जल वर्ष 2007 Water Year 2007

स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल

CONSERVE WATER - SAVE LIFE

GOVERNMENT OF INDIA

भारत सरकार

MINISTRY OF WATER RESOURCES

जल संसाधन मंत्रालय

CENTRAL GROUND WATER BOARD

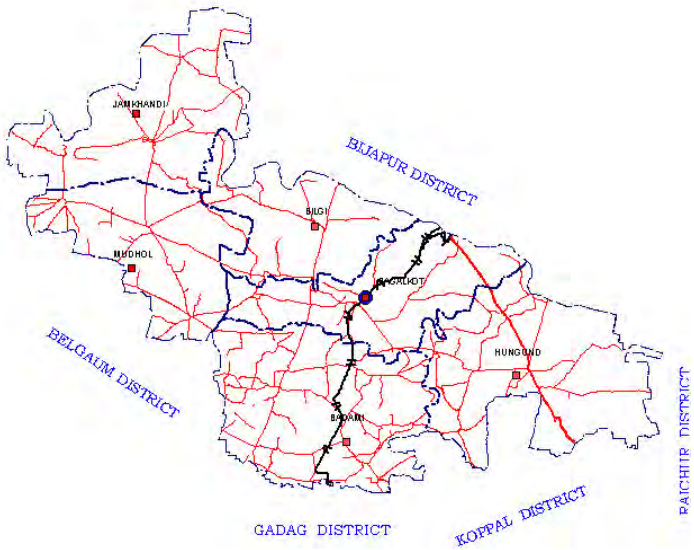
केंद्रीय भूमि जल बोर्ड

GROUND WATER INFORMATION BOOKLET

भूमि जल जानकारी पुस्तिका

BAGALKOTE DISTRICT, KARNATAKA STATE

बागलकोटे जिला, कर्नाटक राज्य



SOUTH WESTERN REGION

दक्षिण पश्चिम क्षेत्र

BANGALURU

बेंगलूरु

SEPTEMBER 2012

सितंबर 2012

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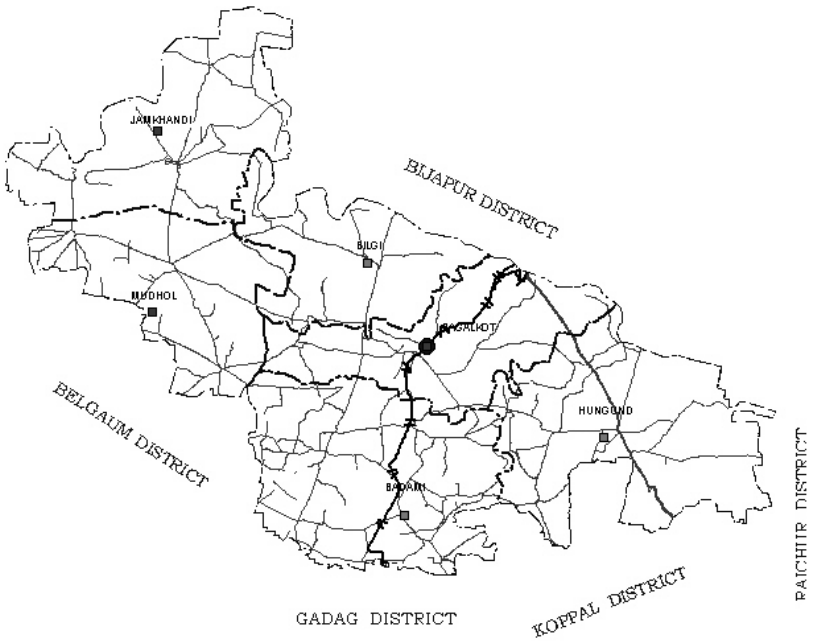

SOUTH WESTERN REGION
BANGALORE
SEPTEMBER 2012

डॉ. एस. सी. धीमान
अध्यक्ष
भारत सरकार
केन्द्रीय भूमि जल बोर्ड
जल संसाधन मंत्रालय
भूजल भवन
एन.एच. 4 फरीदाबाद
मो न. : 9868218549
फोन. न.: 0129-2419075
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सत्यमेव जयते

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Foreword

Groundwater is an essential component of the environment and economy. It sustains the flow in our rivers and plays an important role in maintaining the fragile ecosystems. The groundwater dependence of agrarian states like Karnataka is high. Recent studies indicate that 26 percent of the area of Karnataka State is under over exploited category and number of blocks is under critical category. In view of the growing concerns of sustainability of ground water sources, immediate attention is required to augment groundwater resources in stressed areas. Irrigated agriculture in the state is putting additional stress on the groundwater system and needs proper management of the resources.

Central Ground Water Board is providing all technical input for effective management of ground water resources in the state. The groundwater scenario compiled on administrative divisions gives a better perspective for planning various ground water management measures by local administrative bodies. With this objective, Central Ground Water Board is publishing the revised groundwater information booklet for all the districts of the state.

I do appreciate the efforts of Dr. K.Md.Najeeb, Regional Director and his fleet of dedicated Scientists of South Western Region, Bangalore for bringing out this booklet. I am sure these brochures will provide a portrait of the groundwater resources in each district for planning effective management measures by the administrators, planners and the stake holders.

Dr. S. C. Dhiman

PREFACE

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, vulnerability area 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 30 districts of Karnataka state, incorporating the data up to the period 2011-12.

The Bagalkote 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 H.P.Jayaprakash, Scientist-C and Shri A. Sakthivel, Asst. Hydrogeologist under the guidance of Dr K.R.Sooryanarayana, Scientist-D, Central Ground Water Board, South Western Region, Bangalore. The figures were prepared by Sri.J.Sivaramakrishnan, 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, academicians, hydrogeologists and engineers to plan and manage the water resources in a better way in the district.

(K.Md.Najeeb)
Regional Director

BAGALKOTE DISTRICT AT A GLANCE

Sl.No	Items	Statistics
1	GENERAL INFORMATION	
	i) Geographical area (Sq km)	6593
	ii) Administrative Divisions (As on 31/3/2006)	
	Number of Taluks	6
	Numbers of Villages	623
	iii) Population (As on 2011 census)	18,90,826
	iv) Average Annual rainfall (mm)	564 mm (Av. 10 years: 2001-2010)
2	GEOMORPHOLOGY	
	i) Major physiographic units	Undulating plains interspersed with sporadic dissected hills to rugged topography.
	ii) Major Drainages	Krishna main basin: Malaprabha & Ghataprabha sub-basins.
3	LAND USE (Sq.km)	
	i) Forest area:	811.26
	ii) Net area sown:	4553.41
	iii) Cultivable area:	5035.54
4	MAJOR SOIL TYPES	Red sandy soil, red loamy soil & black cotton soil
6	IRRIGATION BY DIFFERANT SOURCES	
	(Area in Ha & Numbers of Structures)	
	Dugwells	11764
	Tube wells/Borewells	85990
	Tanks/Ponds	811
	Canals	52242
	Others sources (including Lift irrigation)	98348
	Net Irrigated Area	251863

Sl.No	Items	Statistics
7	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (as on 31-3-2007) No of Dug wells No of Piezometers	 28 10
8	PREDOMINENT GEOLOGICAL FORMATIONS	Sandstone, Quartzite, Limestone, Shales, Basalt, Schist, Granite and Gneiss.
9	HYDROGEOLOGY Major water bearing formation (Pre-monsoon Depth to water level during 2011) (Post-monsoon Depth to water level during 2011) Long term water level trend in 10 years (2002-2011) in m/yr.	 Weathered & fractured sandstones, shales, limestones, basalts, gneisses, granites and schists. Min. 0.71 mbgl : Max. 30.68 mbgl Min. 0.50 mbgl : Max. 26.75 mbgl. Rise: Min. 0.085 m/yr to Max.1.344 m/yr Fall: Min. 0.098m/yr to Max.0.194 m/yr
10	GROUND WATER EXPLORATION BY CGWB (As on 31-03-2007) No of well drilled (EW, OW, PZ, Total) Depth range (m) Discharge (lps) Storativity (S) Transmissivity (m2/day)	 31, 02, 25 -100 <1.0 – 9.85 - to 665 m^2/day
11	GROUND WATER QUALITY (NHS Samples) Presence of Chemical constituents more than permissible limits Type of water	 *EC: 607 – 7000 micromhos/cm at 25°C* *>3000 micromhos/cm at 25°C- 7 nos (out of 24 nos)* Cl: 28-638ppm >500ppm- 6nos (out of 24 nos) Carbonate & Bicarbonate Sodium Bicarbonate

Sl.No	Items	Statistics
12	DYNAMIC GROUND WATER RESOURCES (March,2009)- in MCM	
	Annual replenish able Ground water Resources	439.18
	Net Annual Ground Water draft	437.40
	Projected Demand for Domestic and Industrial Uses upto 2025	47.95
	Stage of Ground Water Development in %	100
13	AWARENESS AND TRAINING ACTIVITY	
	Mass Awareness Programmes organized	Nil
	Date	
	Place	
	No of participants	
	Water Management Training Programmes organized	Nil
	Date	
	Place	
	No of participants	
14	EFFORTS OF ARTIFICIAL RECHARGE & RAIN WATER HARVESTING	Nil
	Projects completed by CGWB (No & Amount spent)	
	Projects under technical guidance of CGWB (Numbers)	
15	GROUND WATER CONTROL AND REGULATION	
	Number of OE Blocks	5 - (Badami, Bagalkote , Jamkhandi (p), Mudhol(p), Hungund (p),
	No of Semi Critical Blocks	Hungund (p)
	No of Blocks notified	-
16	MAJOR GROUND WATER PROBLEMS AND ISSUES	Resource scarcity in non-canal command area due to over-exploitation; Water logging and quality deterioration in canal command area. Sporadic fluoride and nitrate pollution.

BAGALKOTE DISTRICT

1.0 Introduction:

Bagalkote is a district formed in November 1997 by bi-furcating Bijapur district. Bagalkote town is the district headquarters. The district is located in the northern part of the state of Karnataka. Historically Bagalkote district is significant because it was the Capital of the Chalukyan Empire of South India under Pulakesi I. The Chalukyas ruled from 550 AD to 753 AD when the Rashtrakutas deposed this dynasty. The 12th Century social reformer Basavanna's ' Aikya Mantap' or holy samadhi and famous shiva temple is located in Kudalsangama in Hungund taluk of the district. Badami was the Capital of Chalukya dynasty. Badami, Aihole, Pattadakallu, Kudalasangama, Banashankari and Mahakoota are the important historical places in the district.

Bagalkote district is bound by Bijapur in the north, Belgaum in the west, Dharwar in the south and Raichur in the east. The district comprising of 6 taluks, occupies an area of 6593 sq.kms (constituting around 3.4 percent of the area of the state) and lies between 15° 49' & 16° 46' north latitude and 74° 58' & 76° 20' east longitude (Fig-1). The area is a gently undulating to a plain terrain, dotted with isolated hills. The elevation ranges from 480 to 729 metres amsl, sloping from west to east. The district falls in the Northern dry Agro-climatic zone and experiences a semi-arid climate. It is one of the drought -prone districts of the State.

The district is drained by the river Krishna and its tributaries Ghatprabha and Malaprabha. All these rivers enter district on the western side and flow in an easterly direction to join the Bay of Bengal. Krishna River enters the district at Terdal village in Jamkhandi taluk and flows in south-easterly direction and forms the northern boundary of the district separating it from Bijapur district. The Ghataprabha River flows in the middle part of the district and joins the Krishna in Chikkasangama village in Bilgi taluk. The Malaprabha flowing in the southern part, joins the Krishna at Kudal Sangama in Hungund Taluk. The Ghataprabha and Malaprabha canal systems serve the western parts of the district. The Dam across the Krishna river at Almatti and the canal systems serve the eastern parts. Rainfall being as low as 560 mm annually, these canals are the lifelines, providing much needed irrigation and drinking water to the district. (The drainage in the district is shown in the Figure–2.

Central Ground Water Board has carried out Systematic hydrogeological surveys when it was in the undivided Bijapur district and Reappraisal hydrogeological surveys after the formation of the district. Exploratory drilling was carried out during 1975-76, 1988-90 & 2004-07 in the district. Seventy bore wells were drilled by CGWB under ground water exploration programme (Fig- 3)

Fig- 1


ADMINISTRATIVE SET-UP
BAGALKOTE DISTRICT
KARNATAKA
N
JAMKHANDI
BIJAPUR DISTRICT
BILGI
MUDHOL
BAGALKOT
BELGAUM DISTRICT
HUNGUND
BADAMI
RAICHUR DISTRICT
GADAG DISTRICT
KOPPAL DISTRICT
LEGEND
KEY MAP
Metalled road
National Highway
Railway track
Taluk boundary
District headquarters
Taluk headquarters
Hilly area

Fig-2

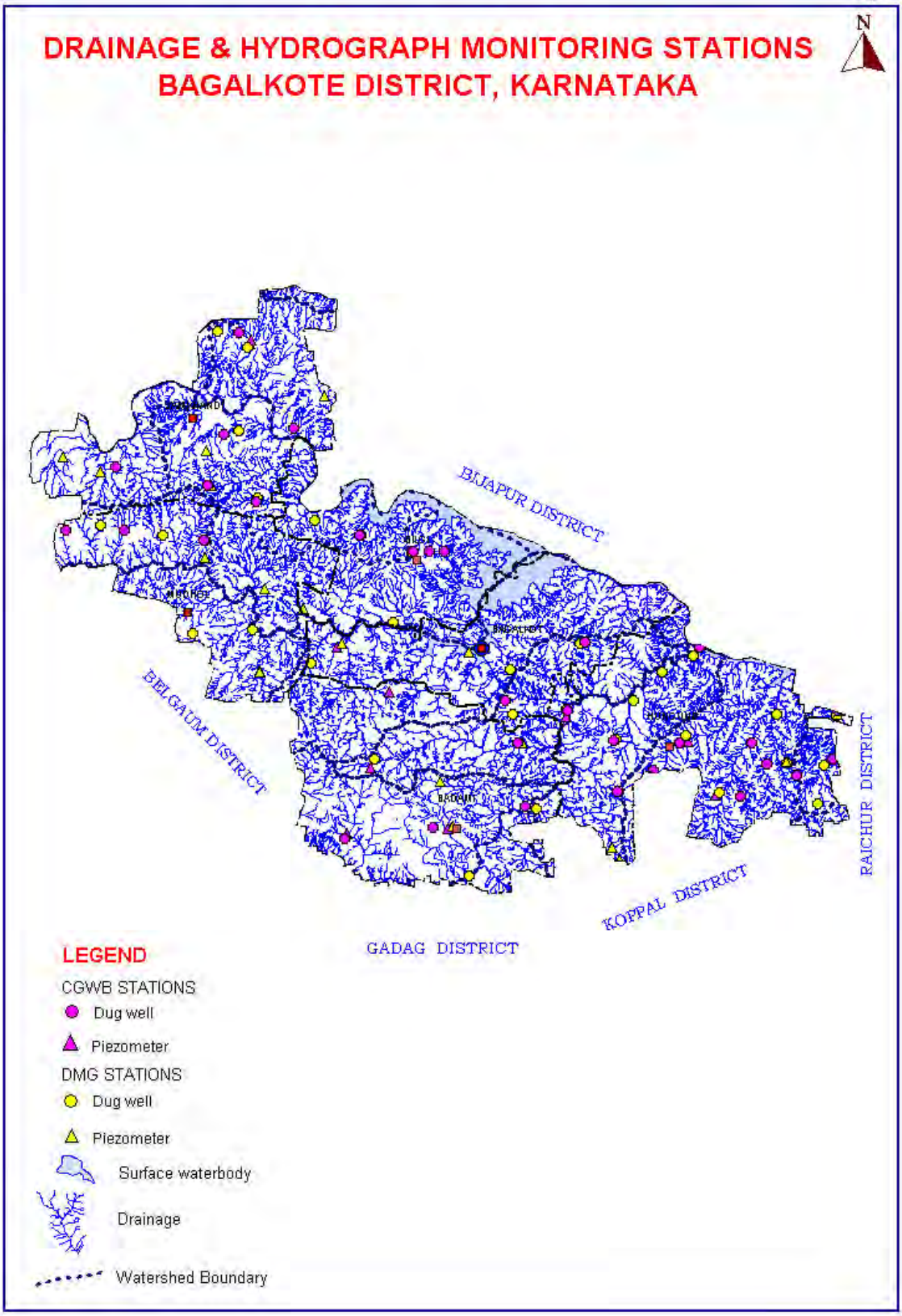
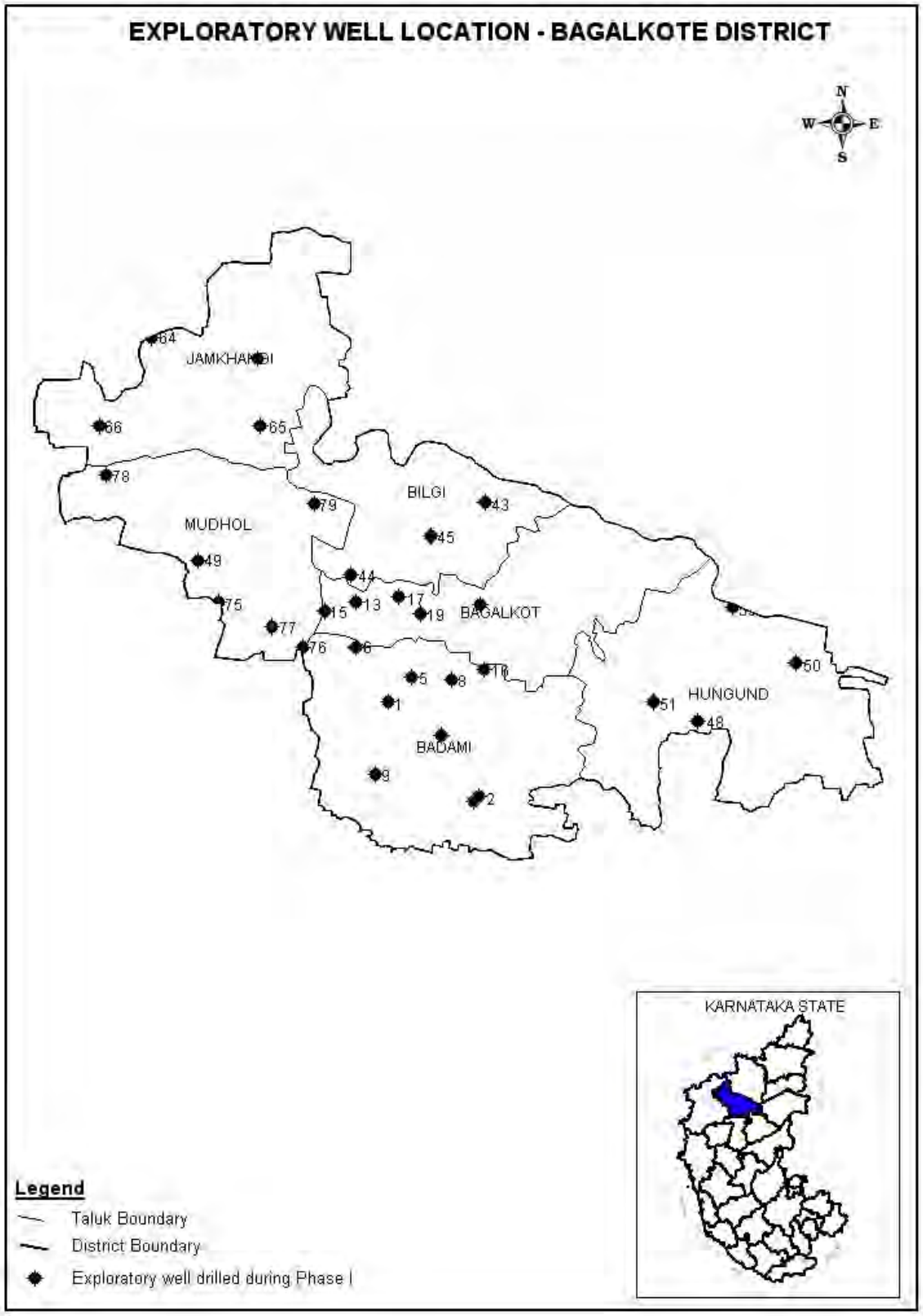

DRAINAGE & HYDROGRAPH MONITORING STATIONS
BAGALKOTE DISTRICT, KARNATAKA
N
BIJAPUR DISTRICT
BELGAUM DISTRICT
RAICHUR DISTRICT
KOPPAL DISTRICT
GADAG DISTRICT
LEGEND
CGWB STATIONS
Dug well
Piezometer
DMG STATIONS
Dug well
Piezometer
Surface waterbody
Drainage
Watershed Boundary

Fig -3


EXPLORATORY WELL LOCATION - BAGALKOTE DISTRICT
N
W
E
S
JAMKHANDI
BILGI
MUDHOL
BAGALKOT
BADAMI
HUNGUND
64
66
65
78
79
43
45
49
44
75
15
13
17
19
77
76
6
5
8
16
1
9
2
51
48
50
KARNATAKA STATE
Legend
Taluk Boundary
District Boundary
Exploratory well drilled during Phase I

2.0 Rainfall & Climate:

There are 6 rain gauges located in each of the 6 taluks (Table 1). The data in respect of these stations from the year 2001 to 2010 are analyzed. The Data are collected from The Directorate of Economics & Statistics and Drought Monitoring Cell, which are the agencies of Government of Karnataka. Average rainfall (10 years) of the district is 551 mm, ranging from 461 mm in Mudhol taluk to 658 mm in Hungund taluk (Table-1). Thus, in general, rainfall in the district gradually increases from west to east. The seasonal distribution indicates that, about 60% of the annual rainfall is received during SW monsoon (June-Sept), 24% during post-monsoon period (Oct-Dec) and the remaining during other seasons. The annual average number of rainy days is 41. Thunderstorms are common during summer bringing relief from swelter.

Table 1: Rainfall details of Bagalkote district

Seasonal & Annual Normal Rainfall for the period 2001-2010 Bagalkote District, Karnataka				
Station	**Pre-Monsoon**	**SW Monsoon**	**NE Monsoon**	**Annual**
	Rainfall (mm)			
Badami	104	382	127	614
Bagalkote	89	302	122	513
Bilgi	94	322	140	557
Hungund	109	385	163	658
Jamkhandi	74	309	119	502
Mudhol	73	291	96	461

Table.2: DISTRICT AND TALUK WISE MONTHLY RAINFALL FOR THE YEAR 2011, BAGALKOTE DISTRICT, KARNATAKA

	DISTRICTS/ TALUKS	JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEPT	SWM	OCT	NOV	DEC	NEM	ANNUAL
		Rainfall (mm)															
XXIV	**BAGALKOTE**	**0**	**1**	**1**	**35**	**88**	**126**	**77**	**87**	**120**	**42**	**326**	**112**	**0**	**0**	**112**	**564**
1	BADAMI	0	0	0	49	132	181	108	75	89	18	290	104	0	0	104	575
2	BAGALKOTE	0	0	0	14	80	94	78	55	205	52	390	92	0	0	92	576
3	BILGI	0	4	0	29	45	78	87	45	70	27	229	118	0	0	118	425
4	HUNGUND	0	4	6	21	49	80	66	100	192	86	444	170	0	0	170	694
5	JAMKHANDI	0	0	0	38	99	137	61	72	95	26	254	98	0	0	98	489
6	MUDHOL	0	0	0	59	125	184	64	176	67	44	351	88	0	0	88	623

The Rainfall distribution in the district is studied for the year 2011. Rainfall is normal in Badami, Bagalkote, Hungund and Jhamakhandi taluks, deficit in Bilgi taluk and excess in Mudhol taluk (Table-2).

The nearest meteorological observatory located at Bijapur and the normals (Table.2) of the observatory may be taken as representative of meteorological conditions in the districts. There are two Hydrometeorological observatories maintained by Water Resources Development Organisation at Mahalingapur and Almatti dam site. Normally, the months of January and February are dry and cool. The month of April is the hottest with mean daily maximum temperature being above 30°C. However, daily temperatures may go above 40°C. With the onset of monsoon there is an appreciable drop in the temperature. Night temperatures are lowest in the cold season; touching 10°C. Humidity is high during monsoon season. During the winter months mist is common leading to foggy conditions occasionally.

Table:2. Climatic Normals. (Bijapur Observatory).

Month	Temp		R.humidity	
	Max.	Min.	Max.	Min.
Jan	30.1	14.0	66	30
Feb	32.2	15.1	61	30
Mar	35.0	18.0	62	32
Apr	35.7	19.5	72	46
May	34.0	20.6	78	58
Jun	27.5	20.6	85	76
Jul	25.2	19.8	90	92
Aug	25.6	19.4	92	87
Sep	27.0	19.0	89	81
Oct	30.1	18.6	81	64
Nov	29.3	17.1	70	47
Dec	29.3	13.9	67	35
Annual average	**30.1**	**18.0**	**76**	**57**

3.0 Geomorphology & Soil Types:

In general, the topography in the southern part of the district is rugged and undulating while in the northern part it is gently undulating to rolling plains with a number of low lying, flat hills. The southern and south-western parts of the district covering Badami, Bagalkote and western parts of Hungund taluks are traversed by chains of detached hills trending in EW direction. The ortho-quartzites and the banded hematite quartzites have formed well defined linear ridges in the central part of the district. The ground elevation ranges from 480 to 729 metres amsl, sloping towards ESE.

Different types of soils are found in the district depending upon the distribution of geological formations and are mostly insitu in nature. The soils can be classified into different groups as described below:

i). Soils in Basaltic terrain: Soils of this type are again classified as shallow, moderate and deep black cotton soils. They are usually light black to black in colour and vary in thickness from 25 cms to 8 mtrs and have high water holding capacity. These soils are fertile but when occupy the low-lying area cause water –logging conditions in canal command areas.

ii).Soils in Limestone terrain: These are dark grey in colour, clayey and calcarious. These have high water holding capacity and low permeability. Low in N but high in K. When compared to black cotton soil are low in nutrients.

iii). Soils in Sandstone terrain: This soil is grayish to yellowish brown in colour. Thickness varies from 1.5 to 1.8m. More permeable and low in P, high in K and medium N content. Alkaline in nature.

iv). Soils in Schist and phyllite terrain: These soils are clayey in nature and limited in thickness. They are well drained with moderate permeability. They are less fertrile.

v). Soils in Gneissic terrain: These soils are generally sandy-loam in nature with grayish to pinkish in colour. Moderate in fertility, good water holding capacity and low in permeability.

3.1 Agriculture and Irrigation : Agriculture is the main occupation of the people in the district. The geographical area is 659300 Ha and 'Net Sown area' is 455341 Ha which is 69.06% of the geographical area. The major crops grown are Jowar, maize, wheat, bajra, sugarcane, sunflower, pulses and groundnut. Net Irrigated area is 25186 Ha which constitutes 55.31% of the Net Sown area and the remaining 54.31% of the area is rainfed. Out of the net irrigated area, nearly 60% is through surface water resources and the remaining 40% through groundwater. A major dam has been built across the Krishna at Alamatti in Basavanabagewadi taluk of Bijapur district, which provides irrigation facility to Karnataka and Andhra Pradesh States. Thus, the Krishna, the Malaprabha and the Ghataprabha canal systems cater to the irrigation needs in parts of Mudhol, Jamkhandi, Bilgi and Badami taluks of the district.

3.2 Geology and mineral wealths: The district is underlain mainly by the crystalline formations of different ages. The pre-Cambrian formations include granites, gneisses, metasediments of Dharwar super Group, shales, sandstones, quartzites and limestones of Kaladgi series, basalts of Eocene to upper Cretaceous and laterites of Pleistocene age. Laterites and river alluvium (Recent) occur as insignificant , stray patches.

The district is endowed with a fairly rich mineral and rock wealths. It is famous for good quality limestone deposit and world-class pink granites of Ilkal area. Limestones and dolomites which are supporting many cement industries are available in plenty at places like Bagalkote, Khajjidoni, Gaddanakeri, Petlur, Varachagallu, Bommanabudni, Hireshellikeri and Chikshellikeri of the district. The other important minerals found in the district are dolomite, iron ores (Ramthal- Hungund taluk) copper ores (Khajjadoni , Gaddanakeri and Kaladgi- Bagalkote taluk), argillites(Katageri- Badami taluk) quartz breccias (Bagalkote). Basalts, Laterites, Granites, Sandstones and quartzites are widely distributed and used as building material. The important idustrial products of the district are polished pink granite, cement, ilkal sarees and sugar.

4.0 Ground Water Scenario:

4.1 Hydrogeology: Groundwater occurs in these hard rock formations in the interconnected interstices of weathered residuum and planar porosities like joints, fractures and shears in unweathered parts. The thickness of weathered zone varies widely in different formations (Fig-4). GW occurs under water table condition in phreatic zone and semi-confined to confined conditions in the fractures at depth. In shallow or phreatic aquifer (NHS), the pre-monsoon (May 2011) depth to water level ranges from 0.71 mbgl to 30.68 mbgl and the general range of water level is 5 to 10m bgl (Fig- 5). During post-monsoon (Nov 2011) it ranges from 0.50 mbgl to 26.75 mbgl 0.36 mbgl to 11.30 mbgl and the general range of water level is 5 to 10m bgl (Fig- 6). Annual water level fluctuation of rise ranges from 0.08 m to 1.84 m and annual water level fluctuation of fall ranges from 0.05 m to 4.70 m. The long term water level trend (2002-2011) reveals that out of the analysed 28 dugwells, 92% of the wells show rise in the range of 0.085 m to 1.344 m and the remaining 8% wells show fall in water level ranging from 0.098m to 0.194. The fall in the long term water level mainly observed in non-command area of the district indicates the effect of high groundwater development where rainfall is the sole source of recharge. Similarly, the rise in water level corresponds to the canal command areas of the district where, recharge to groundwater takes place through applied irrigation and canal seepages in addition to rainfall.

Fig - 4


HYDROGEOLOGY
BAGALKOTE DISTRICT
KARNATAKA
N
BIJAPUR DISTRICT
BELGAUM DISTRICT
GADAG DISTRICT
KOPPAL DISTRICT
RAICHUR DISTRICT
JAMKHANDI
MUDHOL
BILGI
BAGALKOT
BADAMI
HUNGUND
Geology
Basalt
Sandstone,quartzite, shale,slate,limestone and Dolomite
Schist
Gneiss
Ground Water Prospects
Yield upto 1 litres per second
Yield upto 5 litres per second
Yield >5 litres per second
Borewell with Yield in litres per second
LEGEND
Lineament
Isohyet
Decadal mean water level in m bgl
Taluk boundary
Taluk headquarters

Fig- 5

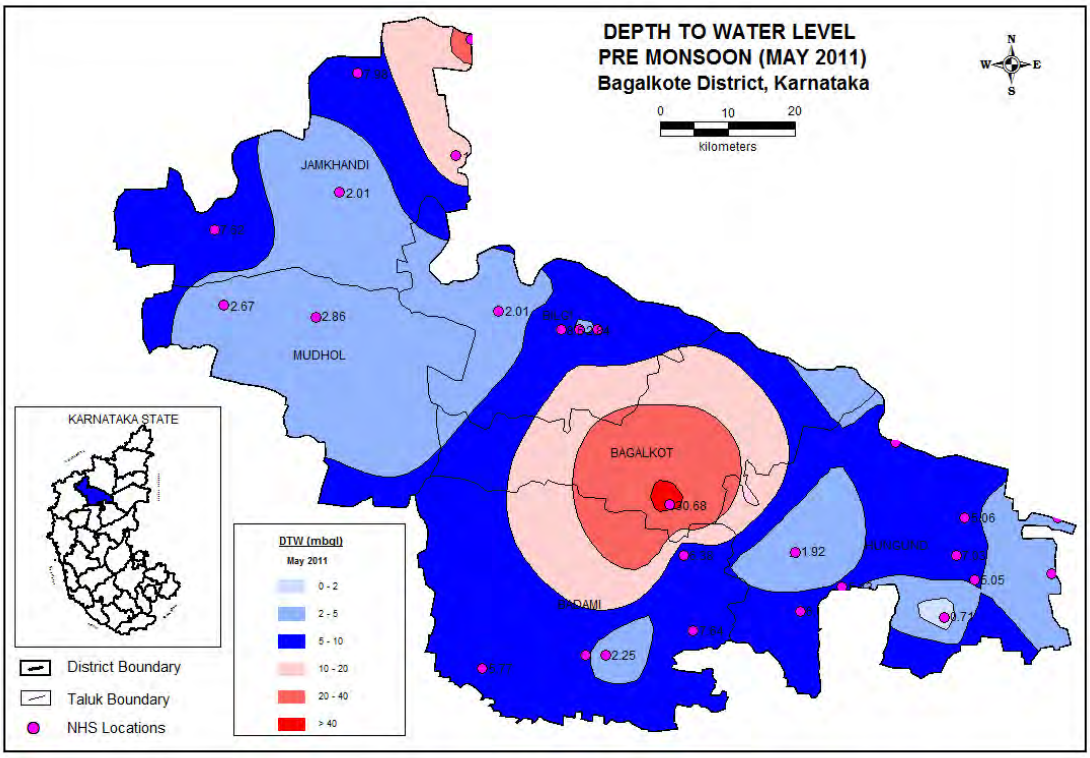

DEPTH TO WATER LEVEL
PRE MONSOON (MAY 2011)
Bagalkote District, Karnataka
0 10 20
kilometers
N
W E
S
JAMKHANDI
2.01
2.67
2.86
MUDHOL
2.01
BILGI
BAGALKOT
0.68
1.92
BADAMI
2.25
HUNGUND
3.05
KARNATAKA STATE
DTW (mbgl)
May 2011
0 - 2
2 - 5
5 - 10
10 - 20
20 - 40
> 40
District Boundary
Taluk Boundary
NHS Locations

Fig-6

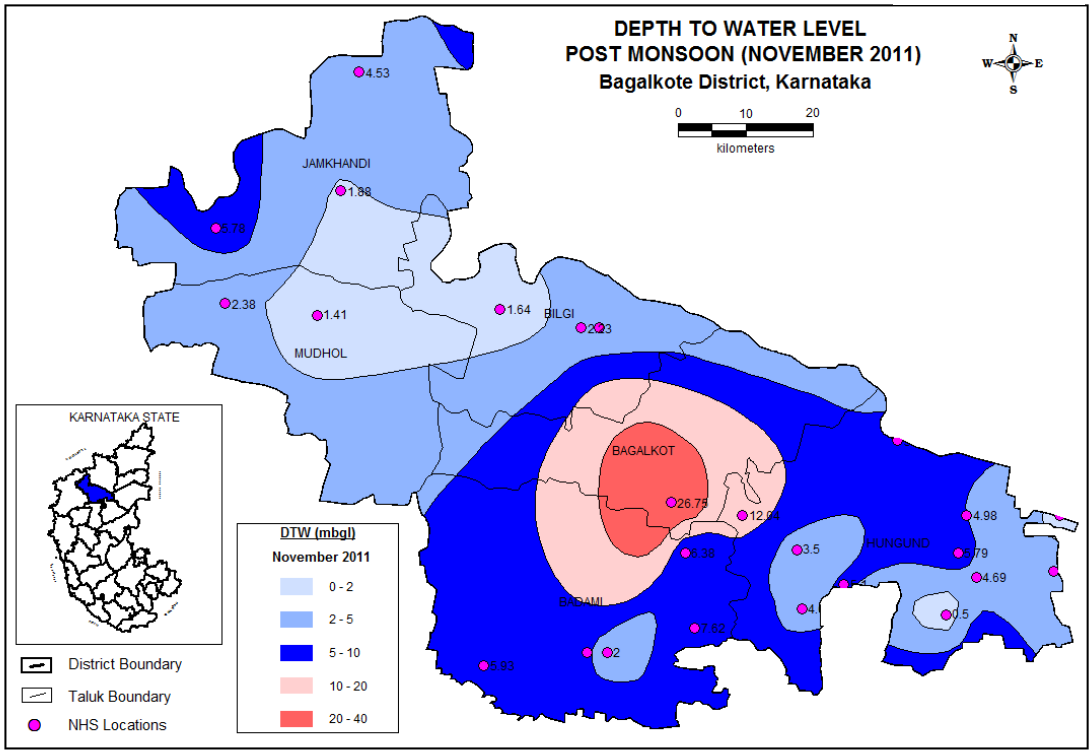

DEPTH TO WATER LEVEL
POST MONSOON (NOVEMBER 2011)
Bagalkote District, Karnataka
0 10 20
kilometers
N
W E
S
4.53
JAMKHANDI
1.38
5.78
2.38
1.41
1.64
BILGI
MUDHOL
BAGALKOT
26.75
12.04
3.5
4.98
5.79
4.69
HUNGUND
BADAMI
7.62
2
KARNATAKA STATE
DTW (mbgl)
November 2011
0 - 2
2 - 5
5 - 10
10 - 20
20 - 40
District Boundary
Taluk Boundary
NHS Locations

Table: 3. Dynamic Ground Water Resources of Bagalkote District as on March 2009;

									Categorisation of % area of taluks.			
Taluk	Total annual GW recharge	Net annual GW availability	Existing gross GW draft for irrigation	existing gross GW draft for domestic and industrial water supply	Existing gross GW draft for all uses	Allocation for domestic and industrial water supply till 2025	Net GW availability for future irrigation development	Stage of GW development	SAFE	SEMI-CRITICAL	CRITICAL	OVER-EXPLOITED
	HAM	HAM	HAM	HAM	HAM	HAM	HAM	%				
Badami	6170	5816	7493	1129	8623	1147	54	148	1			99
Bagalkote	5795	5495	6875	767	7642	788	33	139	5			95
Bilgi	6218	5601	1903	268	2171	515	3230	39	95			5
Hungund	7492	7065	5580	824	6404	917	1334	91	10	38		52
Jamkhandi	10087	9311	6711	608	7319	737	2976	79	30		2	68
Mudhol	11769	10630	11159	422	11581	691	1181	109	40		30	30
Total	47531	43918	39721	4018	43740	4795	8808	100				

4.2 Ground Water Resources: The Resource estimation and categorization is carried out as per the recommendations of GEM-97 Methodology. As per the dynamic ground water resource estimation carried out as on March 2009, the 'Annual Net Groundwater Availability' is 42966 HAM. The 'Existing GW draft for all uses' (irrigation, domestic and industrial) is 43740 HAM. The net GW availability for future irrigation development after allocating for domestic and industrial uses till 2025 is 8808 HAM. The talukawise resource status and stage of GW development is shown in Table 3.

4.3 Groundwater Quality: Groundwater is generally mildly alkaline, moderate to very hard and is of Sodium -Bicarbonate type. In phreatic zone it is more mineralized than in fractured zones. Specific conductance varies from 607 to 7000 *micro mhos/cm at 25°C* and chloride values range from 28 to 638 ppm. The concentrations of both these are found to be higher than the 'permissible limit' of Drinking water Standards in some isolated pockets. Otherwise, water is suitable for drinking and irrigation purposes. Nitrate pollution is noticed on a wide scale and is more prevalent in dug wells than in bore wells. Higher concentrations (>1.5ppm) of fluoride is found in many bore well samples and it is found in lesser (within permissible limit of 1.5 ppm) concentration in dug well samples. The concentration in general, increases with the depth of bore wells and this indicates the possible geogenic nature of fluoride (Fig- 7).

4.4 Groundwater Vulnerability area

Groundwater being a dynamic resource, getting recharged annually, primarily from the rainfall, is vulnerable to various developmental activities and is prone to deterioration in quality and quantity. The vulnerability is high in certain areas while in other areas it is comparatively stable. Based on it's susceptibility to various stress factors the district wise vulnerability map is prepared on a regional scale considering the following factors viz.

1. Area under high stage of ground water development falling in over exploited (generally with stage of development more than100%) and critical (generally stage of development within 85-100%) category as on March 2009.
2. Area having intensive cultivation/ area falling under canal command, thus prone to pollution from fertilisers/ insecticides or water logging.
3. Area having fluoride above maximum permissible limit of 1.5ppm
4. Area having nitrate above maximum permissible limit of 45ppm. (Even though nitrate is point source pollution due to anthropogenic activity and as such area cannot be demarcated, for the convenience of the user group, area having high incidence of pollution is marked. Within the marked area there may be points devoid of high nitrate and vice-versa.)
5. Industrial cluster as identified by Central Pollution Control Board, prone for pollution from industries.

In Bagalkote district, all the taluks are vulnerable to groundwater due to more than one of the above parameters. (Fig - 8). Bilgi taluk, north western parts of Hungund & Mudhol taluks and southern part of Badami taluk are vulnerable to intensive irrigation and fertiliser/pesticide contamination, Flouride and Nitrate contamination. Mudhol, Badami, Bagalkote, parts of Jamkhandi & Hungund are vulnerable to over exploitation and nitrate contamination.

Fig -7

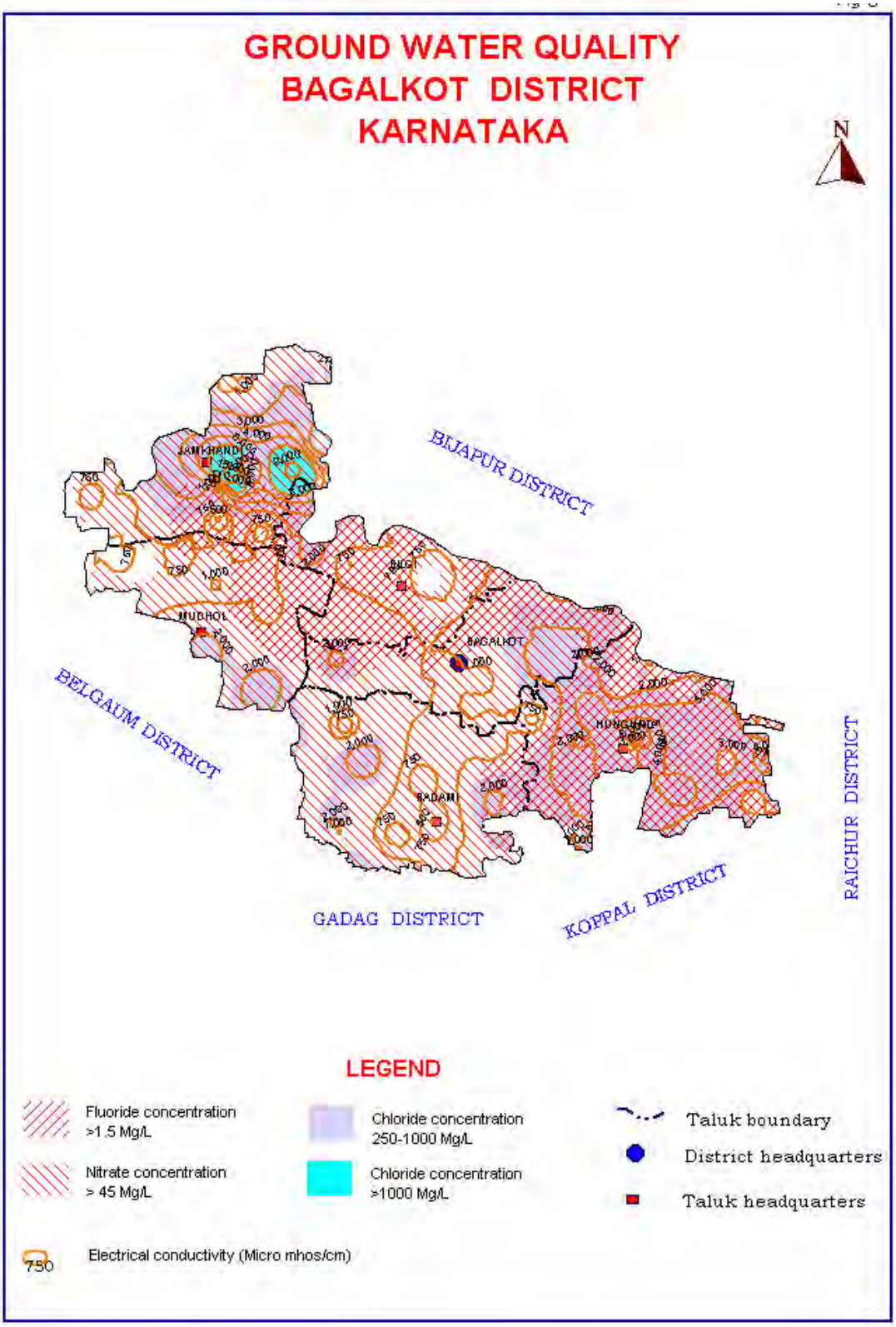
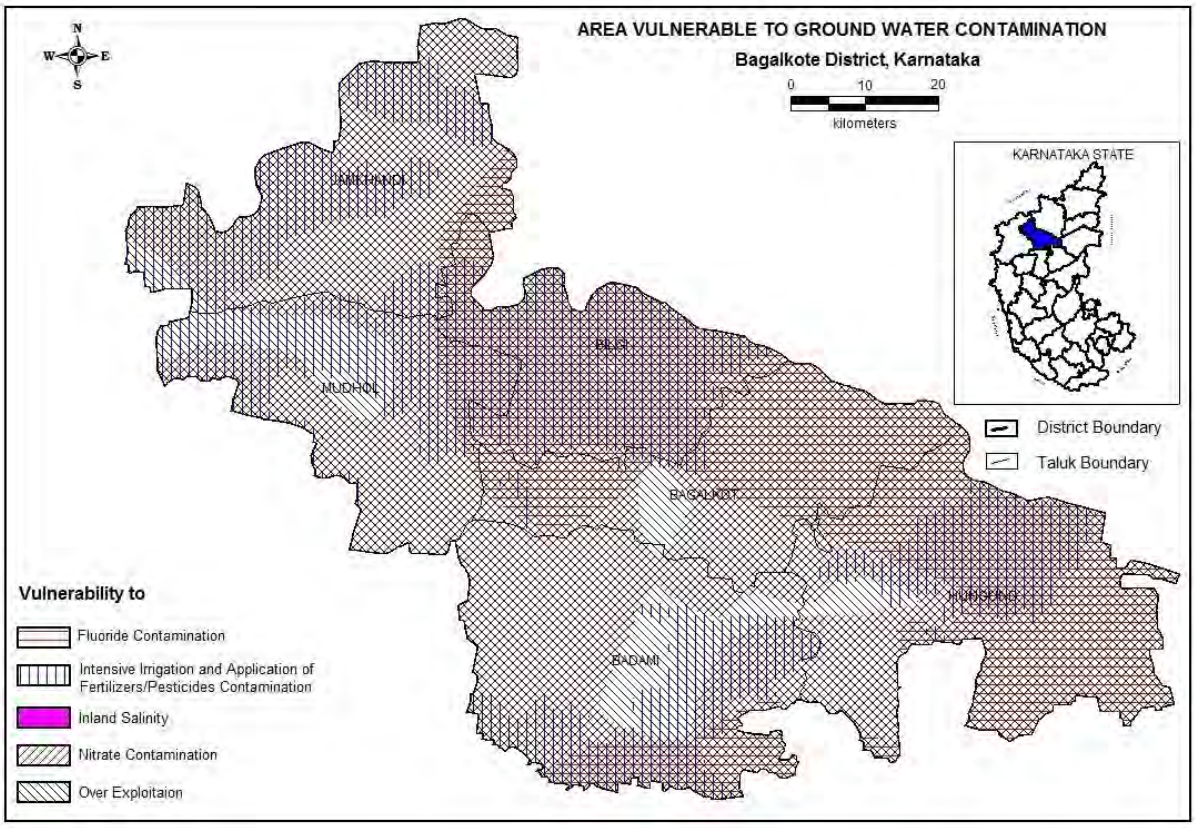

GROUND WATER QUALITY
BAGALKOT DISTRICT
KARNATAKA
N
BIJAPUR DISTRICT
BELGAUM DISTRICT
GADAG DISTRICT
KOPPAL DISTRICT
RAICHUR DISTRICT
JAMKHANDI
MUDHOL
BAGALKOT
BADAMI
HUNGUND
LEGEND
Fluoride concentration >1.5 Mg/L
Nitrate concentration > 45 Mg/L
Chloride concentration 250-1000 Mg/L
Chloride concentration >1000 Mg/L
Taluk boundary
District headquarters
Taluk headquarters
750
Electrical conductivity (Micro mhos/cm)

Fig -8



4.5 Status of Groundwater Development: The stage of development is the lowest in Bilgi taluk (39%) and the highest in Badami taluk (148%). In the taluks having command area, Hungundi has the lowest (8%) and Badami the highest (136%) stage of development. In the taluks having non command area, Jamkhandi has the lowest (95%) & Mudhol has the highest (177 %) stage of development. It is observed that the taluks which are not having canal irrigation facility have witnessed higher groundwater development of more than 95%. The average stage of groundwater development in for the district is 100% (Table 3).

5.0 Groundwater Management Strategy:

Bagalkote district is basically agriculture-dominated district where it is the main occupation of the rural population which constitutes 68.33 % of the total population (2011 census). As per the data total irrigated area constitutes 55.31 % of the net sown area. The contributions of surface water, in irrigated agriculture through major and medium irrigation projects, tanks and lift irrigation schemes is 60.11 %. It is apparent that groundwater is playing equally vital role in agriculture sector apart from being the main source of drinking water in major part of the district. The non-command parts of the all the taluks are showing high groundwater development and are falling in Over-Exploited category (Fig- 9). Hence, judicious use of ground water and its sustainable

management is all the more important. Water-economy irrigation practices like drip and sprinkler irrigation methods should be popularized. Efforts should be oriented towards conservation and augmentation of groundwater. In canal command areas conjunctive use approach can be adopted. In deeper ground water areas of the district and groundwater over development areas, artificial recharge measures like percolation tanks and check dams are to be implemented to augment the groundwater resource. Point recharge structures would help in recharging deeper depleted fractures and fissures so as to have a sustainable yield from bore wells. Technical management of groundwater should be kept in mind while extending institutional finance to farmers and awareness should be created in different user communities. Participatory approach in groundwater management especially in canal command areas is essential.

5.1 Groundwater Development: The average stage of groundwater development in the district is 100% as per the resource computation done in March 2009.The development is more in the taluks having non command areas for irrigation. More than 95% is witnessed in all taluks. Further development in the over-exploited areas should be restricted. In Jamkhandi and Hungund taluks further development of groundwater should be done with all cautions. As groundwater level, in general, is declining, deepening of dug wells, conversion of dugwells into dug-cum-bore wells is needed. The shallow zone of ground water can be developed for irrigation through dug wells in topographic low areas and dug-cum-bore wells in valley slope areas having comparatively deeper water levels. Optimum depth of dug well is 10-12 m having a diameter of 6-7m.The optimum depth of dug-cum bore well is 15-20 m having a diameter of 6-7 m in dug part and 100 mm in lower bore well part to a depth of100 m. A minimum spacing of 75 to 100m between dug wells is recommended. The recommended optimum discharge of dug wells is 3 – 4 lps for the prevailing cropping pattern for a pumping of 4 to5 hrs and 3-5 H.P. pump is needed. The recommended command of each well is 1.2 hectare. Bore wells are possible in all topographic conditions and pinpointing of site, depth, yield prospects etc, should be ascertained by suitable investigations. The minimum distance of 150 m between two bore wells is necessary to avoid mutual interference.

5.2 Groundwater Conservation and Artificial Recharge: Fast, unchecked and indiscriminate withdrawal of groundwater through different abstraction structures has resulted in the decline of ground water level. Hence, arrest of further decline of water level and ground water resource augmentation is essential. Conservation and augmentation can be achieved by adopting water efficient irrigation practices, suitable cropping pattern and constructing appropriate artificial recharge structures.

Rain Water Harvesting would be a remedy in areas where there is ground water quality problem due to high nitrate, chloride and fluoride concentrations and water level decline. Selection of a particular type of RWH structure is area specific. By studying the nature of geological formations, slope of the land, depth of weathering, depth to water level and availability of land and water source for these artificial recharge structures, different types of artificial structures are recommended and shown in the map. The northern part of the district constituting a gently undulating to plain land is suitable for

Fig -9

STATUS OF GROUNDWATER UTILISATION
BAGALKOTE DISTRICT

(As on March 2009)

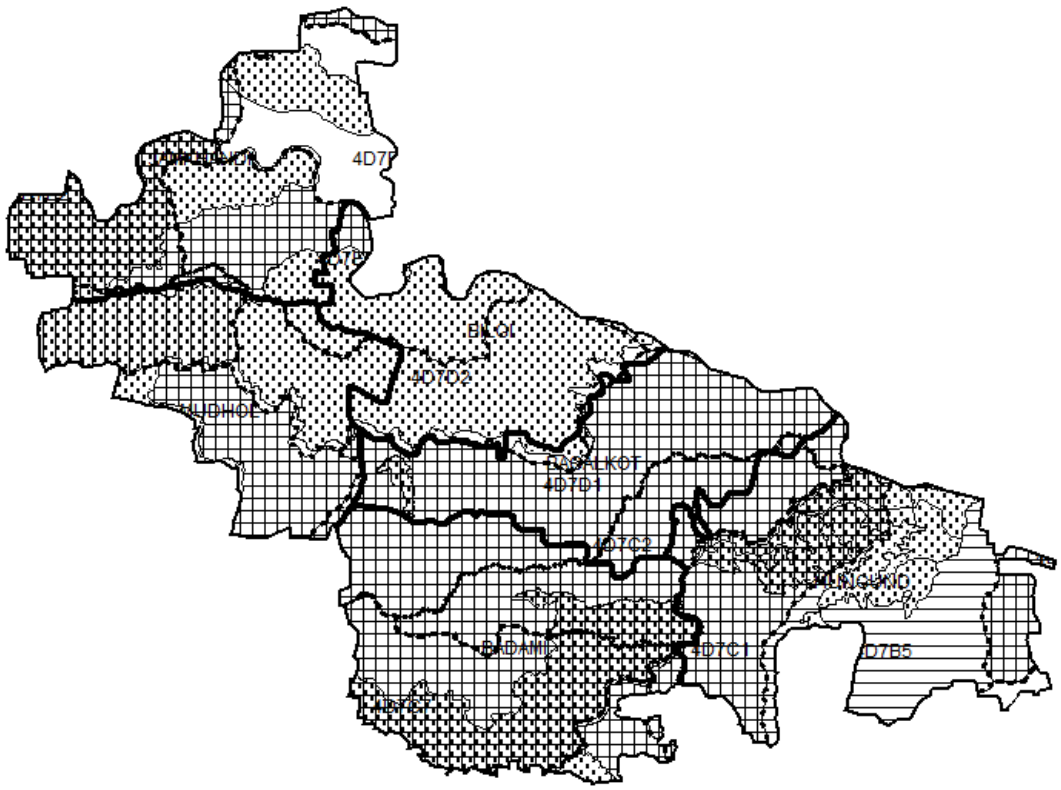
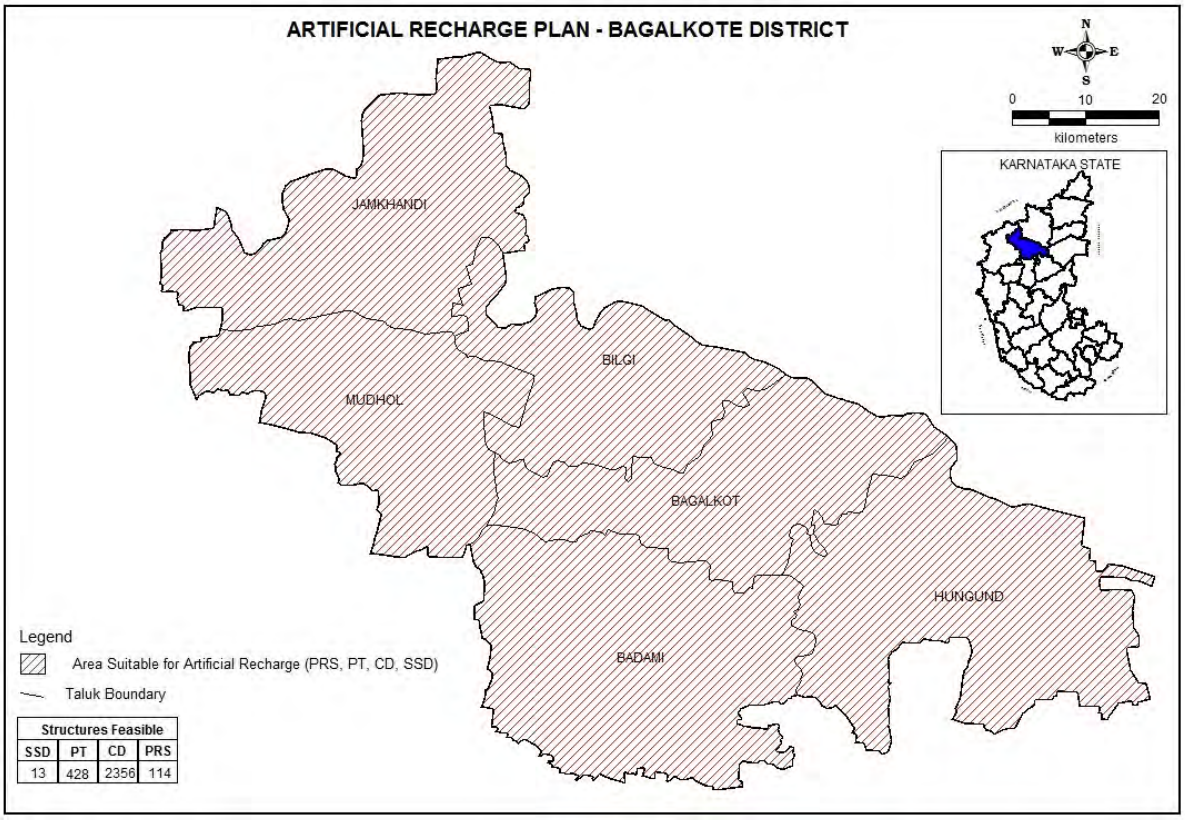


Fig -10



construction of Percolation tanks, Nalla bunds and point recharge structures like recharging through existing borewells / dugwells and recharge pits. The moderate to high sloping, undulating terrain in the southern part of the district covering is suitable for artificial recharge structures like gully plugs, gabian structures, cement plugs, nala bunds, contour bunds and contour trenches. As mentioned earlier, the selection of a suitable artificial recharge structure is site specific and hence, scientific studies should be conducted while selecting the site for a specific type of structure. However, artificial recharge structures are recommended in such areas considering the long-term water level trends. Areas, where Artificial Recharge Structures are feasible of are demarcated in Fig-10.

6.0 Groundwater related issues and problems:

Resource depletion due to over development, water-logging and soil salinity in canal command areas and geogenic and anthropogenic pollution of ground water are the main issues related to groundwater in the district. High groundwater development has taken place in Badami, (148%) Bagalkote (139%) and Mudhol (109%) and in the non-command areas of Jamkhandi and Bilgi taluks. This has led to water scarcity in these areas which adversely affects the domestic and agricultural sectors mainly during summer months

Mining at localized areas for iron ores is being done in Kamatgi and Amingarh areas. Cement industries and extensive Limestone quarrying at Bagalkote and many other places are likely to affect the ground water availability and quality.

Water – logging due to rise in water level is reported from the parts of Bilgi, Mudhol , Jamkhandi and Badami taluks falling in the Krishna, Ghataprabha and Malaprabha canal command areas. Though the exact area under water logging is not readily available, it is suspected that if not properly tackled, this may pose a threat in future resulting in loss of valuable arable land. Conjunctive use of surface and groundwater is a suitable management strategy in the command areas.

The nitrate pollution of shallow aquifers is observed on a wide scale especially in canal command areas which is possibly due to extensive application of nitrogenous chemical fertilizers, shallow water level condition and due to other human interventions. Higher fluoride concentrations are observed in dug wells at places and is comparatively more in deeper aquifers as evidenced in bore well samples. The fluoride is geogenic and its concentration is likely to increase with over-development of groundwater. Though the district is industrially backward, existing cement, textile and engineering industries may cause groundwater pollution locally.

7.0 Awareness and Training Activity: NIL

8.0 Areas notified by CGWA/SGWA:

No area is notified either by CGWA or State government

9.0 RECOMMENDATIONS

After analyzing the present groundwater scenario in Bagalkote district, the following recommendations are made to develop ground water on sustainable basis in different parts of the district.

a) Dugwells which are currently in use, may be further deepened to tap more saturated part of the phreatic aquifer and increase the yield. Wherever dugwells are more than 15 meter in depth, borewells of 100 to 150mm diameter to a depth of 50 m may be tried at the bottom to enhance the yield. Such measures will help in mitigating the irrigation water scarcity.
b) Pinpointing of sites for wells and borewells in feasible areas should be tried after taking technical guidance and scientific investigations. Otherwise, farmers have to suffer heavy financial burden in case of failures of wells.
c) In canal command areas of Badami,Bilgi, Jamkhandi and Mudhol taluks conjunctive use of surface and groundwater should be practiced. Withdrawing more groundwater through dugwells and shallow borewells and transferring it to

upland and tail end areas will solve water scarcity in such areas and reduces the water-logging problem in the command area.

d) Water- use efficiency irrigation methods like drip irrigation and sprinkler irrigation can be practiced in groundwater irrigated agriculture to save water.
e) In situ rainwater harvesting in the villages where ground water carries excess nitrate and fluoride contents, will offer a solution for drinking water problems.
f) Artificial recharge measures like checkdams, percolation tanks, point recharge structures shoud be implemented on extensive scale especially in over-exploited areas like Badami, Bagalkote, Hungund and Mudhol taluks. Suitable artificial recharge structures should be constructed in different terrains which will arrest and store the run-off in rainy season which will otherwise goes waste. This stored water will recharge groundwater and will help in arresting soil erosion and also flood control.
g) Rejuvenation of existing MI tanks by de-silting would enhance their storage and percolation capacities.
h) Institutional financial assistance should be provided to poor farmers for deepening of dugwells and for new borewells. Incentives should be given for those who are interested in implementing rain Water Harvesting schemes. Construction of different Artificial Recharge Structures, which is generally not affordable to individuals, should be taken up by the government.

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