



केन्द्रीय भूमिजल 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

Soraba Taluk, Shimoga District, Karnataka

दक्षिण पश्चिमी क्षेत्र, बेंगलुरु
South Western Region, Bengaluru

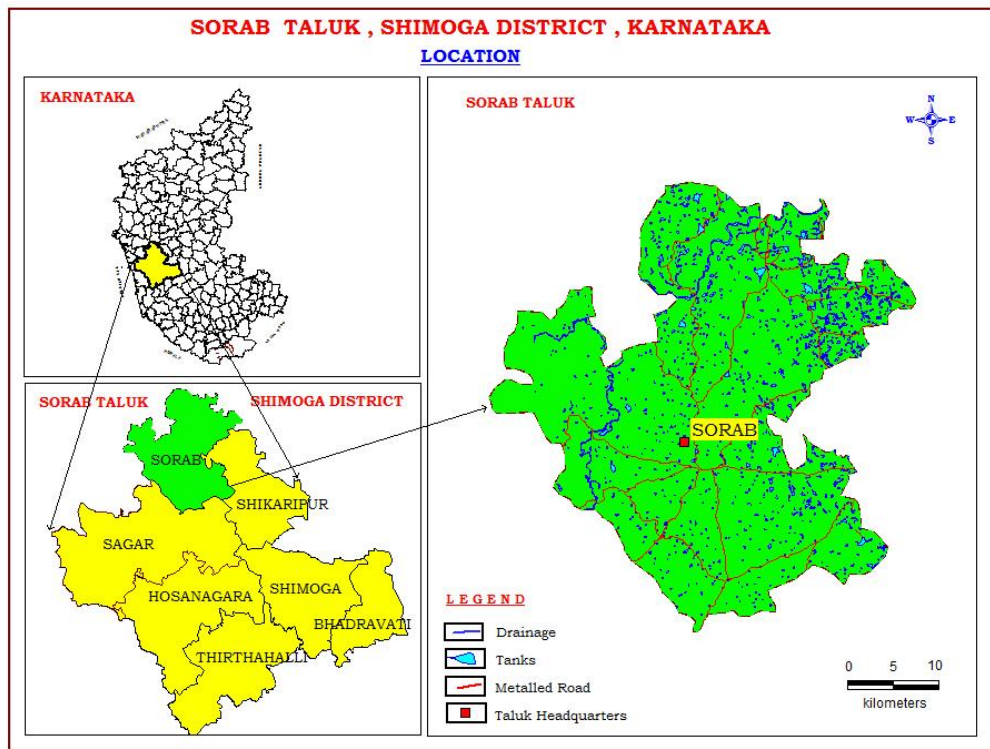
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AQUIFER MAPS AND MANAGEMENT PLAN, SORABA TALUK, SHIMOGA DISTRICT, KARNATAKA STATE

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AQUIFER MAPS AND MANAGEMENT PLAN, SORABA TALUK, SHIMOGA DISTRICT, KARNATAKA STATE

1. INTRODUCTION

National Project on Aquifer Mapping (NAQUIM) initiated by Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India with a vision to identify and map the aquifers at the micro level with their characteristics, to quantify the available groundwater resources, to propose plans appropriate to the scale of demand and institutional arrangements for participatory management in order to formulate a viable strategy for the sustainable development and management of the precious resource which is subjected to depletion and contamination due to indiscriminate development in the recent past.

Groundwater is being increasingly recognized as a dependable source of supply to meet the demands of domestic, irrigation and industrial sectors of the country. The development activities over the years have adversely affected the groundwater regime in many parts of the country. Hence, there is a need for scientific planning in development of groundwater under different hydrogeological situations and to evolve effective management practices with the involvement of community for better groundwater governance.

Aquifer Mapping has been taken up in Shikaripura taluk, Shimogadistrict with a view to formulate strategies for sustainable management plan for the aquifer system in accordance with the nature of the aquifer, the stress on the groundwater resource and prevailing groundwater quality which will help in drinking water security and improved irrigation facility. It will also result in better management of vulnerable areas.

Objectives

The objectives of the aquifer mapping can broadly be stated as:

- To define the aquifer geometry, type of aquifers and their lateral and vertical extent
- To determine the groundwater regime scenario
- To determine the hydrogeochemical characteristics of the aquifer units
- To define 2D and 3-D dispositions of the aquifer units
- To estimate the availability of groundwater resources in the aquifer system
- To develop a sustainable groundwater management plan for the aquifer system

Scope of the Study

The important aspect of the aquifer mapping programme is the synthesis of the large volume of data already generated during specific studies carried out by **Central Ground Water Board (CGWB)** and various Government organizations with a new data set generated that broadly describe the aquifer system. The available generated data are assembled, analyzed, examined, synthesized and interpreted from available sources. These sources are predominantly non-computerized data, which is to be converted into computer based GIS data sets.

Data gaps have been identified after proper synthesis and analysis of the available data collected from different state organizations like GWD, Watershed Department, etc. In order to bridge the data gap, data generation programme has been formulated in an organized way in the study area. Exploration work has been carried out in different segments of the regions and aquifer parameters have been estimated. Groundwater monitoring regime has been strengthened by establishing/adding State agencies additional monitoring wells. 2D and 3D sections have been prepared to bring out more realistic as the data points are more closure to the field.

Ground water Issues in the study area

The main issues pertaining to the Shikaripura taluk is as follows

- About 85% dependency on groundwater for irrigated agriculture
- Lack of surface water resources as alternate water sources
- Source Sustainability for drinking and irrigation, especially in lean periods
- Declining groundwater level trends in wells analyzed tapping phreatic aquifer during pre monsoon period.
- Contamination of Urban areas with municipal waste and sewage

Approach & Methodology

Integrated multi-disciplinary approach involving geological, geophysical, hydrological, hydrogeological and hydrogeochemical components were taken up in 1:50000 scale to meet the objectives of study. Geological map of the study area has been generated based on the GSI maps, geophysical data have been generated through vertical electrical soundings and geoelectrical layers with different resistivity have been interpreted in corroboration with the litho-stratigraphy of the observation wells and exploratory wells down to depths of 250 mbgl. Hydrological and Hydrometeorological data have been collected from Statistical department, Govt of Karnataka. Drainage, Soil and Geomorphology of the taluk were prepared based on the satellite data interpreted by KRSAC.

Based on the data gap analysis, data generation process has been scheduled through establishing key observation wells, integrating Ground Water Directorate (GWD) observation wells, pinpointing exploratory sites for drilling through in-house, collecting geochemical samples in order to study groundwater regime, geometry of the aquifer and aquifer parameters and quality of the groundwater respectively. Groundwater recharge and draft have been computed based on approved guidelines and method to estimate the ground water resources of the aquifer system.

Based on the above studies Management strategies both on the supply side through augmentation of groundwater through artificial recharge and water conservation and on demand side through change in irrigation pattern have been formulated for sustainable management of the groundwater resource.

2. SALIENT INFORMATION

Name of the taluk: **SORABA**

District: **SHIMOGA**; State: **KARNATAKA**

Area: 1139 sq.km.

Population: 2,00,809 (As 2011 census)

Annual Normal Rainfall: 1189 mm

2.1. Study Area

Aquifer mapping studies was carried out in Soraba Taluk, Shimoga district of Karnataka, covering an area of 1139sq.kms under National Aquifer Mapping Project. SORABA TALUK of SHIMOGA district is located between north latitude 14° 13' 16.36" and 14° 39' 14" & east longitude 74° 52' 27" and 75° 17' 49" and is covered in parts of Survey of India Topo sheet Nos. 48J/15, 16, 48N/2,3,4. SORABA TALUK is bounded by Hangal Taluk on north, Sagara Taluk on south, Soraba Taluk on east and Siddapur, Sirsi Taluks on the western side. Location map of Soraba Taluk of Shimoga district is presented in Figure-1. Taluk administration of Soraba Taluk is divided into 6 Hoblies. Soraba town is the Taluk head quarter. There are 281 inhabited and 25 uninhabited villages in the Taluk.

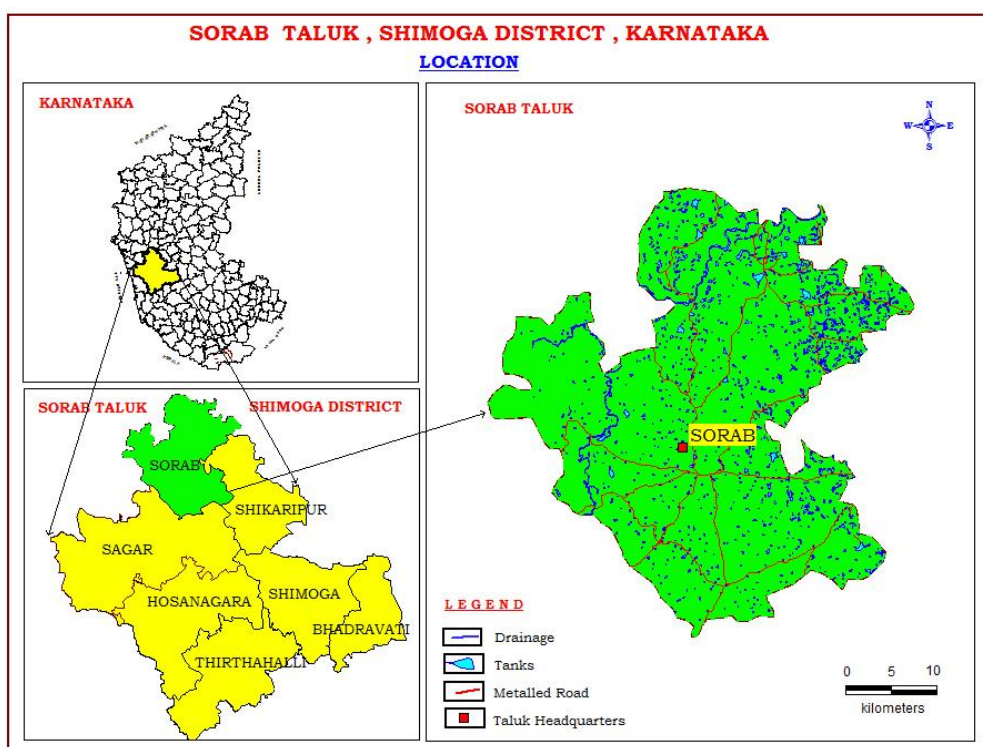


Fig-1: Location map.

2.2. Population

According to 2011 census, the population in the Taluk is 2,00,809, in which 1,89,477 constitute the rural population and 11,302 urban population, which works out to 94 % (rural) and 6 % (urban) of the total population of Taluk. The study area has an overall population density of 175 persons per sq.km. The decadal variation in population from 2001 to 2011 is +8.05 % in Soraba taluk (Table-1).

Table-1: Population details of Soraba 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
200809	101130	99679	11.46	189477	11032	+8.05%	+6.36%	+52.58%

Source: District at a glance 2018-19, Govt. of Karnataka

2.3. Rainfall

Soraba Taluk enjoys semi-arid climate. Dryness and hot weather prevails in major part of the year. The area falls under Southern Transition agro-climatic zone of Karnataka state and. The normal annual rainfall in Soraba Taluk for the period 2001 to 2022 is 1189 mm. 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 10.5% and remaining 6.5% in Pre-Monsoon season (Table-2).

Table-2: Average Rainfall Data of Soraba Taluk, Shimoga district, Karnataka (2001-2018)

STATION	JAN	FEB	MAR	APR	MAY	PRE-MON	JUN	JUL	AUG	SEP	MON	OCT	NOV	DEC	POST-MON
Soraba	1	0	15	33	45	94	229	405	366	129	1129	106	36	2	144

Table-3: The annual rainfall data of Soraba Taluk, Shimoga district, Karnataka (2001-2022)

YEAR	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		
ANN Rainfall	407	1192	1182	1220	1634	1401	2018	1489	1826	1666		
YEAR	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ANN Rainfall	1431	1371	1264	1731	979	989	1080	1304	1792	1534	1811	1908

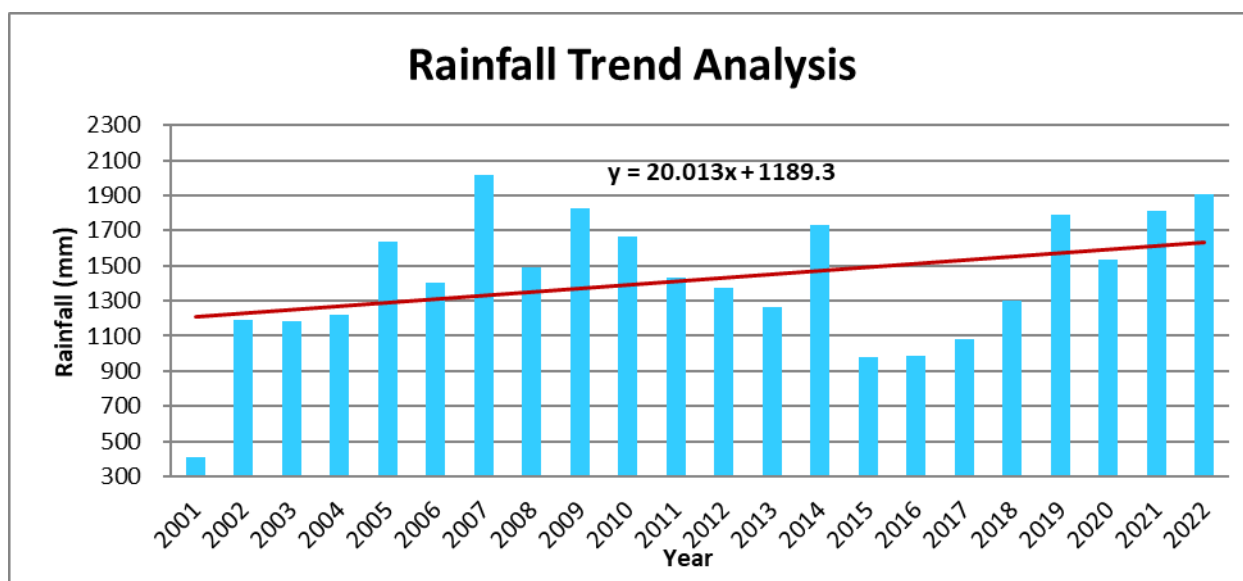


Fig. 2 - Rainfall Trend Analysis

The rainfall pattern in the Soraba Taluk reveals the irregularity of rainfall behaviour (**Fig-2**) and the rainfall varies from 407 mm to 2018 mm (**Table-3**). As mentioned above, the normal annual rainfall of Soraba taluk is 1189mm. Soraba Taluk received rainfall above normal during the years 2004-2014 and 2014 & 2018 to 2022.

2.4. Agriculture & Irrigation

Agriculture is the main occupation in Soraba Taluk. Major Kharif crops are Paddy, Fruits, Cotton & Arecanut. Main crops of Rabi season are Paddy, Maize, vegetables, Oil seeds (Table-4).

Water intensive crops paddy is grown in 46.5% of total crop area. Maize is grown in 33.8%, Arecanutin 11.6%, Fruits in 6.7% and pulses in 0.4% of total crop area of Taluk shown in Table.5.

Table-4: Cropping pattern in Soraba taluk 2017-18 (Ha)

Year	Paddy	Maize	Coconut	Arecanut	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
2017-18	24706	17929	331	6148	228	3549	178	70	83	118

It is observed that the net sown area accounts 41% and area sown more than once is 4% of total geographical area in Soraba taluk. Area not available for cultivation and Forest covers 8% & 23% of total geographical area respectively (Table-5). 63% of net area irrigated is only from bore wells and 18% from tank irrigation (Table-6).

Table-5: Details of land use in Soraba Taluk 2017-18 (Ha)

Taluk	Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
Soraba	114767	26667	9592	6598	47171	5023

Source: District at a glance 2018-19, Govt. of Karnataka

Table-6: Irrigation details in Soraba taluk(in ha)

Source of Irrigation	Net area irrigated (Ha.)	% of area
Canals	0	0
Tanks	16584	61
Wells	350	1
Bore wells	9519	35
Lift Irrigation	80	0
Other Sources	579	2
Total	27112	

Source: District at a glance 2018-19, Govt. of Karnataka

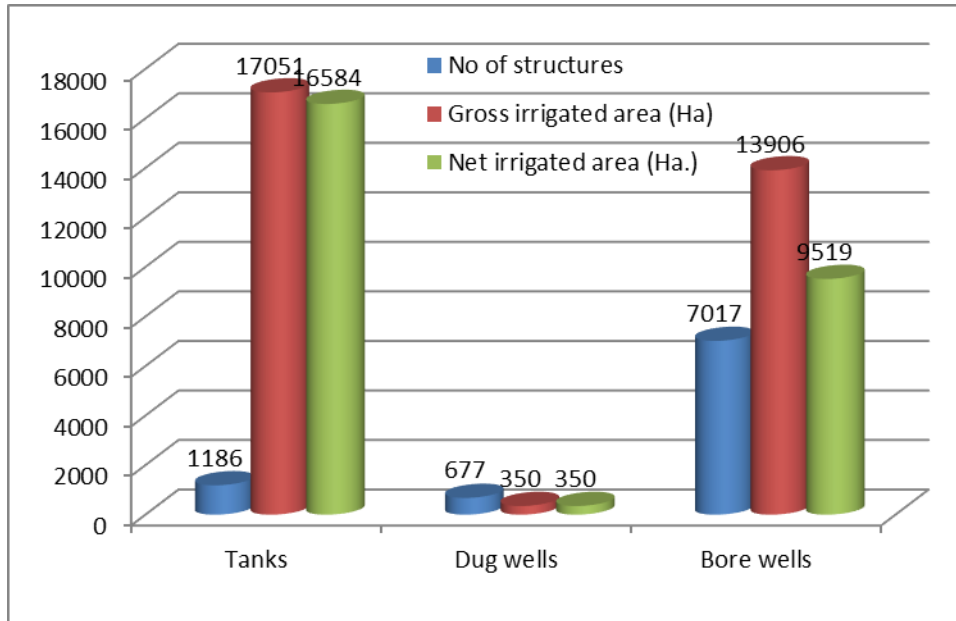


Fig.3. Irrigation source in Soraba taluk, Shimoga district

2.5. Geomorphology, Physiography & Drainage

The general land elevation on the Northeastern side of the Taluk is about 560 m amsl and increases to 600 m amsl in the Southwest. The general slope is mostly towards SW to NE (Fig.-4).

The Taluk is drained by 1st to 4th order streams which flow towards North and east wards. The Kumadvathi River flowing through the center of taluk in SW-NE direction. The tank system is well developed in the Taluk. The general drainage pattern is dendritic to sub-dendritic in nature and mostly joins Kumadvathi River (Fig.-5), which is the tributary of Tungabhadra River.

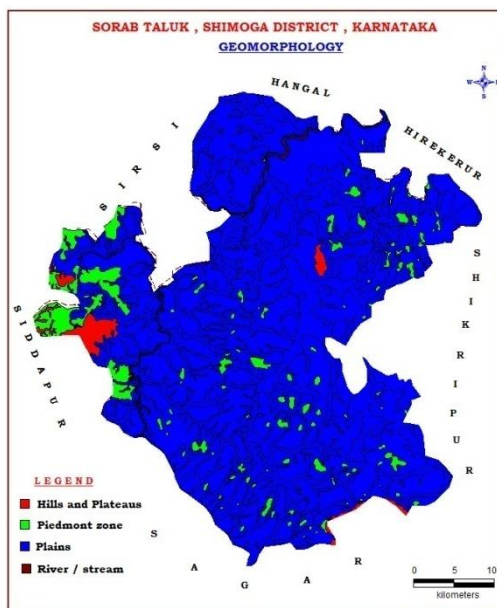


Fig.4. Geomorphology map

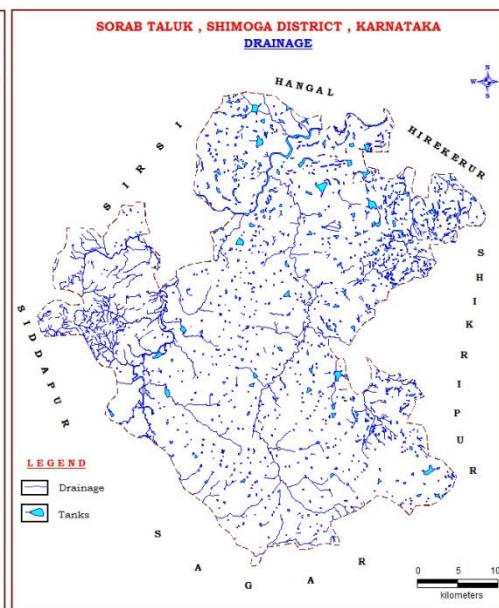


Fig.5. Drainage map

2.6. Soil

In general, the Taluk is covered by clay skeltal soil. Patches of clay loamy soil are also found at places. The clay skeltalsoil in general derive from Schist. **Black cotton** soils are derived from Gnessisin Fig.6.

The land use map of the taluk is shown in Fig.7. Major part of the taluk is covered by Forest and followed by Agriculture activity.

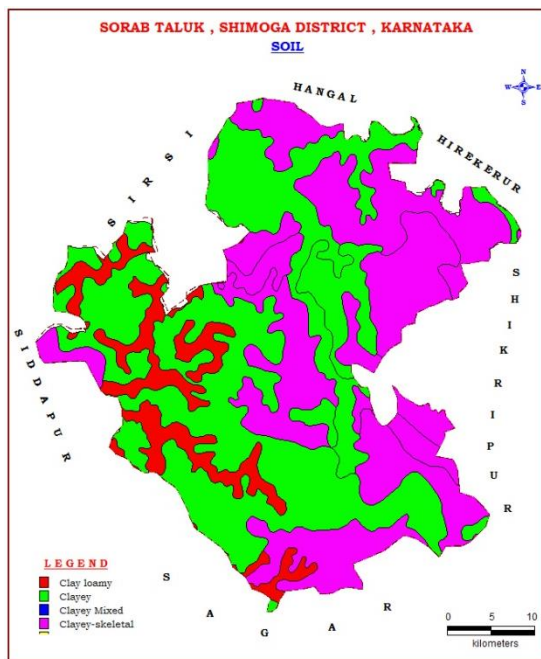


Fig-6: Soil Map

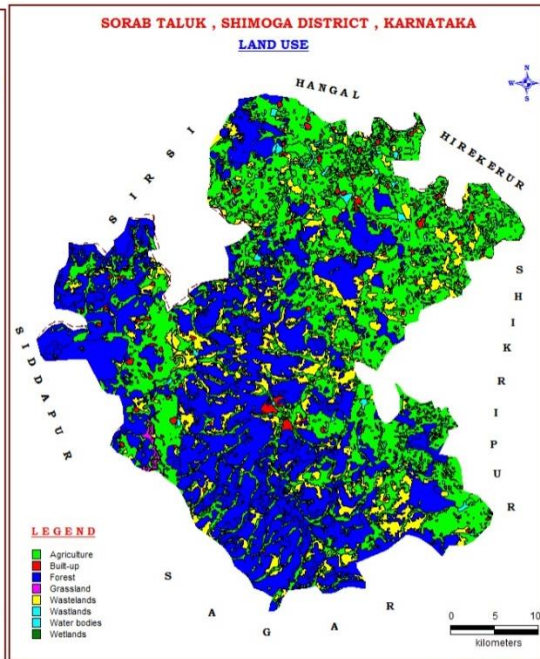


Fig-7: Land use Map

2.7. Ground water resource availability and extraction

Aquifer wise total ground water resources up to 200 m depth is given in Table-7 below.

Table-7: Total Ground Water Resources (2022) (Ham)

Taluk	Annual replenishable GW resources	Fresh In-storage GW resources	Total availability of fresh GW resources
SORABA	14645	0	14645

2.8. Existing and future water demands (as per GEC-2022)

- Net Annual Ground Water Availability for Future Use (ham): 6728.23
- Ground Water Resource for Domestic Utilisation for projected year 2025 (ham): 494.48

2.9. Water level behavior

(a). **Depth to water level:** The depth to water levels of Aquifer-I in Pre-monsoon are in the range from 1.60 to 16.16 m (Fig.8), in Post-monsoon are from 3.11 to 13.00 m (Fig.9) and of Aquifer-II in Pre-monsoon are in the range from 5 to 13.80 m (Fig.10), in Post-monsoon are from 2.72 to 11.90 m (Fig.11). The depth to water level data is shown in **Table.8**

(b). **Seasonal Fluctuation:** The seasonal fluctuation in Aquifer-I is from -5.52 to 3.25m (Fig.12) and in Aquifer-II is from -0.3 to 7.6m (Fig.13)

(c). **Decadal Average water level:** The decadal average water level of Pre-monsoon are in the range from 7.11 to 18.34 m and Post-monsoon from 4.12 to 13.01m. Shown in table.9

Table-8: Depth to water level for pre-monsoon and post-monsoon

S.No	LOCATION	Pre-monsoon May-22	Post-monsoon Nov-22	Fluctuation
Aquifer-I				
1	Anavatti	4.76	3.11	1.65
2	Ankaravalli	13.45	13.00	0.45
3	Chandraguthi	4.40	4.85	-0.45
4	Hosabale	7.71	7.08	0.63
5	Hosabale	8.00	10.10	-2.10
6	M.Lingadalli	8.86	6.90	1.96
7	Shivapura	1.60	7.10	-5.50
8	Sorab	16.16	12.91	3.25
9	Ulavi	4.15	3.69	0.46
Aquifer-II				
10	Anavatti1	7.86	2.72	5.14
11	Agasanahalli	7.8	5.3	2.5
12	Anavatti	7.5	6.4	1.1
13	Hunasavalli	12.3	8.2	4.1
14	Joladagudde	5	5.3	-0.3
15	Kuppagadde	10.6	6.8	3.8
16	Sorab	10.4	3.6	6.8
17	Ulavi	10.8	3.2	7.6
18	Yelasi	13.8	11.9	1.9

Table.09. Decadal Average depth to water level of Pre & Post-monsoon

Location	Lattitude	Longitude	2012-21 Mean (Pre-monsoon)	2012-21 Mean(Post-monsoon)
Anavatti	14.5667	75.1417	9.04	4.47
Chandraguthi	14.4333	74.9508	7.61	4.12
Hosabale	14.3250	75.0500	7.11	5.29
MadsurLingadalli	14.2089	75.0831	12.62	7.47
Sorab	14.3667	75.1000	18.34	13.01

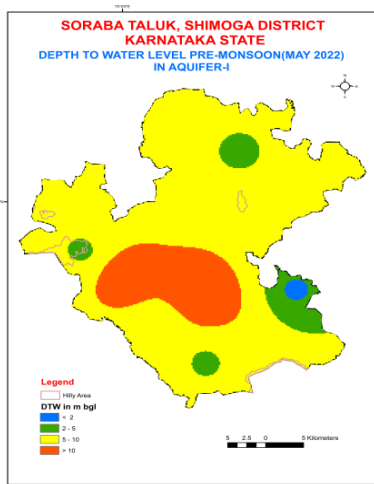


Fig.8.Pre -monsoon DTW of Aq-I

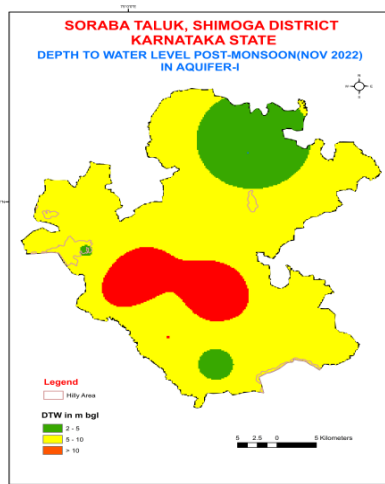


Fig.9.Post-monsoon DTW of Aq-I

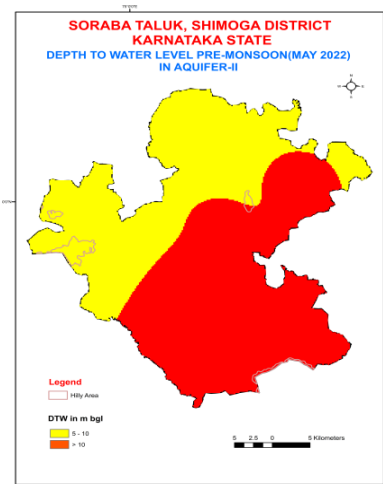


Fig.10.Pre-monsoon DTW of Aq-II

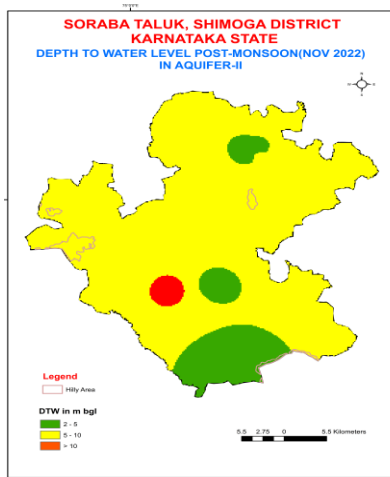


Fig.11. Post-monsoon DTW of Aq-II

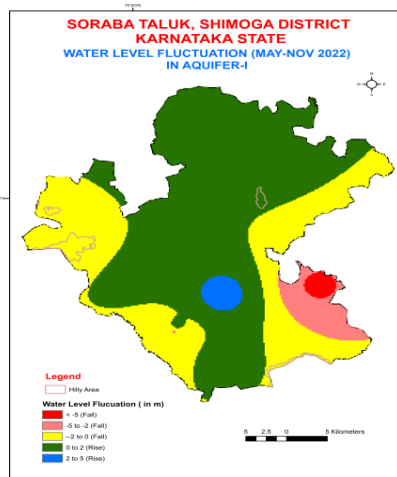


Fig.12. Water Level fluctuation of Aq-I

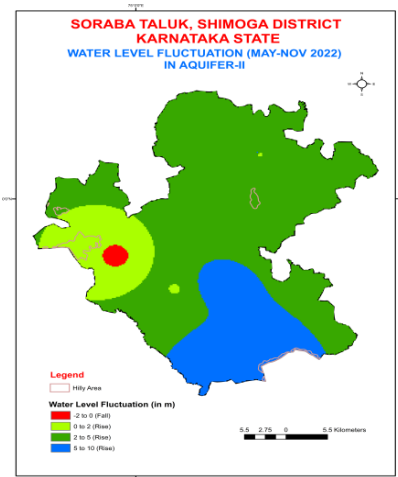


Fig.13. Water Level fluctuation of Aq-II

3. AQUIFER DISPOSITION

3.1. Number of aquifers: In Soraba taluk, there are mainly two types of aquifer systems;

- I. Aquifer-I (Phreatic aquifer) Weathered Schist & Banded Gneiss
- II. Aquifer-II (Fractured aquifer) Fractured Schist & Banded Gneiss

In Soraba taluk, Fractured Schist & Banded Gneiss is the main water bearing formations.

Ground water occurs within the weathered and fractured Schist & Banded Gneiss under water table condition and semi-confined condition. In the Taluk, bore wells were drilled from a minimum depth of 80 mbgl to a maximum of 190 mbgl (Table-10a&b). Depth of weathered zone (Aquifer-I) ranges from 16 mbgl to 48 mbgl (Fig.14). Ground water exploration reveals that aquifer-II fractured formation was encountered between the depths of 23 to 185 mbgl. Yield ranges from 0.9 to 6.18 lps (Fig.15). Transmissivity ranges from 16.8 to 58m²/day (Table-11).

Depth wise Aquifer System:

The data generated from ground water monitoring wells, micro level hydrogeological inventories, exploratory and observation wells, various thematic layers were utilized to decipher the aquifer disposition of the area. In the Taluk, if we consider the vertical distribution of aquifer, two types of aquifer system are observed i.e., Aquifer – I which is a shallow phreatic aquifer and Aquifer – II which constitutes the deeper fractured aquifer.

a) Aquifer-I (Shallow Phreatic aquifer)

Aquifer – I comprises of weathered schist and weathered Banded Gneissic Complex. The spatial distribution of depth of occurrence and aquifer thickness of Aquifer-I is depicted in **Fig. 14A**. It indicates that the depth of occurrence of aquifer – I ranges from 16 to 48 m bgl. However, it mainly occurs in the depth range of 16 to 30 m bgl covering about 10% of the area in South-West part of the Taluk. The depth of occurrence of 30 to 60 m bgl is observed more than 90% of area majority of the taluk

b) Aquifer-II (Deeper Fractured aquifer)

It comprises of fractured Banded Gneissic Complex and Schistose rock. The spatial distribution of depth of occurrence and aquifer thickness of Aquifer-II is depicted in **Fig. 19B**. It indicates that the depth of occurrence of aquifer – II ranges from 47 to 185 m bgl. However, it mainly occurs in the depth range of 50 to 100 m bgl covering 90% of the area mainly throughout the taluk. The depth of occurrence of 100 to 200 m bgl is observed in about 10% of area in western parts. The perusal of the map for fractured aquifer thickness indicates that it ranges from 3 to 19 m, however, the aquifer thickness of 2.5 to 5 m is observed in 20% of the area covering south-west & Eastern parts aquifer thickness of 5 to 7.5 m is observed in about 60% of the area covering at North, Centre & East of the

taluk. 7.5 to 10 m thickness is observed in 5% of the area in western part of the taluk. The higher fractured aquifer thickness of 10 to 20 m is observed only in 15% area in western part of the taluk.

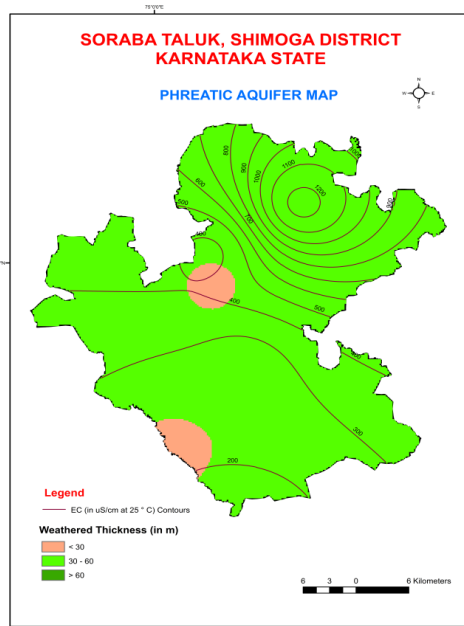


Fig.14A. Phreatic Aquifer map

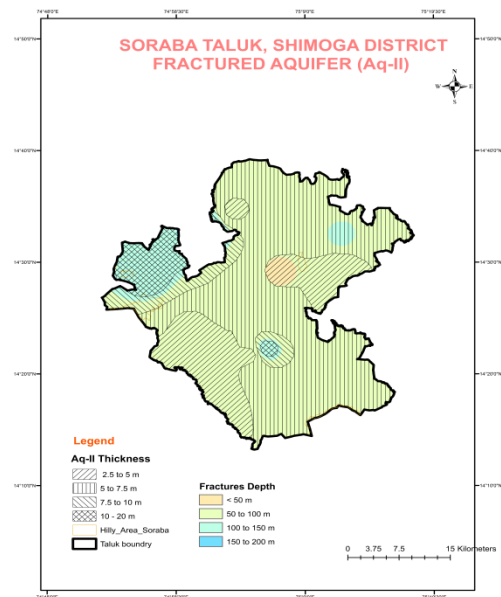


Fig.14B. Fractured Aquifer map

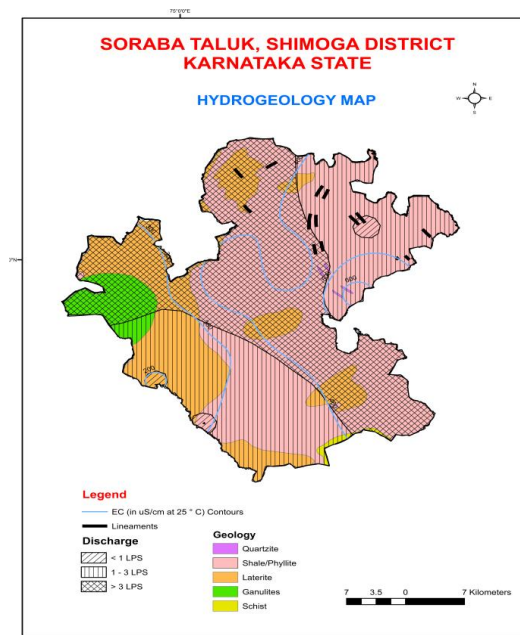


Fig.15. Hydrogeology map

Table-10a: Details of Ground Water Exploration

SI No.	Location	Latitude	Longitude	Depth drilled (mbgl) / Casing (m)	Lithology	Fracture Zones encountered (mbgl)	SWL (mbgl)	Discharge (lps)	Drow down (m)	T (m ² /day)
1	Soraba EW	14.370833	75.098611	129.1 & 35.75	Greywacke	34,48,55,90,97,125	8.34	5.95	5.93	44.8
2	Soraba OW1	14.370833	75.098611	126 & 48.30	Greywacke	23,31,55,81,90,93,107,123	8.09	6.18	3.85	39
3	Soraba OW2	14.370833	75.098611	145.4 & 40.5	Greywacke	37.55.68,119	9	4.4	7.82	58
4	Samanavalli	14.544444	75.004167	147.45 & 34.30	Greywacke	37,86,89,137,154,185	5.88	2.97	16.31	16.8
5	Jade	14.577778	75.054167	190.10 & 25.72	Amphibolite	25,48,52,66,69,70	11.9	0.977	-	
6	Mugur	14.598611	75.118056	77.25	Greywacke					

Table.10b. Well inventory data

Village	Latitude	Longitude	Total depth	Casing depth	Fractures depth
Erakasavi	14.350390	75.234592	133	45	66
Dugur	14.255680	75.102308	133	50	60,100
BadadaBylu	14.348466	74.975220	230	30	57,60
Tandigere	14.370199	75.030973	100	33	53
Ankaravalli	14.406172	74.993592	133	40	37,50,66
Horabile	14.476315	74.937173	175	35	30,100,120
Kereguppa	14.470277	75.058023	100	22	40,66
Kuppegadda	14.486324	75.115450	80	30	35
Annekoppa	14.540258	75.197956	120	35	106
GudiginaKoppa	14.455675	75.187728	133	33	40,53
Kummuru	14.414874	75.120790	150	35	60
Nadahalli	14.361927	75.074976	162	47	66
Magadi	14.294019	75.025533	133	16	35,50,66

Table-11: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Weathered Schist & BGC	Fractured Schist & BGC
Thickness range (mbgl)	16-48	Fractures upto 185 mbgl
Depth range of occurrence of fractures (mbgl)	-	47-185
Range of yield potential (lps)	Poor yield	0.9 to 6.18
T (m ² /day)	-	16.8 to 58
Quality Suitability for Domestic & Irrigation	Suitable	Suitable

3.2. 3-D aquifer disposition and Cross-Sections

3.2.1. Aquifer disposition – Rockworks output

Sub-surface aquifer disposition are prepared based upon the outcome of ground exploration programme. Mainly, four zones are categorized namely Top soil, Weathered, Fractured and Massive zones. These zones are represented using rockworks to depict the subsurface sections and models and presented in **Fig.-16, Fig.-17 and Fig.18.**

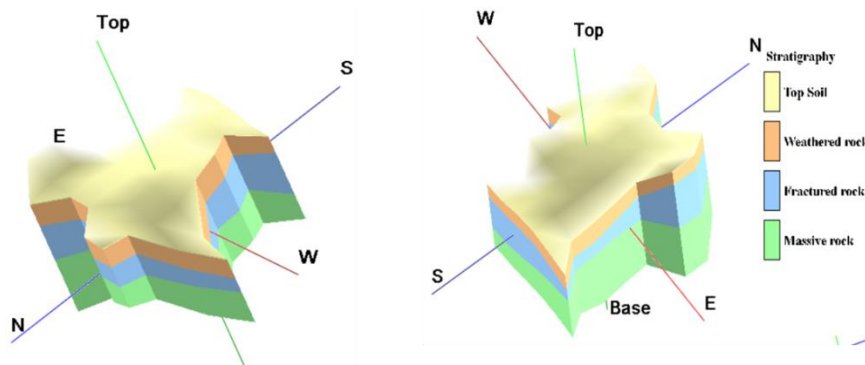


Fig. 16. Sub-surface 3D model view of Soraba taluk

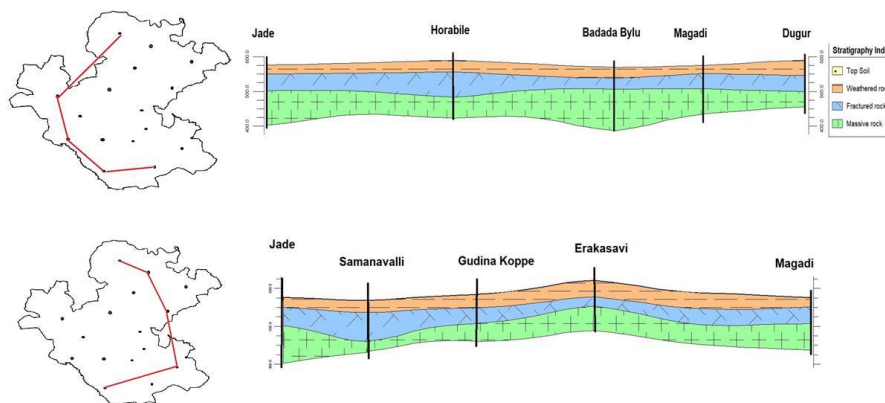


Fig-17: Cross sections in different directions

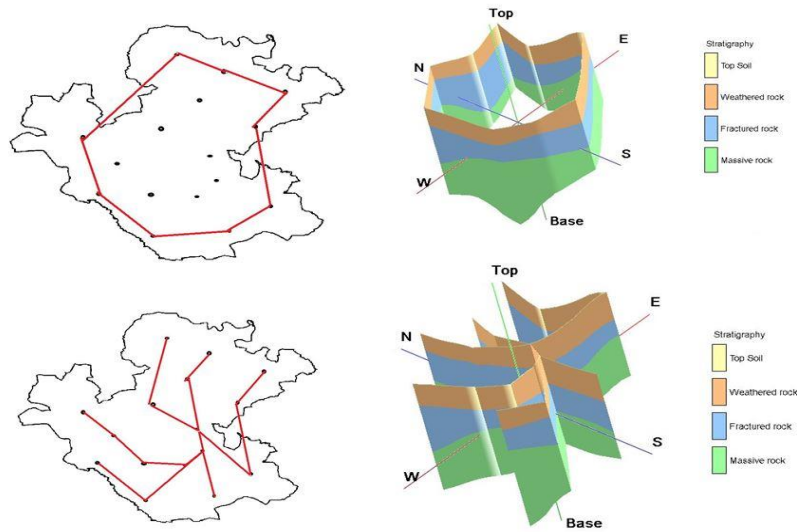


Fig-18: Fence in different directions

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

4.1. Aquifer wise resource availability and extraction

Table.12: Present Dynamic Ground Water Resource of Soraba taluk (2022)

Annual extractable ground water resources (ham)	Existing gross ground water draft for irrigation (ham)	Existing gross ground water draft for industrial water supply (ham)	Existing gross ground water draft for domestic water supply (ham)	Existing gross ground water extraction for all uses (ham)	Allocation of Ground Water Resource for Domestic Utilisation for projected year 2025 (ham)	Net ground water availability for future irrigation development (ham)	Existing stage of ground water extraction (%)	Category
14645.92	7423.2	0.00	470.32	7893.52	494.98	6728.23	53.90	safe

Table.13: Comparison of ground water availability and draft scenario in Soraba 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 (%)
	2017			2020			2022		
Soraba	9637	6404	66.44	13391	7290	54.44	14646	7893	53.90

It is seen that the stage of ground water extraction is improved in the taluk in comparison with 2017. However, with respect to 2017 estimations, there is an decrease of 10% in the stage of ground water development i.e.,66 to 54% though the taluk is categorized as “Safe”.

4.2. Chemical quality of ground water and contamination

Interpretation from Chemical Analysis results in Sorabtaluk is mentioned as under and the data is shown in Table.14.

- **ELECTRICAL CONDUCTIVITY:** In general, EC values range from 110 to 1230 μ /mhos/cm in the aquifer-I at 25°C (Fig.19).and range from 190 to 630 μ /mhos/cm in the aquifer-II (Fig.20).
- **CHLORIDE:** Chloride concentration in ground water ranges between 11 and 118 mg/l in the aquifer-I (Fig.21).and ranges between 11 and 124 mg/l in the aquifer-II (Fig.22).
- **NITRATE:** Nitrate concentration in ground water ranges from 2 and 23 mg/l in the Aquifer–I (Fig.23).and ranges from 0 and 13 mg/l in the Aquifer –II(Fig.24).
- **FLUORIDE:** Fluoride concentration in ground water ranges between 0.07 and 0.62 mg/l in the aquifer-I and ranges between 0.02 and 0.12 mg/l in the aquifer-II (Fig.25).

Table-14: Quality of ground water in Soraba taluk of Shimoga district.

S. No.	Location	EC (mg/L)	Cl (mg/L)	NO3 (mg/L)	F (mg/L)
Aquifer-I					
1.	Anavatti	1230	188	7	0.62
2.	Ankaravalli	190	14	6	0.19
3.	Chandraguti	360	57	20	0.18
4.	Hosabale	200	32	10	0.08
5.	Jaddihalli	380	35	23	0.45
6.	MadsurLingadalli	110	11	2	0.07
7.	Sorab	250	21	13	0.26
Aquifer-II					
8.	Ankaravalli	250	11	1	0.02
9.	BadadaBylu	190	11	0	0.03
10.	Erakasavi	460	71	13	0.12
11.	GudiginaKoppa	630	124	11	0.03

12.	Horabile	200	18	5	0.10
13.	Kereguppa	490	50	13	0.07
14.	Kummuru	500	64	9	0.15
15.	Kuppegadda	350	50	13	0.02
16.	Nadahalli	320	14	1	0.03
17.	Tandigere	260	21	1	0.02

In general, ground water quality in Soraba taluk is good for drinking purpose as per “Indian Standard Drinking Water Specification 2012”. Ground water samples have also been tested and found suitable for agriculture & irrigation purposes in entire part of the taluk, where EC is less than 750 μ /mhos/cm.

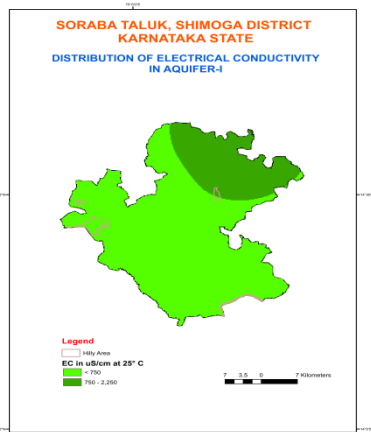


Fig.19. Distribution of EC in Aq-I

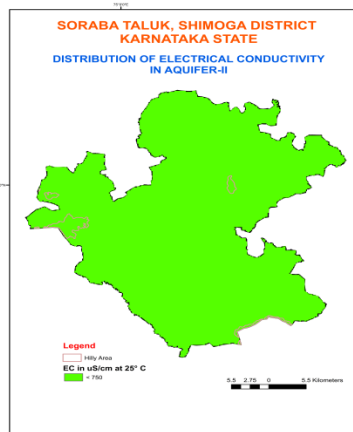


Fig.20. Distribution of EC in Aq-II

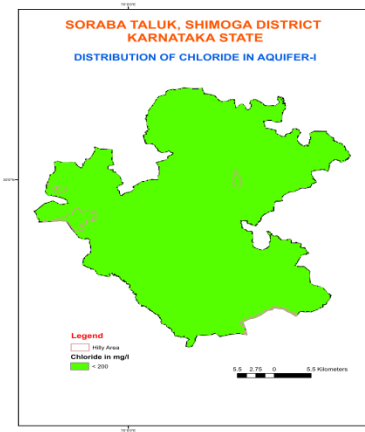


Fig.21. Distribution of Cl in Aq-I

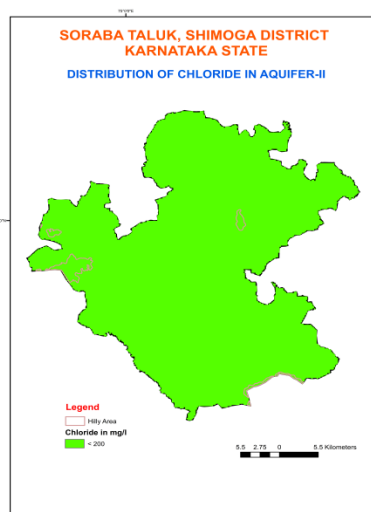


Fig.22. Distribution of Cl in Aq-II

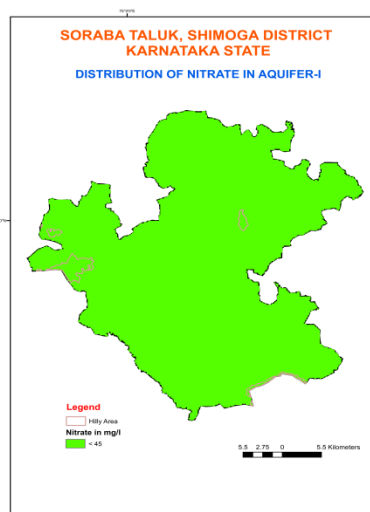


Fig.23. Distribution of NO₃ in Aq-I

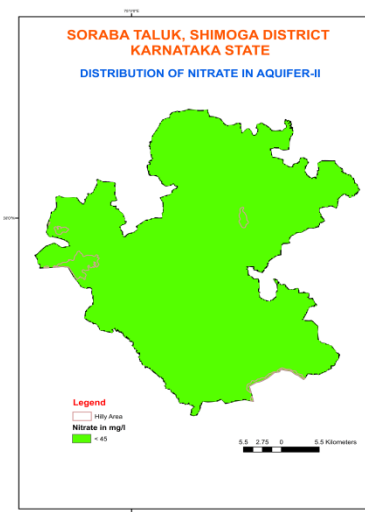


Fig.24. Distribution of NO₃ in Aq-II

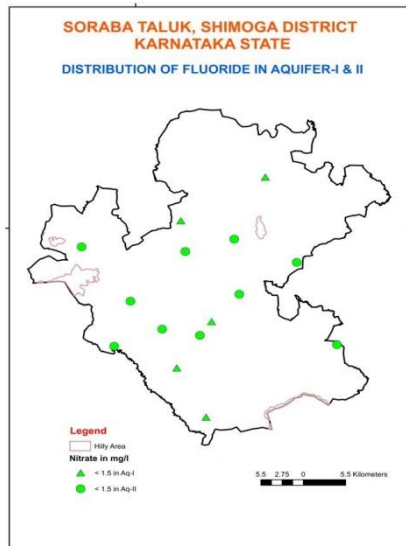


Fig.25. Distribution of F inAq-I &II.

5. GROUND WATER MANAGEMENT PLAN

5.1. Resource Enhancement by Supply Side Interventions

Recharge to dry **phreatic aquifer zone (Aq-I)** through construction of artificial recharge structures, viz; check dams, percolation tanks & Sub surface dyke (**Table-15**) is recommended. 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.

In Soraba taluk, 1104 sq.km area is feasible for recharge and the surface surplus non-committed runoff availability is 149.784 MCM, which is considered for planning of AR structures. For this, a total of 4 sub-surface dykes, 135 percolation tanks, 32 filterbedsand 794 Check dams are proposed. The volume of water expected to be conserved/recharged @75% efficiency is 112.338 MCM through these AR structures. The approximate cost estimate for construction of these AR structures is Rs. 107.62 Cr. The additional area which can be brought under assured ground water irrigation will be about 13500 hectares. However, the figures given are tentative locations (annexure 1A & B) and pre-field studies / DPR are recommended prior to implementation of these recharge structures (Fig.26).

Table-15: Quantity of non-committed surface runoff & expected recharge through AR structures

Artificial Recharge Structures Proposed	Soraba taluk
Area feasible for artificial recharge (sq.km)	1104
Non committed monsoon runoff available (MCM)	149.784
Total no. of existing artificial recharge structures	9
Number of Check Dams proposed	794
Number of Percolation Tanks proposed	135

Number of Filter beds proposed	32
Number of Sub surface dyke proposed	4
Tentative total cost of the project (Rs. in Cr)	107.62
Excepted recharge (MCM)	26.53
Additional irrigation potential (Hectares)	112.338

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

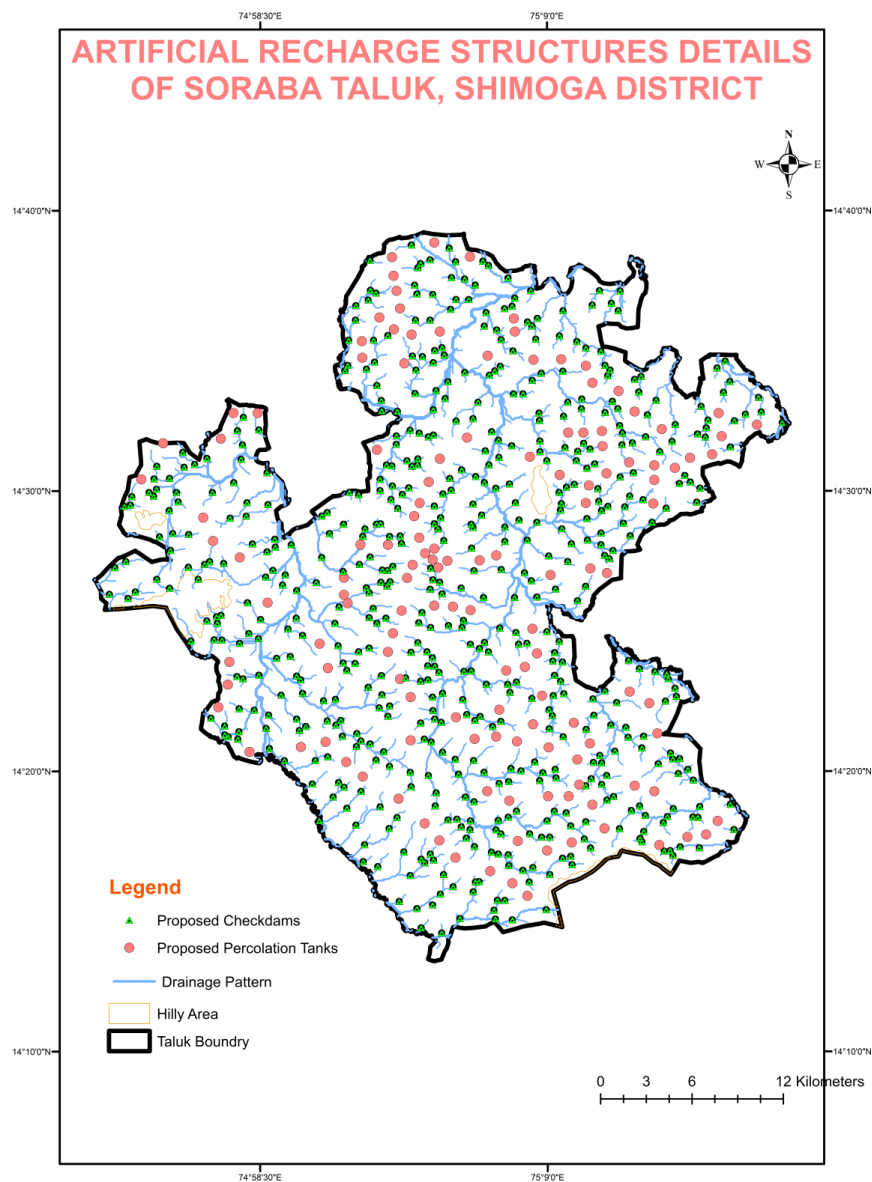


Fig.26. Details of tentative Artificial Recharge Structures in Soraba taluk.

5.2. Resource Savings by Demand Side Interventions

5.2.1. Water Use Efficiency by Micro Irrigation Practices

It is observed that bore wells contribute 35% of the source for irrigation in Soraba Taluk. The water efficient methodology may be applied for growing Maize which is grown in 17929 ha and is ground water dependent as compared to the other crops which are mainly grown during kharif. Initially, the micro irrigation techniques (drip) are proposed in 25% of Maizecultivated area of 17929 ha i.e., 4481 ha. Considering the crop water requirement of 0.50 m and savings of 25% i.e., 0.125 m by drip irrigation, it will contribute in saving ground water by 1616 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. (Table-16).

Table 16: Improvement in GW availability (2022) due to savings by adopting water use efficiency

Annual Extractable GW Resource (Ham)	Total GW extraction for all uses	Stage of ground water extraction	Maize Area proposed for WUE	Unit savings	Total Saving due to adopting WUE measures	Cumulative annual Extractable GW Resource	Expected improvement in stage of ground water extraction after the implementation of the project	Expected improvement in overall stage of ground water extraction
HAM	HAM	%	HA	M	HAM	HAM	%	%
14645.90	7893.53	53.89	4482	0.125	1616	16262	5.35	53.89 to 48.53

5.2.2. Change in cropping pattern

Water intensive crop like paddy are grown in 46% of total cropped area. At present, the stage of ground water extraction is lower side @ 53.84% (2022), thus change in cropping pattern has not been suggested.

5.3. Ground Water Development Plan

In Soraba Taluk, the present stage of ground water extraction (2022) is merely 53.89 %, say 54% with net ground water availability for future use of 6728.23ham and total extraction of 7893.53ham. The ground water draft for irrigation purpose is estimated to be 7423.26ham and there is further scope for developing the resource for irrigation as a part of development with appropriate scientific backing. The implementation of the plan should be based on site specific detailed hydrogeological and scientific surveys for pinpointing the sites for construction additional abstraction structures.

As per tentative estimates, 168dug wells and 1356bore wells are recommended to be constructed in feasible areas which is likely to create about 990hectares of additional irrigation potential (Table-17).

Table – 17: Feasibility of Additional GW abstraction structures based on GWRA 2022 availability

Annual Extractable GW Resource (Ham)	16262
Net GW Availability for future use (Ham)	6728
Stage of GW Extraction (%)	53.89
GW Resources available to increase SOE to 60% (Ham)	9757
Total Extraction / Draft (Ham)	7893
Balance GWR available to enhance SOE 60% (Ham)	1864
DW unit draft (Ham)	1.00
BW unit draft (Ham)	1.25
No. of DW feasible considering 9% of balance GWR with unit draft of 1 ham	168
No. of BWs feasible considering 91% of balance GWR with unit draft of 1.25 ham	1356
Additional irrigation potential created by DW's considering crop water requirement of 0.65 m (Ha)	109
Additional irrigation potential created by BW's considering crop water requirement of 0.65 m (Ha)	881
Total irrigation potential created by DW's and BW's (Ha)	990

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

5.4. Regulation and Control

Soraba Taluk has been categorized as “**Safe**”. However, the mandatory guidelines like rainwater harvesting and artificial recharge issued by Karnataka Ground Water Authority(KGWA) needs to be strictly implemented to avoid the taluk from safe category to semi critical or higher category in the future.

5.5. Other interventions proposed

- **Periodical maintenance of artificial recharge structures** should also be incorporated in the Recharge Plan.
- Excess nitrate concentration is found in ground water samples require remedial measures viz.
 - Dilution of nitrate rich ground water through artificial recharge & water conservation.
 - Roof top rain water harvesting.
 - Improving quality by proper drainage and limited usage of Nitrogenous fertilizers
- Excess fluoride concentration is found in ground water samples of deeper aquifer require remedial measures viz.
 - Alternate source
 - Removal technology

6. SUMMARY AND RECOMMENDATIONS

The main ground water issues are Low Ground Water Development, Limited Ground Water Potential / Limited Aquifer Thickness / Sustainability, Deeper Water Levels particularly in Aquifer-II in some parts, hilly and plateau areas which are all inter-related or inter dependent and Inferior Ground Water Quality due to fluoride contamination especially in deeper aquifer. The summary of ground water management plan of Soraba Taluk is given in **Table-18**.

Table 18: Summary of Management plan of Soraba Taluk

Present stage of Ground water Extraction and Category as per GEC-2022(%)	53.89%, Safe
Annual Extractable Ground Water Resources (ham)	14645
Existing Gross Ground Water Extraction for all uses	7893
Ground Water Resource Enhancement by Supply side Interventions	
Area Feasible for Artificial Recharge (ha)	110400
Expected additional recharge from monsoon surplus runoff (ham)	149784
Additional irrigation potential (Hectares)	13500
Ground Water Resource Savings by Demand side Interventions	
Maize Area proposed for WUE (ha)	17929
Expected Saving due to adopting WUE measures (ham)	1616
Expected improvement in stage of ground water extraction after adopting WUE measures and implementation of the project (%)	53.89 to 48.53
Government to take initiatives to encourage at least 70% farmers to adopt water use efficiency irrigations practices like dip & sprinkler irrigation	-
Ground Water Resource Development Plan	
Balance GWR available to enhance SOE 60% (Ham)	1864
No. of DW feasible considering 9% of balance GWR with unit draft of 1 ham	168
No. of BWs feasible considering 75% of balance GWR with unit draft of 1.25 ham	1356
Additional irrigation potential created by DW's considering crop water requirement of 0.65 m (Ha)	109
Additional irrigation potential created by BW's considering crop water requirement of 0.65 m (Ha)	881
Total irrigation potential created by DW's and BW's (Ha)	990
Excess Nitrate concentration	In limited places especially in shallow aquifer Dilution of nitrate rich ground water through artificial recharge & water conservation. Roof top rain water harvesting Improving quality by controlling usage of Nitrogenous fertilizers in agriculture field and maintaining the proper domestic drainage network system
Excess Fluoride concentration	In limited places especially in deeper aquifer Alternate source Removal technology

As per the resource estimation – 2022, Soraba taluk falls under Safe category with the stage of ground water extraction is 53.89 %. 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: In Soraba taluk, 1104 sq.km area is feasible for recharge and the surface surplus non-committed runoff availability is 149.784 MCM, which is considered for planning of AR structures. For this, a total of 4 sub-surface dykes, 135 percolation tanks, 32 filterbeds and 794 Check dams are proposed. The volume of water expected to be conserved/recharged @75% efficiency is 112.338 MCM through these AR structures. The approximate cost estimate for construction of these AR structures is Rs. 107.62 Cr. The additional area which can be brought under assured ground water irrigation will be about 13500 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: It is observed that bore wells contribute 35% of the source for irrigation in Soraba Taluk. The water efficient methodology may be applied for growing Maize which is grown in 17929 ha and is ground water dependent as compared to the other crops which are mainly grown during kharif. Initially, the micro irrigation techniques (drip) are proposed in 25% of Maize cultivated area of 17929 ha i.e., 4481 ha. Considering the crop water requirement of 0.50 m and savings of 25% i.e., 0.125 m by drip irrigation, it will contribute in saving ground water by 1616 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: Water intensive crop like paddy are grown in 46% of total cropped area. At present, the stage of ground water extraction is lower side @ 53.84% (2022), **thus change in cropping pattern has not been suggested.**

Ground Water Resource Development Plan: In Soraba Taluk, the present stage of ground water extraction (2022) is merely 53.89 %, say 54% with net ground water availability for future use of 6728.23ham and total extraction of 7893.53ham. The ground water draft for irrigation purpose is estimated to be 7423.26ham and there is further scope for developing the resource for irrigation as a part of development with appropriate scientific backing. The implementation of the plan should be based on site specific detailed hydrogeological and scientific surveys for pinpointing the sites for construction additional abstraction structures. As per tentative estimates, 168 dug wells and 1356 bore wells are recommended to be constructed in feasible areas which is likely to create about 990 hectares of additional irrigation potential.

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.

Water Linkages with other Activities: Water sector has strong linkages with other developmental activities. Hence, the proposed management plans cannot be considered as static and needs to be reviewed and improved from time to time.

A) Tentative Locations of Proposed Check Dams, Shikaripura taluk

S.No	Longitude	Lattitude	Village
1	75.0855556	14.2372222	Holekoppa
2	75.0730556	14.2402778	Holekoppa
3	75.1285230	14.2450000	Mysavi
4	75.1182468	14.2455136	Kaisodi
5	75.0966667	14.2458333	Bhadrapura
6	75.1173885	14.2507219	Kaisodi
7	75.1491667	14.2511111	Mysavi
8	75.0704433	14.2517452	Devanagudikoppa
9	75.0800000	14.2538889	Baragi
10	75.0596599	14.2559681	Halasinakoppa
11	75.1239849	14.2565939	Kaisodi
12	75.1194444	14.2566667	Kaisodi
13	75.0847222	14.2602778	Baragi
14	75.1047222	14.2616667	Doguru
15	75.0925000	14.2647222	Horanylu
16	75.1061111	14.2675000	Doguru
17	75.1388889	14.2675000	Kanahalli
18	75.1083333	14.2677778	Doguru
19	75.0663889	14.2713889	Kerekoppa
20	75.0866667	14.2719444	Brahmana Dodderi
21	75.1513889	14.2719444	Kanahalli
22	75.1350000	14.2744444	Kanahalli
23	75.1411111	14.2761111	Kanahalli
24	75.0465811	14.2767057	Kyasanuru
25	75.1263889	14.2772222	Ulavi
26	75.1650000	14.2777778	Kannuru
27	75.0752778	14.2788889	Kerekoppa
28	75.0377778	14.2797222	Veeranapura
29	75.0805556	14.2805556	Dalavayihosakoppa
30	75.0730556	14.2811111	Kerekoppa
31	75.1591667	14.2816667	Kannuru
32	75.1641667	14.2827778	Kannuru
33	75.2263889	14.2832440	Shyandlakoppa
34	75.1260880	14.2837057	Karjikoppa
35	75.0786111	14.2841667	Chiranth Hosakoppa
36	75.1200000	14.2841667	Ulavi
37	75.1158333	14.2852778	Ulavi
38	75.0625245	14.2854248	Kyasanuru
39	75.2211111	14.2858333	Shyandlakoppa
40	75.2247222	14.2861111	Shyandlakoppa

41	75.1762367	14.2877129	Hunavalli
42	75.2425000	14.2877778	Indihalli
43	75.2308333	14.2883333	Shyandlakoppa
44	75.1055556	14.2886111	Hodabatte
45	75.0385982	14.2897093	Ramagondanakoppa
46	75.2075000	14.2913889	Hesarikoppa
47	75.1725000	14.2930556	Hunavalli
48	75.2063889	14.2933333	Hesarikoppa
49	75.1005556	14.2936111	Malalagadde
50	75.1463889	14.2941667	Karjikoppa
51	75.1513889	14.2941667	Karjikoppa
52	75.1216667	14.2961111	Kolisalu
53	75.1391404	14.2961532	Karjikoppa
54	75.2086111	14.2975000	Hesarikoppa
55	75.1186135	14.2984724	Kolisalu
56	75.2636111	14.2986111	Indihalli
57	75.1027778	14.2987308	Malalagadde
58	75.1938889	14.2991667	Brahmana Induvalli
59	75.0535467	14.2993800	Moodagodu
60	75.0975000	14.3002778	Malalagadde
61	75.1641667	14.3008333	Brahmana Holekatte
62	75.0333333	14.3013889	Magadi
63	75.2205556	14.3027778	Hesari
64	75.1733333	14.3033333	Nadavada Holekatte
65	75.1030556	14.3038889	Malalagadde
66	75.1497222	14.3038889	Brahmana Sagaddhe
67	75.0110699	14.3040089	Nadavada Dodderi
68	75.1200044	14.3041579	Kolisalu
69	75.0894444	14.3044444	Banadakoppa
70	75.0948253	14.3048848	Malalagadde
71	75.0583333	14.3058333	Hirle
72	75.2416667	14.3058333	Karekoppa
73	75.1261111	14.3061111	Kolisalu
74	75.2386111	14.3061111	Karekoppa
75	75.2230556	14.3063889	Hesari
76	75.2096151	14.3070573	Hesari
77	75.1613889	14.3086111	Talabylu
78	75.1541667	14.3096281	Kattinakere
79	75.1311111	14.3097222	Pura
80	75.2011111	14.3100000	Hinduvalli
81	75.2266667	14.3111111	Karekoppa
82	75.0277778	14.3113889	Nadavada Dodderi
83	75.0480556	14.3122222	Hosabale
84	75.2427279	14.3123163	Chitturu
85	75.2061111	14.3126869	Hinduvalli

86	75.0816667	14.3127778	Nisarani
87	75.2613889	14.3136111	Chitturu
88	75.1052778	14.3152778	Avalagodu
89	75.1862161	14.3162161	Shigga
90	75.0194444	14.3180556	Muttigoppa
91	75.0999427	14.3180556	Shiravanthe
92	75.1902778	14.3183333	Shigga
93	75.0822222	14.3205556	Nisarani
94	75.0363889	14.3213889	Balagodu
95	75.0261111	14.3238889	Muttigoppa
96	75.0669444	14.3241667	Melina Kirugunasi
97	75.1733333	14.3247222	Shigga
98	75.1830609	14.3255491	Shigga
99	75.0067210	14.3258245	Aralige
100	75.1205556	14.3261111	Kondagalale
101	75.0227778	14.3266667	Muttigoppa
102	75.1263889	14.3272222	Kondagalale
103	75.1452778	14.3277778	Ammagondanakoppa
104	75.2388889	14.3280556	Hirekasavi
105	75.1766667	14.3288889	Shigga
106	75.1552778	14.3294444	Kulavalli
107	75.0775000	14.3308333	Chilanuru
108	75.1861111	14.3308333	Kundagasavi
109	75.0958333	14.3316667	Kuppe
110	75.2297222	14.3319444	Kavadi
111	75.1472222	14.3325000	Kumbatthi
112	75.0663889	14.3327778	Kelagina Kirugunasi
113	75.1113889	14.3327778	Byrakoppa
114	75.1338889	14.3336111	Chimanuru
115	75.1547222	14.3344444	Kulavalli
116	75.2355556	14.3344444	Hirekasavi
117	75.1277778	14.3350000	Heggodu
118	75.0537560	14.3363397	Kasaraguppa
119	75.2175000	14.3377778	Chikkasavi
120	75.1830556	14.3383333	Kasavadikoppa
121	75.1780556	14.3386111	Kasavadikoppa
122	75.1422222	14.3388889	Chimanuru
123	74.9897222	14.3397222	Abasi
124	75.1050000	14.3397222	Halagalale
125	75.0086160	14.3397247	Abasi
126	75.0455556	14.3400000	Kasaraguppa
127	75.0938066	14.3404733	Kappagalale
128	75.2263889	14.3405556	Chikkasavi
129	75.2305556	14.3408333	Hirekasavi
130	75.0161111	14.3419444	Abasi

131	75.1819444	14.3427778	Kasavadikoppa
132	75.2250000	14.3441667	Chikkasavi
133	75.0861111	14.3447222	Kappagalale
134	75.0502778	14.3450000	Kasaraguppa
135	75.1911111	14.3452778	Manemane
136	74.9805556	14.3469444	Abasi
137	75.2075000	14.3472222	Jiralekoppa
138	75.0336111	14.3480556	Goggehalli
139	75.0419444	14.3497222	Dyavagodu
140	75.0791667	14.3508333	Nadahalli
141	75.0363889	14.3513889	Dyavagodu
142	74.9613889	14.3525000	Andavalli
143	75.0750000	14.3525000	Nadahalli
144	75.1991667	14.3536111	Arekoppa
145	74.9555556	14.3538889	Andavalli
146	75.1595491	14.3538913	Hiruru
147	75.2086111	14.3541667	Arekoppa
148	75.0250535	14.3542202	Abasi
149	74.9534419	14.3550415	Andavalli
150	75.0338889	14.3558333	Kakkarasi
151	74.9620403	14.3568918	Andavalli
152	74.9988889	14.3576193	Kadasuru
153	75.1736111	14.3581944	Tavarekoppa
154	75.1511111	14.3586111	Shanthigeri
155	74.9786111	14.3588889	Kadasuru
156	75.1977778	14.3594444	Arekoppa
157	75.0027778	14.3600000	Kadasuru
158	75.1166667	14.3600000	Halagalale
159	74.9533333	14.3602778	Andavalli
160	75.0211111	14.3608333	Hejje
161	75.1886111	14.3608333	Yalavalli
162	75.0727497	14.3620895	Nadahalli
163	75.0852778	14.3625000	Maruru
164	75.1216667	14.3630556	Kunaji
165	75.0158333	14.3633333	Hejje
166	75.0241667	14.3636111	Thandige
167	75.1058333	14.3636111	Halagalale
168	74.9972222	14.3644444	Kadasuru
169	75.0813889	14.3644444	Nadahalli
170	74.9450000	14.3650000	Andavalli
171	75.1090278	14.3659722	Kunaji
172	75.0527778	14.3661111	Gundashettykoppa
173	75.1530556	14.3663889	Shanthigeri
174	75.1783333	14.3666667	Mavale
175	74.9801399	14.3668045	Hejje

176	75.1008333	14.3670833	Hireshakuna
177	75.0802778	14.3694444	Nadahalli
178	74.9713889	14.3697222	Andavalli
179	75.1511111	14.3700000	Shanthigeri
180	74.9622222	14.3705556	Andavalli
181	75.0475000	14.3711111	Yalashi
182	75.0538889	14.3722222	Gundashettykoppa
183	75.1922222	14.3741667	Bedhavatti
184	75.2219444	14.3750000	Kolagunasi
185	75.0136111	14.3752778	Thandige
186	75.0984722	14.3759722	Hireshakuna
187	75.0208333	14.3761111	Thandige
188	75.1777778	14.3763889	Chennapura
189	75.1405556	14.3766667	Kodakani
190	75.0800000	14.3775000	Halesoraba
191	75.2286111	14.3777778	Chatradahalli
192	75.1536111	14.3783333	Andige
193	74.9877778	14.3786111	Hejje
194	75.0491667	14.3788889	Yalashi
195	75.1600000	14.3794444	Andige
196	75.0008333	14.3797222	Hejje
197	75.0861111	14.3797222	Thirumalapura
198	75.1272222	14.3802778	Kodakani
199	75.1850000	14.3811111	Bedhavatti
200	75.2277778	14.3826737	Chatradahalli
201	75.0408333	14.3833333	Yalashi
202	75.1127778	14.3850000	Kanukoppa
203	75.1258333	14.3850000	Kodakani
204	75.1311111	14.3863889	Kodakani
205	75.0727778	14.3869444	Halesoraba
206	75.1580556	14.3869444	Uruganahalli
207	74.9997222	14.3877778	Hejje
208	75.0772222	14.3877778	Halesoraba
209	74.9644444	14.3883333	Holemaruru
210	75.2235997	14.3883333	Sutthakote
211	75.0636111	14.3888889	Kardigere
212	74.9608333	14.3897222	Holemaruru
213	74.9972222	14.3900000	Hejje
214	75.0488889	14.3902778	Tavarehalli
215	75.1543353	14.3903530	Uruganahalli
216	74.9741667	14.3905556	Holemaruru
217	75.2227778	14.3911111	Sutthakote
218	75.0839554	14.3921930	Halesoraba
219	75.2155556	14.3925000	Bilavani
220	75.0991667	14.3927778	Chikkashakuna

221	75.1036111	14.3930556	Chikkashakuna
222	75.0277778	14.3933333	Jambehalli
223	75.2061111	14.3943547	Bilavani
224	75.0813889	14.3958333	Halesoraba
225	75.0770833	14.3961111	Halesoraba
226	75.0327778	14.3975000	Jambehalli
227	75.0255556	14.3977778	Jambehalli
228	75.1591667	14.3983333	Uruganahalli
229	75.1533333	14.3988889	Uruganahalli
230	75.1994444	14.3991667	Kumashi
231	74.9850000	14.4005556	Antharavalli
232	75.0800000	14.4008333	Halesoraba
233	74.9933333	14.4016667	Antharavalli
234	75.1544444	14.4038889	Hireyavali
235	75.0669444	14.4041667	Narashipura
236	75.1140992	14.4043520	Bilagi
237	75.0350000	14.4044444	Jambehalli
238	75.0766667	14.4044444	Halesoraba
239	75.1086111	14.4063889	Bilagi
240	75.0413889	14.4066667	Jambehalli
241	75.0225000	14.4080556	Kanthanahalli
242	75.1030556	14.4088889	Oturu
243	75.1325000	14.4088889	Uppahalli
244	74.9625000	14.4094444	Kathavayi
245	75.1375000	14.4094444	Uppahalli
246	75.0711030	14.4098420	Kuderegalali
247	75.1116667	14.4100000	Bilagi
248	75.1572222	14.4105556	Devathikoppa
249	74.9327778	14.4108333	Basthikoppa
250	74.9516667	14.4113889	Kathavayi
251	74.9469443	14.4115740	Kathavayi
252	74.9738889	14.4122222	Chandragutthi
253	75.0008333	14.4141667	Gunjanuru
254	74.9680556	14.4152778	Chandragutthi
255	75.1308333	14.4158333	Kummaru
256	75.1497222	14.4163889	Hireyavali
257	74.9919444	14.4180556	Gunjanuru
258	75.1209907	14.4184907	Kummaru
259	75.0980142	14.4188476	Oturu
260	75.0788889	14.4188889	Chitrattihalli
261	75.0897222	14.4200000	Chitrattihalli
262	74.9488889	14.4213889	Chandragutthi
263	75.0205556	14.4213889	Kanthanahalli
264	75.0461111	14.4213889	Saremaruru
265	75.0716667	14.4216667	Bilavagodu

266	74.9425000	14.4227778	Chandragutthi
267	75.0988889	14.4230556	Oturu
268	74.9752778	14.4236111	Chandragutthi
269	74.9969444	14.4244444	Gunjanuru
270	75.0516667	14.4244444	Thyavagodu
271	75.0413889	14.4247222	Saremaruru
272	74.9483333	14.4252778	Chandragutthi
273	74.9511111	14.4261111	Chandragutthi
274	75.0736111	14.4277778	Bilavagodu
275	75.0438673	14.4302854	Thyavagodu
276	75.0230556	14.4311111	Kallambi
277	74.9672222	14.4336111	Chandragutthi
278	75.1683333	14.4347222	Udri
279	74.8944444	14.4361111	Kodambi
280	75.1111111	14.4366667	Thotlagondana(Halli)koppa
281	75.1300000	14.4366667	Udri
282	75.1436111	14.4369444	Udri
283	74.8830556	14.4386111	Chandragutthi State Forest
284	75.0858333	14.4388889	Bendekoppa
285	75.0413925	14.4395558	Surekoppa
286	74.8988889	14.4400000	Chandragutthi State Forest
287	74.9972222	14.4408333	Gudavi
288	75.0786111	14.4416667	Thavanandhi
289	75.1550000	14.4416667	Udri
290	74.9197222	14.4422222	Chandragutthi State Forest
291	75.0975000	14.4423611	Dodderikoppa
292	75.0397222	14.4425000	Surekoppa
293	75.1733333	14.4433333	Udri
294	75.0522419	14.4434945	Surekoppa
295	74.9886111	14.4441463	Nyarasi
296	75.0091667	14.4455556	Gudavi
297	75.0486111	14.4458333	Surekoppa
298	75.0844444	14.4458333	Thavanandhi
299	75.0541667	14.4461111	Surekoppa
300	75.1402778	14.4466667	Udri
301	75.0802778	14.4472222	Thavanandhi
302	74.9119444	14.4475000	Chandragutthi State Forest
303	74.9372222	14.4475000	Chandragutthi State Forest
304	74.9783333	14.4488889	Pura
305	74.9902778	14.4501389	Pura
306	75.1361111	14.4513889	Udri
307	75.0255556	14.4522222	Gudavi
308	75.1052742	14.4526391	Korakodu
309	75.0525000	14.4527778	Surekoppa
310	74.9827495	14.4528786	Pura

311	75.0494444	14.4530556	Surekoppa
312	75.1219444	14.4533333	Korakodu
313	75.0788889	14.4541667	Thavanandhi
314	74.8863889	14.4544444	Chandragutthi State Forest
315	74.9312004	14.4547222	Baragavalli
316	75.0558333	14.4552778	Surekoppa
317	74.9411111	14.4563889	Baragavalli
318	75.0354867	14.4563889	Gudavi
319	74.9527778	14.4569444	Mannatthi
320	74.8930556	14.4580556	Kodambi
321	74.9441667	14.4580556	Kundagodu
322	75.1625000	14.4580556	Udri
323	75.1877778	14.4597222	Guduginakoppa
324	75.0125000	14.4605556	Gudavi
325	75.0419444	14.4608333	Surekoppa
326	75.1508333	14.4613889	Udri
327	75.1850000	14.4616667	Guduginakoppa
328	74.9791667	14.4638889	Bennuru
329	75.1900231	14.4645853	Guduginakoppa
330	74.9202778	14.4647222	Naraji
331	75.1038889	14.4661111	Kuppagadde
332	74.9841667	14.4666667	Bennuru
333	74.9938889	14.4680556	J.I.Hosuru Agrahara
334	75.1827778	14.4680556	Guduginakoppa
335	74.9702778	14.4686111	Bennuru
336	75.1647222	14.4686111	Guddekoppa
337	75.0611111	14.4688889	Kerekoppa
338	75.1241667	14.4700000	Kuppagadde
339	75.0869444	14.4705556	Kuppagadde
340	75.1377778	14.4708333	Kuppagadde
341	75.1744444	14.4708333	Guddekoppa
342	74.9838889	14.4713889	Bennuru
343	74.9136111	14.4727778	Nelluru
344	75.0375000	14.4730556	Thekkuru
345	75.0538889	14.4730556	Kerekoppa
346	75.0602778	14.4733333	Kerekoppa
347	75.2005556	14.4733333	Kanukoppa
348	74.9313889	14.4741667	Horabyly
349	74.9216667	14.4747222	Nelluru
350	75.0172222	14.4747222	J.I.Hosuru Agrahara
351	75.1827778	14.4750000	Chikkabburu
352	75.0388889	14.4775000	Thekkuru
353	75.0833333	14.4775000	Vuyiguddekoppa
354	75.1588889	14.4775000	Guddekoppa
355	75.1047222	14.4783333	Kuppagadde

356	75.1241667	14.4786111	Kuppagadde
357	75.0258333	14.4802778	J.I.Hosuru Agrahara
358	75.0458333	14.4802778	Thekkuru
359	75.1036111	14.4802778	Kuppagadde
360	75.0483333	14.4805556	Kolaga
361	75.0811111	14.4805556	Bommenahalli
362	75.1963889	14.4808333	Chikkabburu
363	75.1436111	14.4813889	Bettadakurli
364	75.2138889	14.4813889	Thatthuru
365	75.1327778	14.4827778	Haya
366	75.1741667	14.4836111	Balekoppa
367	74.9566667	14.4838889	Mangalore
368	75.0850000	14.4841667	Bommenahalli
369	74.9664556	14.4850942	Mangalore
370	75.0125212	14.4851850	J.I.Hosuru Agrahara
371	75.1100166	14.4857131	Kuppagadde
372	75.0158333	14.4872222	J.I.Hosuru Agrahara
373	74.9194444	14.4883333	Sindli
374	75.1830556	14.4883333	Negavadi
375	75.1580556	14.4886111	Bettadakurli
376	75.0588889	14.4897222	Kolaga
377	75.2225000	14.4897222	Thatthuru
378	75.1972222	14.4905556	Thatthuru
379	74.8922222	14.4908333	Kuntagalale
380	75.1869444	14.4908333	Negavadi
381	75.0811111	14.4911111	Bommenahalli
382	74.8958333	14.4916667	Kuntagalale
383	74.9797222	14.4919444	Kamaruru
384	75.1047222	14.4922222	Gendla
385	75.1586111	14.4925000	Bettadakurli
386	74.9669444	14.4930556	Kamaruru
387	75.1305556	14.4930556	Haya
388	75.2411111	14.4933333	Gangavalli
389	74.9250000	14.4936111	Sindli
390	75.1813889	14.4938889	Negavadi
391	75.2084206	14.4947877	Thatthuru
392	75.0547222	14.4950000	Kolaga
393	74.8966667	14.4966667	Kuntagalale
394	74.9100000	14.4969444	Kuntagalale
395	75.2002778	14.4969444	Thatthuru
396	75.0350000	14.4977778	Sampagodu
397	75.0616667	14.4980556	Dyavanahalli
398	75.0863889	14.4983333	Nittakki
399	74.9072222	14.4991667	Kuntagalale
400	74.9238889	14.4991667	Sindli

401	74.9458333	14.4991667	Harishi
402	75.1572222	14.4991667	Bettadakurli
403	75.0293348	14.4992763	Sampagodu
404	75.0480556	14.5002778	Hunasekoppa
405	75.0913889	14.5005556	Nittakki
406	74.9117294	14.5010408	Kuntagalale
407	75.1808333	14.5013889	Negavadi
408	75.1186111	14.5016667	Gendla
409	75.2430556	14.5016667	Hiremagadi
410	75.0655556	14.5019444	Dyavanahalli
411	75.1616667	14.5022222	Bettadakurli
412	75.0555556	14.5030556	Dyavanahalli
413	75.1664454	14.5040120	Bettadakurli
414	75.1269444	14.5041667	Mathighatta
415	75.2305556	14.5044444	Hiremagadi
416	74.9588889	14.5050000	Mangarasikoppa
417	75.1116667	14.5050000	Gendla
418	75.2372222	14.5052778	Hiremagadi
419	75.0480556	14.5069444	Jaddihalli
420	74.9102778	14.5072222	Thelagundli
421	74.9197222	14.5075000	Thelagundli
422	75.0905556	14.5075000	Thalaguppa
423	75.1944444	14.5083333	Negavadi
424	75.1063889	14.5086111	Gendla
425	75.2338889	14.5091667	Hiremagadi
426	75.2025000	14.5108333	Negavadi
427	74.9791667	14.5108576	Kamaruru
428	75.0977492	14.5126065	Thalaguppa
429	75.1741667	14.5134722	Hireyadagodu
430	74.9286111	14.5141667	Thelagundli
431	74.9119444	14.5147222	Thelagundli
432	75.0675000	14.5147222	Puttanahalli
433	75.0552778	14.5150000	Jaddihalli
434	75.0519444	14.5155556	Jaddihalli
435	75.0708333	14.5155556	Puttanahalli
436	75.1144444	14.5155556	Kathuru
437	74.9350000	14.5158333	Harishi
438	75.1788889	14.5161111	Hireyadagodu
439	75.0644444	14.5180556	Basuru
440	75.1497222	14.5180556	Thudaneeru
441	75.1677778	14.5180556	Hireyadagodu
442	74.9633333	14.5188889	Kamaruru
443	75.0711111	14.5191667	Puttanahalli
444	74.9425000	14.5194444	Chikkalagodu
445	75.1205556	14.5200000	Hasavi

446	74.9277778	14.5230556	Thelagundli
447	75.1455556	14.5233333	Thudaneeru
448	75.2186111	14.5233333	Thyavaratheppa
449	75.1686111	14.5236111	Hireyadagodu
450	75.1122222	14.5238889	Siddihalli
451	75.1761111	14.5250000	Hireyadagodu
452	75.1608333	14.5258333	Thudaneeru
453	75.2616667	14.5261111	Ginivala
454	75.1283333	14.5269444	Hasavi
455	74.9641667	14.5275000	Hirekaligodu
456	75.1955556	14.5275000	Chikkayedagodu
457	75.0579210	14.5278231	Haralikoppa
458	75.1722222	14.5283333	Hireyadagodu
459	75.2019444	14.5286111	Chikkayedagodu
460	75.2261111	14.5294444	Thyavaratheppa
461	75.1455556	14.5297222	Badanakatte
462	75.1202778	14.5302778	Hasavi
463	75.2463889	14.5319444	Hanche
464	75.0775000	14.5322222	Kerehalli
465	75.2100000	14.5322222	Ennikoppa
466	75.0580441	14.5327778	Haralikoppa
467	75.0805888	14.5333334	Kerehalli
468	75.2416667	14.5338889	Hanche
469	75.0719444	14.5344444	Kerehalli
470	75.1958333	14.5344444	Hunasavalli
471	75.1161111	14.5352778	Siddihalli
472	74.9611111	14.5358333	Iduru
473	75.0663889	14.5361693	Kerehalli
474	74.9741667	14.5363889	Iduru
475	75.2469444	14.5375000	Hanche
476	75.1941667	14.5388889	Hunasavalli
477	75.2280556	14.5394444	Kunitheppa
478	75.2933333	14.5405556	Gummanahalu
479	75.0944444	14.5416667	Kathavalli
480	75.2641667	14.5416667	Jogihalli
481	75.1452778	14.5419444	Badanakatte
482	75.2480556	14.5420833	Barangi
483	75.1047222	14.5430556	Kotekoppa
484	74.9647222	14.5438889	Iduru
485	75.1600000	14.5444444	Thalluru
486	75.2111111	14.5452778	Kamanavalli
487	75.2708333	14.5455556	Jogihalli
488	75.1450000	14.5463889	Kubaturu
489	75.1852778	14.5466667	Thalluru
490	75.2805556	14.5469444	Yalivala

491	75.0586111	14.5475000	Vardhikoppa
492	75.0490736	14.5477778	Chagaturu
493	75.0805556	14.5483333	Thumarikoppa
494	75.1708333	14.5488889	Thalluru
495	75.1930556	14.5488889	Thalluru
496	75.2438889	14.5502778	Barangi
497	75.1077778	14.5527778	Kotekoppa
498	75.1625000	14.5527778	Thalluru
499	75.1897222	14.5533333	Thalluru
500	75.0488889	14.5538889	Chagaturu
501	75.2163889	14.5538889	Kamanavalli
502	75.1711111	14.5547222	Thalluru
503	75.0877778	14.5550000	Kathavalli
504	75.2788889	14.5555556	Yalivala
505	75.1294444	14.5577778	Hosahalli
506	75.1352778	14.5577778	Kodikoppa
507	75.0694444	14.5580556	Thumarikoppa
508	75.2575000	14.5586111	Barangi
509	75.2058333	14.5588889	Chikkachavati
510	75.0822222	14.5597222	Hosakoppa
511	75.0461111	14.5627778	Kaligeri
512	75.0894444	14.5650000	Bennuru
513	75.2613889	14.5650000	Barangi
514	75.1408333	14.5658333	Kubaturu
515	75.2033333	14.5663889	Chikkachavati
516	75.2072222	14.5680556	Chikkachavati
517	75.1869444	14.5686111	Hurali
518	75.1147222	14.5688889	Kubaturu
519	75.1463889	14.5700000	Kubaturu
520	75.0997222	14.5705556	Bennuru
521	75.1594985	14.5712550	Anavatti
522	75.1180556	14.5713889	Kubaturu
523	75.0266667	14.5716667	Halekoppa
524	75.0700000	14.5719444	Salagi
525	75.1883333	14.5719444	Hurulikoppa
526	75.0397222	14.5725000	Jade
527	75.2536111	14.5730556	Bennegere
528	75.1213889	14.5741667	Kubaturu
529	75.0283333	14.5747222	Halekoppa
530	75.1852778	14.5747222	Hurali
531	75.0805556	14.5763889	Bankasana
532	75.0447222	14.5766667	Jade
533	75.2586111	14.5772222	Bennegere
534	75.0738889	14.5800000	Thalagundli
535	75.0677778	14.5802778	Thalagundli

536	75.0872222	14.5808333	Bankasana
537	75.1827778	14.5830556	Hurali
538	75.1291667	14.5833333	Kubaturu
539	75.0813889	14.5836111	Shanuvalli
540	75.1736111	14.5850000	Hurali
541	75.0858333	14.5852778	Kachavi
542	75.1680556	14.5888889	Kodihalli
543	75.0288889	14.5897222	Kallukoppa
544	75.0441667	14.5897222	Mangapura
545	75.1219444	14.5900000	Mooguru
546	75.1430556	14.5902778	Neerlagi
547	75.1575000	14.5922222	Kodihalli
548	75.0527778	14.5925000	Mangapura
549	75.1191667	14.5958333	Mooguru
550	75.1116667	14.5980556	Thelagadde
551	75.1408333	14.5980556	Neerlagi
552	75.1380556	14.6005556	Dwarahalli
553	75.0330556	14.6016667	Kamaruru
554	75.0697222	14.6016667	Talagadde Forest
555	75.0786111	14.6016667	Madhapura T.
556	75.1440278	14.6026389	Dwarahalli
557	75.1127778	14.6061111	Mooguru
558	75.1597222	14.6072222	Thoravandha
559	75.1933333	14.6072222	Moodidoddikoppa
560	75.0911111	14.6080556	Kodikoppa
561	75.1240278	14.6084722	Mooguru
562	75.1286111	14.6098611	Dwarahalli
563	75.0333333	14.6102778	Kamaruru
564	75.1775000	14.6105556	Moodidoddikoppa
565	75.1891667	14.6116667	Moodidoddikoppa
566	75.0408333	14.6136111	Soornagi
567	75.0944444	14.6138889	Kodikoppa
568	75.1022222	14.6138889	Mallasamudra
569	75.1302778	14.6147222	Thuyilakoppa
570	75.0802778	14.6169444	Shanthapura
571	75.0705556	14.6172222	Shanthapura
572	75.0455556	14.6177778	Soornagi
573	75.1945391	14.6189264	Moodidoddikoppa
574	75.1400000	14.6191006	Dwarahalli
575	75.1819444	14.6191667	Moodidoddikoppa
576	75.0422222	14.6194444	Soornagi
577	75.0691667	14.6225000	Shanthapura
578	75.1061111	14.6225000	Shakunahalli
579	75.0997222	14.6261111	Arathalagadde
580	75.1261111	14.6266667	Thuyilakoppa

581	75.0916667	14.6269444	Arathalagadde
582	75.0711111	14.6327778	Alahalli
583	75.1141667	14.6341667	Shankarikoppa
584	75.0727778	14.6352778	Alahalli
585	75.0941667	14.6363889	Bilagale
586	75.1108333	14.6366667	Shankarikoppa
587	75.0419444	14.6372222	Soornagi
588	75.0786111	14.6375000	Bilagale
589	75.0902778	14.6444444	Bilagale
590	75.0672222	14.6463889	Binkavalli

B) Tentative Locations of Proposed Percolation Tanks, Shikaripura taluk

S.No	Longitude	Lattitude	Village
1	75.137774	14.259365	Kanahalli
2	75.128580	14.266846	Kaisodi
3	75.115092	14.274030	Ulavi
4	75.093939	14.282113	Malalagadde
5	75.149749	14.286271	Kannuru
6	75.218133	14.289508	Shyandlakoppa
7	75.164778	14.291046	Hunavalli
8	75.131967	14.291964	Karjikoppa
9	75.084130	14.292284	Chiranth Hosakoppa
10	75.235310	14.294276	Karekoppa
11	75.246657	14.295760	Indihalli
12	75.184716	14.299404	Hinduvalli
13	75.075241	14.302455	Talakalakoppa
14	75.253719	14.303826	Malalikoppa
15	75.177368	14.313465	Shigga
16	75.126767	14.315889	Pura
17	75.059298	14.317112	Melina Kirugunasi
18	75.162958	14.318559	Shigga
19	75.150384	14.318567	Kumbatthi
20	75.215097	14.321508	Kavadi
21	75.113276	14.321578	Kuppe
22	75.203139	14.324808	Chikkasavi
23	75.169403	14.325432	Shigga
24	75.037526	14.330274	Balagodu
25	75.027406	14.338948	Goggehalli
26	75.168187	14.340385	Kottari
27	74.968516	14.344928	Andavalli
28	75.150710	14.347573	Hiruru
29	74.999802	14.347920	Kadasuru
30	75.175863	14.349948	Yalavalli
31	75.014831	14.350910	Abasi

32	75.131388	14.351173	Kunaji
33	75.066669	14.351798	Nadahalli
34	75.105624	14.352681	Halagalale
35	75.118750	14.354028	Halagalale
36	75.216970	14.355895	Arekoppa
37	75.141210	14.361335	Shanthigeri
38	75.166057	14.362216	Mavale
39	75.094280	14.365545	Hirehakuna
40	75.120663	14.370018	Kodakani
41	74.949493	14.371539	Andavalli
42	75.212079	14.373841	Kolagunasi
43	75.066676	14.377516	Halesoraba
44	75.146742	14.378377	Andige
45	75.200121	14.380730	Gerukoppa
46	74.955319	14.384997	Holemaruru
47	75.060237	14.388283	Kardigere
48	75.124970	14.393341	Kodakani
49	75.016245	14.394809	Gunjanuru
50	75.136323	14.395428	Kodakani
51	74.956237	14.398453	Thoruvagondanakoppa
52	75.143691	14.403497	Hireyavali
53	75.052878	14.404432	Jambhalli
54	75.011215	14.409282	Gunjanuru
55	75.055949	14.415496	Thyavagodu
56	75.140939	14.418152	Bekkavali
57	75.061168	14.428951	Thyavagodu
58	75.103205	14.429236	Thotlagondana(Halli)koppa
59	75.092467	14.431333	Dodderikoppa
60	75.081114	14.431935	Bendekoppa
61	75.028333	14.433333	Kallambi
62	74.979550	14.433743	Nyarasi
63	75.026073	14.438371	Kallambi
64	75.064549	14.448387	Thavanandhi
65	75.026074	14.448562	Gudavi
66	75.152006	14.450142	Udri
67	75.186376	14.451313	Guduginakoppa
68	75.176251	14.454012	Guduginakoppa
69	75.083521	14.454578	Thavanandhi
70	75.067927	14.456161	Thavanandhi
71	75.089102	14.458547	Kuppagadde
72	75.108742	14.458837	Korakodu
73	75.080134	14.459315	Thavanandhi
74	74.962559	14.460618	Hosabale
75	75.118871	14.461823	Korakodu
76	75.075601	14.463037	Thavanandhi

77	75.081111	14.465833	Kuppagadde
78	75.052886	14.468079	Kerekoppa
79	75.036111	14.468225	Thekkuru
80	74.946255	14.470375	Kundagodu
81	75.071922	14.472308	Vuyiguddekoppa
82	74.940261	14.484273	Mangalore
83	75.068857	14.485167	Kolaga
84	75.214647	14.492555	Thatthuru
85	75.173520	14.492888	Negavadi
86	75.072235	14.492941	Dyavanahalli
87	75.175369	14.503353	Negavadi
88	75.077764	14.505499	Nittakki
89	75.215274	14.506609	Thatthuru
90	74.902501	14.506987	Kuntagalale
91	75.157571	14.509645	Bettadakurli Forest
92	75.186118	14.510522	Negavadi
93	75.227866	14.513774	Hiremagadi
94	75.215282	14.515281	Vrutthikoppa
95	75.199937	14.517089	Nellikoppa
96	75.084522	14.519252	Thalaguppa
97	75.237081	14.519746	Hanche
98	75.139468	14.520422	Hasavi
99	75.250589	14.521825	Hanche
100	75.046153	14.524645	Haralikoppa
101	75.183750	14.526667	Hireyadagodu
102	74.915806	14.528477	Thelagundli
103	74.950992	14.531224	Hirekaligodu
104	75.101104	14.531805	Shiddehalli Plantation
105	75.256434	14.532584	Ginivala
106	75.172017	14.534754	Thalluru
107	75.162808	14.534760	Thalluru
108	75.183376	14.535642	Hunasavalli
109	75.219908	14.536807	Thyavaratheppa
110	75.277931	14.539437	Gummanahalu
111	75.254608	14.546341	Barangi
112	74.958664	14.546476	Kenchikoppa
113	74.973400	14.546478	Iduru
114	75.203341	14.547288	Kamanavalli
115	75.193527	14.559557	Chikkachavati
116	75.177567	14.564354	Hurali
117	75.173583	14.574524	Hurali
118	75.062917	14.575972	Thalagundli
119	75.141654	14.578134	Kubaturu
120	75.158541	14.578422	Neerlagi
121	75.037261	14.579370	Jade

122	75.113715	14.580541	Vitalapura
123	75.036955	14.589238	Kallukoppa
124	75.067355	14.593118	Thalagundli
125	75.130303	14.594886	Mooguru
126	75.084551	14.594907	Thelagadde
127	75.056528	14.596250	Talagadde Forest
128	75.129694	14.602661	Mooguru
129	75.047705	14.603290	Talagadde Forest
130	75.060297	14.608670	Talagadde Forest
131	75.058150	14.619137	Talagadde Forest
132	75.056310	14.628108	Talagadde Forest
133	75.055391	14.639172	Binkavalli
134	75.102995	14.639455	Shakunahalli
135	75.081193	14.647837	Bilagale

(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)