केन्द्रीय भूमि जल बोर्ड

जल शक्ति मंत्रालय, जल संसाधन, नदी विकास
और गंगा संरक्षण विभाग
भारत सरकार

Central Ground Water Board

Ministry of Jal Shakti,
Department of Water Resources, River Development
and Ganga Rejuvenation
Government of India

Report on

AQUIFER MAPPING AND MANAGEMENT PLAN

Belagavi Taluk, Belagavi District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु

South Western Region, Bengaluru

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भारत सरकार
जल शक्ति मंत्रालय
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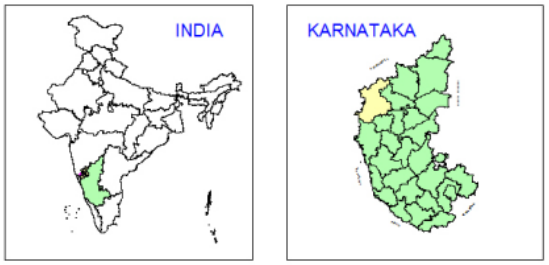
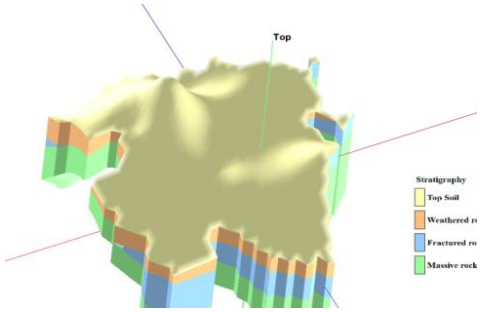
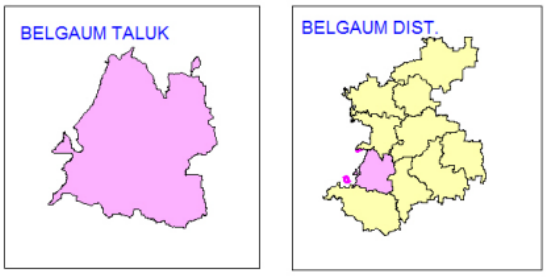
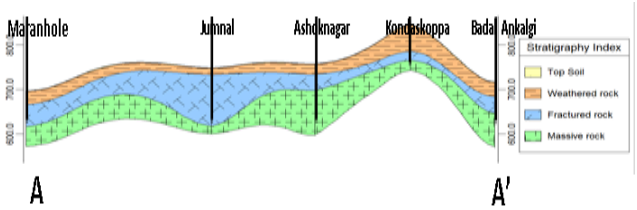
AQUIFER MAPS AND MANAGEMENT PLAN, BELGAVI TALUK, BELAGAVI DISTRICT, KARNATAKA STATE

(AAP – 2019-2020)









By

A. Suresha, Scientist 'D', CGWB, SWR, Bengaluru

MAY 2022

AQUIFER MAPS AND MANAGEMENT PLAN, **BELAGAVI** TALUK, **BELAGAVI** DISTRICT, KARNATAKA STATE

(AAP – 2019-2020)

Contents

AQUIFER MAPS AND MANAGEMENT PLAN, **BELAGAVI** TALUK, **BELAGAVI** DISTRICT, KARNATAKA STATE

1 SALIENT FEATURES

Name of the taluk	: BELAGAVI
District	: Belagavi
State	: Karnataka
Area	: 1037 sq.km.
Population	: 957373
Annual Normal Rainfall	: 1435mm, 68 rainy days. (1941 -2000)

1.1 Study area

Aquifer mapping studies have been carried out in Belagavi taluk,Belagavi district of Karnataka covering an area of 1037sq.kms under National Aquifer Mapping Project. Belagavi taluk of Belagavi district is located in between North Latitudes 15°41'32.64'' and 16°04'17.76" and between East Longitudes 74° 19' 54.12" and 74°42'3.96" and is falling in parts of Survey of India Toposheet47L/12, 48/5, 48I/6, 48I/9, 48I/10, 48I/13. The study area is bounded on the North by Hukkeri taluk, on the East by Bailahongala taluk, on the South by Khanapur taluk of Belagavi district and on the West by Maharashtra state. Location map of Belagavitaluk of Belagavi district is presented in **Fig-1.**

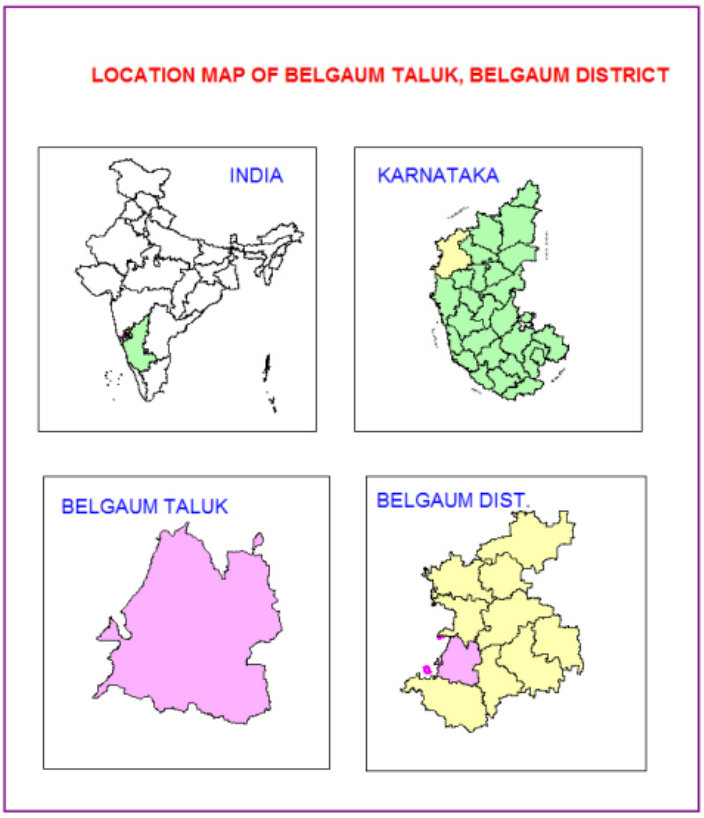


Fig 1: Location map of Belagavi taluk of Belagavi district

Administratively, Belagavi town is the taluk headquarters and there are 13 other urban settlements in the taluk. There are 59gramapanchayats, 119 inhabited and 1 uninhabited villages in the taluk.

1.2 Population

According to 2011 census, the human population in Belagavi taluk is 957373out of which67% constitutes the urban population and only 33% constitute the rural population. The taluk has an overall population density of 928 persons per sq.km. In Belagavi taluk, the decadal variation in population from 2001-2011 is 17.39%. The population details are given in **Table-1.**

Table-1: Population details of Belagavi taluk

Total	Male	Female	Share of the district population	Rural population	Urban population	Decadal change in population	Decadal change in rural population	Decadal change in urban population
957373	486704	470669	20.03	313511	643862	17.39	1.43	27

Source: District at a glance 2017-18, Govt. of Karnataka

1.3 Rainfall and Climate

The climate of the district as a whole can be termed as semi-arid. The variation in the maximum temperature during the year ranges from 27°C to 35.7° C and minimum from 13.90°C to 20.60°C. The district experiences pleasant winters and hot dry summers. The hot season extends from March to May, during which the daily maximum temperature often shoots up to 35.7°C.

Agro-climatologically the district can be divided into three zones taking into consideration the rainfall pattern-quantum and distribution, soil types, texture, depth and physio-chemical properties, elevation, topography major crops and type of vegetation i.e. high rainfall “Hilly zone”, “Northern transitional zone” and “Northern dry zone” from southwest to northeast respectively. Belagavi taluk falls under “Northern transitional zone**”** of agro-climatic zones of Karnataka state. The normal annual rainfall in Belagavi taluk for the period 1941 to 2000 is 1045mm. Seasonal rainfall pattern indicates that major amount of rainfall was recorded during South-West Monsoon seasons, which contributes about 82% of the annual normal rainfall, followed by North-East Monsoon season constituting 10% and remaining 8% in Pre-Monsoon season.

Computations were carried out for the 30-year blocks of 1981-2010; the mean monthly rainfall at Belagavi is ranging between 0 mm during February to 116 mm during June. The coefficient of variation percent for pre-monsoon, monsoon and post-monsoon season is 64, 39 & 65 percent respectively. Annual CV at this station works out to be 26 percent.

Statistical Analysis of Rainfall Data of Belagavi taluk, (1981 to 2010),Annual rainfall (mm) in Belagavi rain gauge station from 2007 to 2020 and Monthly rainfall for the year 2020 recorded in various rain gauge stations in Belagavi is give in **Table-2a, 2b and 2c** respectively. The perusal of Table – 2a indicates that the rainfall ranges from 702 mm (2015) to 2442 (2019), whereas the average rainfall is 1293 mm. The rainfall trend analysis for the period 2007-2020 of Belagavi taluka is presented in **Fig.3** and it indicates that the rainfall is increasing @ 19.19 mm / year.

Table-2a: Statistical Analysis of Rainfall Data of Belagavi taluk, (1981 to 2010)

Station Belagavi	JAN	FEB	MAR	APR	MAY	PRE	JUN	JUL	AUG	SEP	SW	OCT	NOV	DEC	NE	Annual
NRM	1	0	4	18	56	81	116	96	84	110	406	109	22	4	136	622
ST.DEV	5	1	8	22	50	52	70	56	40	86	160	76	32	11	88	164
CV%	324	381	203	119	89	64	60	58	47	78	39	69	146	269	65	26

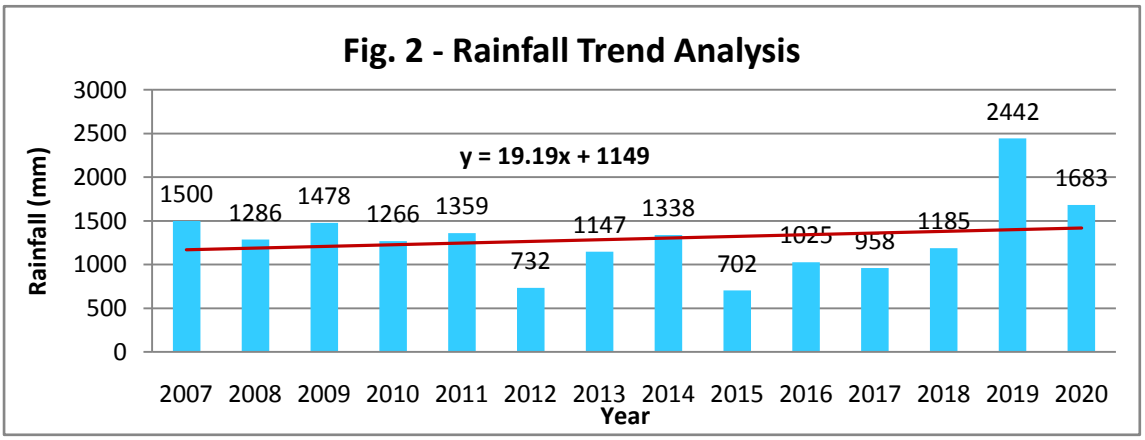
Table- 2b: Annual rainfall (mm) in Belagavi rain gauge station from 2007 to 2020

2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
1500	1286	1478	1266	1359	732	1147	1338	702	1025	958	1185	2442	1683	1293

Source: District at a glance 2017-18, Govt. of Karnataka

Table- 2c:Monthly rainfall for the year 2020 recorded in various rain gauge stations in Belagavi

Year	Raigauge station	Jan	Feb	Mar	Apr	May	PRE	Jun	Jul	Aug	Sep	SW	Oct	Nov	Dec	NE	Total
2020	Belgaum IB	0.00	0.00	88.60	29.80	20.30	138.70	259.70	241.30	593.70	157.00	1251.70	202.20	0.00	0.00	202.20	1592.60
	Belgaum Rly	0.00	0.00	83.00	41.00	20.00	144.00	254.60	247.00	680.00	143.00	1324.60	175.00	0.00	0.00	175.00	1643.60
	Bagewadi	0.00	0.00	32.60	68.00	39.80	140.40	207.40	207.40	557.00	188.61	1160.41	167.20	0.00	0.00	167.20	1468.01
	Desur	0.00	0.00	64.00	35.40	18.60	118.00	332.00	305.80	719.60	179.20	1536.60	99.00	0.00	0.00	99.00	1753.60
	Kakti	0.00	0.00	56.40	120.20	57.60	234.20	227.80	247.90	514.10	159.15	1148.95	200.60	0.00	0.00	200.60	1583.75
	Rakaskoppa	0.00	0.00	6.30	13.30	51.70	71.30	438.10	322.20	1233.00	227.30	2220.60	92.30	0.00	0.00	92.30	2384.20
	Sambra	0.00	0.00	19.30	32.80	23.10	75.20	185.20	191.70	405.50	300.20	1082.60	188.30	0.00	0.00	188.30	1346.10
	Santi-Bastwad	0.00	0.00	44.00	24.00	19.80	87.80	299.20	285.60	730.70	165.30	1480.80	132.60	0.00	0.00	132.60	1701.20
	Sulebhavi	0.00	0.00	71.80	37.20	17.60	126.60	162.70	216.60	446.80	191.00	1017.10	256.60	0.00	0.00	256.60	1400.30
	Uchagaon	0.00	0.00	9.40	83.40	111.60	204.40	383.00	301.80	775.80	185.10	1645.70	108.90	0.00	0.00	108.90	1959.00
	Average	0.00	0.00	47.54	48.51	38.01	134.06	274.97	256.73	665.62	189.59	1386.91	162.27	0.00	0.00	162.27	1683.24



1.4 Agriculture & Irrigation

Agriculture is the main occupation in Belagavi taluk. Major Kharif crops are paddy, maize and vegetables. Important crops of Rabi season are maize, vegetables and oilseeds (**Table-3**). Water intensive crops like sugarcane and paddy are grown in 42.01 and 9.17% respectively of the total crop area. However, paddy is grown during Kharif period and is mainly dependent on rain water. Jowar is grown in 10.27% and oil seeds in 18.90% of total crop area in the taluk. The annual crop sugarcane is grown in 5984 Ha (9.17%) and short duration crop vegetable is grown in 1087 Ha (10.86%) of the crop area which require ground water during post monsoon season especially during summer.

Table-3: Cropping pattern in Belagavi taluk 2017-2018 (Ha)

Crop	Paddy	Maize	Bajra	Jowar	Ragi	Wheat	Pulses	Fruits	Vege tables	Oil seeds	Sugar cane	Cotton	Total crop
Area(ha)	27403	366	30	6700	221	55	2584	1307	7087	12328	5984	1169	65234
Area %	42.01	0.56	0.05	10.27	0.34	0.08	3.96	2.00	10.86	18.90	9.17	1.79	

Source: District at a glance 2017-18, Govt. of Karnataka

About 22% of the geographical area is covered by forest. It is observed that net sown area accounts for 47.49% and area sown more than once is 16.72% of total geographical area in Belagavi taluk. Area not available for cultivation, the other uncultivable land and fallow land cover are 9.29%, 6.56% and 14.73% respectively of total geographical area. About 39.68% of net area irrigated is from wells and 48.77% are from bore wells constituting 88% of irrigation is from ground water. Thus major source of irrigation is ground water **(Fig.-3)** and the irrigation from other sources is only 12%. Even though, irrigation tanks are present, the irrigation from tanks is not appreciable. The details of land use and the details of Irrigation are given in **Table 4 and 5** respectively. The land use pattern is given in **Fig.-4**.

Table-4: Details of land use in Belagavi taluk 2017-2018 (Ha)

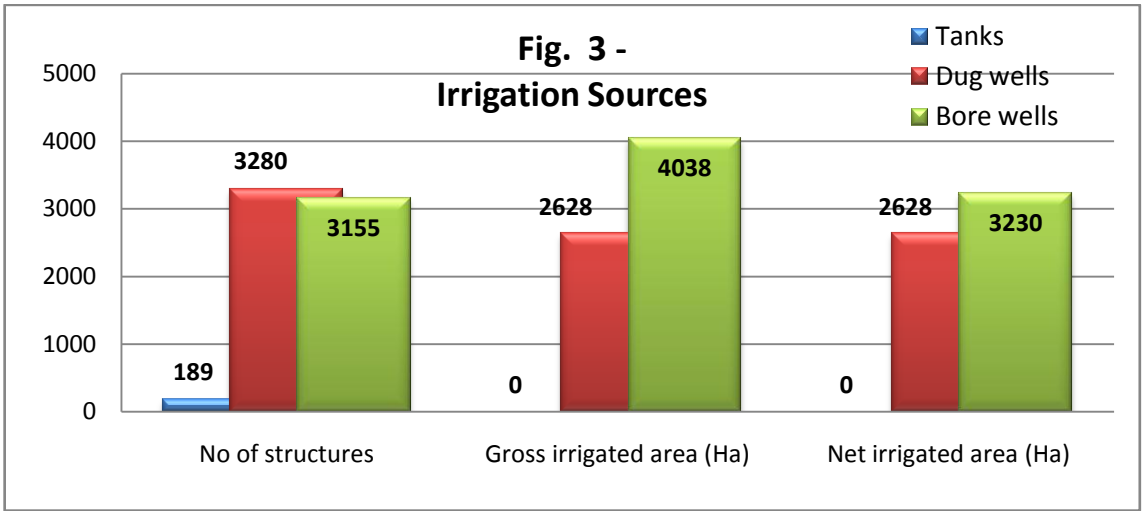
Total Geographical Area	Area under Forest	Area not available for cultivation	Other uncultivable land	Fallow land	Net sown area	Area sown more than once	Gross sown area
103721	22643	9638	6801	15275	49364	17344	66708
% of the area	21.83	9.29	6.56	14.73	47.59	16.72	64.31

Source: District at a glance 2017-18, Govt. of Karnataka

Table-5: Details Irrigation in Belagavi taluk

Source of Irrigation	No of structures	Gross area Irrigated (Ha)	Net area Irrigated (Ha.)	% of area
Canals	0	0	0	0.00
Tanks	189	0	0	0.00
Wells	3280	2628	2628	39.68
Bore wells	3155	4038	3230	48.77
Lift Irrigation	8	0	0	0.00
Other Sources	0	956	765	11.55
Total	6632	7622	6623	100.00

Source: District at a glance 2017-18, Govt. of Karnataka



In Belagavi taluk, two minor irrigation projects namely, Markandeya project and Ballarinala project are irrigating parts of thetaluk. Out of these two projects, Ballarinala project is under implementation. The salient features of these projects are given in **Table -6 a & 6 b.**

Table- 6 a: Details of Markandeya Project

S. No.	Beneficiary villages	Total area (Ha)	Developed Area	Undeveloped Area	Developed Command	Undeveloped Command
1	Kankikoppa	50.51	50.51	0.00	50.51	0.00
2	Hudali	165.38	165.38	0.00	165.38	0.00
		215.89	215.89		215.89	0.00

Table- 6b: Details of Ballary Nalla Project

S. No.	Beneficiary villages	Total area (Ha)	Developed Area	Undeveloped Area	Developed Command	Undeveloped Command
1	Hudali	181.51	0	181.51	0	181.51
2	Suladhal	175.87	0	175.87	0	175.87

1.5 Geomorphology, Physiography & Drainage

The taluk is located on the eastern side of the Western Ghats and its topography is predominantly undulating. A “rugged terrain” marks the western part of the taluk with deep cutting ravines on the foothills of the Western Ghats. The elevation of these hills varies from 795m amsl around Parsenahatti to994m amsl on north western part along the board of Maharashtra state. The northern western part of Belagavi taluk is a plateau region formed by basaltic lava flows which represents “Deccan pedeplain”. The central and eastern parts exhibit moderate to gently “undulating terrain” having sparsely distributed knolls and tors. The rest of the taluk is in general “plateau area”. The elevation in the plains varies from 773m around Belagavi to 696 m amsl around Hudali. This has its bearing on the regional slope which is towards northeast. The differential altitude is significant because, it is likely to cause irregular ground water flow patterns on the micro scale **(Fig.-5).**

The major part of Belagavi taluk falls in Krishna river basin. The Ghataprabha river along with its tributaries drain the major part of the taluk and are perennial and effluent in nature and flow in North-Easterly direction. The Markandeya river in the north and Ballarinala in the central part of the taluk along with minor nalas form the tributaries of Ghataprabha river. The drainage density varies from 0.80 to 3.4 km/sq.km. The drainage in the taluk is dendritic to sub-dendritic in nature **(Fig.-6).**

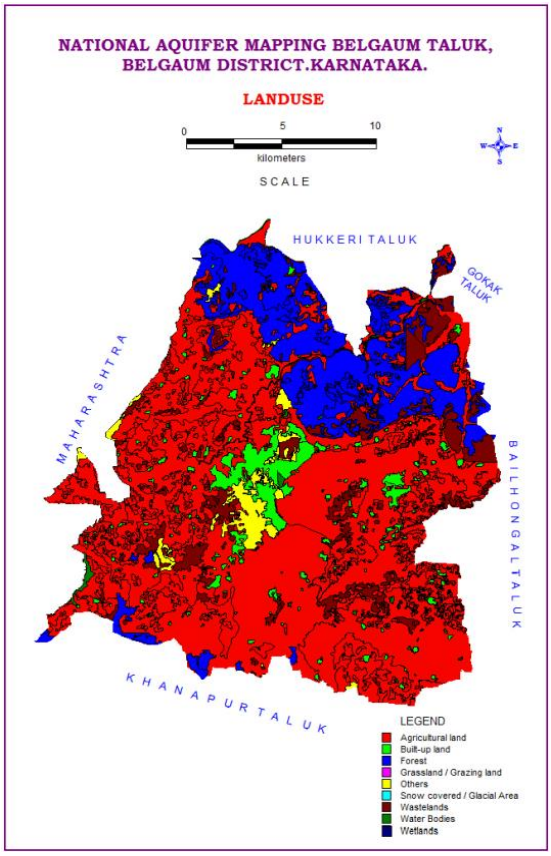


Fig 4: Land use Map

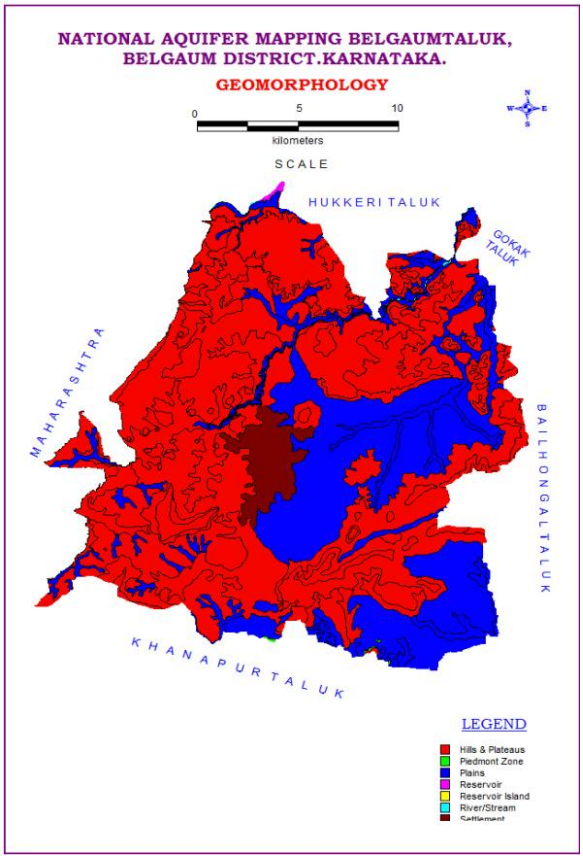


Fig 5: Geomorphology Map

1.6 Soil

The soils of Belagavi taluk can broadly be classified into red soils, black soils and laterite soils. These soils vary in depth and texture, depending on the parent rock type, physiographic settings and climatic conditions. By and large, black soils are predominating in the basalt/ meta basalt terrain and the red soils are found in the eastern and south-eastern part of the taluk in Kaladgi formation area. These soils in turn can be grouped into different categories viz. Shallow black soil, medium black soil, Deep to very black soil, mixed red & black soil, red loamy soil, which cover large tracks of land and the other two lateritic and alluvium soils are local in nature. The soil profile of

Belagavi taluk is given in **Table-7.** The soil map is shown in **Fig- 7** and slope map is shown in **Fig- 8.**

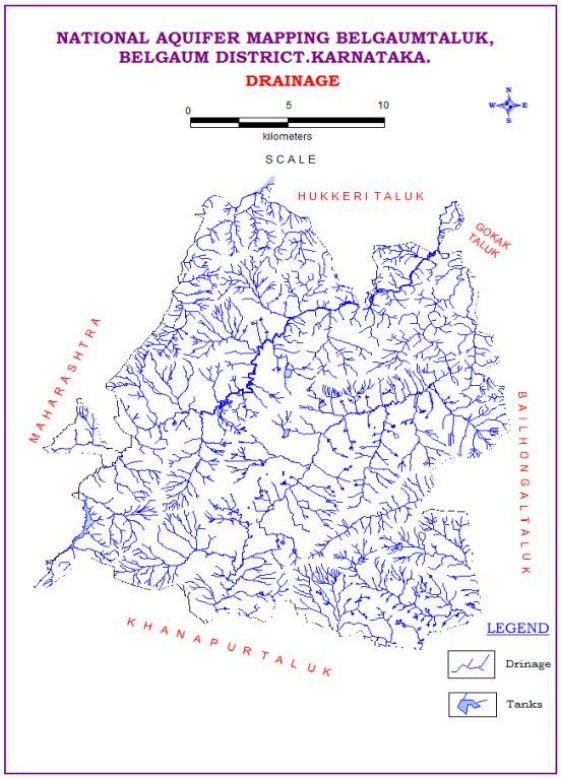


Fig 6: Drainage Map

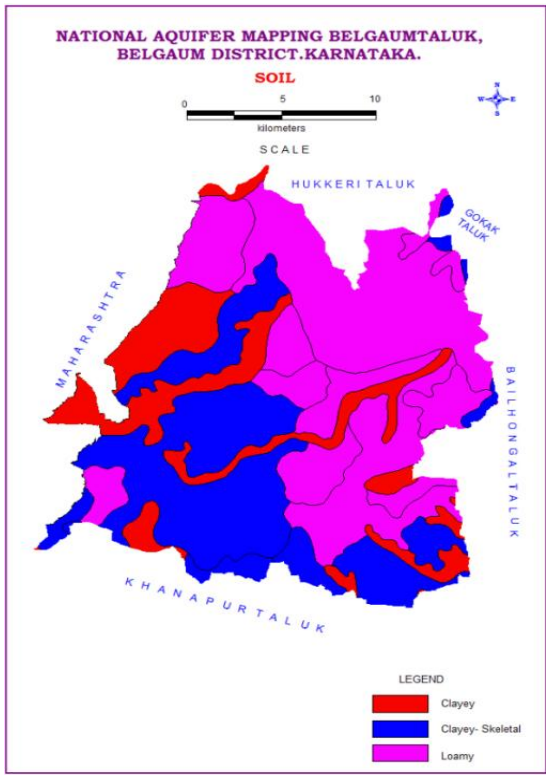


Fig 7: Soil Map

Table-7: Soil profile of Belagavi taluk (Source: District irrigation plan, Belagavi district)

S. No.	Soil Type	Area (ha)	Area (ha)			
	Major soil classes		0-3% (ha)	3-8% (ha)	8-25% (ha)	>25% (ha)
1	Very shallow, red loamy soils	20442				
2	Very shallow, red gravelly clay soils	353				
3	Shallow, red gravelly mixed with deep black soils	10283				
4	Medium deep, red gravelly clay soils	1933				
5	Deep, lateritic clay soils	4603				
6	Deep, lateritic gravelly clay soils	25145				
7	Deep, laterite clayey soils	0				
8	Very shallow, mixed black clayey and brown loamy soils	25213				
9	Deep, black clayey soils	4545				
10	Very shallow, alluvial loamy soils	547				
11	Deep, alluvial black clayey soils	2475				
12	Deep, alluvial black calcareous clayey soils	4453				
13	Deep, forest brown clayey soils (gravelly in patches)	897				
Total		100889	93191	7698	0	0

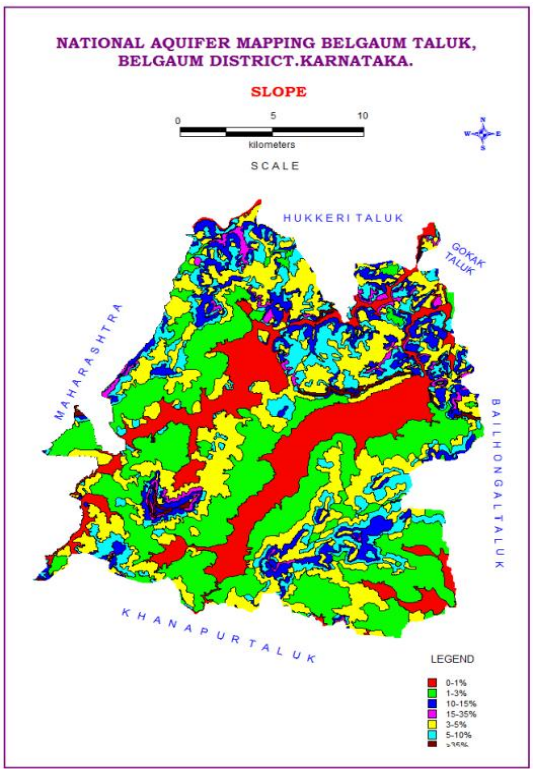


Fig 8: Slope Map

1.7 Ground Water Resource Availability and Extraction

Aquifer wise total ground water resources down to 200 m depth are given in **Table-8.a** below as per 2017 estimations. The details of dynamic (Phreatic) ground water resources are shown in **Table.8.b**

Table 8 a: Total Ground Water Resources, Belagavi taluk (as on March 2017 Figures in 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
Belagavi	7885	2535	1885	12276

Table.8.b Dynamic Ground Water Resource, Belagavi taluk (as on March 2017 Figures in Ham)

Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross GW 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 Develop-ment	Existing Stage of Ground Water Development	Category
7885	3759	754	4513	839	3329	57%	Safe

1.8 Existing and Future Water Demands (as per GWRA-2017 and 2020)

As per the GWRA 2017, the net ground water availability is 7885 ham and the total ground water draft for all uses is 4513 ham with stage of development at 57% and the taluk falls in Safe category. Thus there is further scope for future irrigation development @ 3329 Ham. The domestic (Industrial sector) demand for next 25 years is estimated at 839 Ham.

The details of dynamic (Phreatic) ground water resources for Belagavi taluk as on March 2020 is shown in Table.8.c. It is observed that the stage of ground water extraction is slightly gone down in the taluk from 57 % to 54 % from 2017 to 2020 with an increase in the net ground water availability during 2020 with a figure of 9345.79 Ham.

Table.8.c Detail of Dynamic Ground Water resource, Belagavi taluk, (as on March 2020)

Annual Extractable GW Resource (Ham)	GW Extraction for Irrigation Use (Ham)	GW Extraction for Industrial Use (Ham)	GW Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for for Domestic Use as on 2025 (Ham)	Net GW Availability for future use (Ham)	Stage of GW Extraction (%)	Categorization (Over-Exploited/ Critical/ Semi-critical/ Safe/Saline)
9345.79	4119.41	0.0	894.46	5013.95	965.92	4290.16	53.65	Safe

1.9 Water level behaviour

The depth to water level and water level fluctuation for the year 2019 is given in **Table-9a and 9b r**espectively for Aquifer I an Aquifer II.

Table 9a: Depth to water level and Water level fluctuation, Aquifer – I

Location	May 2019	Nov 2019	Seasonal water level fluctuation
Belgaum	7.57	2.35	5.22
Chandgad	6.98	1.45	5.53
Halaga	8.48	2.18	6.3
Hirebagewadi	Dry	1.69	
Kuduchi	5.65	1.28	4.37
Piranwadi	Dry	2.24	
Sutgatti	16.3	5.26	11.04
Uchagaon	17.6	3.68	13.92
Vantamuri	1.6	GL	1.6
Yamanapur	8.90	4.75	4.15
Khangaon	6.70	1.80	4.9
Sambra	15.15	3.25	11.9
Sulga	10.90	8.35	2.55
Yelebail	Dry	8.60	
Desur	5.80	1.30	4.05
Hindwadi	11.40	4.35	7.05

Table 9b: Depth to water level and Water level fluctuation, Aquifer – II

PZ location	May 2019	Nov 2019	Seasonal water level fluctuation
Belgaum	12.82	8.87	3.95
Kadoli	12.05	1.20	10.85
Halaga	5.25	1.50	3.75
Hirebagewadi	14.70	2.75	11.95

During pre-monsoon, water level map shows that in 10% of the area water level ranges between 2 and 5 mbgl, in 40 % of the area water level ranges between 5 and 10 mbgl and in 50% of the area water level ranges in between 10 and 20 mbgl. During post monsoon, water level map shows that in 70 % of the area water level ranges in between GL and 2mbgl, in 30 % of the area water level ranges in between 2 and 5 mbgl. The seasonal water level fluctuation map shows that in 10% of the area water level fluctuation is in the range of 2 to 4 m and in the remaining area water level fluctuation is in the range of 4 to 8m. The premonsoon, post monsoon and seasonal fluctuation maps are shown in **figure 9, 10 and 11** respectively.

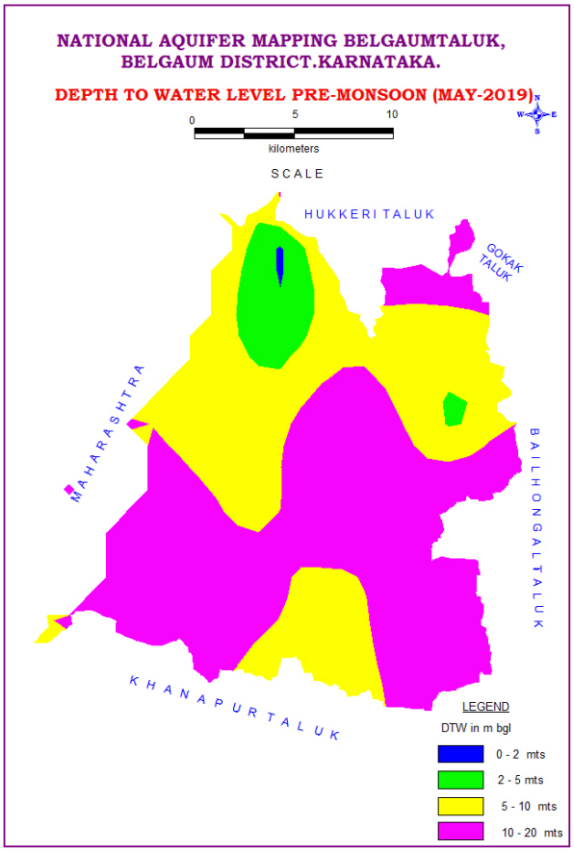


Fig-9: Pre monsoon water level

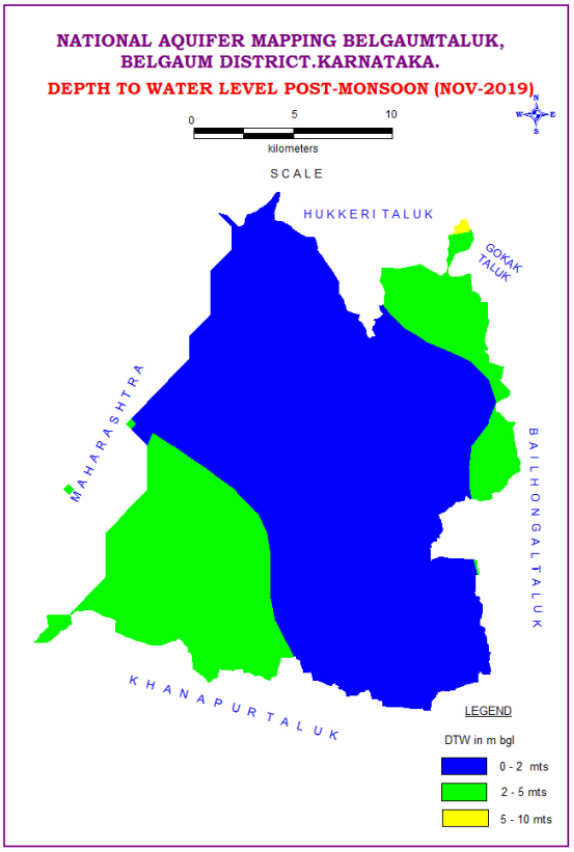


Fig-10: Post monsoon water level

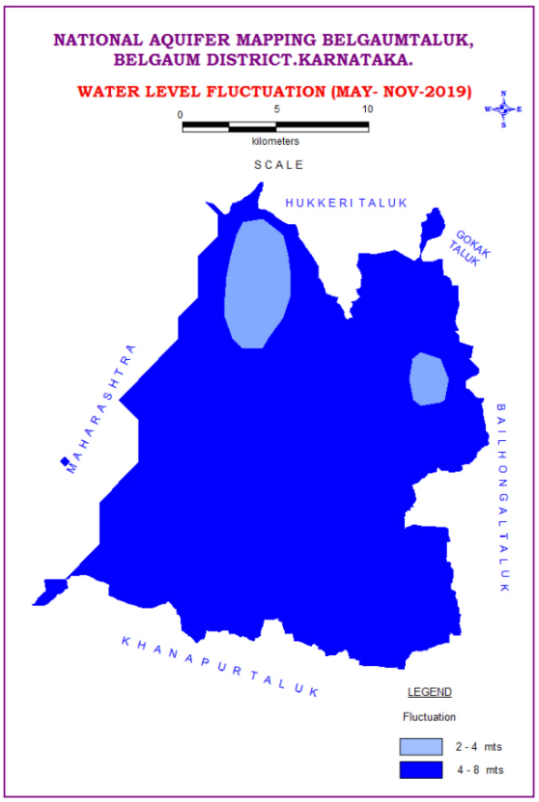


Fig-11: Water level fluctuation

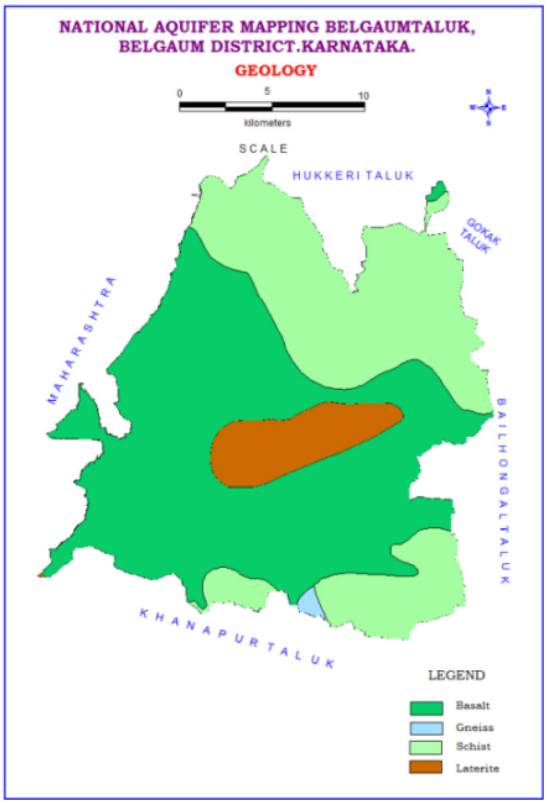


Fig-12: Geology

2 AQUIFER DISPOSITION

The occurrence and movement of water in the subsurface is broadly governed by geological frameworks i.e., nature of rock formations including their porosity (primary and secondary) and permeability. The principal aquifers in the area is Basalt/meta-basalt, sandstone and quartzite and the occurrence and movement of ground water in these rocks is controlled by various factors and it primarily depends on the degree of interconnection of secondary pores/voids developed by fracturing and weathering in the hard rock.

2.1 Aquifer Types

In Belagavi taluk, there are mainly two types of aquifer systems;

- **Aquifer-I (Phreatic aquifer)** comprising Weathered Basalt/meta basalt, sandstone and quartzite.
- **Aquifer-II (Fractured aquifer)** comprising Fractured Basalt/ Metabasalt, sandstone and quartzite.

In **Belagavi taluk**, Basalt/meta-basalt, sandstone and quartzite are the main water bearing formations **(Fig-12).** Ground water occurs within the weathered and fractured Basalt, Meta basalt, Sandstone and Quartzite under water table condition and semi-confined condition. In Belagavi taluk bore wells were drilled from a minimum depth of 40.0mbgl to a maximum of 178 mbgl. The depth of weathered zone (Aquifer-I) ranged from 3.0mbgl to 30.0 mbgl. Ground water exploration reveals that aquifer-II (fractured formation) has been encountered between the depth of 30 and 100mbgl. Yield ranges from 0.5 to 2.0lps.

The details of bore well drilled and the basic characteristics of each aquifer are summarized in **Table-10a and 10b** respectively. The 2D, 3D aquifer disposition and fence diagram are presented in **Fig-13 a and 13 b** respectively.

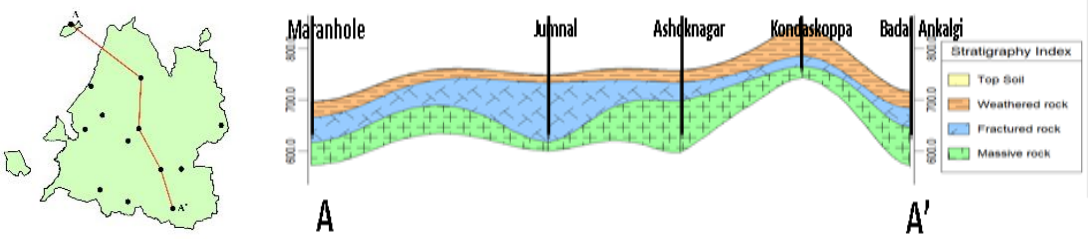
Table 10a: Details of Ground Water Exploration

Location	Depth (m bgl)	Casing depth (m bgl)	Lithology	Most promising water bearing Zones						S.W.L (mbgl)	Discharge (lpm)
				1		2		3			
				From	To	From	To	From	To		
Belgaum	40.65	20.5	Basalt	21.3	22.3					9.17	0.13
Desur	80	14	Arcn, grgn	26	27	36	38	50	51	5.33	0.4
Morihal	36		Arcn, grgn							0	Negl
Asoknagar	177.9	22.8	Phyllites	64	65					6.485	Negl
Agasge	80	18	Basalt	31	32	43	44			33.17	0.5
Kallehol	204.7	18.5	Basalt							>50	V.Poor
Kolikopp	55.9	3	Basalt							46.25	
Mannur	161	24.2	Basalts							22.25	
Jumnal	150.45	14.5	Shale/s.st	137	138					12.42	2.0
Santebastawadi	156.55	32.1	Greywacke							4.97	V.Poor
Baloge	174.85	16.5	Granite	20.3	21.3	64	65			2.11	0.75
Badal Ankalgi	150.55	30.4	Schist	71.3	72.3					21.7	V.Poor

Table 10b: Basic characteristics of the Aquifers

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Basalt, Meta basalt, greywacke and granite	Fractured / Jointed Basalt, Meta basalt, greywacke and granite
Depth range (m bgl)	10 to 30	30 to 180
Depth range of occurrence of fractures (mbgl)	3 to 30 weathered part	30 - 100 90% between 30 - 100
Thickness range (mbgl)	Upto 8 to 10	1.00 to 2.00
Range of yield potential (lps)	Poor yield	0.5 – 2.0
Specific Yield	2%	0.2%

2D AQUIFER DISPOSITION



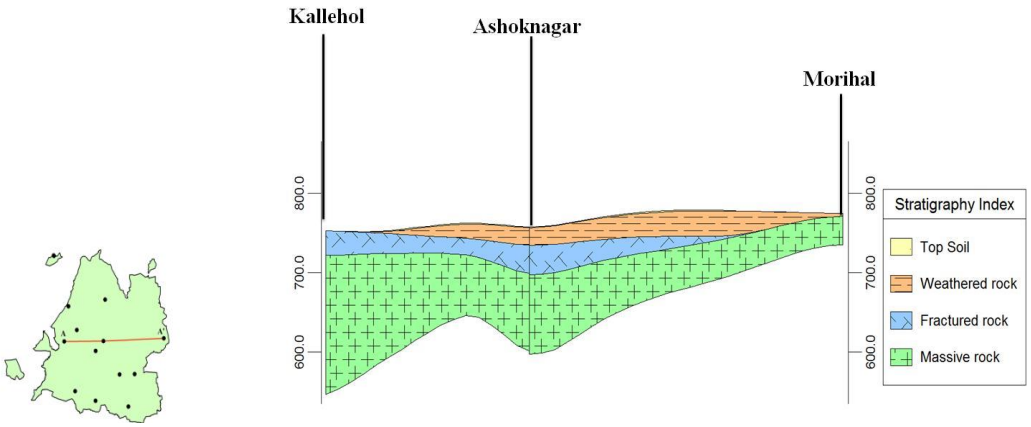
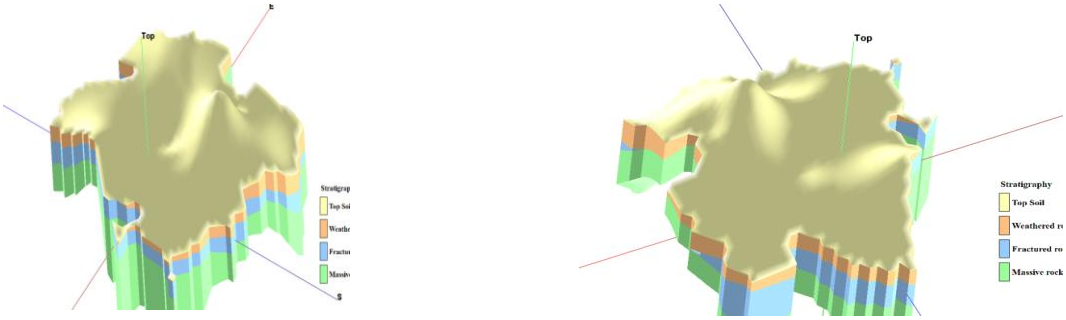


Fig.13a: 2-D Aquifer disposition

3D AQUIFER DISPOSITION



3D FENCE DIAGRAM

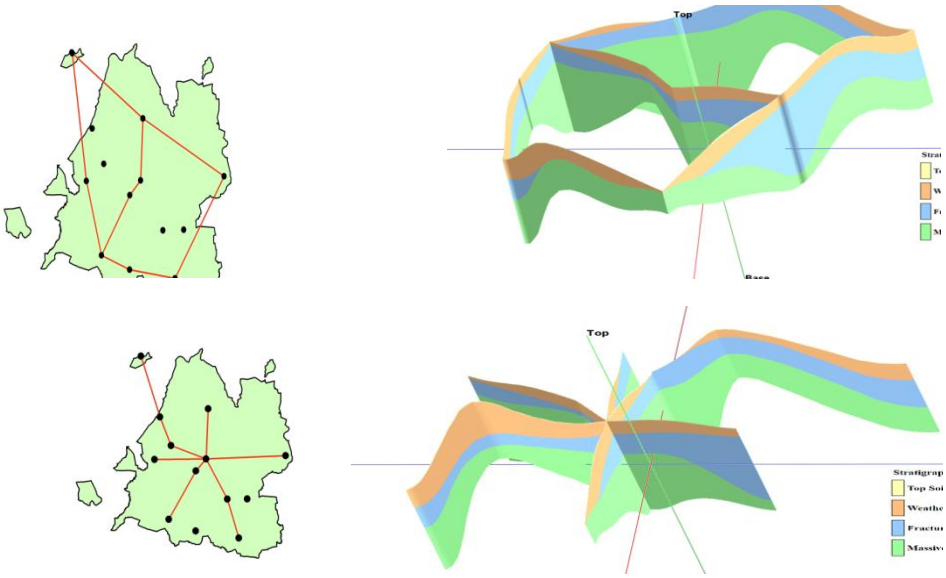


Fig.13 b: 3D Aquifer disposition

3 GROUND WATER RESOURCE, EXTRACTION, CONTAMINATION AND OTHER ISSUES

The main ground water issues are Limited Ground Water Potential / Limited Aquifer Thickness / Sustainability, declining water level trend which are all inter-related or inter dependent and Inferior ground water quality due to nitrate contamination in major part of the area.

3.1 Comparison of Ground Water Resource and Extraction

The Dynamic Ground Water Resource 2017 and as on 2020 have already been summarised above and are shown in Table 8. The comparison of the resource as on 2009, 2011, 2013 and 2017 are summarised below. It is observed that the ground water availability has remained more or less same during the years 2009, 2011 and 2013. However, the same has in improved during 2019. It is attributable to the improvement in the irrigation practice, influence of command area and also due to the water conservation / recharge activities carried out in the taluk by various state govt. and other agencies.

Table – 8: Comparison of ground water availability and draft scenario

GW availability (ham)	GW draft (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 (%)	GW availability (ham)	GW draft (ham)	Stage of GW Development (%)
2009			2011			2013			2017		
6357	4991	79	6390	3691	58	6296	3943	63	7885	3329	57

3.2 Chemical Quality of Ground Water and Contamination

The interpretation from Chemical Analysis results in Belagavi taluk is mentioned as under, whereas the chemical data of aquifer I is given in **Table-11**:

- **Electrical Conductivity:** In general, EC values range from 280 to 1404 µ/mhos/cm at 25^{o}C which are within the permissible limit **(Fig-14).**
- **Chloride:** Chloride concentration in ground water ranges between 39 and 241 mg/l which are within the permissible limit.**(Fig-15).**
- **Nitrate:** Nitrate value ranges from 0 to 80 mg/l in Aquifer –I and major part of the taluk is having nitrate contamination. **(Fig-16)**
- **Fluoride:** Fluoride concentration in ground water ranges between 0.06 – 0.91 mg/l which are within the permissible limit of 1.5 mg/l**(Fig-17).**

Table-11: Chemical data of Aquifer I

Location	pH	EC in µS/cm at 25°C	Cl^-	NO_3	F^-
Piranwadi	7.40	660	167	80	0.36
Prabhunagar	7.05	1404	241	50	0.53
Halaga	7.95	670	98	19	0.33
Belgaum	8.22	550	71	25	0.91
Vantamuri	7.60	360	42	71	0.42
Sutgatti	8.03	580	104	0	0.06
Sulibhavi	8.24	720	92	61	0.43

Kudchi	8.31	630	92	41	0.31
Chandgad	8.17	660	64	12	0.26
Uchagaon	8.52	280	39	23	0.27

Fig-14: Electrical conductivity distribution

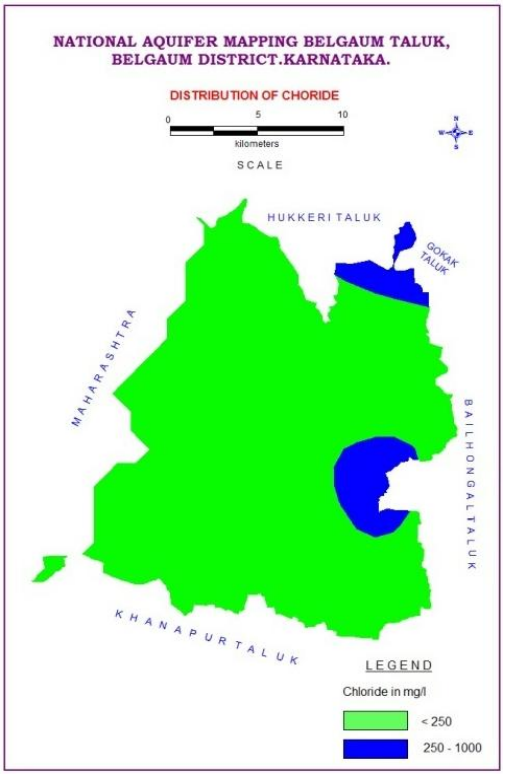


Fig-15: Chloride distribution

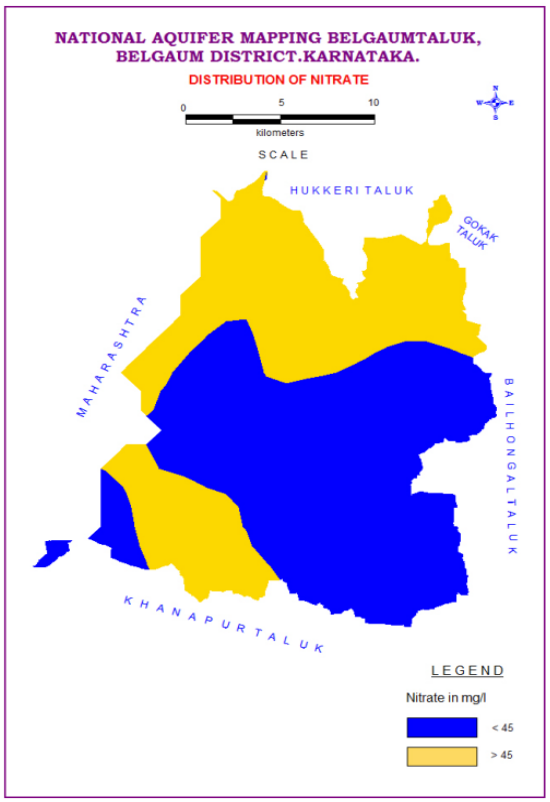


Fig-16: Nitrate distribution

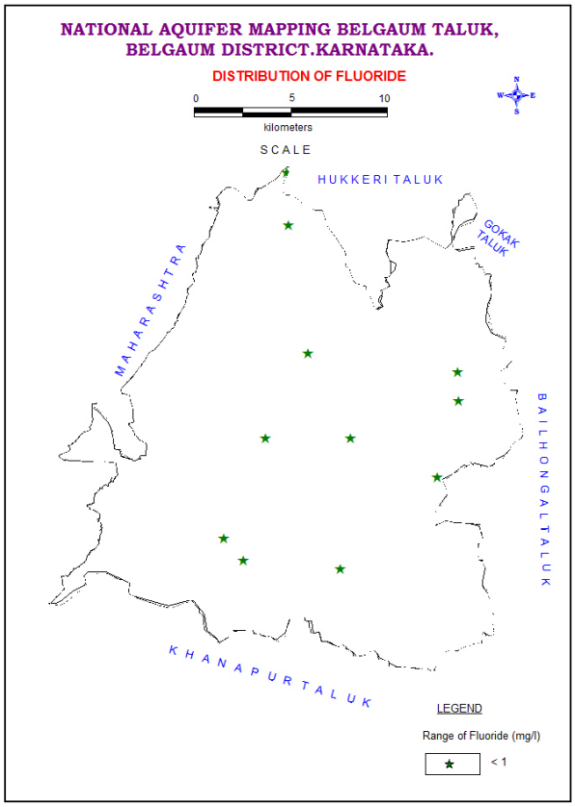


Fig-17: Fluoride distribution

In general, ground water quality in Belagavi taluk is good for drinking purpose except in some areas as depicted in above illustrated maps, where nitrate 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 AND PROPOSED MANGEMENT STRATEGY

4.1 Resource Enhancement by Supply Side Interventions

The overall stage of ground water development is at moderate levels of 57% as per GEC 2017 and 54% as on 2020.. However, the pre-monsoon long term ground water trend shows the declining trend in the range of negligible to 1.28 m/year in 70% of the area where as 30% of the area show rising trend in the range of 0.013 m/year to 0.86 m/ year. During post monsoon, 66% of the area show rise in water level in the range of 0.01m/year to 0.44 m/year and 34% of the area show fall in water level in the range of 0.0071 to 0.23 m/year. During the pre-monsoon(2019) water level in 50% of the area the ranged from 10 to 20 mbgl and in 40% of the area water level ranged between 5 and 10 mbgl. The seasonal water level fluctuation during 2019 in 90% of the area ranged between 4 to 8m.

Considering the long-term water level trend, seasonal water level, seasonal fluctuation and declining trend of annual rainfall till 2018 **(Fig-2),** it is proposed to construct artificial recharge (AR) structures to enhance the ground water resources and to arrest the decline in long term ground water level **(Table-12).** The area feasible for recharge in Belagavi taluk is worked out as 936 sq.km. and the surface surplus non-committed runoff availability is 93.202 MCM, which is considered for planning of AR structures. For this, a total of 2 sub-surface dykes, 82 percolation tank and 393 Check dams are proposed. The volume of water expected to be conserved/recharged @75% efficiency is 69.902 MCM through these AR structures. The approximate cost estimate for construction of these AR structures is Rs. 5618.138 Lakhs. The additional area which can be brought under assured ground water irrigation will be about 0.084 lakh hectares. However, the figures given are tentative and pre-field studies / DPR are recommended prior to implementation of these recharge structures. The area feasible for AR and tentative locations of sites proposed for artificial recharge is shown in **Fig.18.** The tentative list of the proposed Percolation tanks and Check dams are listed **in Annexure-I and II** respectively**.**

Table-12: Details of Proposed AR structures

Geog. Area	Area feasible for AR	No of proposed AR structures			Availability of surface non committed monsoon runoff. (MCM)	Total cost in lakhs	Expected benefits of artificial recharge and RWH	
		Sub surface dyke	Percolation tank	Check dam			Vol. of water likely to be recharged (MCM)	Additional irrigation potential (lakh Hectares)
1037	936	1	19	102	21.408	1418.489	16.05	0.019

Note: The numbers proposed are tentative and actual feasibility studies are required in field to finalize the actual locations for the construction of AR structures.

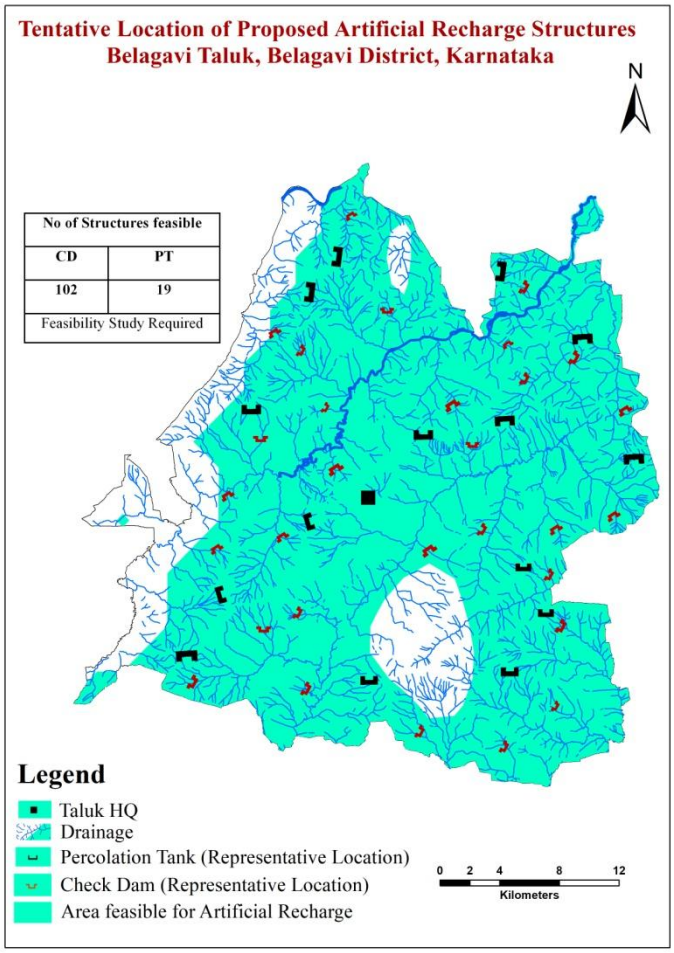


Fig.19 Tentative Locations of AR Structures

4.2 Resource Savings by Demand Side Interventions

4.2.1 Water Use Efficiency by Micro Irrigation Practices

It is observed that wells and bore wells are the source for 5858 ha of net irrigation in the taluk constituting about 88% of the irrigated area. Adoption of water use efficiency (WUE) techniques will contribute in ground water resource enhancement in the long run by way of saving of water. Efficient irrigation practices like Drip irrigation & sprinkler needs to be adopted by the farmers in the existing 5858 ha of net irrigated area by wells & bore wells. At present, the irrigation draft is 4119.41 ham (2020).

The water efficient methodology may be applied for growing sugarcane which is grown in 10% of the cropped area and is largely ground water dependent as compared to the other crops which are mainly grown during kharif. Efficient irrigation techniques will contribute in saving ground water by 1128 ham and thus will improve stage of development appreciably by 12%. In long run the practice of Efficient irrigation techniques will also add to the ground water resource in large extent. **(Table-13).**

Table 13: Improvement in GW availability (2020) due to saving by adopting water use efficiency

Net annual ground water availability	Existing total ground water extraction for all uses	Existing stage of ground water extraction	Saving due to adopting WUE measures	Proposed extraction after adopting WUE	Expected improvement in stage of ground water development after the implementation of the project	Expected improvement in overall stage of ground water extraction (SOE)
HAM	HAM	%	HAM	HAM	%	%
9345.79	5013.95	53.65	1128	3885.95	12	41.57

4.2.2 Change in cropping pattern

Water intensive crops like paddy & sugarcane are grown in 42% and 9% respectively of total cropped area. However, paddy is grown during kharif period and sugarcane grown in 10% of the cropped area. At present, the stage of ground water extraction is moderate @ 53.65% (2020), and adoption of WUE / micro irrigation practices will further bring down the SOE down to 41.57%, thus change in cropping pattern has not been suggested.

4.3 Ground Water Development Plan

In Belagavi taluka, the present stage of ground water extraction (2020) is 53.65% with net ground water availability of 9345.79 ham and total extraction of 5013.95 ham. The ground water draft for irrigation purpose is @ 4119.41 ham, thus there is some scope of increasing the ground water extraction in the area. Also the ground water development is most probably linked to the low ground water potential areas, declining water level trend and limited aquifer thickness in Aquifer-II. To overcome these, it is imperative to have a robust ground water resource development plan for the area. The implementation of the plan needs to based on site specific detailed hydrogeological, geophysical and scientific surveys for pinpointing the sites for construction of dugwells and borewells.

In view of above, the focus of proposed ground water development plan is to up the ante of ground water development from the present 53.65% to 60% within 1 year in a systematic way by adopting scientific approach. About 297 dugwells (15-30 m depth; 3 to 5 m diameter @ Rs. 3.00 lakh/dugwell) are recommended to be constructed in feasible areas. Further 237 borewells (40-100 m depth; 150 mm dia @ Rs. 2.00 lakh/borewell) are also recommended to be drilled in feasible areas. Additional irrigation potential which can be created considering crop water requirement of 0.65 m (Ha) will be 913 ha. The total expenditure proposed to be incurred will Rs. 13.65 Cr. The detailed ground water development strategy to uplift the ground water use in the feasible areas is presented in Table – 14a and 14b.

Table – 14 a: Feasibility of Additional GW abstraction structures based on GWRA 2020 availability

Annual Extractable GW Resource (Ham)	Net GW Availability for future use (Ham)	Stage of GW Extraction (%)	GWR required to take SOE to 60%	Total Extrac-tion / Draft	Balance GWR available to enhance SOE 60%	No. of DW feasible considering 50% of balance GWR with unit draft of 1 ham	No. of BWs feasible considering 50% of balance GWR with unit draft of 1.25 ham

9345.79	4290.16	53.65	5607.47	5013.95	593.52	297	237

Table – 14 b: Ground Water Resource Development Plan as per GWRA 2020 availability

Items	**Proposed Structures**		**Total**
Present GW Availability is 93.45 MCM Present Gross Annual Extraction is 50.13 MCM Present Stage of GW Development is 53.65%	**Dug wells - 297** Depth: 15 to 30 m Dia: 3 to 5 m Cost -Rs. 3.00 lakh, Av. Annual Gross draft - 1.00 ham	**Bore well - 237** Depth: 40 to 100 m Dia – 150 mm Cost -Rs. 2.00 lakh, Av. Annual Gross draft - 1.50 ham	**534**
Total Estimated Expenditure (Rs. in Cr.)	**8.90**	**4.75**	**13.65**
Additional irrigation potential created considering crop water requirement of 0.65 m (Ha)	**457**	**457**	**913**

Note- Hydrogeological and scientific intervention is needed for pinpointing the sites for construction of dugwells and Borewells

4.4 Other interventions proposed

Excess nitrate concentration is found in ground water samples of the area, thereby requiring remedial measures viz.

- Dilution of nitrate rich ground water through artificial recharge & water conservation.
- Roof top rain water harvesting.
- Limited usage of Nitrogenous fertilizers.

5 SUMMARY AND RECOMMENDATIONS

The main ground water issues are Low Ground Water Development, Limited Ground Water Potential / Limited Aquifer Thickness / Sustainability, which are all inter-related or inter dependent and Inferior Ground Water Quality due to nitrate contamination major part of the area. The summary of ground water management plan of Belagavi taluk is given in **Table-15.**

Table 15: Summary of Management plan of Belagavi taluk

Stage of GW Extraction and Category (2020)	53.65%, Safe
Annual Extractable GW Resource (Ham)	9345.79
Total Extraction (Ham)	5013.95
Total GW Resources (Dynamic & Static up to the depth of 200 mbgl) (Ham)	13766
Ground Water Draft for Irrigation (Ham)	4119.41
Ground Water Resource Enhancement by Supply side Interventions	
No of Proposed AR structures SSD PT CD	 1 19 102
Expected Additional Recharge to GW due to AR (Ham)	1605

Additional Irrigation Potential that can be created (Ha)	1900
Total Estimated Expenditure (Rs. in Cr.)	14.18
Change in Stage of GW Extraction (%)	53.65 to 45.78
Ground Water Resource Savings by Demand side Interventions	
Expected Saving due to adopting WUE measures in sugarcane area (Ham)	1128
Change in Stage of GW development (%)	53.65 to 41.57
Ground Water Resource Development Plan	
Balance GWR available to enhance SOE 60% (Ham)	593.52
No. of wells proposed **DW** – Depth: 15 to 30 m, Dia: 3 to 5 m, Unit Cost –Rs. 3.00 lakh, Av. Annual Gross draft – 1.00 ham **BW** – Depth: 40 to 100 m, Dia: 150 mm, Unit Cost – Rs. 2.00 lakh, Av. Annual Gross draft – 1.50 ham	 297 237
Additional irrigation potential created considering crop water requirement of 0.65 m (Ha)	913
Total Estimated Expenditure (Rs. in Cr.)	13.65
Increase in Stage of GW Extraction (%)	53.65 to 60
Ground Water Quality – Nitrate contamination	Improving quality by proper drainage of sewage and Limited usage of Nitrogenous fertilizers

As per the resource estimation – 2020, Belagavi taluk falls under Safe category with the stage of ground water extraction is 53.65%. However, there is need to formulate management strategy to tackle the water scarcity related issues in the taluk in the coming days to avoid water crisis in the future. It is suggested to adopt a scientific and multi-pronged ground water management strategy covering supply side interventions, demand side interventions, ground water development interventions and ground water quality protection aspects as mentioned in the management plan suggested above

Ground water resource enhancement by supply side interventions: Quantity of surface water available through non-committed surface run-off is estimated to be 2140 ham. This can be used to recharge the aquifer mainly through percolation tanks (19), check dams (102) and sub surface dyke structures (1). The volume of water expected to be conserved/recharged @75% efficiency is 1605 ham through these AR structures. The approximate cost estimate for construction of these AR structures is Rs. 14.18 Cr. The additional area which can be brought under assured ground water irrigation will be about 1900 hectares. However, the figures given are tentative and pre-field studies / DPR are recommended prior to implementation of these recharge structures.

Ground water resource enhancement by demand side interventions: At present about 97 % of irrigation is by wells and bore wells (ground water). The micro irrigation practices like drip and sprinkler irrigation are comparatively less practiced in comparison with traditional surface flooding mode of irrigation. The micro irrigation water efficient methodology needs to be adopted for growing water intensive sugarcane crop which is grown in 5985 ha (9%) of the cropped area and is

largely ground water dependent. Efficient irrigation techniques will contribute in saving ground water by 1128 ham and thus will improve stage of development marginally. However, in long run the practice of efficient irrigation techniques will add to the ground water resource in large extent.

Change in cropping pattern: Farmers are facing inadequacy of groundwater for agriculture during summer and can opt for more rain-fed Jowar and water efficient pulses for agricultural production. Vegetables are grown both in khariff and Rabi season in 7087ha (10.86 % of the cropped area) and mostly grown from ground water. As the stage of ground water extraction is moderate, change is cropping pattern is not proposed, however various **WUE** practices need to be adopted vigorously in irrigation sector.

Ground Water Resource Development Plan: The present stage of ground water extraction is 53.65% with net ground water availability of 9345.79 ham and total extraction of 5013.95 ham, with major ground water draft taking place for irrigation purpose @ 4119.41 ham, thus further scope of ground water extraction is present in the area. Also the ground water development is most probably linked to the low ground water potential areas, limited aquifer thickness in Aquifer-II, low sustainability.

The focus of proposed ground water development plan is to up the ante of ground water development from the present 53.65% to 60% in the span of 1 year in a systematic way by adopting scientific approach. About 297 dugwells (15-30 m depth; 3 to 5 m diameter @ Rs. 3.00 lakh/dugwell) are recommended to be constructed in feasible areas. Further 237 borewells (40-100 m depth; 150 mm dia @ Rs. 2.00 lakh/borewell) are also recommended to be drilled in feasible areas. Additional irrigation potential which can be created considering crop water requirement of 0.65 m (Ha) will be 913 ha. The total expenditure proposed to be incurred will Rs. 13.65 Cr. This will bring an additional area of 913 ha under command of ground water irrigation, thereby improving the irrigation potential.

Ground Water Contamination: In view of ground water contamination with higher concentration of Fluoride, EC and Nitrate, identification of contamination free ground water source is essential. Belagavi city area is provided with 15 MGD water from Rakaskoppa and Hidkal dam for drinking water supply through KUWSSB. Other than that, Belagavi city is having plenty of large diameter dug wells which are supplementing the local water requirement. Well known military establishment in Belagavi Marata life infantry area is having several large diameter dug wells such as Ibrahim well, Military Mahadeva well, Nagjeera well full fill the some part of water requirement in the lean period. Outside the military area, renowned congress well-constructed during the freedom struggle to cater during the 'Belgaum Adhiveshan' in 1924, the well in the premises of KPTCL office, well in front of Kaveri cold drinks are in use for localised water supply. Recently, several such well are renovated and put in use for the localised water requirement. For arresting nitrate contamination, proper drainage of sewage and scientific disposal of sewage water by the concerned urban/rural agency needs to be adopted along with limited usage of Nitrogenous fertilizers by farmers to avoid nitrate contamination. All the ground water sources for drinking water supply may be checked for ground water quality parameters as per BIS norms.

WUE in Domestic Sector: WUE practices are the prime management option in domestic sector as well in view of having high density clusters of urban households and establishments. In premium apartments and infrastructure projects, use of three-way line for fresh water, bathroom water and toilet water will enable reuse of grey water for gardening, car washing and flushes etc. The water saver fixtures/ aerators can be used for kitchen & bathroom pipes, bath showers and water free urinals.

Regulation and Control: Taluk is categorised as "Safe". However, the mandatory guidelines like rainwater harvesting and artificial recharge issued by Karnataka Ground Water Authority needs to be strictly implemented to avoid the taluk from deteriorating from safe category to semi critical category in the future.

Other Management Options proposed:

- Secondary or Tertiary treated water from Sewage Treatment Plant (STP) of Belagavi city can be used for filling of tanks after treatment and eliminating industrial effluents. Sewage treatment plants should be installed at various parts of the city before it is discharged to streams and nala to avoid contamination of surface and ground water.
- Continuation of augmenting surface water supply (import) from surface water sources to reduce stress on ground water in urban areas.
- Periodical maintenance of artificial recharge structures is recommended for better recharge and long life of the structure
- RTRWH from each building and in-situ storage and use /mixing with surface water supply or groundwater in urban areas.
- Priority to promote recycle and reuse of treated wastewater effective in urban pockets.

Annexure-I : Tentative Locations of Proposed Percolation tanks, Belgavi Taluk, Belagavi District

S. No	Longitude	Latitude	Village	Grama Panchayat	Taluk
1	74.4526	15.7524	Vaghavade	Waghawade	Belagavi
2	74.5196	15.7588	Sulage U	Sulaga (Y)	Belagavi
3	74.6067	15.7633	Kanavi Kavinakoppa	Kk Koppa	Belagavi
4	74.4054	15.7686	Kiniye	Kinaye	Belagavi
5	74.6294	15.7995	Hulikatte	Aralikatti	Belagavi
6	74.4272	15.809	Bijagarni	Bijagarni	Belagavi
7	74.6142	15.8267	Chandanahosura	Tarihal	Belagavi
8	74.4829	15.8527	Belagaov		Belagavi
9	74.6852	15.8881	Karadigudda	Kardiguddi	Belagavi
10	74.5532	15.9069	Kanabaragi		Belagavi
11	74.6038	15.9123	Asthegi	Ashte	Belagavi
12	74.445	15.921	Gojige	Ambewadi	Belagavi
13	74.6024	15.9498	Bharamehatti	Tummarguddi	Belagavi
14	74.4562	15.9505	Agasage	Agasge	Belagavi
15	74.6523	15.9606	Thummaraguddi	Tummarguddi	Belagavi
16	74.4786	15.9918	Bambarage	Bambarga	Belagavi
17	74.5246	15.9969	Halabhavi	Hosavantamuri	Belagavi
18	74.5981	16.0046	Panagutthi	Rangdolli	Belagavi
19	74.4949	16.0133	Godihala	Bambarga	Belagavi

(Source: Master Plan, CGWB, 2020. It is likely that the number of structures proposed may vary depending upon the ground truth verification and feasibility criteria)

Annexure-II : Tentative Locations of Proposed Check Dams, Belgavi Taluk, Belagavi District

S. No	Longitude	Latitude	Village	Grama Panchayat	Taluk
1	74.6035	15.7173	Badasa (Ka)	Badas (Kh)	Belagavi
2	74.5499	15.7238	Nandhihalli	Nandihalli	Belagavi
3	74.563	15.728	Nandhihalli	Nandihalli	Belagavi
4	74.5216	15.7409	Rajahamsagada	Sulaga (Y)	Belagavi
5	74.6351	15.7414	Bendigeri	Bendigeri	Belagavi
6	74.4647	15.7419	Vaghavade	Waghawade	Belagavi
7	74.617	15.7481	Halagimardi	Kk Koppa	Belagavi
8	74.5035	15.7494	Desura	Desur	Belagavi
9	74.4802	15.7505	Vaghavade	Waghawade	Belagavi
10	74.4335	15.7534	Ranakunde	Kinaye	Belagavi
11	74.4057	15.755	Kiniye	Kinaye	Belagavi
12	74.4986	15.7567	Sulage U	Sulaga (Y)	Belagavi
13	74.6014	15.7578	Halagimardi	Kk Koppa	Belagavi
14	74.5973	15.7584	Kanavi Kavinakoppa	Kk Koppa	Belagavi
15	74.4227	15.7654	Kiniye	Kinaye	Belagavi
16	74.6234	15.7674	Bagewadi	Hirebagewadi	Belagavi
17	74.5079	15.7697	Sulage U	Sulaga (Y)	Belagavi
18	74.587	15.7718	Kanavi Kavinakoppa	Kk Koppa	Belagavi
19	74.6335	15.7767	Bagewadi	Hirebagewadi	Belagavi
20	74.62	15.7794	Siddanabavi	Hirebagewadi	Belagavi
21	74.4534	15.7878	Kattalawadi	Macche	Belagavi
22	74.6504	15.789	Aralikatte	Aralikatti	Belagavi
23	74.6621	15.7894	Aralikatte	Aralikatti	Belagavi
24	74.6393	15.7896	Hulikatte	Aralikatti	Belagavi
25	74.4072	15.7898	Navage	Kinaye	Belagavi
26	74.4397	15.7898	Navage	Kinaye	Belagavi
27	74.6408	15.7946	Basapura	Aralikatti	Belagavi
28	74.5927	15.7953	Kamakarahatti	Bastwad	Belagavi
29	74.4745	15.797	Majje	Macche	Belagavi
30	74.413	15.8011	Navage	Kinaye	Belagavi
31	74.4405	15.8117	Hungarage	Mandoli	Belagavi
32	74.5864	15.8165	Shaganamatte	Mastmardi	Belagavi
33	74.4105	15.8185	Belagundhi	Belagundi	Belagavi
34	74.6313	15.8202	Chandanahosura	Tarihal	Belagavi
35	74.444	15.8247	Hungarage	Mandoli	Belagavi
36	74.6017	15.8307	Masthamardi	Mastmardi	Belagavi
37	74.4248	15.8342	Bokanura	Belagundi	Belagavi
38	74.5569	15.8345	Alaravada		Belagavi
39	74.6075	15.8358	Basarikatte	Mastmardi	Belagavi
40	74.4935	15.8366	Belagaov		Belagavi
41	74.4651	15.8431	Savagaov	Benkanhalli	Belagavi
42	74.4448	15.8447	Savagaov	Benkanhalli	Belagavi

S. No	Longitude	Latitude	Village	Grama Panchayat	Taluk
43	74.59	15.8476	Shindholi	Nilaji	Belagavi
44	74.6366	15.8479	Mavinakatte	BalekundariKh	Belagavi
45	74.4711	15.8528	Benakanahalli	Benkanhalli	Belagavi
46	74.4764	15.8566	Benakanahalli	Benkanhalli	Belagavi
47	74.6724	15.8567	Karadigudda	Kardiguddi	Belagavi
48	74.4298	15.8665	Kallehola	Sulaga (U)	Belagavi
49	74.6333	15.8667	Honnihala	Modaga	Belagavi
50	74.6808	15.8678	Karadigudda	Kardiguddi	Belagavi
51	74.6561	15.8692	Marihala	Marihal	Belagavi
52	74.4993	15.8844	KangaraliKurdha	KangraliKh	Belagavi
53	74.6709	15.8894	Marihala	Marihal	Belagavi
54	74.5585	15.8956	Kanabaragi		Belagavi
55	74.5847	15.8999	Mucchandi	Mucchandi	Belagavi
56	74.6093	15.9021	Asthegi	Ashte	Belagavi
57	74.4511	15.9036	Gojige	Ambewadi	Belagavi
58	74.6174	15.9058	Chandhagada	Ashte	Belagavi
59	74.4335	15.9061	Gojige	Ambewadi	Belagavi
60	74.471	15.9071	Ambewadi	Ambewadi	Belagavi
61	74.6387	15.9144	KhanagaovBudharooka	Sulebhavi	Belagavi
62	74.5561	15.9178	Kanabaragi		Belagavi
63	74.6802	15.9192	Thummaraguddi	Tummarguddi	Belagavi
64	74.4911	15.9215	Kadoli	Kadoli	Belagavi
65	74.607	15.9229	Chandhagada	Ashte	Belagavi
66	74.5717	15.9236	Kanabaragi		Belagavi
67	74.6399	15.9356	Chandhura	Sulebhavi	Belagavi
68	74.5785	15.936	Kanabaragi		Belagavi
69	74.4698	15.9362	Agasage	Agasge	Belagavi
70	74.6641	15.9387	Thummaraguddi	Tummarguddi	Belagavi
71	74.6144	15.9395	Bharamehatti	Tummarguddi	Belagavi
72	74.4614	15.9399	Agasage	Agasge	Belagavi
73	74.5932	15.9479	Bharamehatti	Tummarguddi	Belagavi
74	74.4661	15.9511	Mannikeri	Kednur	Belagavi
75	74.6485	15.9511	Thummaraguddi	Tummarguddi	Belagavi
76	74.4755	15.9558	Kedhakuru	Kednur	Belagavi
77	74.6659	15.9587	Thummaraguddi	Tummarguddi	Belagavi
78	74.6052	15.9604	Nandhi	Rangdolli	Belagavi
79	74.4826	15.9612	Kadoli	Kadoli	Belagavi
80	74.4608	15.967	Hundhiganuru	Handignur	Belagavi
81	74.6366	15.973	Hudli	Hudali	Belagavi
82	74.5105	15.9785	Honaga	Honaga	Belagavi
83	74.5309	15.9815	Heggeri	Honaga	Belagavi
84	74.4944	15.9825	Bambarage	Bambarga	Belagavi
85	74.4856	15.9873	Bambarage	Bambarga	Belagavi

S. No	Longitude	Latitude	Village	Grama Panchayat	Taluk
86	74.4678	15.9881	Kattana Bhavi	Bambarga	Belagavi
87	74.5538	15.989	Heggeri	Honaga	Belagavi
88	74.4678	15.9914	Kattana Bhavi	Bambarga	Belagavi
89	74.4898	15.9923	Bambarage	Bambarga	Belagavi
90	74.6404	15.9925	Malabemardi	Hudali	Belagavi
91	74.6155	15.9949	Panagutthi	Rangdolli	Belagavi
92	74.6551	15.9964	Malabemardi	Hudali	Belagavi
93	74.6101	16.0054	Panagutthi	Rangdolli	Belagavi
94	74.5186	16.0106	Halabhavi	Hosavantamuri	Belagavi
95	74.6037	16.0134	Panagutthi	Rangdolli	Belagavi
96	74.511	16.0145	Ramadurga	Hosavantamuri	Belagavi
97	74.4866	16.0159	Godihala	Bambarga	Belagavi
98	74.5035	16.0212	Ramadurga	Hosavantamuri	Belagavi
99	74.4883	16.0299	Godihala	Bambarga	Belagavi
100	74.5082	16.0365	Suthagatti	Hosavantamuri	Belagavi
101	74.5008	16.0449	Suthagatti	Hosavantamuri	Belagavi
102	74.5155	16.0459	Suthagatti	Hosavantamuri	Belagavi

(Source: Master Plan, CGWB, 2020. It is likely that the number of structures proposed may vary depending upon the ground truth verification and feasibility criteria)