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

Sidlaghatta Taluk, Chikballapur District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बैंगलोर

South Western Region,Bengaluru

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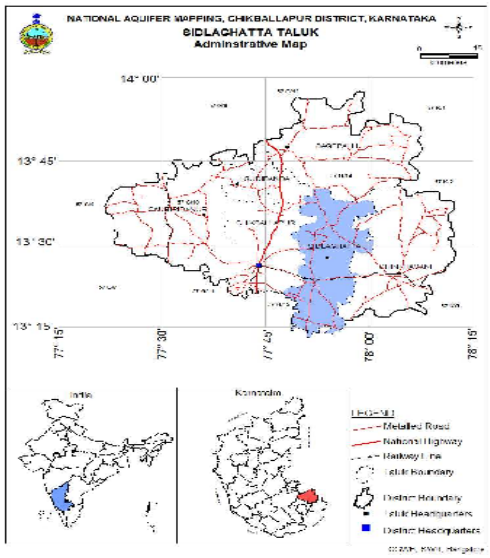
Government of India
Ministry of Water Resources, River Development & Ganga Rejuvenation
Central Ground Water Board

SIDLAGHATTA TALUK AQUIFER MAPS AND MANAGEMENT PLANS, CHIKBALLAPUR DISTRICT, KARNATAKA STATE



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March 2017

SIDLAGHATTA TALUK AQUIFER MAPS AND MANAGEMENT PLANS,

CHIKBALLAPUR DISTRICT, KARNATAKA STATE

CONTENTS

AQUIFER MANAGEMENT PLAN OF SIDLAGHATTA TALUK, CHIKBALLAPUR DISTRICT, KARNATAKA STATE

1.SALIENT INFORMATION

Name of the taluk : **SIDLAGHATTA**
District : Chikballapur;
State : Karnataka
Area : 666 sq.km.
Population : 2,14,169
Annual Normal Rainfall : 735 mm

1.1 Aquifer management study area

Aquifer mapping studies was carried out in Sidlaghatta taluk, Chikballapur district of Karnataka, covering an area of 666 sq.kms under National Aquifer Mapping Project. Sidlaghatta taluk of Chikballapur district is located between north latitude $13^0$13'06.2" and $13^0$40'04.1" & east longitude $77^0$47'31.3" and $78^0$01'03.1", and is covered in parts of Survey of India Toposheet Nos. 57G/14, 57G/15, 57G/16, 57K/2 and 57K/3. Sidlaghatta taluk is bounded by Bagepalli taluk on north, Hoskote taluk of Bangalore Rural district on south, Chintamani taluk on east and Chikballapur taluk on western side. Location map of Sidlaghatta taluk of Chikballapur district is presented in Figure-1**.**

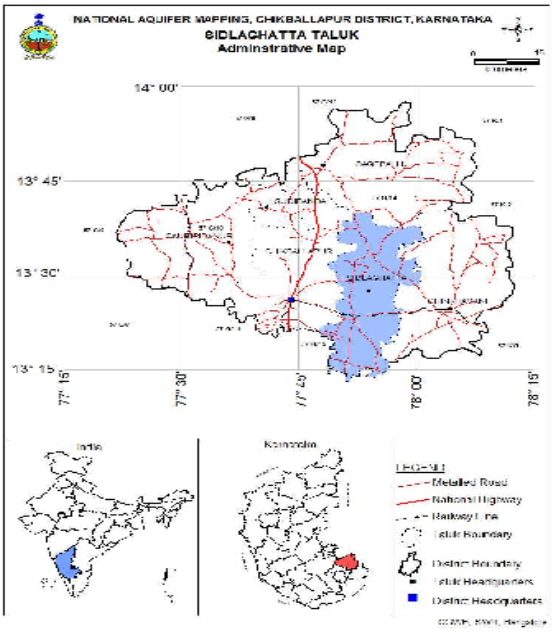

Fig 1. Location Map of Sidlaghatta taluk, Chikballapur district

Taluk administration of Sidlaghatta taluk is divided into 4 Hoblies and Sidlaghatta is only one town, which is also the taluk head quarter. There are 245 inhabited and 46 uninhabited villages in Sidlaghatta taluk (Table-1).

Table 1: Administrative divisions of Sidlaghatta taluk, Chikballapur district

Taluk	No. of Villages		VA circles	Hoblies	Gram Panchayats	Municip alities	Cities / Towns / Urban Agglomeration
	Inhabited	Uninhabited					
Sidlaghatta	245	46	42	4	27	1	1

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

1.2 Population

According to 2011 census, the population in Sidlaghatta taluk is 214169, in which 163010 constitute the rural population and 51159 is the urban population, which works out to 76% (rural) and 24% (urban) of the total population of taluk. The taluk has an overall population density of 320 persons per sq.km. The decadal variation in population from 2001-2011 is 9.4% in Sidlaghatta taluk.

1.3 Rainfall

Sidlaghatta taluk enjoys semiarid 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 normal annual rainfall in Sidlaghatta taluk for the period 1901 to 2014 is 734.7 mm. Seasonal rainfall pattern indicates that, major amount of (388.7 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 53% of the annual normal rainfall, followed by North-East Monsoon season (217.3 mm) constituting 30% and remaining (128.7 mm) 17% in Pre-Monsoon season (Table-2).

Computations were carried out for the 114 year blocks of 1901-2014.The mean monthly rainfall at Sidlaghatta taluk is ranging between 4.2 mm during January to 142.7mm during September (Table-2).

Table 2: Normals of Monthly, Seasonal and Annual Rainfall of Sidlaghatta Station (1901 to 2014)

JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
4.2	4.2	11.7	31.9	76.7	128.7	62.4	79.6	104.0	142.7	388.7	133.4	68.5	15.4	217.3	734.7

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Sidlaghatta taluk. Major Kharif crops are maize, ragi, tur and vegetables. Main crops of Rabi season are ragi, maize, horse gram, groundnut, sunflower and fruits (Table-3). Ragi is grown in 29% and maize account 9.5% of total crop area. Fruits and vegetables are grown in 15% of total crop area of taluk.

Table 3: Cropping pattern in Sidlaghatta taluk 2013-2014 (Ha)

Year	Paddy	Maize	Ragi	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
	Area under cultivation (Ha)									
2013-2014	125	3650	10979	0	2194	3477	2362	656	8	15

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

It is observed that net sown area accounts 46% and area sown more than once is 3% of total geographical area in Sidlaghatta taluk (Table-4). 37% area falls under uncultivable land excluding fallow land. Groundwater from bore wells forms the only source of irrigation.

Table 4: Details of land use in Sidlaghatta taluk 2013-2014 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Sidlaghatta	63700	19720	8501	2544	23595	7335

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

1.5 Geomorphology, Physiography & Drainage

The topography of the Sidlaghatta taluk is undulating to plain (Fig.-2).

There are no perennial rivers in Sidlaghatta taluk. The taluk is drained by river basins namely Ponnaiyar and Pennar. These rivers and their tributaries are small and carry water only during rainy season. The drainage is highly dendritic in nature (Fig-3). The Pennar river flows towards north covering parts of Sidlaghatta taluk. River Papagni enters in Sidlaghatta taluk and flows towards NE. South Pinakani originates from Nandi hills and flows in Chikballapur and Sidlaghatta taluks (Fig.-3).

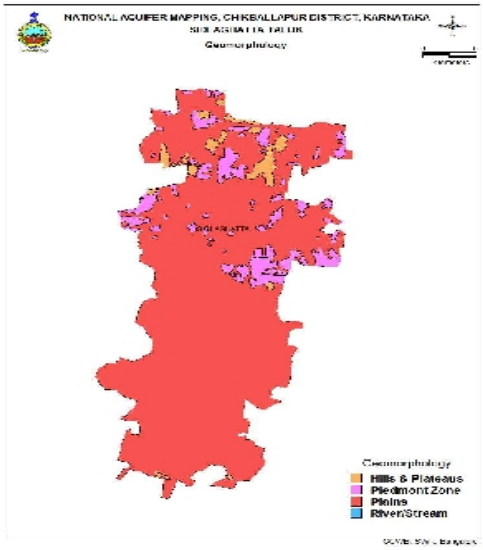

Fig 2. Geomorphology Map

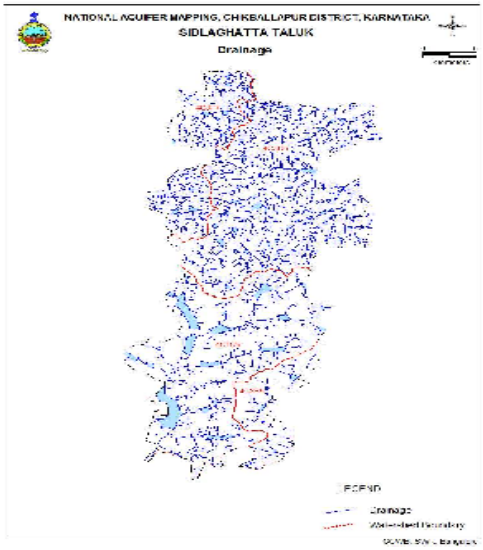

Fig 3. Drainage Map

1.6 Soil

Sidlaghatta taluk is covered red loamy soil to red sandy soil and lateritic soil.

1.7 Ground water resource availability and extraction

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

Table 5: Total GW Resources (2011) (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
Sidlaghatta	6445	0	2727	9172

1.8 Existing and future water demands (as per GEC-2011)

- Net ground water availability for future irrigation development : Nil
- Domestic (Industrial sector) demand for next 25 years : 5.13 MCM

1.9 Water level behavior

(a) Depth to water level

Aquifer – I : The dug wells in the taluk are dried up, hence there is no water level.

Aquifer – II : Pre-monsoon & Post-monsoon water level are given in Table below and shown in Figures 4 & 5 respectively.

Taluk	Pre-monsoon Water Level (mbgl)			Post-monsoon Water level (mbgl)		
	Minimum	Maximum	Average	Minimum	Maximum	Average
Sidlaghatta	4.20	88.3	34.89	2.54	98.64	39.04

(b) Water level fluctuation

Aquifer-II (Fig.-6)

A. Seasonal Fluctuation: Rise ranges between 0.36 to 3.33 m;
Fall ranges between 0.04 to 69.34 m.

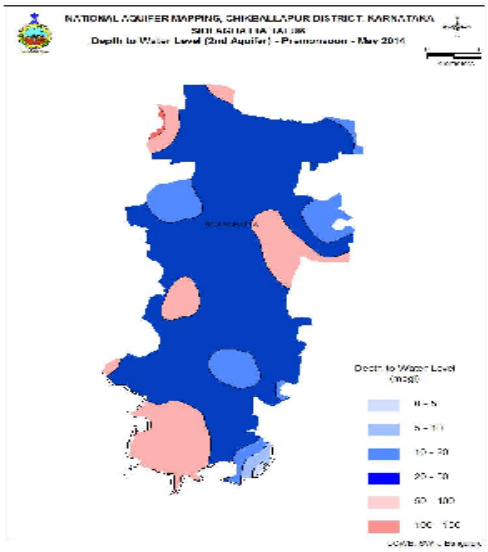

Fig 4. Pre-monsoon Depth to Water Level (Aq-II)

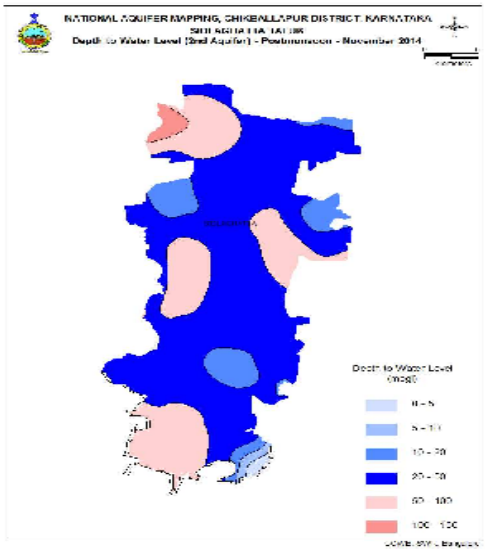

Fig 5. Post-monsoon Depth to Water Level (Aq-II)

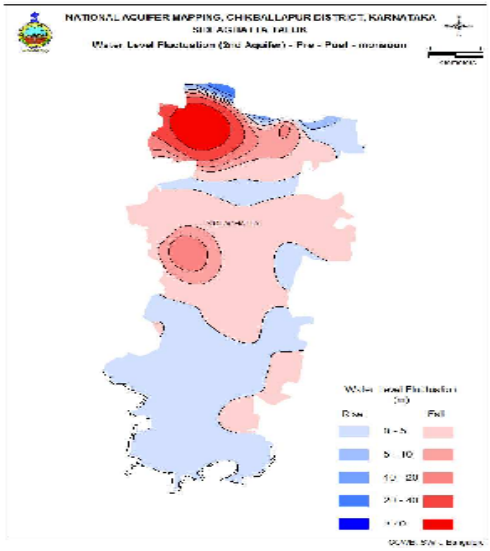

Fig 6. Water Level Fluctuation (Aq-II)

2. AQUIFER DISPOSITION

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

i. **Aquifer-I (Phreatic aquifer)** comprising Weathered Banded Gneissic Complex
ii. **Aquifer-II (Fractured aquifer)** comprising Fractured Banded Gneissic Complex

In Sidlaghatta taluk, fractured Banded Gneissic Complex / gneisses and laterite are the main water bearing formations (Figure-7). Ground water occurs within the weathered and fractured gneisses and laterite under water table condition and semi-confined condition. In Sidlaghatta taluk bore wells were drilled from a minimum depth of 106 mbgl to a maximum of 515 mbgl (Table 6). Thickness of weathered zone (Aquifer-I) ranges from 5.5 mbgl to 90.0 mbgl (Figure 8). Ground water exploration reveals that aquifer-II fractured formation was encountered between the depths of 36 to 505 mbgl. Yeild ranges from 0.1 to 11.75 lps. The most productive granular zones with good discharge encountered are in between 100 to 200 m. Transmissivity ranges from 0.7 to 38.9 m^2/day. The basic characteristics of each aquifer are summarized in Table 7.

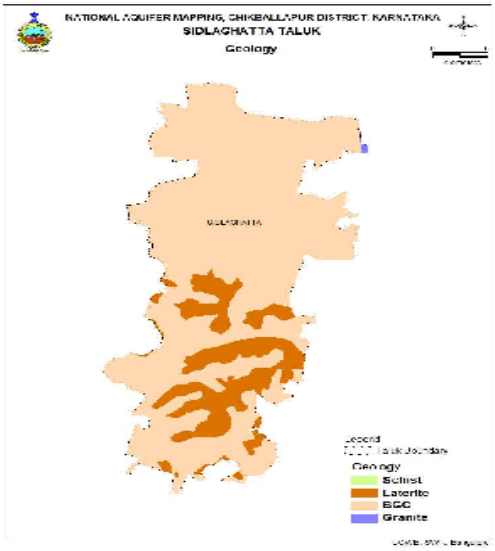

Fig 7. Geology Map

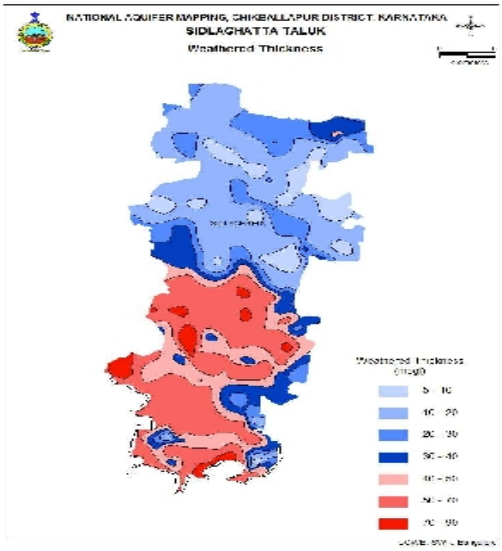

Fig 8. Weathered thickness map (Aq-I disposition)

Table 6: Details of Ground Water Exploration

S. No	Location	Latitude	Longitude	Depth Drilled (mbgl)	Casing Depth (m)	Fracture Zones (mbgl)	SWL (mbgl)	Q (lps)	DD (m)	T (m2/ day)
1	Dibburahalli	13°33'15"	77°54'18"	263.3	24	66.0-66.5, 245.0-245.5, 261.5-262.0		2	-	
2	Tummanahalli-EW	13°21'39"	77°54'58"	221	36	38.0-39.0, 54.0-55.0, 80.0-81.0, 99.0-100.0, 199.0-200.0, 217.0-218.0	11.6	5.15	-	
3	Tummanahalli-OW	13°21'39"	77°54'59"	241.8	26	36.0-37.0, 45.0-46.0, 94.0-95.0	36	5.15	-	
4	Ganjikunte	13°29'23"	77°58'57"	254.5	5.5	124.0-125.0	124	0.014		
5	Mallur	13°20'50"	77°48'45"	515	52.8	58.5-59.5, 132.0-133.0, 156.0-157.0, 193.0-194.0, 504.5-505.5	50.5	1.36		
6	Jangamanakote-EW	13°15'38"	77°50'45"	318	56	62-64,82-84,142-144	27.2	0.01		
7	Siddlaghatta-EW	13°23'10"	77°51'40"	501	90	346-352		1		
8	Seegehalli-EW	13°23'10"	77°57'20"	500	46	67-68		0.07		
9	Korlaparti	13°29'15"	77°57'29"	150		14.77, 26-27.96, 49.50, 92-94	8.44	2.75	19.53	19.8
10	Yenangur	13°16'40"	77°51'30"	253		38.6, 96.59, 184.41, 246.7	37.5	1.54	21.2	13
11	Kanchagarnahalli	13°29'15"	77°57'29"	106.2		102-106	9.11	5.41	7.09	38.9
12	Settigere	13°36'40"	77°59'10"	250		18.77, 171.17	4.88	0.75	31.23	0.66
13	Hosahudya	13°7'31"	78°7'55"	345.6		105 – 108;233-235:253-255	92.57	11.75		
14	Hosahudya OW	13°7'31"	78°7'55"	184		56-57: 90.5-91.5	29.7	1.75		

Table 7. Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered gneisses and laterite	Fractured / Jointed gneisses and laterite
Thickness range (mbgl)	30	Fractures extends upto 300 mbgl
Depth range of occurrence of fractures (mbgl)	-	30 – 300 65% between 30 - 200
Range of yield potential (lps)	Mostly Dry	< 1 - 5
Specific Yield	2%	0.2%
T (m^2/day)	-	0.7 – 38.9
Quality Suitability for Irrigation	Yes	Yes
Suitability for Domestic purposes	Yes	Yes
Remarks	Over exploited	Ground water in hard rocks exists within the fractures & 1 to 3 sets of fractures are likely to be encountered up to the depth of 500 m bgl.

2.2 3 D aquifer disposition and Cross-Sections

A. Aquifer disposition – Rockworks output (Fig.-9 & Fig.-10)

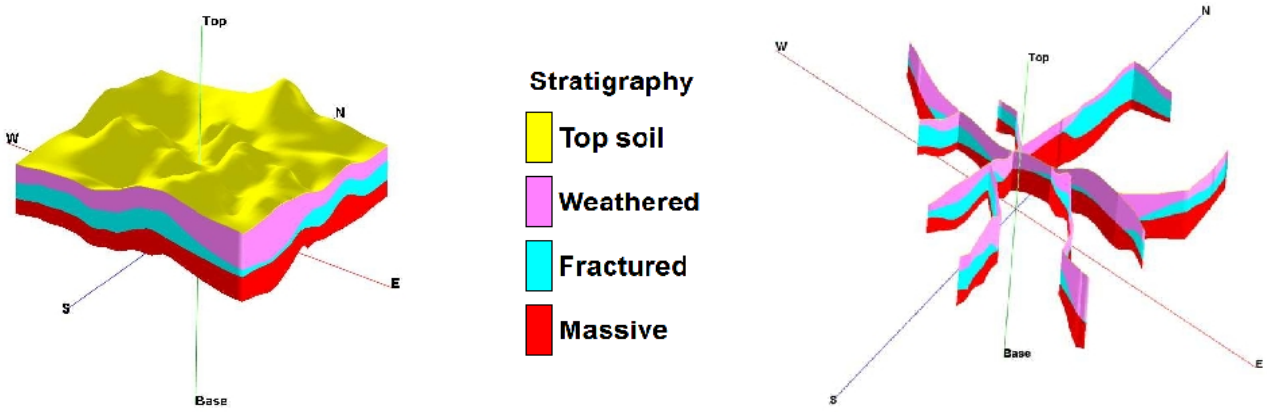

Fig 9. 3D aquifer Disposition and Fence Diagram

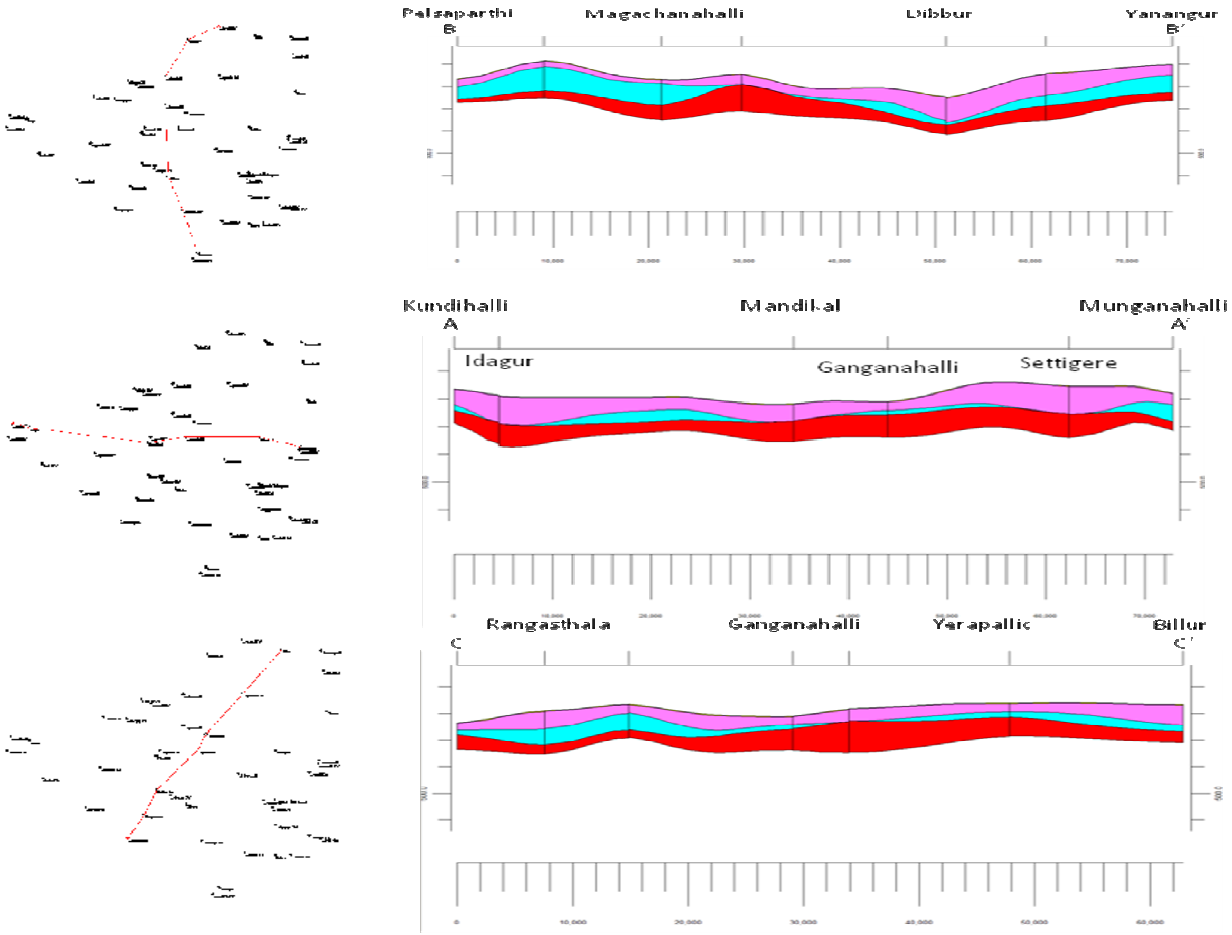

Fig 10. Cross sections of aquifers in different directions

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

a. Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2011)

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
Sidlaghatta	6445	8709	513	9222	513	0	143	OVER-EXPLOITED

(b) Present total Ground Water Resource (in 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
Sidlaghatta	6445	0	2727	9172

(c) Comparison of ground water availability and draft scenario in Sidlaghatta taluk

Taluk	GW availability (in ham)	GW draft (in ham)	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Stage of GW development
	2009			**2011**			**2013**		
Sidlaghatta	5990	8446	141	6445	9222	143	6308	9184	146

b. Chemical quality of ground water and contamination

Range of chemical constituents from analytical results of 23 samples in Sidlaghatta taluk is presented in Table-8 below:

Table 8: Range of chemical constituents in ground water of Sidlaghatta taluk

→ Chemical constituents in PPM	P^h	EC in m/mhos/cm at 25 ^{0} c	Total hardness as$CaCo_3$	Ca	Mg	Na	K	HCO_3	CO_3	Cl	So_4	No_3	F	B
Aquifer II (Bore wells)														
Range	7.5 to 8.3	220 to 1830	60 to 500	20 to 80	2.4 to 73	19 to 174	1.6 to 25	43 To 288	0 to 9	28 to 355	8 to 120	8 to 75	0.21 to 1.63	0.001 to 0.57

Electrical Conductivity: Out of 23 samples, EC values ranges from 220 to 1830 µ/mhos/cm at 25^{o}C which indicates ground water has EC value within the permissible limit in both the aquifers (Fgure-11).

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 0.21 & 1.63 mg/l. Out of 23 samples,3 samples show fluoride higher than the permissible limit of 1.5 mg/l (Fgure-12).

Nitrate: Nitrate value ranges between 8 to 75 mg/l. Out of 23 samples, 5 (22%) samples show nitrate higher than the permissible limit of 45 mg/l. Nitrate contamination is due to extensive use of fertilizers, hence is anthropogenic in origin (Fgure-13).

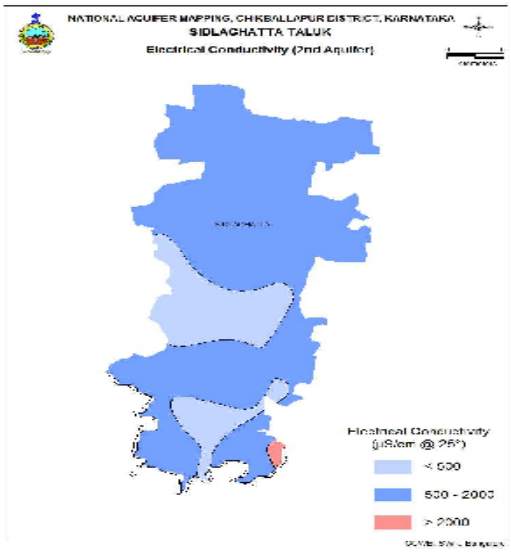

Fig 11. Electrical Conductivity Map

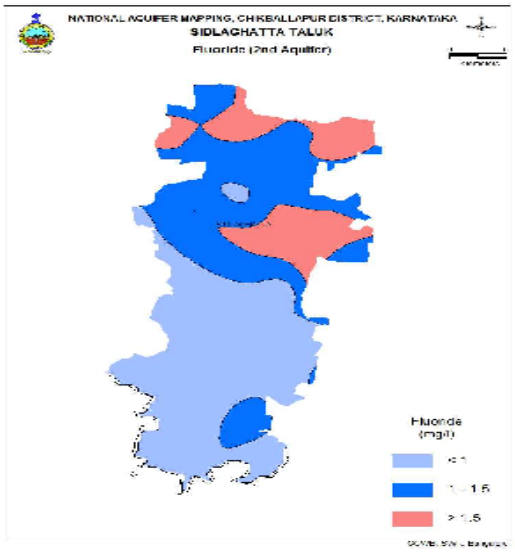

Fig 12. Fluoride Map

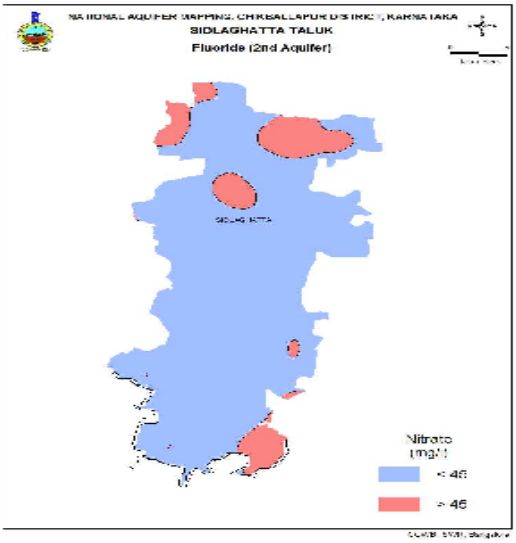

Fig 13. Nitrate Map

In general ground water quality in Sidlaghatta 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. GROUND WATER RESOURCE ENHANCEMENT

a. Aquifer wise space available for recharge and proposed interventions

Recharge dry phreatic aquifer (Aq-I) in the taluk through construction of artificial recharge structures, viz; check dams, percolation tanks & point recharge structures (Table-9). 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 (Figure-14).

Table 9. Quantity of non-committed surface runoff & expected recharge through AR structures

Artificial Recharge Structures Proposed	Sidlaghatta taluk
Non committed monsoon runoff available (MCM)	9.00
Number of Check Dams	56
Number of Percolation Tanks	4
Number of Point Recharge structures	6
Tentative total cost of the project (Rs. in lakhs)	217.03
Excepted recharge (MCM)	5.10
Expected rise in water level (m)	0.4
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	4.25

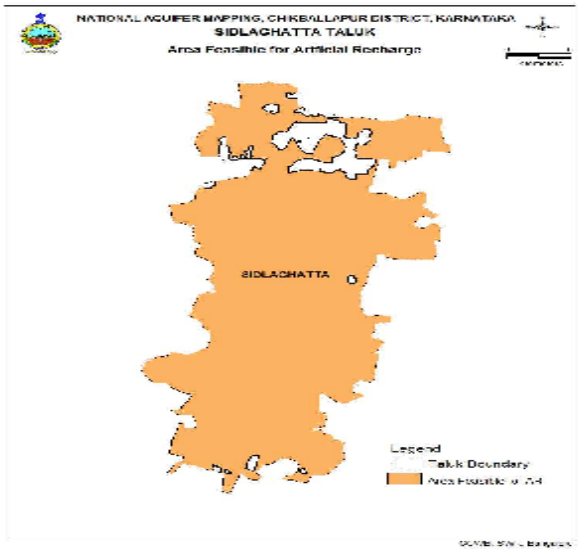

Fig 14. Area feasible for AR structures

b. Proposed Yettinahole Project

Yettinahole project is a drinking water supply scheme which neither proposes irrigation use nor development of any command areas.

The project envisages Drinking Water Supply Scheme to Chikballapur district along with other six districts ie. Kolar, Bangalore Rural, Ramnagaram, Tumkur, Hassan and Chickmagalur by Karnataka Neeravri Nigam Ltd, Government of Karnataka.

The project proposal comprises two components namely, drinking water and tank filling. In Sidlaghatta taluk, iImplementation of the project helps to recharge 829 Ham to groundwater by which there will be increase in the groundwater availability and the stage of GW development will come down (Table-10).

c. Urban Tertiary Treated Water

The Government of Karnataka is contemplating a scheme/project to replenish 32 tanks of Chikballapur district with the treated sewage water from Bangalore city lakes. Tanks in Chikballapur district would be replenished by processing of about 110 MLD (about 33 MCM/year, considering 300 days of treatment). The project will contribute 338 Ham of water for recharging the aquifer in Sidlaghatta taluk (Table-10).

Overall, recharge through AR structures, implementation of Yettinahole and urban tertiary treated waste water projects help to recharge 1677 Ham of water to groundwater by which there will be 30% increase in the groundwater availability and the stage of GW development will come down to 114 % from 143%.

The increase in groundwater availability on recharging the available water from different sources and consequent change in groundwater scenario is presented in the Table-10.

Table-10: Ground Water Availability and Draft Scenario in Sidlaghatta taluk and Expected Improvement in Stage of Ground Water Development

Taluk	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for all uses	Existing stage of Ground Water Development	Expected Recharge from Artificial Recharge Projects	Additional Potential from proposed Yettinahole Project	Proposed Tertiary Treated Waste Water of Bangalore City	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**	**Ham**	**Ham**		**%**
Sidlaghatta	6445	9222	143	510	829	338	8121	30	114

5. Demand side interventions

a. Water use efficiency

Agriculture is the main occupation and source of livelihood of the rural population in Sidlaghatta taluk. As there are no other sources, groundwater is the only source for agriculture. Therefore, agriculture sector is major consumer of groundwater. Because of over-exploitation, dug wells are dry and yield of bore wells also is on declining trend. Hence, farmers are facing inadequacy of groundwater for agriculture and in the district about 70% of the farmers have adopted to change in cropping pattern and water economy irrigation practices like drip irrigation and sprinkler irrigation.

Heavy water consuming crops like paddy and sugarcane are not grown. If, the remaining 30% farmers also adopt the water use efficient irrigation practices, there will be additional saving in water. Therefore, encouragement from government is essential for achieving full target of water use efficiency in the tauk.

b. Regulation and Control

- Sidlaghatta taluk has been categorized as Overexploited, since the stage of ground water development has reached 143% (GEC-March 2011). Hence, stringent action has to be taken up through Karnataka Ground Water Authority to control further ground water exploitation in the taluk.
- Ground water recharge component needs to be made mandatory in the taluk.

c. Quality issue management options

The main quality issues in the Sidlaghatta taluk are fluoride and nitrate in both the aquifers. But, they are sporadic in nature. Fluoride is geogenic. Nitrate contamination is local in nature and is anthropogenic.

For remediation, the following management measures are suggested.

- Alternate source
- Removal technique
- Artificial recharge
- In-situ rainwater harvesting
- Centralized drinking water supply from Yettinahole Project
- Prevention of contamination

6. Summary

The summary of Management plan of Sidlaghatta taluk is given in Table-11.

Table-11: Summary of Management plan of Sidlaghatta taluk

Sidlaghatta taluk is over-exploited & present stage of GW Development (2011)	145%
Net Annual Ground Water Availability (MCM)	64.45
Existing Gross Ground Water Draft for all uses	92.22
Groundwater development feasibility	NIL
Total GW Resources (Dynamic & Static upto the depth of 200 mbgl) (MCM)	91.72
Expected additional recharge from monsoon surplus runoff (MCM)	5.10
Change in Stage of GW development, %	143 to 132
Expected additional recharge from Proposed Yettinahole project (50% live capacity of MI tank) (MCM)	8.29
Change in Stage of GW development, %	132 to 118
Expected additional recharge from Proposed project of filling MI tanks with Urban	3.38

Tertiary treated water (MCM)		
Change in Stage of GW development, %		118 to 114
Water Use efficiency measures	• 70 % farmers have adopted water use efficiency irrigations practices like dip & sprinkler irrigation • Water intensive crops (Paddy & Sugarcane) are not being cultivated and • Government to take initiative to encourage remaining 30% farmers to adopt water use efficiency irrigations practices	
Groundwater quality aspects - Fluoride & Nitrate	• Alternate source • Removal technique • Artificial recharge • In-situ rainwater harvesting • Centralized drinking water supply from Yettinahole Project • Prevention of contamination	

SIDLAGHATTA TALUK AQUIFER MAPS AND MANAGEMENT PLANS, CHIKBALLAPUR DISTRICT, KARNATAKA STATE

1. SALIENT INFORMATION

Name of the taluk : **SIDLAGHATTA**
District : Chikballapur;
State : Karnataka
Area : 666 sq.km.
Population : 2,14,169
Annual Normal Rainfall : 735 mm

1.1 Aquifer management study area

Aquifer mapping studies was carried out in Sidlaghatta taluk, Chikballapur district of Karnataka, covering an area of 666 sq.kms under National Aquifer Mapping Project. Sidlaghatta taluk of Chikballapur district is located between north latitude $13^0$13'06.2" and $13^0$40'04.1" & east longitude $77^0$47'31.3" and $78^0$01'03.1", and is covered in parts of Survey of India Toposheet Nos. 57G/14, 57G/15, 57G/16, 57K/2 and 57K/3. Sidlaghatta taluk is bounded by Bagepalli taluk on north, Hoskote taluk of Bangalore Rural district on south, Chintamani taluk on east and Chikballapur taluk on western side. Location map of Sidlaghatta taluk of Chikballapur district is presented in Figure-1**.**

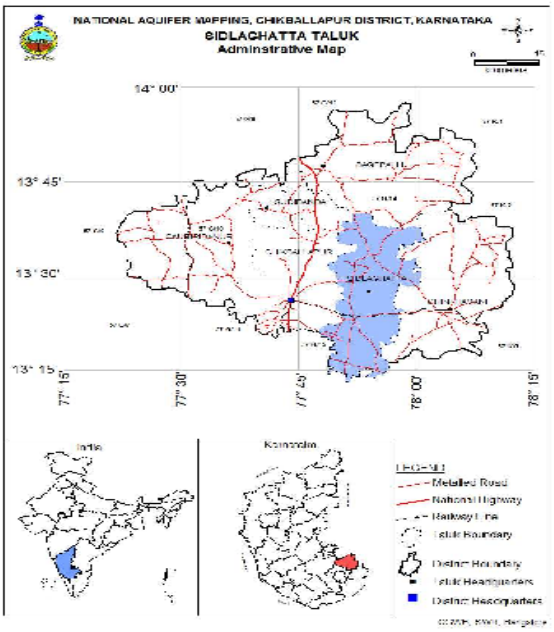

Fig 1. Location Map of Sidlaghatta taluk, Chikballapur district

Taluk administration of Sidlaghatta taluk is divided into 4 Hoblies and Sidlaghatta is only one town, which is also the taluk head quarter. There are 245 inhabited and 46 uninhabited villages in Sidlaghatta taluk (Table-1).

Table 1: Administrative divisions of Sidlaghatta taluk, Chikballapur district

Taluk	No. of Villages		VA circles	Hoblies	Gram Panchayats	Municip alities	Cities / Towns / Urban Agglomeration
	Inhabited	Uninhabited					
Sidlaghatta	245	46	42	4	27	1	1

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

1.2 Population

According to 2011 census, the population in Sidlaghatta taluk is 214169, in which 163010 constitute the rural population and 51159 is the urban population, which works out to 76% (rural) and 24% (urban) of the total population of taluk. The taluk has an overall population density of 320 persons per sq.km. The decadal variation in population from 2001-2011 is 9.4% in Sidlaghatta taluk.

1.3 Rainfall

Sidlaghatta taluk enjoys semiarid 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 normal annual rainfall in Sidlaghatta taluk for the period 1901 to 2014 is 734.7 mm. Seasonal rainfall pattern indicates that, major amount of (388.7 mm) rainfall was recorded during South-West Monsoon seasons, which contributes about 53% of the annual normal rainfall, followed by North-East Monsoon season (217.3 mm) constituting 30% and remaining (128.7 mm) 17% in Pre-Monsoon season (Table-2).

Computations were carried out for the 114 year blocks of 1901-2014.The mean monthly rainfall at Sidlaghatta taluk is ranging between 4.2 mm during January to 142.7mm during September (Table-2).

Table 2: Normals of Monthly, Seasonal and Annual Rainfall of Sidlaghatta Station (1901 to 2014)

JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
4.2	4.2	11.7	31.9	76.7	128.7	62.4	79.6	104.0	142.7	388.7	133.4	68.5	15.4	217.3	734.7

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Sidlaghatta taluk. Major Kharif crops are maize, ragi, tur and vegetables. Main crops of Rabi season are ragi, maize, horse gram, groundnut, sunflower

and fruits (Table-3). Ragi is grown in 29% and maize account 9.5% of total crop area. Fruits and vegetables are grown in 15% of total crop area of taluk.

Table 3: Cropping pattern in Sidlaghatta taluk 2013-2014 (Ha)

Year	Paddy	Maize	Ragi	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
	Area under cultivation (Ha)									
2013-2014	125	3650	10979	0	2194	3477	2362	656	8	15

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

It is observed that net sown area accounts 46% and area sown more than once is 3% of total geographical area in Sidlaghatta taluk (Table-4). 37% area falls under uncultivable land excluding fallow land. Groundwater from bore wells forms the only source of irrigation.

Table 4: Details of land use in Sidlaghatta taluk 2013-2014 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Sidlaghatta	63700	19720	8501	2544	23595	7335

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

1.5 Geomorphology, Physiography & Drainage

The topography of the Sidlaghatta taluk is undulating to plain (Fig.-2).

There are no perennial rivers in Sidlaghatta taluk. The taluk is drained by river basins namely Ponnaiyar and Pennar. These rivers and their tributaries are small and carry water only during rainy season. The drainage is highly dendritic in nature (Fig-3). The Pennar river flows towards north covering parts of Sidlaghatta taluk. River Papagni enters in Sidlaghatta taluk and flows towards NE. South Pinakani originates from Nandi hills and flows in Chikballapur and Sidlaghatta taluks (Fig.-3).

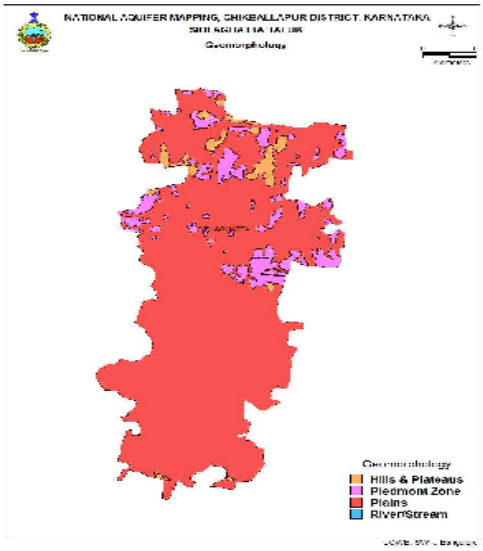

Fig 2. Geomorphology Map

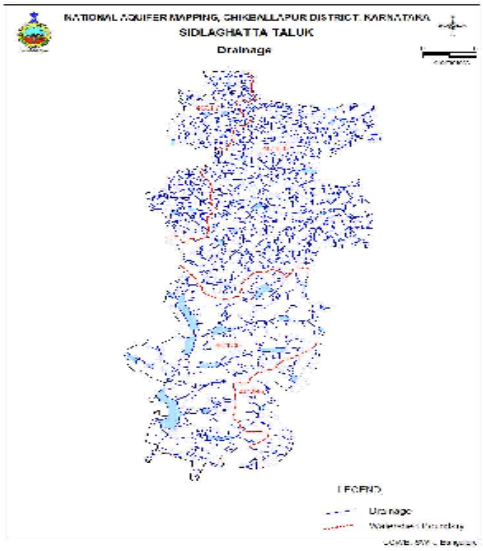

Fig 3. Drainage Map

1.6 Soil

Sidlaghatta taluk is covered red loamy soil to red sandy soil and lateritic soil.

1.7 Ground water resource availability and extraction

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

Table 5: Total GW Resources (2011) (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
Sidlaghatta	6445	0	2727	9172

1.8 Existing and future water demands (as per GEC-2011)

- Net ground water availability for future irrigation development : Nil
- Domestic (Industrial sector) demand for next 25 years : 5.13 MCM

1.9 Water level behavior

(a) Depth to water level

Aquifer – I : The dug wells in the taluk are dried up, hence there is no water level.

Aquifer – II : Pre-monsoon & Post-monsoon water level are given in Table below and shown in Figures 4 & 5 respectively.

Taluk	Pre-monsoon Water Level (mbgl)			Post-monsoon Water level (mbgl)		
	Minimum	Maximum	Average	Minimum	Maximum	Average
Sidlaghatta	4.20	88.3	34.89	2.54	98.64	39.04

(b) Water level fluctuation

Aquifer-II (Fig.-6)

A. Seasonal Fluctuation: Rise ranges between 0.36 to 3.33 m;
Fall ranges between 0.04 to 69.34 m.

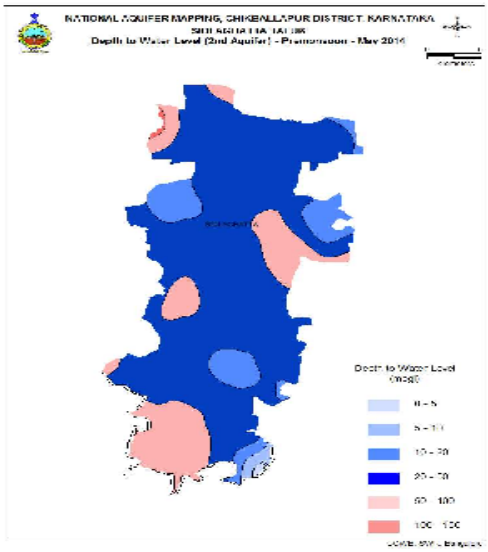

Fig 4. Pre-monsoon Depth to Water Level (Aq-II)

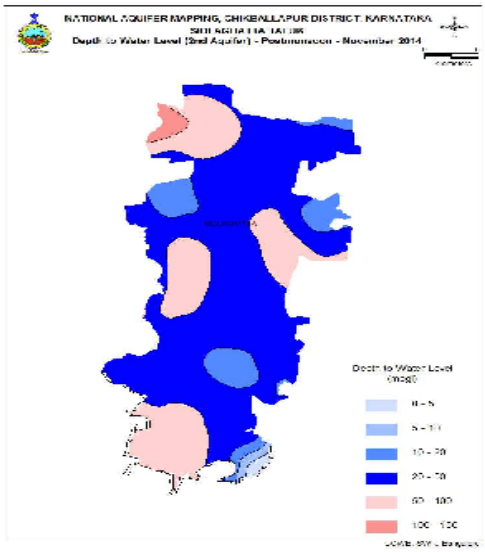

Fig 5. Post-monsoon Depth to Water Level (Aq-II)

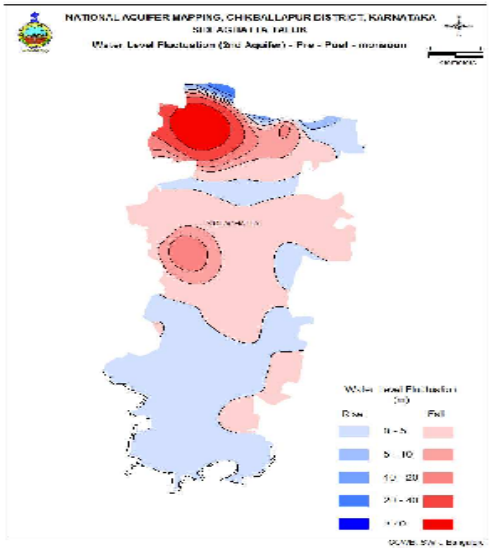

Fig 6. Water Level Fluctuation (Aq-II)

2. AQUIFER DISPOSITION

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

i. **Aquifer-I (Phreatic aquifer)** comprising Weathered Banded Gneissic Complex
ii. **Aquifer-II (Fractured aquifer)** comprising Fractured Banded Gneissic Complex

In Sidlaghatta taluk, fractured Banded Gneissic Complex / gneisses and laterite are the main water bearing formations (Figure-7). Ground water occurs within the weathered and fractured gneisses and laterite under water table condition and semi-confined condition. In Sidlaghatta taluk bore wells were drilled from a minimum depth of 106 mbgl to a maximum of 515 mbgl (Table 6). Thickness of weathered zone (Aquifer-I) ranges from 5.5 mbgl to 90.0 mbgl (Figure 8). Ground water exploration reveals that aquifer-II fractured formation was encountered between the depths of 36 to 505 mbgl. Yeild ranges from 0.1 to 11.75 lps. The most productive granular zones with good discharge encountered are in between 100 to 200 m. Transmissivity ranges from 0.7 to 38.9 m^2/day. The basic characteristics of each aquifer are summarized in Table 7.

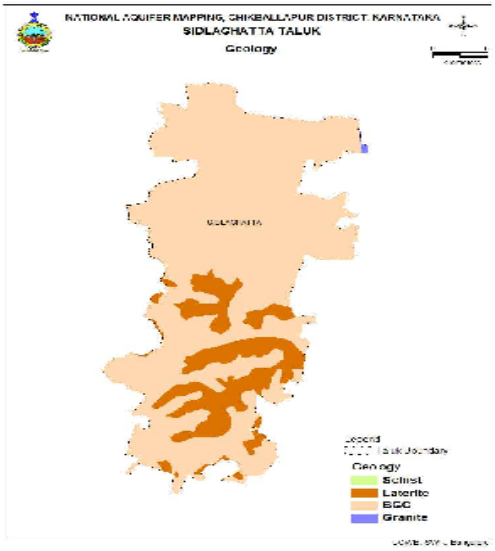

Fig 7. Geology Map

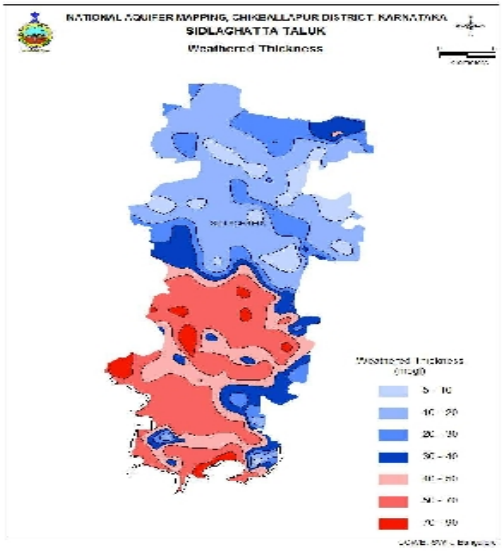

Fig 8. Weathered thickness map (Aq-I disposition)

Table 6: Details of Ground Water Exploration

S. No	Location	Latitude	Longitude	Depth Drilled (mbgl)	Casing Depth (m)	Fracture Zones (mbgl)	SWL (mbgl)	Q (lps)	DD (m)	T (m2/ day)
1	Dibburahalli	13°33'15"	77°54'18"	263.3	24	66.0-66.5, 245.0-245.5, 261.5-262.0		2	-	
2	Tummanahalli-EW	13°21'39"	77°54'58"	221	36	38.0-39.0, 54.0-55.0, 80.0-81.0, 99.0-100.0, 199.0-200.0, 217.0-218.0	11.6	5.15	-	
3	Tummanahalli-OW	13°21'39"	77°54'59"	241.8	26	36.0-37.0, 45.0-46.0, 94.0-95.0	36	5.15	-	
4	Ganjikunte	13°29'23"	77°58'57"	254.5	5.5	124.0-125.0	124	0.014		
5	Mallur	13°20'50"	77°48'45"	515	52.8	58.5-59.5, 132.0-133.0, 156.0-157.0, 193.0-194.0, 504.5-505.5	50.5	1.36		
6	Jangamanakote-EW	13°15'38"	77°50'45"	318	56	62-64,82-84,142-144	27.2	0.01		
7	Siddlaghatta-EW	13°23'10"	77°51'40"	501	90	346-352		1		
8	Seegehalli-EW	13°23'10"	77°57'20"	500	46	67-68		0.07		
9	Korlaparti	13°29'15"	77°57'29"	150		14.77, 26-27.96, 49.50, 92-94	8.44	2.75	19.53	19.8
10	Yenangur	13°16'40"	77°51'30"	253		38.6, 96.59, 184.41, 246.7	37.5	1.54	21.2	13
11	Kanchagarnahalli	13°29'15"	77°57'29"	106.2		102-106	9.11	5.41	7.09	38.9
12	Settigere	13°36'40"	77°59'10"	250		18.77, 171.17	4.88	0.75	31.23	0.66
13	Hosahudya	13°7'31"	78°7'55"	345.6		105 – 108;233-235:253-255	92.57	11.75		
14	Hosahudya OW	13°7'31"	78°7'55"	184		56-57: 90.5-91.5	29.7	1.75		

Table 7. Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered gneisses and laterite	Fractured / Jointed gneisses and laterite
Thickness range (mbgl)	30	Fractures extends upto 300 mbgl
Depth range of occurrence of fractures (mbgl)	-	30 – 300 65% between 30 - 200
Range of yield potential (lps)	Mostly Dry	< 1 - 5
Specific Yield	2%	0.2%
T (m^2/day)	-	0.7 – 38.9
Quality Suitability for Irrigation	Yes	Yes
Suitability for Domestic purposes	Yes	Yes
Remarks	Over exploited	Ground water in hard rocks exists within the fractures & 1 to 3 sets of fractures are likely to be encountered up to the depth of 500 m bgl.

2.2 3 D aquifer disposition and Cross-Sections

A. Aquifer disposition – Rockworks output (Fig.-9 & Fig.-10)

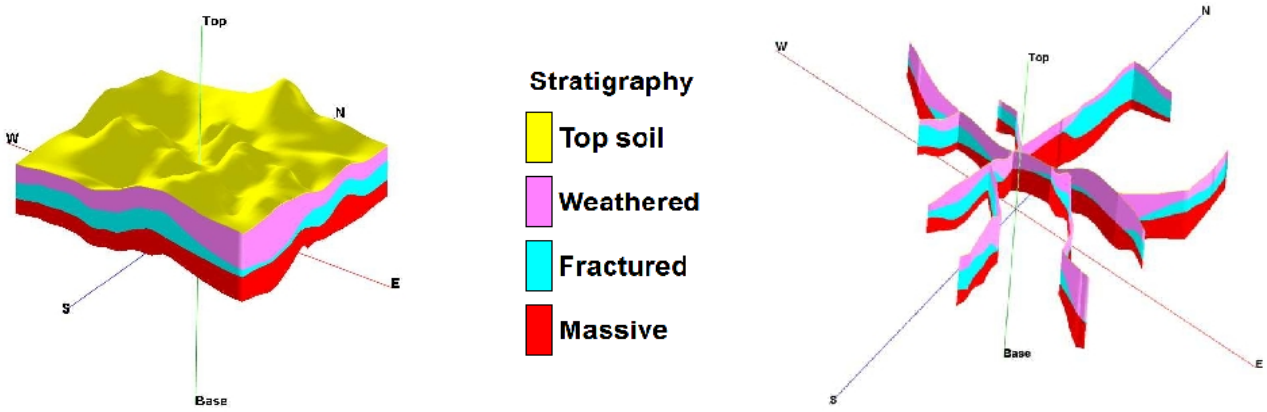

Fig 9. 3D aquifer Disposition and Fence Diagram

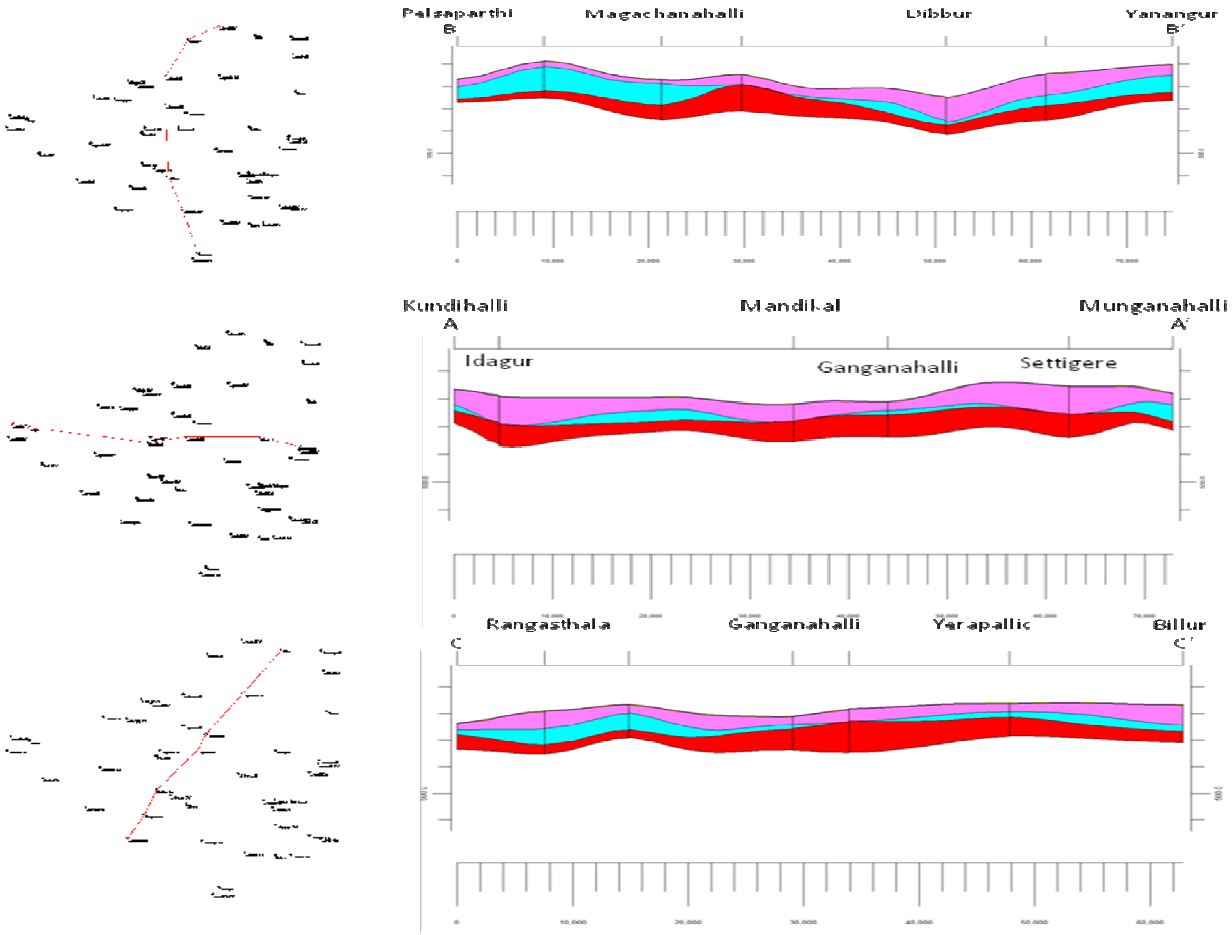

Fig 10. Cross sections of aquifers in different directions

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

a. Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (2011)

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
Sidlaghatta	6445	8709	513	9222	513	0	143	OVER-EXPLOITED

(b) Present total Ground Water Resource (in 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
Sidlaghatta	6445	0	2727	9172

(c) Comparison of ground water availability and draft scenario in Sidlaghatta taluk

Taluk	GW availability (in ham)	GW draft (in ham)	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Stage of GW development	GW availability (in ham)	GW draft (in ham)	Stage of GW development
	2009			**2011**			**2013**		
Sidlaghatta	5990	8446	141	6445	9222	143	6308	9184	146

b. Chemical quality of ground water and contamination

Range of chemical constituents from analytical results of 23 samples in Sidlaghatta taluk is presented in Table-8 below:

Table 8: Range of chemical constituents in ground water of Sidlaghatta taluk

Chemical constituents in PPM →	P^h	EC in m/mhos/cm at 25^0 c	Total hardness as $CaCo_3$	Ca	Mg	Na	K	HCO_3	CO_3	Cl	So_4	No_3	F	B
Aquifer II (Bore wells)														

Range	7.5 to 8.3	220 to 1830	60 to 500	20 to 80	2.4 to 73	19 to 174	1.6 to 25	43 To 288	0 to 9	28 to 355	8 to 120	8 to 75	0.21 to 1.63	0.001 to 0.57

Electrical Conductivity: Out of 23 samples, EC values ranges from 220 to 1830 µ/mhos/cm at 25^{o}C which indicates ground water has EC value within the permissible limit in both the aquifers (Fgure-11).

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 0.21 & 1.63 mg/l. Out of 23 samples,3 samples show fluoride higher than the permissible limit of 1.5 mg/l (Fgure-12).

Nitrate: Nitrate value ranges between 8 to 75 mg/l. Out of 23 samples, 5 (22%) samples show nitrate higher than the permissible limit of 45 mg/l. Nitrate contamination is due to extensive use of fertilizers, hence is anthropogenic in origin (Fgure-13).

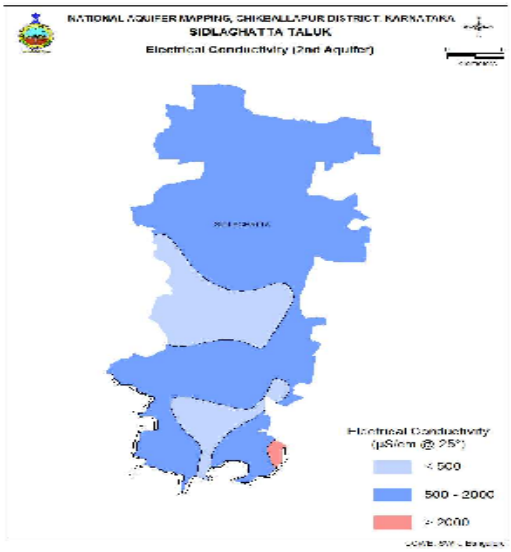

Fig 11. Electrical Conductivity Map

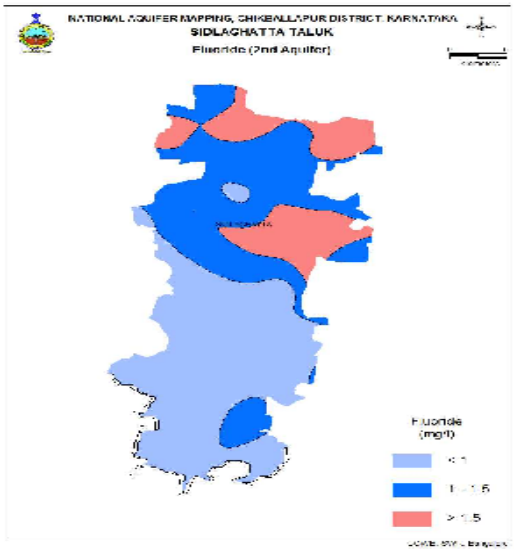

Fig 12. Fluoride Map

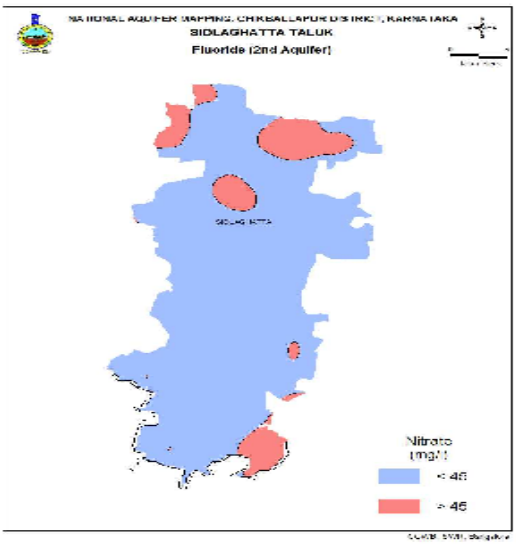

Fig 13. Nitrate Map

In general ground water quality in Sidlaghatta 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. GROUND WATER RESOURCE ENHANCEMENT

a. Aquifer wise space available for recharge and proposed interventions

Recharge dry phreatic aquifer (Aq-I) in the taluk through construction of artificial recharge structures, viz; check dams, percolation tanks & point recharge structures (Table-9). 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 (Figure-14).

Table 9. Quantity of non-committed surface runoff & expected recharge through AR structures

Artificial Recharge Structures Proposed	Sidlaghatta taluk
Non committed monsoon runoff available (MCM)	9.00
Number of Check Dams	56
Number of Percolation Tanks	4
Number of Point Recharge structures	6
Tentative total cost of the project (Rs. in lakhs)	217.03
Excepted recharge (MCM)	5.10
Expected rise in water level (m)	0.4
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	4.25

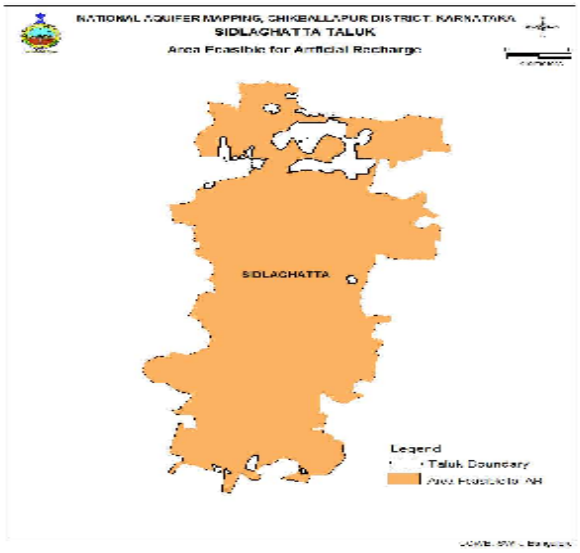

Fig 14. Area feasible for AR structures

b. **Proposed Yettinahole Project:** Yettinahole project is a drinking water supply scheme which neither proposes irrigation use nor development of any command areas.

The project envisages Drinking Water Supply Scheme to Chikballapur district along with other six districts ie. Kolar, Bangalore Rural, Ramnagaram, Tumkur, Hassan and Chickmagalur by Karnataka Neeravri Nigam Ltd, Government of Karnataka.

The project proposal comprises two components namely, drinking water and tank filling. In Sidlaghatta taluk, iImplementation of the project helps to recharge 829 Ham to groundwater by which there will be increase in the groundwater availability and the stage of GW development will come down (Table-10).

c. Urban Tertiary Treated Water

The Government of Karnataka is contemplating a scheme/project to replenish 32 tanks of Chikballapur district with the treated sewage water from Bangalore city lakes. Tanks in Chikballapur district would be replenished by processing of about 110 MLD (about 33 MCM/year, considering 300 days of treatment). The project will contribute 338 Ham of water for recharging the aquifer in Sidlaghatta taluk (Table-10).

Overall, recharge through AR structures, implementation of Yettinahole and urban tertiary treated waste water projects help to recharge 1677 Ham of water to groundwater by which there will be 30% increase in the groundwater availability and the stage of GW development will come down to 114 % from 143%.

The increase in groundwater availability on recharging the available water from different sources and consequent change in groundwater scenario is presented in the Table-10.

Table 10: Ground Water Availability and Draft Scenario in Sidlaghatta taluk and Expected Improvement in Stage of Ground Water Development

Taluk	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for all uses	Existing stage of Ground Water Development	Expected Recharge from Artificial Recharge Projects	Additional Potential from proposed Yettinahole Project	Proposed Tertiary Treated Waste Water of Bangalore City	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**	**Ham**	**Ham**		**%**

Sidlaghatta	6445	9222	143	510	829	338	8121	30	114

5. DEMAND SIDE INTERVENTIONS

a. Water use efficiency

Agriculture is the main occupation and source of livelihood of the rural population in Sidlaghatta taluk. As there are no other sources, groundwater is the only source for agriculture. Therefore, agriculture sector is major consumer of groundwater. Because of over-exploitation, dug wells are dry and yield of bore wells also is on declining trend. Hence, farmers are facing inadequacy of groundwater for agriculture and in the district about 70% of the farmers have adopted to change in cropping pattern and water economy irrigation practices like drip irrigation and sprinkler irrigation.

Heavy water consuming crops like paddy and sugarcane are not grown. If, the remaining 30% farmers also adopt the water use efficient irrigation practices, there will be additional saving in water. Therefore, encouragement from government is essential for achieving full target of water use efficiency in the tauk.

b. Regulation and Control

- Sidlaghatta taluk has been categorized as Overexploited, since the stage of ground water development has reached 143% (GEC-March 2011). Hence, stringent action has to be taken up through Karnataka Ground Water Authority to control further ground water exploitation in the taluk.
- Ground water recharge component needs to be made mandatory in the taluk.

c. Quality issue management options

The main quality issues in the Sidlaghatta taluk are fluoride and nitrate in both the aquifers. But, they are sporadic in nature. Fluoride is geogenic. Nitrate contamination is local in nature and is anthropogenic.

For remediation, the following management measures are suggested.

- Alternate source
- Removal technique
- Artificial recharge
- In-situ rainwater harvesting
- Centralized drinking water supply from Yettinahole Project
- Prevention of contamination

6. SUMMARY

The summary of Management plan of Sidlaghatta taluk is given in Table-11.

Table 11: Summary of Management plan of Sidlaghatta taluk

Sidlaghatta taluk is over-exploited & present stage of GW Development (2011)	145%
Net Annual Ground Water Availability (MCM)	64.45
Existing Gross Ground Water Draft for all uses	92.22
Groundwater development feasibility	NIL
Total GW Resources (Dynamic & Static upto the depth of 200 mbgl) (MCM)	91.72
Expected additional recharge from monsoon surplus runoff (MCM)	5.10
Change in Stage of GW development, %	143 to 132
Expected additional recharge from Proposed Yettinahole project (50% live capacity of MI tank) (MCM)	8.29
Change in Stage of GW development, %	132 to 118
Expected additional recharge from Proposed project of filling MI tanks with Urban Tertiary treated water (MCM)	3.38
Change in Stage of GW development, %	118 to 114
Water Use efficiency measures	• 70 % farmers have adopted water use efficiency irrigations practices like dip & sprinkler irrigation • Water intensive crops (Paddy & Sugarcane) are not being cultivated and • Government to take initiative to encourage remaining 30% farmers to adopt water use efficiency irrigations practices
Groundwater quality aspects - Fluoride & Nitrate	• Alternate source • Removal technique • Artificial recharge • In-situ rainwater harvesting • Centralized drinking water supply from Yettinahole Project • Prevention of contamination