL (POOR QUALITY)	2874.06	3265.67	909.93	2445.32	578.98
6	NAVALGUND	5043.80	627.36	899.12	438.35	7008.64
7	NAVALGUND (POOR QUALITY)	712.90	712.90	712.90	712.90	712.90
	<b>TOTAL</b>	27535.30	5677.16	5214.55	4589.50	42303.61

**Table1 (B)**

Sl No	Taluk	Net Annual Ground Water Availability (ham)	Existing Gross Ground Water Draft For Irrigation (ham)	Existing Gross Ground Water Draft For Domestic And Industrial Water Supply (ham)	Existing Gross Ground Water Draft For All Uses (ham)
1	DHARWAD	8823.76	3035.41	405.77	3441.18
2	HUBLI	4536.887	1303.495	249.1793	1552.674
3	KALGHATGI	5732.105	1831.091	180.7177	2011.809
4	KUNDAGOL	3387.546	691.2491	246.1344	937.3835
5	KUNDAGOL (POOR QUALITY)	521.082	-	-	0.0
6	NAVALGUND	6676.085	2690.637	426.2606	3116.897
7	NAVALGUND (POOR QUALITY)	641.61	0.0	-	0.0
	Total	30319.07	9551.88	2610.35	11059.94

### 4.3 GROUND WATER QUALITY

The water in phreatic aquifer zones found in potable form whereas it is alkaline to saline in the deeper zones, especially in the eastern part of district. The electrical conductivity (EC) of waters observed in the range of 900 to 1200  $\mu\text{m}/\text{cm}$ , at places in Dharwar, Hubli and Navalgund taluks it recorded between 4000 to >7500 at 25°C. The higher concentration, i.e. more than permissible limit of Nitrate ( $\text{NO}_3$ ) as >45 mg/litre occur in many localities as indicated in fig.5. The fluoride presence in some pockets of the central and eastern border areas noticed as around 1.5mg/l, is greater than the permissible limit as depicted in fig.5, the rest of the area have acceptable limit of 0.2 to 1.0 mg/lit. The presence of chloride as high as >1000 mg/l in many parts of eastern region observed as in the area demarcated in the **Fig-6**, is said to be due to the extensive use of chemical fertilizers in agricultural lands.

### 4.4 STATUS OF GROUND WATER DEVELOPMENT (ADMIN.BLOCKWISE)

The ground water developmental activities in the district mainly concentrated in the valley regions and along the banks of rivers/streams. The extraction of groundwater for irrigation in western region is comparatively high and is in low rate in the eastern region as detailed in the table-2. The borewells tapping within the depth range of 150-to 200 mbgl yield an adequate quantum of water as the presence of saturated fractured zones in exploratory wells. It is observed that the yield of dug and dug-cum-borewells exhibit wide variation but the borewell drilled along the lineament yield copious water as seen in (Devar Gudihal village) Dharwad taluk.

Table-2 Taluk wise ground water draft data

Taluk	Existing Gross Ground Water Draft For Irrigation (HAM)	Existing Gross Ground Water Draft For domestic & Industrial purpose (HAM)	Existing Gross Ground Water Draft For All Uses (HAM)
Dharwad	3035.41	405.77	3441.18
Hubli	1303.49	249.18	1552.67
Kalghatgi	1831.09	180.72	2011.81
Kundagol	691.25	246.13	937.38
Navalgund	2690.64	426.26	3116.90

In all there are 13543 irrigation electric motors registered in the district, DAG-2006. The wells in the highly weathered Gr.gneissic rock aquifer in the eastern parts get depleted resulted in drying of wells during post-monsoon periods. A major part of domestic need is met from groundwater through various drinking water supply schemes implemented by government viz mini-water supply BW-347 nos, accelerated rural water supply, Piped water supply BW-399 nos and 2500 bore wells installed with hand pumps (DAG-2006).

In general the ground water development found between 27.67 to 46.69% over the taluks, where as the district average rate accounted for 35.44%.

Since the water levels in the area as a whole has not shown any appreciable decline the district is categorized as “SAFE” category in terms of development. An area of about 21 % in Navalgund taluk as shown in **Fig.7** has been identified as over exploited, is categorized as “OVER EXPLOITED”.

The previous record reveals a remarkable increase in the usage of ground water with a total drawl of 9551.88 Ham of groundwater.

## 5.0 GROUND WATER MANAGEMENT STRATEGY

Since, the district with the major part of the domestic water and agriculture demand met from groundwater the water management aspect become an integral part for all round socio economical development of the region, in addition to that the environmental management and ecological stability. Hence, a proper groundwater management strategy is essential to make most economical, efficient and judicious use of water to achieve sustainable development of the resource.

### 5.1 GROUND WATER DEVELOPMENT

The development of water supply model should be resource based and should be from the point of view of total supply and demand.

Keeping in view, with the statistical data of water resources, population growth and its utilization pattern, additional demand within the priority areas of drinking, Irrigation and Industrial sector can be identified. And, hence the resource allocation becomes handy to ensure the optimum distribution of resources in the needy areas.

The groundwater resource have been distributed on the basis of population density in 2004 and fractional load/dependence (0.5 for cities and areas having surface water supply & 1.0 for other areas) on ground water during the year 2004 and thus the potential created for development as detailed in table-3.

Table-3 Taluk wise ground water balance data

Taluk	Allocation for Domestic and Industrial Use For Next 25 Years in HAM	Net Groundwater Availability For Future Irrigation Development. HAM	Average Crop Water Requirement (m)	Balance Ground Water Irrigation Potential Available Ha
Dharwad	583.27	5205.07	0.69	7543.58
Hubli	349.97	2883.417	0.815511	3535.719
Kalghatgi	251.20	3649.816	0.8175	4464.607
Kundagol	347.28	2349.015	0.849916	2763.82
Navalgund	615.91	3437.015	0.615658	5582.671
<b>Total</b>	2147.64	17524.34	3.79	23900.36

With the existing scenario the feasible abstraction structures as presented in table-4, viz DW/DCB have been proposed to utilize the resources and effectively develop the potential created for the future.

Table-4 Taluk wise proposed ground water development.

Taluk	Balance.of resource available Ham	Total structures with unit draft of 1.10 ham	irrigation potential created in the dist as on March 2004 in Ha
DHARWAD	5205.07	4731.9	7553.54
HUBLI	2883.42	2621.3	3535.72
KALGHATGI	3649.82	3318.0	4464.61
KUNDAGOL	2349.01	2135.5	2763.82
NAVALGUND	3437.01	3124.6	5582.67
<b>Total</b>	<b>17524.33</b>	<b>15931.2</b>	<b>23900.36</b>

In view of the ever-growing population and subsequent demand for various economical developmental activities adaptation of unconventional means to artificially recharge the ground water in the water level depleting areas and over exploited areas is advocated. The spacing between wells proposed > 200m metres for the eastern region to achieve optimum/sustainable yield and avoid the interference during simultaneous pumping of wells in the vicinity.

## 5.2 WATER CONSERVATION & ARTIFICIAL RECHARGE

Keeping in view of the resources availability, the following groundwater abstraction and recharge structures have been proposed (Table-5A&B) to maintain the Aquifer potential and their sustainable development as the area demarcated in Fig.7.

Table-5A Details of ground water extraction and recharge structures proposed in the district.

SL. No	Taluk in Dharwad dt	Number of Proposed Recharge Structure				Available non comitted Monsoon runoff. Mcm
		Sub surface dyke@Rs 4.5 lakhs/str	PercoLation tank @Rs20 lakhs/str	Checkdam. @ Rs2.4lakhs/str	Filter Beds Rs 1.5lakhs/str	
1	DHARWAD	5	25	82	49	9.87
2	HUBLI	3	16	54	33	6.53
3	KALGHATGI	0	2	7	4	0.90
4	KUNDAGOL	5	23	77	46	9.28
5	NAVALGUND	8	40	132	79	15.90

Table-5B Details of ground water extraction and recharge structures proposed in the district.

SI No	Taluku	Recharge Capacity of each structure (MCM)				Total Recharge capacity .MCM	Expected benefit by the proposal	
		Sub surfac e dyke	Percolation tank	Check dam	Filte Beds		Likely recharge (MCM)	Addl Irriga- tion Poten- tial.in Lac.Ha
1	DHARWAD	1.48	4.94	2.47	0.99	9.87	7.40	0.00892
2	HUBLI	0.98	3.27	1.63	0.65	6.53	4.90	0.00590
3	KALGHATGI	0.13	0.45	0.22	0.09	0.90	0.67	0.00081
4	KUNDAGOL	1.39	4.64	2.32	0.93	9.28	6.96	0.00838
5	NAVALGUND	2.38	7.95	3.97	1.59	15.90	11.92	0.01437

In view of the socio-economical development with subsequent demand for fresh water and changes in the local environment it is necessary to conserve the water resource and adopt unconventional means to artificially recharge the ground water in the water level declining/prone to decline areas and prevent further decline in the water level and deterioration in the quality of water. In the groundwater "SAFE" category areas of the district it is advocated for the development of a water supply model so that the optimum utilization of resource is achieved.

The Conjunctive use of both surface and ground water resources practiced in the canal command area and in western parts during monsoon period would improve the resource availability during scarcity periods. The present surface water supply to twin city, Hubli-Dharwad (area 74Km<sup>2</sup>, population about 8 lakh) can be brought down by implementing roof-top rainwater harvesting to supplement the domestic requirement during monsoon periods, the other area experiencing the drinking water scarcity can also adopt this rainwater harvesting method in a big way.

## **6.0 GROUNDWATER RELATED ISSUES & PROBLEMS IN THE DISTRICT**

Though the study area enjoys a low to moderate annual rainfall resulted in drought (RFdeficiency) condition and saline nature of ground water especially in the taluks of Navalgund and Kundgol are experiencing shortage of safe water for domestic use. In Navalgund taluk about 21 % of the area has been over exploited as indicated in fig.5. The quality deterioration in many parts of the district can be attributed partly to the natural means of decomposing of host rock/aquifer by prevailing weather condition over the year. Indiscriminate dumping of wastes on the land and usage of chemical fertilizers in the agricultural land by human activities also leads to groundwater deterioration.

The wells sunk in schistose rock aquifers especially in Kalghatgi, Dharwad taluks and highly weathered Gr.gneissic rock aquifer in the eastern parts the wells go dry for several months during summer periods. The present water supply to the twincity-urban area (74km<sup>2</sup>) having a population of about 8 lakh-2001 census receives from Neerasagar tank and Malaprabha river (Renuka sagar resevoir) is reported to be inadequate. The leakage in the said surface water supply network system is estimated around 40%. A proposal is in the anvil to improve the existing source-Renukasagar through Malaprabha stage-III at a cost of 237 crores with the assistance of World Bank.

## **7.0 AWARENESS&TRAINING ACTIVITY**

### **7.1 Mass awareness Programme(MAP) by CGWB**

Mass awareness campaign on ground water protection and conservation was organised in Karnataka University, Dharwar on 27<sup>th</sup> December 2000. As a Chief guest Shri.H.K.Patil, the then honorable minister for major and medium irrigation, Government of Karnataka attended the campaign and Dr. D.K. Chadha the then

Chairman of CGWB presided over the function. In the function the distinguished dignitaries addressed various aspects of ground water and its conservation. Dr. D.K. Chadha explained in detail about the various aspects involved in ground water conservation processes, harnessing of rainwater and artificial recharge to ground water.

## **7.2 Presentation & lectures delivered in Public forum/Radio/TV/Institution of repute, Grassroots/association/NGO/Academic institution etc.**

An investigation carried out on the “groundwater recharge & water quality” around Hubli-Dharwad by the “Centre for Arid zone Studies, University of Wales, Bangor” draws the conclusion with an anticipation of a rise in the groundwater recharge by the year 2010 after the implementation of Mallaprabha III-stage, a surface water supply project to the city.

## **8.0 AREAS NOTIFIED BY CGWA/SGWA**

The groundwater in a major parts of the district developed partially and thus falls in ‘SAFE’ category except a small area in Navalgund taluk (about 21%) falling under over exploited category.

## **9.0 RECOMMENDATIONS**

Considering the prevailing scenario of the groundwater resources and its development the following recommendations are made for achieving the sustainable development of resources in the district.

- 1) The dug wells found in the dried weathered, fractured zones can temporarily be modified for groundwater recharging purpose to ensure the better utility.
- 2) Construction of check dams and sub surface dykes at appropriate places across the nallahs and streams and the areas where water table is having declining trend on priority basis.
- 3) A comprehensive programme should be formulated to harvest the rainwater through existing building rooftops and check dams, surface tanks, bunds and subsurface dykes to augment the groundwater resources in terms of quality and quantity.
- 4) The ground water worthy areas such as topographic lows, valley portions low fluctuations zones should be developed with an adequate soil conservation measures to prevent the soil erosions.
- 5) Constant monitoring of ground water quality should be carried out in the district especially in the Bennihalla watershed canal command areas so as to have check on the ground water quality status and recording of trace elements and organic compound would help in categorizing the quality of water.
- 6) A detailed geophysical study should be conducted in the eastern part of the district to demarcate aquifer geometry, the extent of fresh water zones and salinity prone areas.

- 7) A comprehensive action plan for development of groundwater prepared for the district would facilitate effective implementation of groundwater development activities.
- 8) The highly brackish groundwater quality areas in the eastern part can be developed for growing salt tolerant crops such as Onion, Chillies, Wheat etc to control the soil salinity.
- 9) The farming community in the district should be encouraged with financial assistance and technical guidance to conserve and develop groundwater through modern irrigation methods.

Fig-1

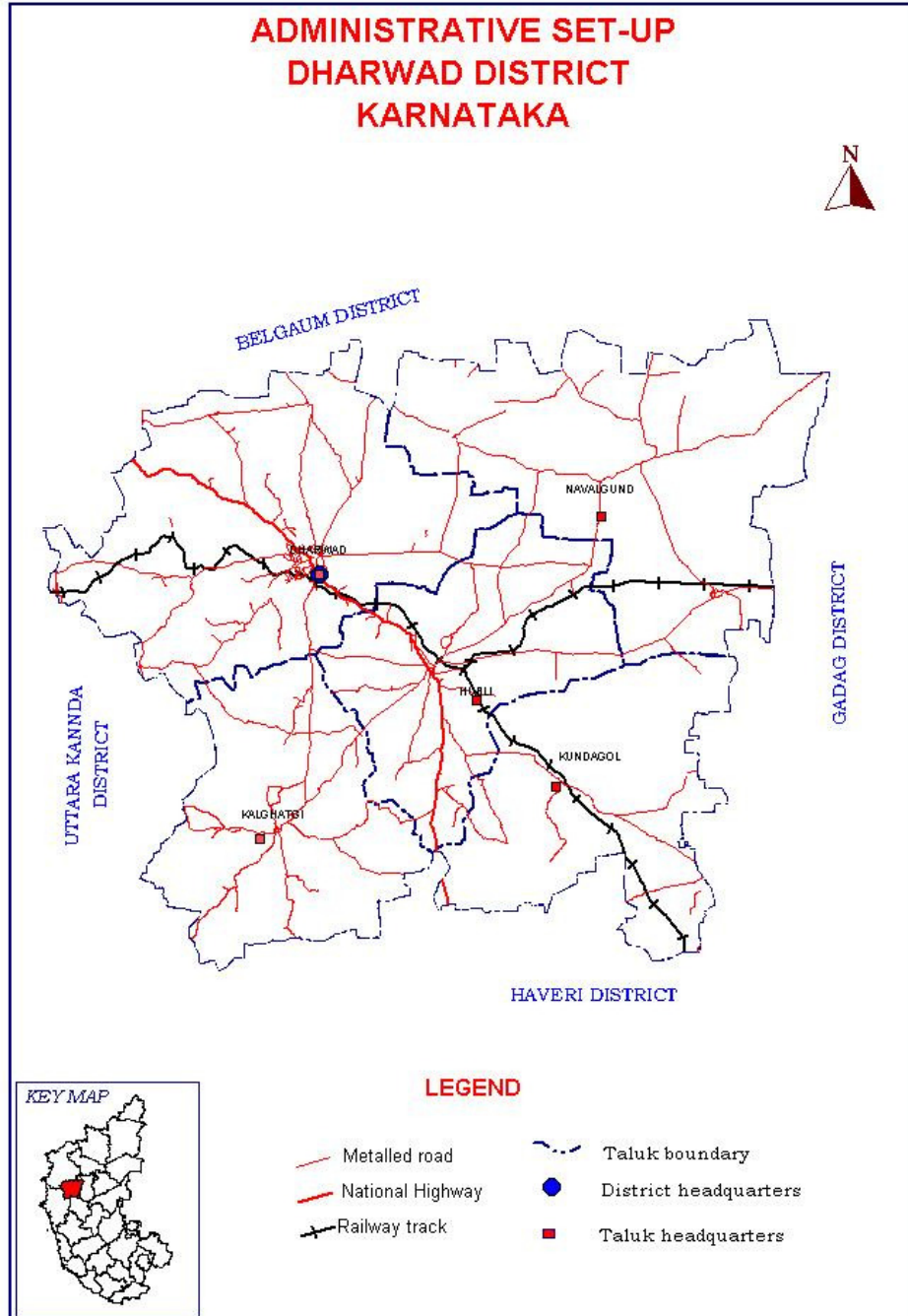


Fig-2

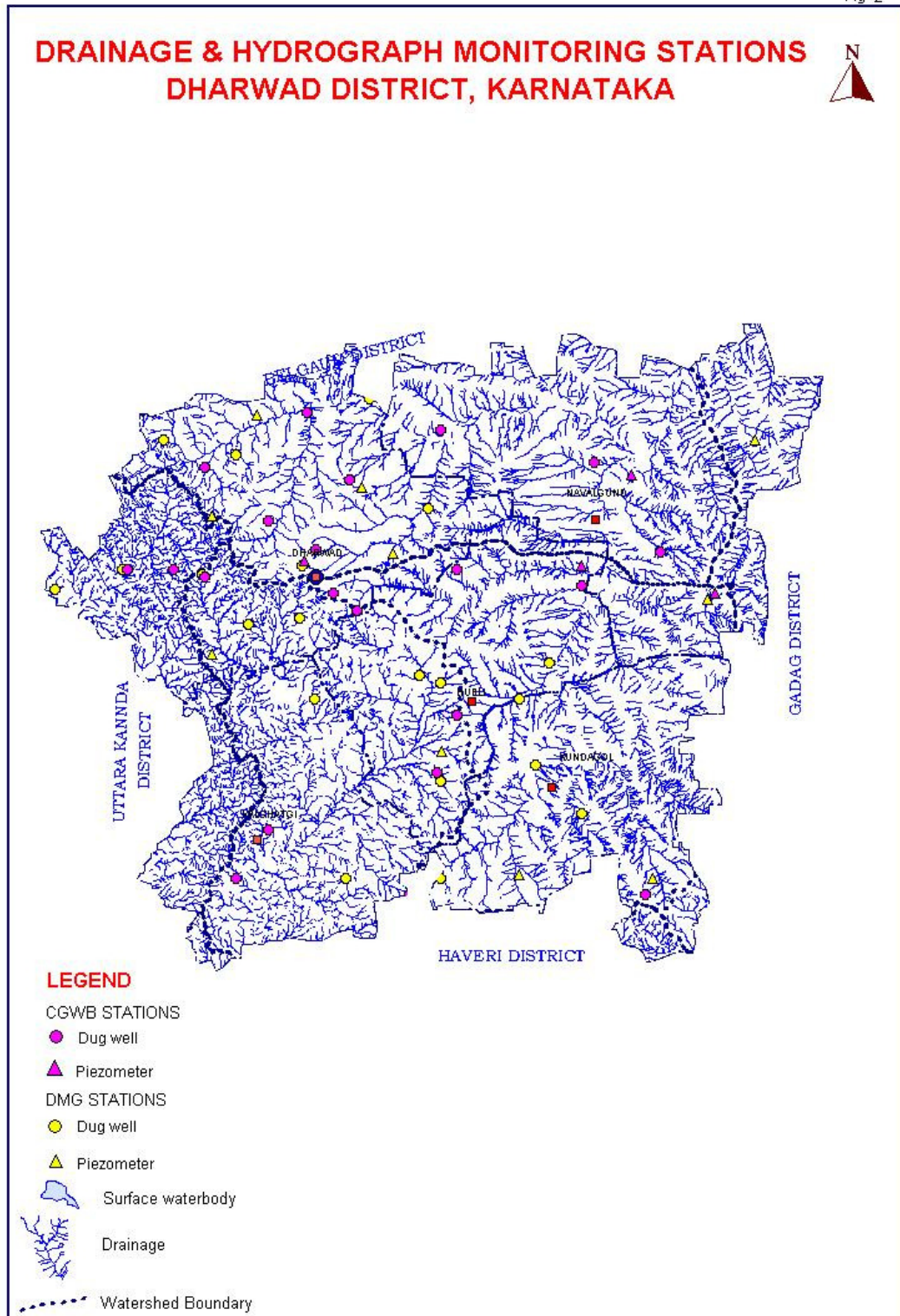


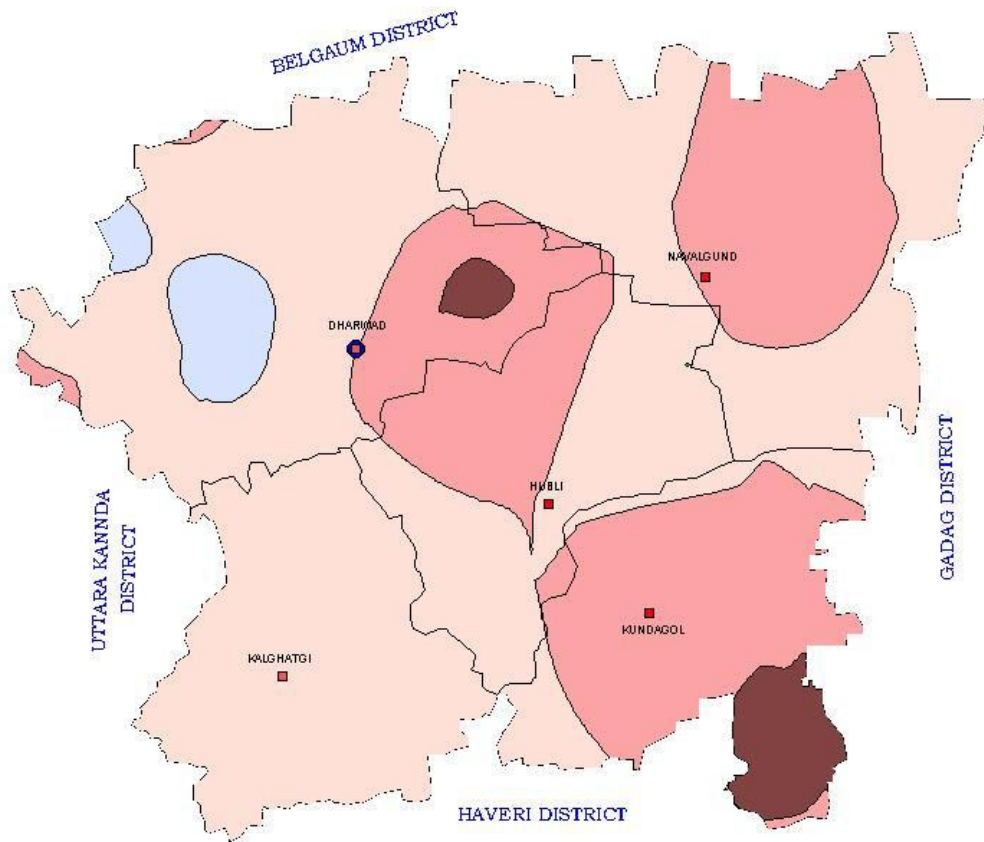


Fig. 4

# DEPTH TO WATER LEVEL PRE-MONSOON (MAY-2006) DHARWAD DISTRICT, KARNATAKA



0 10 20 kilometres



## LEGEND

Depth to Water Level (m bgl)



-  2 - 5
-  5 - 10
-  10 - 20
-  > 20

Fig-5

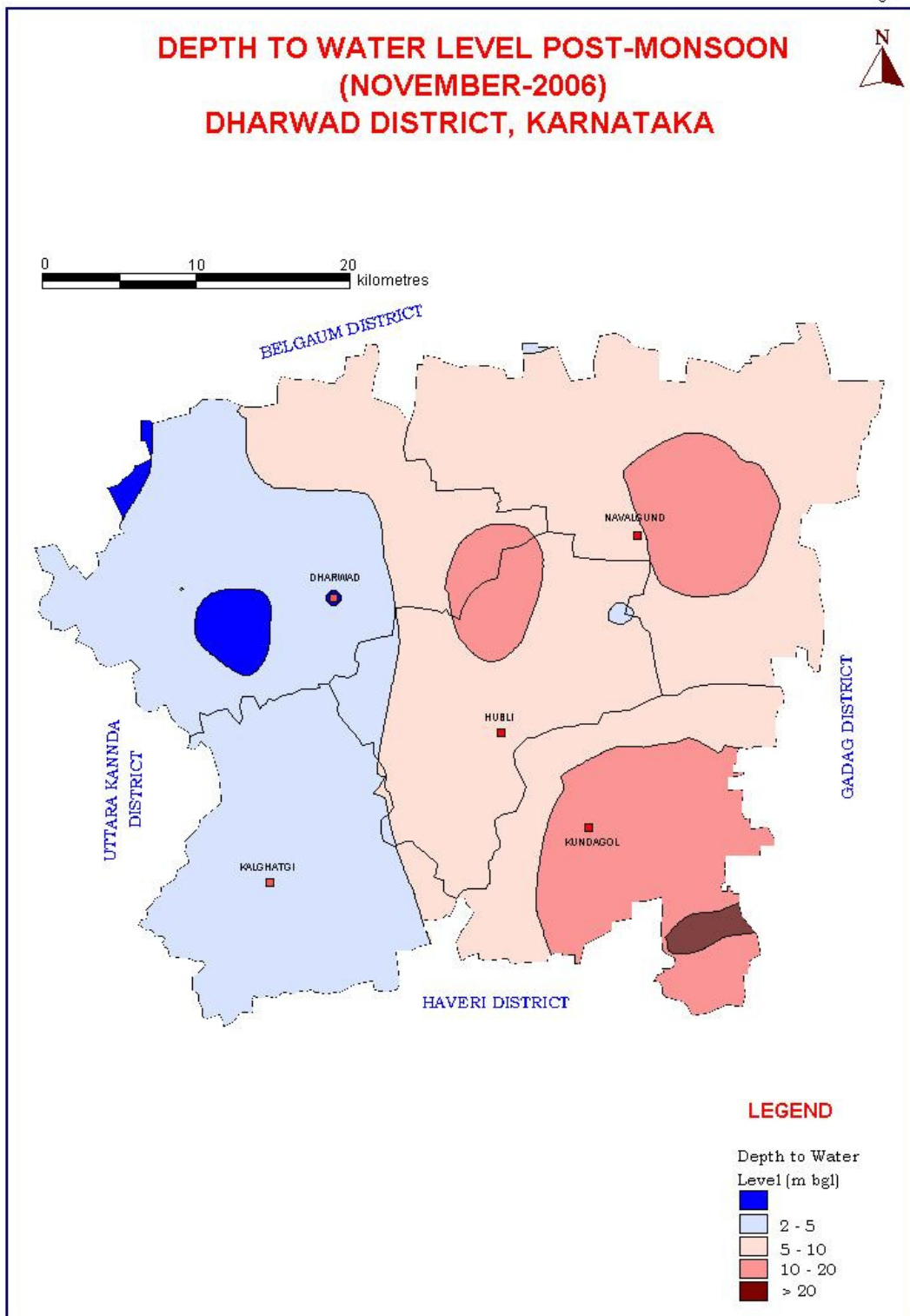


Fig-6

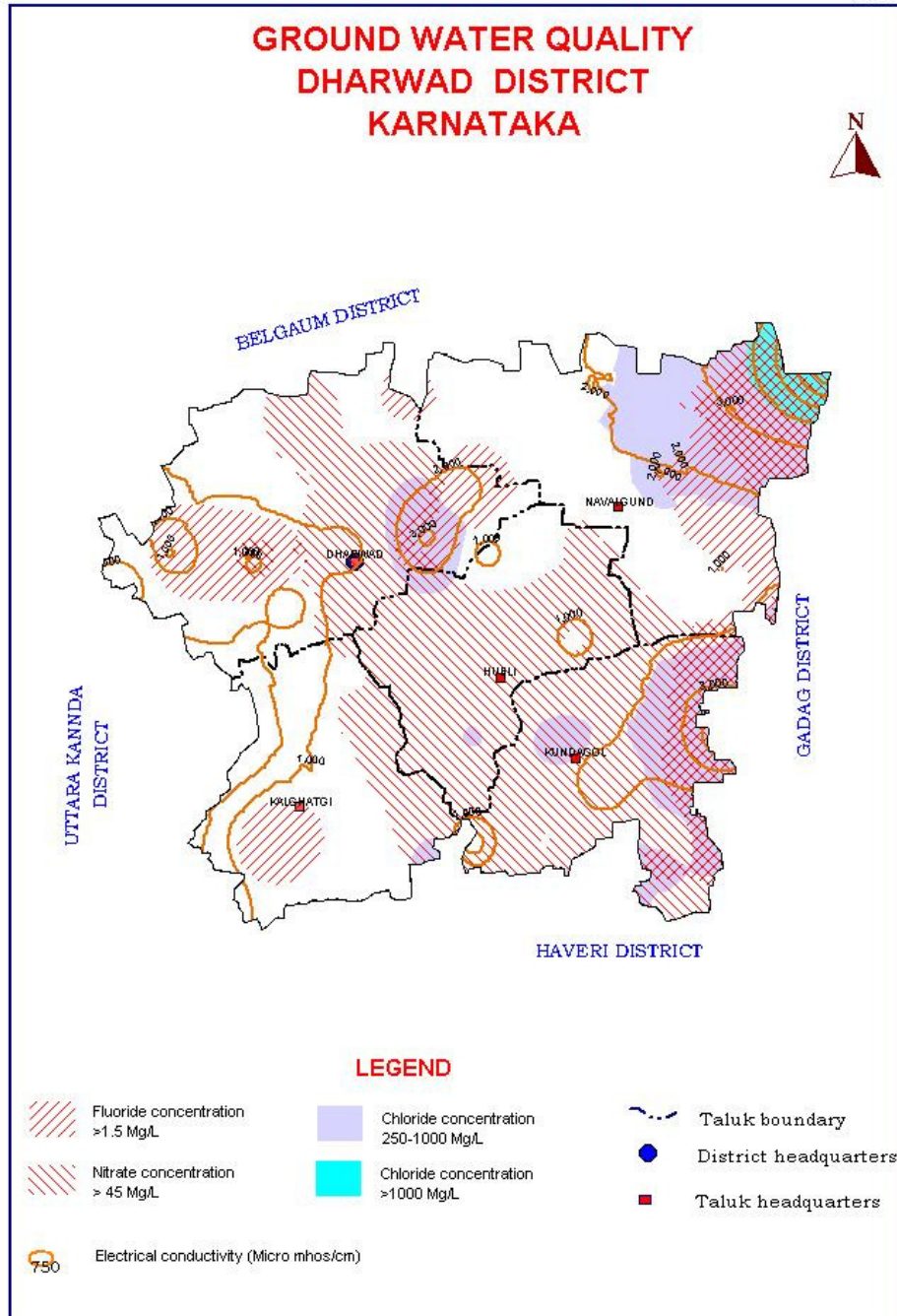


Fig -7

