केंद्रीय भूमि जल बोर्ड
जल संसाधन, नदी विकास और गंगा संरक्षण
विभाग, जल शक्ति मंत्रालय
भारत सरकार
Central Ground Water Board
Department of Water Resources, River
Development and Ganga Rejuvenation,
Ministry of Jal Shakti
Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

HONNALI TALUK,

DAVANAGERE DISTRICT, KARNATAKA

दक्षिण पश्चिमी क्षेत्र, बैंगलोर
South Western Region, Bengaluru

AQUIFER MANAGEMENT PLAN OF HONNALI TALUK, DAVANAGERE DISTRICT, KARNATAKA STATE

CONTENTS

AQUIFER MANAGEMENT PLAN OF HONNALI TALUK, DAVANAGERE DISTRICT, KARNATAKA STATE

1.0 Salient information

Name of the Taluk: **HONNALI**

District: Davanagere; State: Karnataka

Area: 872 sq.km.

Population: 2,33,206

Annual Normal Rainfall: 685 mm

1.1 Aquifer Management study area

Aquifer mapping studies was carried out in Honnali Taluk, Davanagere district of Karnataka, covering an area of 872 sq.kms under National Aquifer Mapping Project. Honnali Taluk of Davanagere district is located between north latitude $14^0$03'24.1" and $14^0$21'42.6" & east longitude $75^0$24'00.8" and $75^0$50'58.0", and is covered in parts of Survey of India Toposheet Nos. 48N/8, 48N/11, 48N/12, 48N/15 and 48N/16. Honnali Taluk is bounded by Harihar Taluk (Haveri district) on north, Shimoga Taluk (Shimoga district) on south, Channagiri Taluk on east and Shikaripur Taluk (Shimoga district) on western side. Location map of Honnali Taluk of Davanagere district is presented in **Figure-1**.

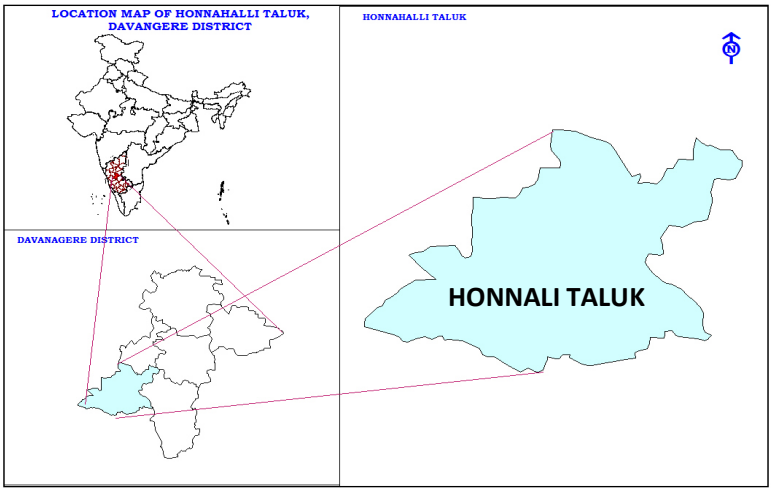

Figure-1: Location Map of Honnali Taluk, Davanagere district

Taluk administration of Honnali Taluk is divided into 6 Hoblies and Honnali is only one town, which is also the Taluk head quarter. There are 154 inhabited and 19 uninhabited villages in the Taluk.

1.2 Population

According to 2011 census, the population in Honnali Taluk is 233206, in which 215278 constitute the rural population and 17928 is the urban population, which works out to 92% (rural) and 8% (urban) of the total population of Taluk. The study area has an overall population density of 267 persons per sq.km. The decadal variation in population from 2001-2011 is 4.77 % in Honnali Taluk.

1.3 Rainfall

Honnali Taluk enjoys semi-arid climate. Dryness and hot weather prevail in major part of the year. The area falls under Central Dry agro-climatic zone of Karnataka state and is categorized as drought prone. The normal annual rainfall in Honnali Taluk for the period 1981 to 2010 is 685 mm. Seasonal rainfall pattern indicates that, major amount of (399 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 58% of the annual normal rainfall, followed by North-East Monsoon season (193 mm) constituting 28% and remaining (93 mm) 14% in Pre-Monsoon season (Table-1).

Computations were carried out for the 30 years blocks of 1981- 2010, the mean monthly rainfall at Honnali Taluk is ranging between 1mm during January to 132 mm during October. The coefficient of variation percent for premonsoon, monsoon and post monsoon season are 87, 37 & 64 percent respectively. Annual CV at this station works out to be 32 percent (Table-1).

Table-1: Statistical Analysis of Rainfall Data of Honnali Taluk, Davanagere District, Karnataka (1981 to 2010)

STATION		JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
HONNALI	NRM	1	0	8	29	55	93	98	96	97	108	399	132	51	10	193	685
	STDEV	3	2	18	39	58	81	53	60	41	93	148	87	90	20	124	222
	CV%	414	386	237	132	105	87	54	62	42	86	37	66	177	209	64	32

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Honnali Taluk. Major Kharif crops are paddy, maize, jowar, tur and vegetables. Main crops of Rabi season are ragi, maize, horse gram, cotton, groundnut, and sunflower (Table-2). Paddy accounts 30% and maize grown in 43% of total crop area of Taluk.

Table-2: Cropping pattern in Honnali Taluk 2014-2015 (Ha)

Year	Paddy	Maize	Ragi	Jowar	Pulses	Fruits	Vegetables	Other cereals	Oil seeds	Sugarcane	Cotton
2014-2015	20810	29593	940	2823	3223	924	1093	978	4232	555	3096

It is observed that net sown area accounts 63% and area sown more than once is 22% of total geographical area in Honnali Taluk. 24% area falls under forest and 12% area under land not available for cultivation (**Table-3**). 42% of net area irrigated is from canals and 40% from wells & borewells (**Table-4**).

Table-3: Details of land use in Honnali Taluk 2014-2015 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Honnali	88794	21168	11028	456	56057	19820

Source: District at a glance 2014-15, Govt. of Karnataka

Table-4: Irrigation details in Honnali Taluk (Ha)

Source of Irrigation	Net area irrigated (Ha.)	% of net area irrigated
Canals	10317	42
Tanks	0	0
Wells	930	4
Bore wells	8911	36
Lift Irrigation	3158	13
Other Sources	1159	5
Total	**24475**	

Source: District at a glance 2014-15, Govt. of Karnataka

1.5 Geomorphology, Physiography & Drainage

The geomorphology of the district is characterized by vast stretches of undulated plains interspersed with sporadic ranges or isolated clusters of low ranges of rocky hills (**Fig.-2**). Honnali Taluk falls in the plain region. Dalba Ranga Gudda (1013 m amsl) in

Honnali Taluk is the highest peak in the Davanagere district. The Honnali Taluk, Davangere district falls under Krishna River basin. The important rivers of the district are Tungabhadra and its tributary, Chikka Hagari. The drainage network is influenced by South West monsoon (**Fig.-3**).

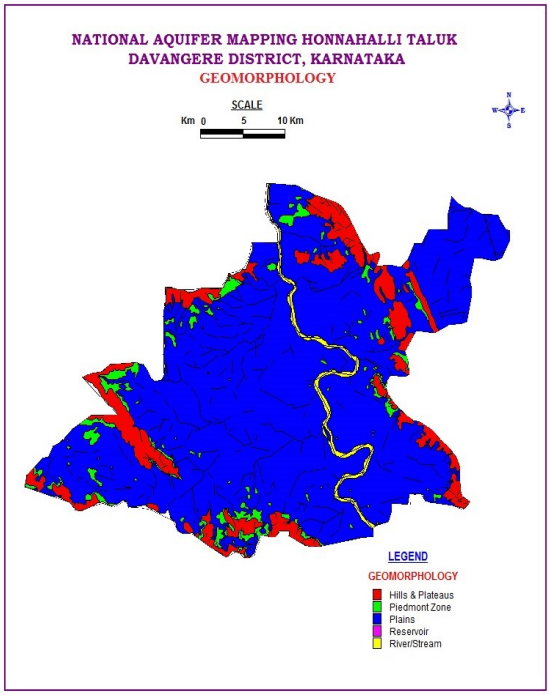

Figure-2: Geomorphology Map

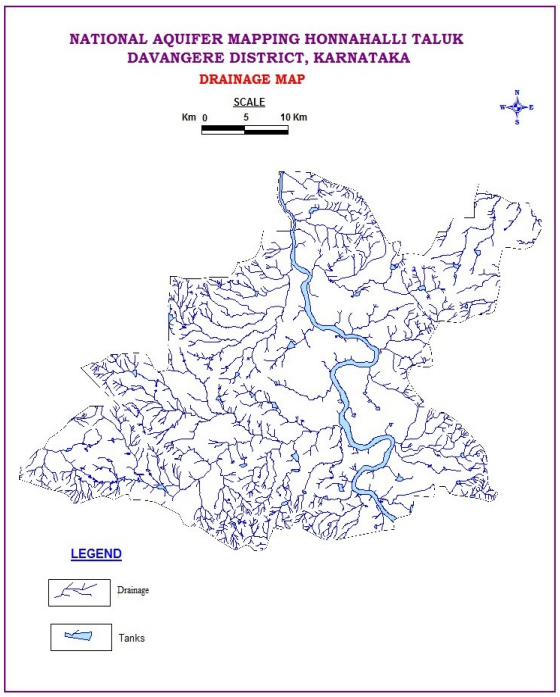

Figure-3: Drainage Map

1.6 Soil

Major part of the Taluk is covered by red sandy soil and followed by black soil. The Red Sandy soil comprises of red loams, red sandy, sandy loams and medium black soils.

1.7 Ground water resource availability and extraction

Aquifer wise total ground water resources up to 200 m depth is given in **Table-5** below.

Table-5: Total GE Resources (2017) (Ham)

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
Honnali	12526	10853	1437	25538

1.8 Existing and future water demands (as per GEC-2017)

- Net ground water availability for future irrigation development: 44.62 MCM
- Domestic & Industrial sector demand for next 25 years: 5.42 MCM

1.9 Water level behavior

(a) Depth to water level

Aquifer - I

- Pre-monsoon: 1.9 - 12.15 mbgl (**Fig.-4**)
- Post-monsoon: 2.2 - 11.8 mbgl (**Fig.-5**)

Aquifer - II

- Pre-monsoon: 2.30 mbgl (**Fig.-6**)
- Post-monsoon: 0.24 mbgl (**Fig.-7**)

(b) Water level fluctuation

Aquifer-I (**Fig.-8**)

- Seasonal Fluctuation: Rise ranges between 0.35 to 1.8 m;
  Fall ranges upto 1.00 m

Aquifer-II (**Fig.-9**)

- Seasonal Fluctuation: Rise shows 2.06 m

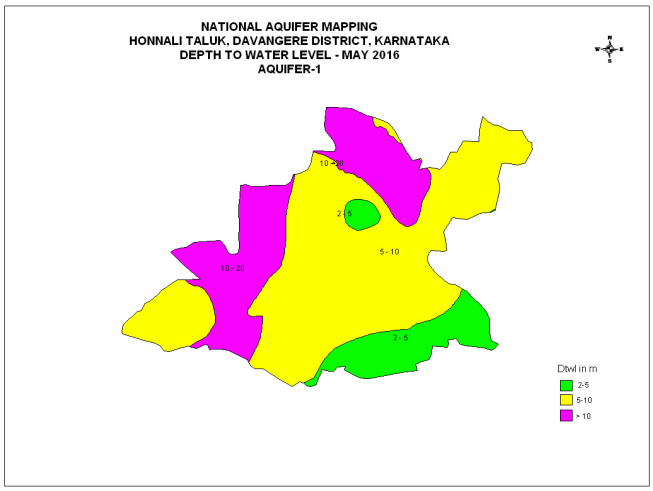

Figure-4: Premonsoon Depth to Water Level (Aq-I)

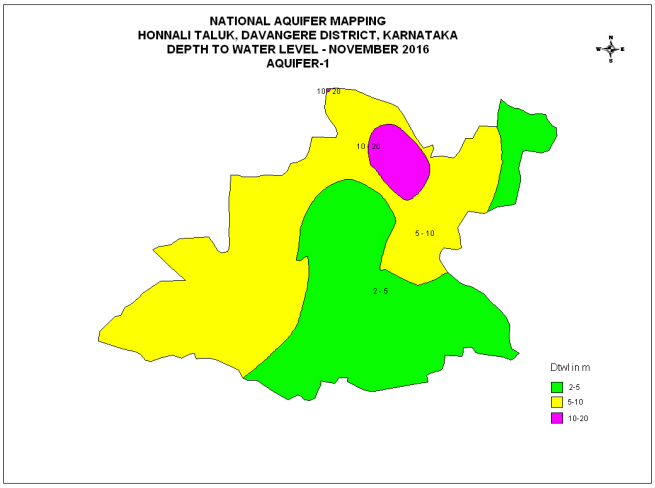

Figure-5: Post monsoon Depth to Water Level (Aq-

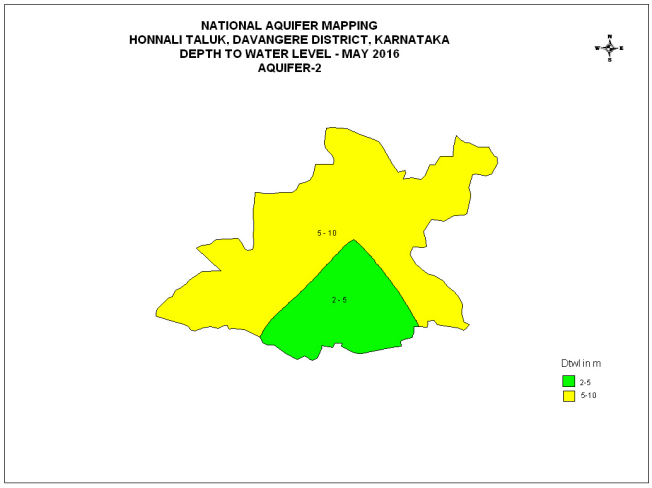

Figure-6: Premonsoon Depth to Water Level (Aq-II)

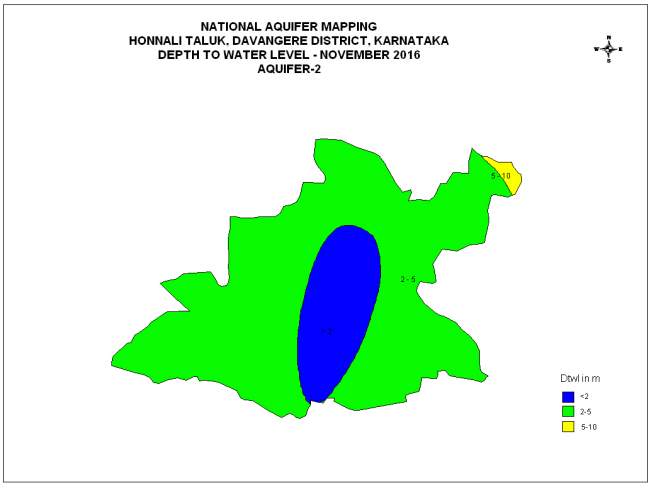

Figure-7: Postmonsoon Depth to Water Level (Aq-II)

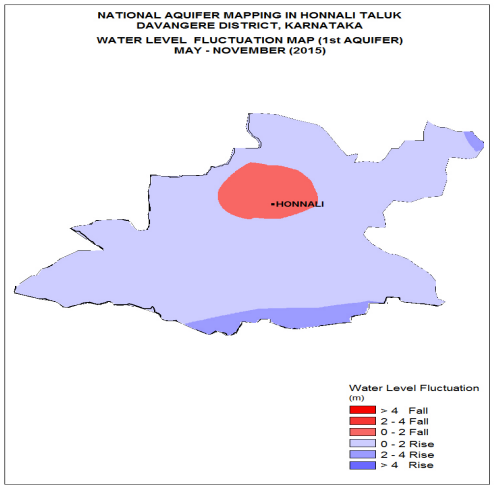

Figure-8: Water Level Fluctuation (Aq-I)

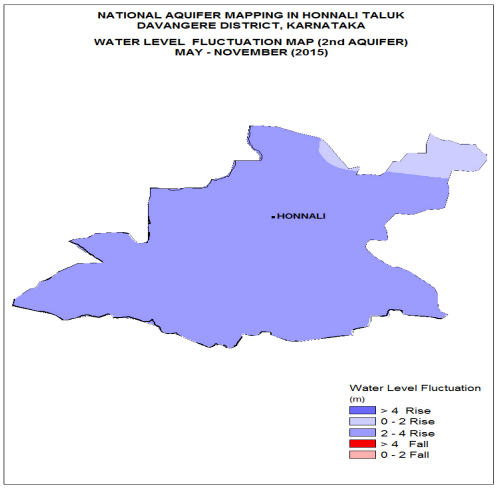

Figure-9: Water Level Fluctuation (Aq-II)

2.0 Aquifer disposition

2.1 Number of aquifers: In Honnali Taluk, there are mainly two types of aquifer systems;

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

In Honnali Taluk, granitic-gneisses and schists are the main water bearing formations (**Figure-10**). Ground water occurs within the weathered and fractured granitic-gneisses and schist under water table condition and semi-confined condition. In Honnali Taluk bore wells were drilled from a minimum depth of 64 mbgl to a maximum of 200 mbgl (**Table-6**). Depth of weathered zone (Aquifer-I) ranges from 10.6 mbgl to 22.20 mbgl (**Figure-11**). Ground water exploration reveals that aquifer-II fractured formation was encountered between the depth of 21 to 155 mbgl. Yield ranges from 0.43 to 9.04 lps. Transmissivity ranges from 0.5 m^2/day to 75.88m^2/day. Storativity ranges from 0.07 to 0.21.

The basic characteristics of each aquifer are summarized in **Table-7**.

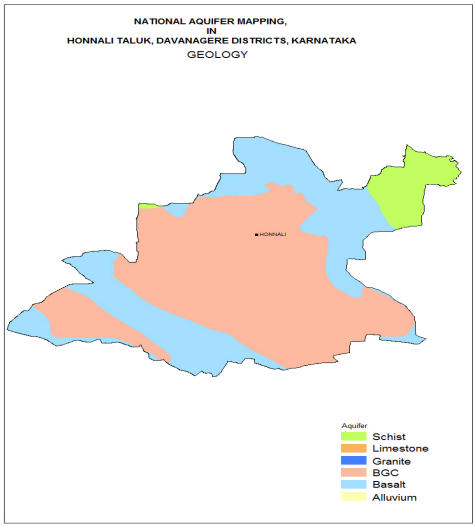

Figure-10: Geology Map

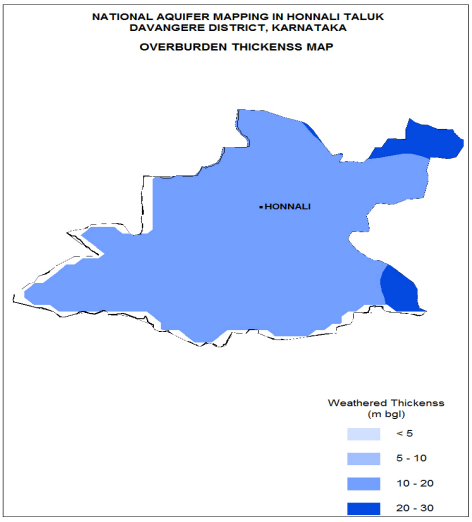

Figure-11: Weathered Thickness Map (Aq-I disposition)

Table-6: Details of Ground water Exploration

Sl. No	Location	Latitude	Longitude	Depth Drilled (mbgl)	Casing Depth (m)	SWL (mbgl)	Q (lps)	DD (m)
1	Hirebasur	14°11'25"	75°40'50"	193	21.95	3.8	0.43	-
2	Kunkuva	14°14'10"	75°32'40"	200	10.6	7.64	0.75	15.79
3	Koda chigondanahalli	14°9'0"	75°36'20"	160.45	19.3	8.02	0.8	8.09
4	Kattige	14°14'10"	75°32'40"	200	18.7	9.1	2.21	23.7
5	Hanagawadi	14°5'15"	75°43'10"	141.15	15.72	3.92	7.45	9.59
6	Hanagawadi	14°5'15"	75°43'10"	127	22.20	3.75	9.04	14.39
7	Arabaghatte	14°11'20"	75°38'0"	191	19.5			-

Table-7: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Gneiss / Schist	Fractured / Jointed Gneiss / Schist
Thickness range (mbgl)	20	Fractures up to 200 mbgl
Depth range of occurrence of fractures (mbgl)	-	20 - 200 80% between 50 - 200
Range of yield potential (lps)	Poor yield	1 - 5
Specific Yield	2%	0.2%
T (m^2/day)	-	0.5 – 55.3
Quality Suitability for Irrigation	Suitable	Suitable
Suitability for Domestic purposes	Suitable	Suitable
Remarks	Over exploited	Ground water potential fractures, 1 to 3 sets likely up to the depth of 200 m bgl.

2.2 3 D aquifer disposition and

(A) Aquifer disposition – Rockworks output (Fig.-12 & Fig.-13)

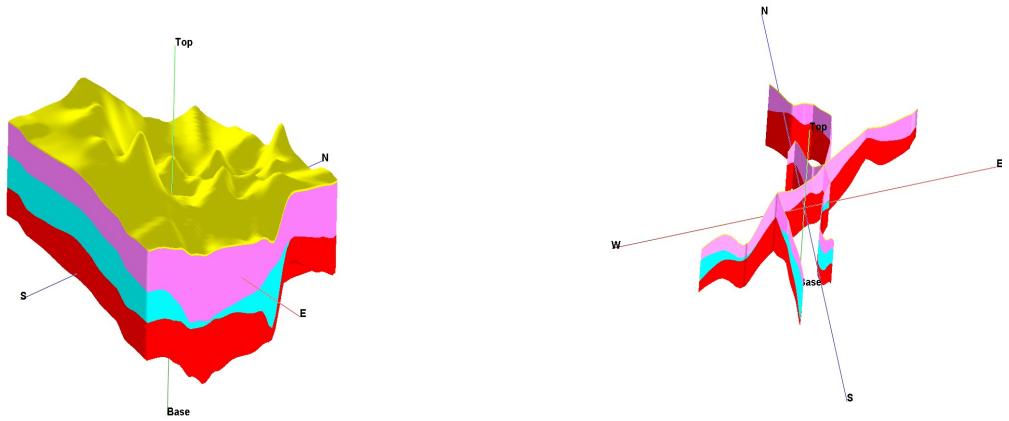

Figure-12: 3D aquifer Disposition & Fence Diagram

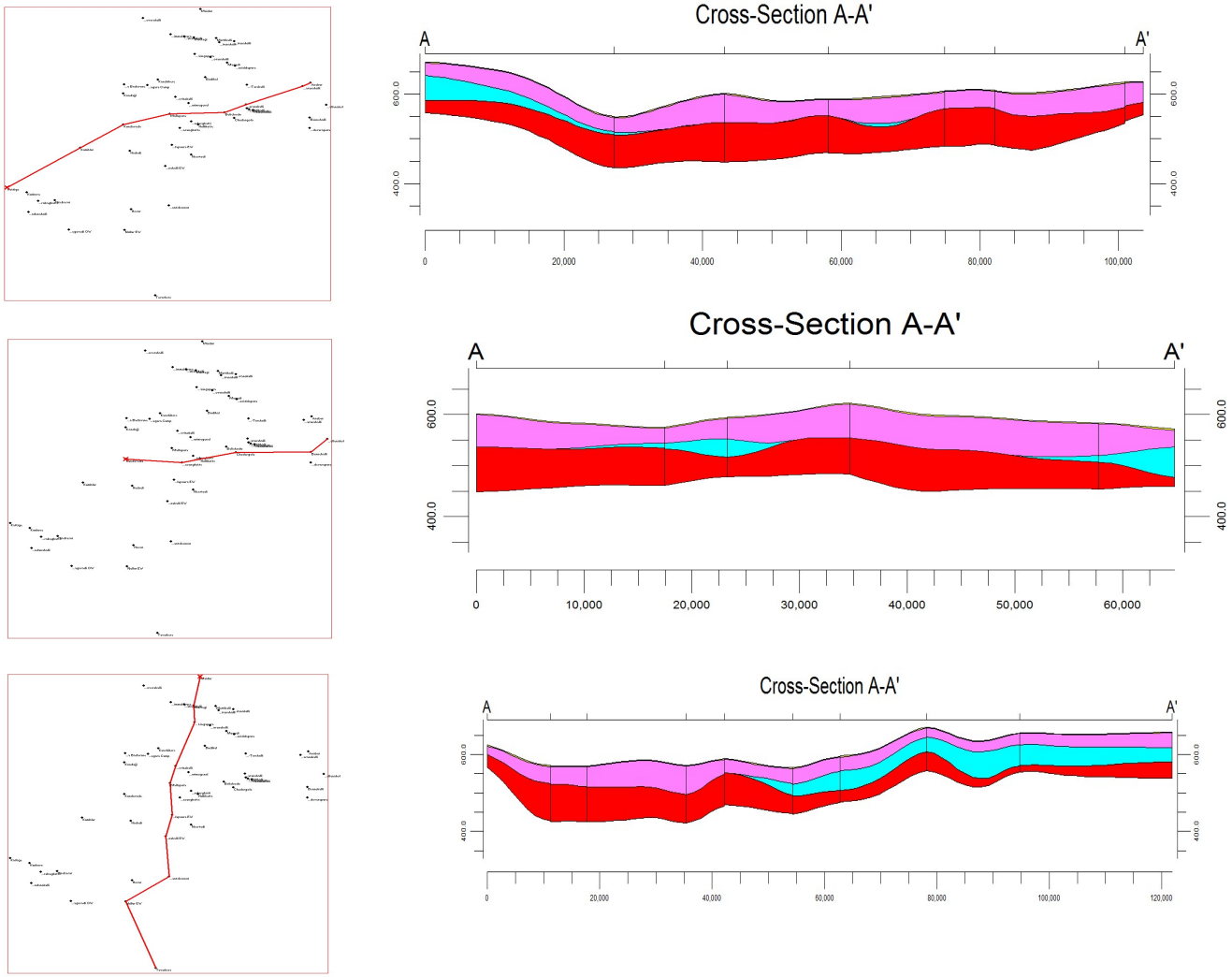

Figure-13: Cross sections of aquifers in different directions

3.0 Ground water resource, extraction, contamination and other issues

3.1 Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2017)

TALUK	NET ANNUAL GROUND WATER AVAILABILITY	EXISTING GROSS GROUND WATER DRAFT FOR IRRIGATION	EXISTING GROSS GROUND WATER DRAFT FOR DOMESTIC AND INDUSTRIAL WATER SUPPLY	EXISTING GROSS GROUND WATER DRAFT FOR ALL USES	ALLOCATION FOR DOMESTIC AND INDUSTRIAL USE FOR NEXT 25 YEARS	NET GROUND WATER AVAILABILITY FOR FUTURE IRRIGATION DEVELOPMENT	EXISTING STAGE OF GROUND WATER DEVELOPMENT	CATEGORY
Honnali	12526	7683	343	8026	542	4462	64	SAFE

(b) 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
Honnali	12526	10853	1437	25538

(c) Comparison of ground water availability and draft scenario in Honnali Taluk

Taluk	GW availability (Ham)	GW draft (Ham)	Stage of GW development	GW availability (Ham)	GW draft (in Ham)	Stage of GW development	GW availability (Ham)	GW draft (Ham)	Stage of GW development	GW availability (Ham)	GW draft (Ham)	Stage of GW development
	2009			2011			2013			2017		
Honnali	13164	5388	41	13681	5819	43	13249	6049	46	12526	8026	64

3.2 Chemical quality of ground water and contamination

Interpretation from Chemical Analysis results of 15 samples in Honnali Taluk is mentioned as under:

ELECTRICAL CONDUCTIVITY: Out of 9 samples, EC values ranges from 538 to 1700 µ/mhos/cm at 25^{o}C which indicates ground water has EC value within the permissible limit in both the aquifers (**Figure-14**).

FLUORIDE: Fluoride concentration in ground water is of geogenic origin in areas underlain by younger granites/ gneisses containing minerals like Flurospar & fluroapatite F value ranges between 0.1 - 2.1 mg/l. Out of 9 samples, 2 samples indicate fluoride greater than the permissible limit of 1.5 mg/l, which constitutes 22% of the samples analyzed (**Figure-15**).

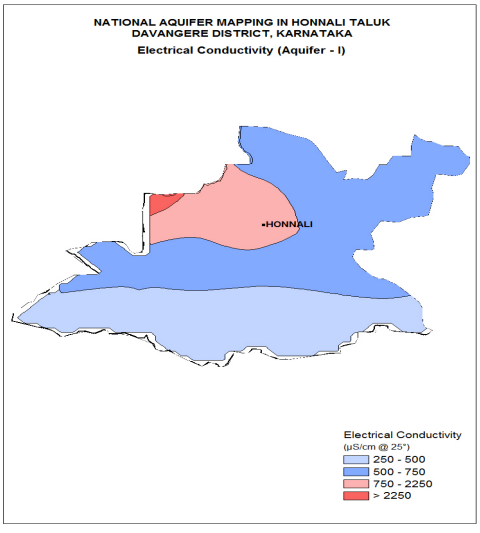

Figure-14: Electrical Conductivity Map

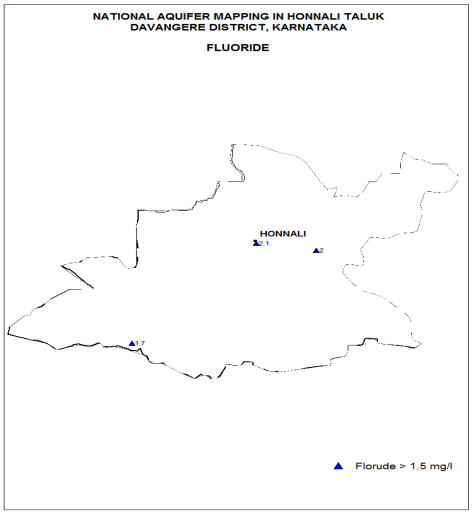

Figure-15: Fluoride Map

NITRATE: Nitrate value ranges between 12 to 55 mg/l. Out of 8 samples, 3 samples indicate nitrate greater than the permissible limit of 45 mg/l, which constitutes 37% of the samples analyzed. Nitrate contamination is due to extensive use of fertilizers, hence is anthropogenic in origin.

In general ground water quality in Honnali Taluk is good for drinking purpose except in some areas as depicted in above illustrated maps, where nitrate & fluoride 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.

4.0 Ground water resource enhancement

4.1 Aquifer wise space available for recharge and proposed interventions

Recharging the drying phreatic aquifer (Aq-I) in the taluk through construction of artificial recharge structures, viz., check dams, percolation tanks and point recharge structures **(Table-8)** is a viable option in non-command feasible areas. 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.

Table 8: Quantity of non-committed surface runoff and expected recharge through AR structures (As per Master Plan on Artificial Recharge in Karnataka & Goa,2020)

Artificial Recharge Structures Proposed	Honnali Taluk
Non committed monsoon runoff available (MCM)	28.741
Number of Check Dams	135
Number of Percolation Tanks	00
Number of Subsurface dykes	01
Tentative total cost of the project (Rs. in lakhs)	1368.199
Expected recharge (MCM)	21.556
Additional irrigation potential (in Lakh hectares)	0.026

4.1 Improvement in GW availability due to Recharge, Honnali Taluk

Taluk	Net annual ground water availability	Existing gross ground water draft for all uses	Existing stage of ground water development	Expected recharge from proposed Artificial Recharge structures	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of the project	Expected improvement in overall stage of ground water development
	HAM	HAM	%	HAM	HAM		%
Honnali	12526	8026	64	2155.6	14681.6	54.67	9.33

4.2 Alternate water sources

- **Proposed GW Recharge and Assured Supply of Drinking Water Schemes (Inter basin Transfer):** Inter-basin transfer from Tunga Basin under Project-2 service canal is proposed in the "Integrated Irrigation Development Schemes" by Shri.G.S.Paramashivaiah, Retd. CE, Irrigation Department and submitted to the Govt. of Karnataka.
- Under this project, it is proposed to fill Minor Irrigation tanks with 79 TMC of water to 19 Taluks of Bellary, Davanagere, Tumkur and Kolar districts. 50% recharge is considered from the surface water proposed to fill the tanks for irrigation, which includes recharge from tanks, canal seepage and return flow from irrigation.
- **For Honnali Taluk, it is not considered as recharge from above project, since the Taluk is under safe category.**

5.0 Demand side interventions

5.1 Advanced irrigation practices

It is observed that borewells and canals are 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 11182 ha of gross irrigated area by wells & borewells.
- Irrigation draft is 7683 Ham.
- Efficient irrigation techniques will contribute in saving ground water by 2304.9 Ham and thus will improve stage of development by 7.42% from 54.67% to 47.25% (**Table-8**).

5.2 Change in cropping pattern

Water intensive crops like paddy & sugarcane are only grown from canal irrigation in the Honnali Taluk. Hence, change in cropping pattern has not been suggested.

Table-8: Improvement in GW availability due to saving by adopting water use efficiency

Taluk	Cumulative annual ground water availability after implementing AR structures & irrigation development schemes	Existing gross ground water draft for all uses	Stage of ground water development after implementing AR structures	Saving due to adopting WUE measures	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of the project	Expected improvement in overall stage of ground water development
	Ham	Ham	%	Ham	Ham		%
Honnali	14681.6	8026	54.67	2304.9	16986.5	47.25	7.42

5.3 Water Logging and additional area of irrigation

Area prone for water logging falls between 2-5 m pre-monsoon water level contour is estimated (Table-9). In these areas, quantum of withdrawal of ground water is calculated considering specific yield of 2% and water column to be reduced to 5 mbgl. The volume of ground water withdrawn in Honnali Taluk is 925 Ham (0.327 TMC). Additional area of crop can be irrigated using 75% of irrigation efficiency is calculated on the basis of recommendation of Agriculture University, Bangalore. Accordingly, since maize is grown in 43% of total crop area of Taluk, it is suggested that additional area of 1388 ha can be irrigated for Maize or 2314 ha for Jowar crops (**Table-9**).

5.4 Regulation and Control

- Honnali Taluk has been categorized as **Safe**, since the stage of ground water development is **64%** (GEC March 2017).
- The net ground water availability for future irrigation development is 4462 Ham.

5.5 Other interventions proposed

- Excess nitrate & fluoride concentration is found in ground water samples requires remedial measures viz.
  - Dilution of nitrate rich ground water through artificial recharge & water conservation and Roof top rain water harvesting.

Table-9: Withdrawal of Ground Water and Increase in area of Irrigation in Honnali

Water Level Range (mbgl)	Water Level to be reduced to (mbgl)	Water Column (m)	Area (Ha)	Specific Yield	Volume of Ground Water to be withdrawn		Area of crop can be irrigated using 75% of Irrigation Efficiency (Ha)	
					(Ham)	(TMC)	Maize	Jowar
0 - 2	5	4	0	0.02	0	0.000	0	0
2 - 5	5	3	15422	0.02	925	0.327	1388	2314
Total					**925**	**0.327**	**1388**	**2314**

5.6 Alternate Management Plan for Honnali Taluk

As per GEC-2017, the stage of ground water development of Honnali Taluk is 64% only and the Taluk categorized as 'Safe'. Instead of recharging ground water from AR structures & schemes proposed under inter -basin and savings from water use efficiency (WUE), it is proposed to create additional irrigation potential from the said sources. The volume of water is calculated from the different sources and summarized in **Table-10**. As per Master Plan on artificial recharge in Karnataka and Goa,2020 an additional irrigation potential of 0.026 lakh hectares is likely to be created.

Table-10: Volume of Water proposed / saved and Increase in area of Irrigation

Interventions	**Volume of Water proposed by artificial recharge / savings by WUE**	
	(Ham)	**(TMC)**
Artificial Recharge	2155.6	0.76
Savings from Water Use Efficiency	2304.9	0.81
Volume of GW to be withdrawn from Water Logged area	925	0.327
Total	**5385.5**	**1.897**
Additional Irrigation Potential (lakh hectares)	**0.026**	