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

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

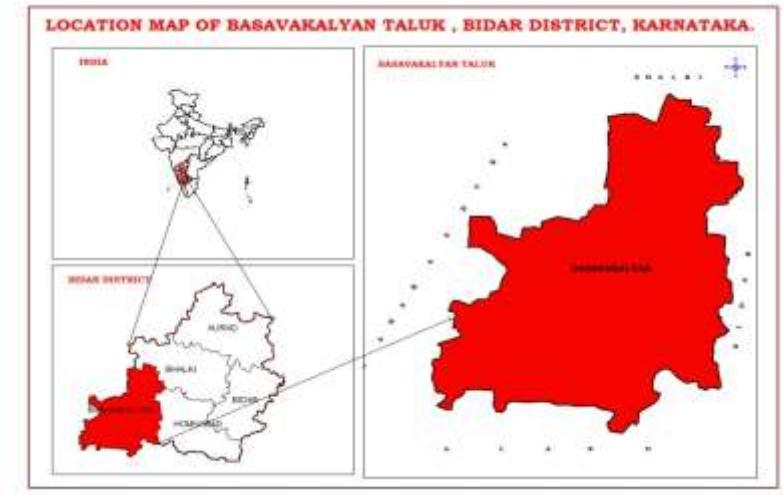
BASAVAKALYANA TALUK, BIDAR DISTRICT, KARNATAKA

दक्षिण पश्चिमी क्षेत्र, बैंगलोर
South Western Region, Bengaluru

FOR OFFICIAL USE ONLY
No. RP/NAQUIM/2019-20/84

Government of India
Ministry of Jal Shakti
Department of Water Resources, RD & GR
Central Ground Water Board

AQUIFER MANAGEMENT PLAN OF BASAVAKALYANA TALUK, BIDAR DISTRICT, KARNATAKA STATE



By
Dr. Ananth Kumar Ars
Scientist - D

South Western Region
Bangalore

August, 2020

AQUIFER MANAGEMENT PLAN OF
BASAVAKALYANA TALUK, BIDAR DISTRICT,
KARNATAKA STATE

CONTENTS

AQUIFER MANAGEMENT PLAN OF BASAVAKALYANA TALUK, BIDAR DISTRICT, KARNATAKA STATE

1. SALIENT INFORMATION

Name of the Taluk: Basavakalyana

District: Bidar

State: Karnataka

Area: 1209 sq.km.

Population: 3, 45, 247

Normal Annual Rainfall: 792 mm

1.1 Aquifer Management study area

Aquifer mapping studies was carried out in Basavakalyana Taluk, Bidar district of Karnataka covering an area of 1209 sq. kms under National Aquifer Mapping Project. Basavakalyana Taluk of Bidar district is located between North latitude 17°36'28.07" and 18°03'55" and East longitude 76°41'31.9" and 77°05'42.4", and is covered in parts of Survey of India Toposheet Nos. 56 B/16, 56 C/9, 56 C/10, 56 C/13,56 C/14, 56 G/1 and 56G/2. Basavakalyana Taluk is bounded by Bhalki Taluk on north, Aland Taluk of Kalburgi district on south, Humnabad Taluk on east and Maharashtra state on western side.

Location map of Basavakalyana Taluk of Bidar district is presented in **Figure-1**.

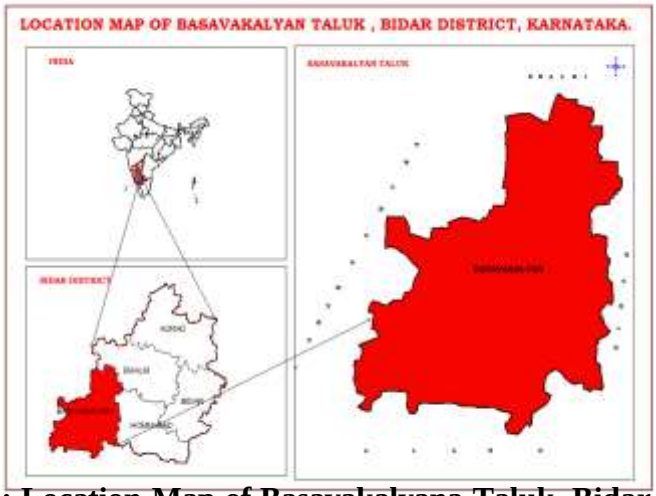


Fig 1: Location Map of Basavakalyana Taluk, Bidar district

The Taluk is divided into 6 Hoblies and Basavakalyana is the only town, which is also the Taluk head quarter. There are 112 inhabited and 3 uninhabited villages in Basavakalyana Taluk.

1.2 Population

According to 2011 census, the population in Basavakalyana Taluk is 3,45,247 in which 275530 the rural population and 69717 is the urban population. This works out to be 80% (rural) and 20% (urban) of the total population of the Taluk. The study area has an overall population density of 285 persons per sq.km. The decadal variation in population from 2001-2011 is 15.11% in Basavakalayan Taluk.

1.3 Rainfall

Basavakalyana Taluk enjoys semi-arid climate. Dryness and hot weather prevail in major part of the year. The area falls under Central Dry agro-climatic zone of Karnataka state and is categorized as drought prone. The normal annual rainfall in Basavakalyana taluk for the period 1981 to 2010 is 792 mm. Seasonal rainfall pattern indicates that major amount of rainfall (606 mm) was recorded during South-West Monsoon seasons, which contributes about 77% of the annual normal rainfall followed by North-East Monsoon season (114 mm) constituting 14% and remaining (73 mm) 9 % in Pre-Monsoon season (**Table-1**).

Table 1: Statistical Analysis of Rainfall Data of Basavakalyana Station, (1981 to 2010)

STATION		Jan	Feb	Mar	Apr	May	Pre	Jun	Jul	Aug	Sep	SW	Oct	Nov	Dec	NE	Annual
Basavakalyana	NRM	7	4	15	15	31	73	113	160	160	172	606	86	23	5	114	792
	ST.DEV	14	7	26	16	43	58	55	115	95	96	201	66	38	9	74	200
	CV%	189	197	171	102	141	79	49	72	59	56	33	77	168	175	65	25

Computations were carried out for the 30 years block of 1981- 2010, the mean monthly rainfall at Basavakalyana Taluk is ranging between 4 mm during February to 172 mm during September. The coefficient of variation percent for pre-monsoon, monsoon and post monsoon season is 79, 33 & 65 percent respectively. Annual CV at

this station works out to be 25 %.

1.4 Agriculture & Irrigation

Agriculture is the main occupation in Basavakalyana Taluk. Major Kharif crops are Jowar, Bajra, Wheat, Maize, Paddy, Sugarcane and vegetables. Main crops of Rabi season are Tur, Bengal Gram, Maize, Horse gram, Groundnut, and Sunflower (**Table-2**). Pulses are grown in 42% and Jowar in 16% of total crop area of the Taluk. Oil seeds accounts 36% of total crop area.

Table 2: Cropping pattern in Basavakalyana Taluk

Year	Paddy	Maize	Bajra	Jowar	Pulses	Fruits	Vegetables	Oil seeds	Sugarcane	Cotton
Area under cultivation (Ha)										
2015-2016	597	690	1732	9960	26230	593	534	22646	3611	0

Source: District at a Glance 2015-16, Govt. of Karnataka

It is observed that net sown area accounts 50 % and area sown more than once is 6 % of total geographical area in Basavakalyana Taluk (**Table-3**). 100 % of net area irrigated is only from bore wells (**Table-4**).

Table 3: Details of land use in Basavakalyana Taluk 2015-2016 (Ha)

Total Geographical Area	Area under Forest	Area not available for cultivation	Fallow land	Net sown area	Area sown more than once
119438	7143	10941	31250	60513	7560

Source: District at a Glance 2015-16, Govt. of Karnataka

Table 4: Irrigation details in Basavakalyana Taluk

Source of Irrigation	Net area irrigated (Ha)	% of area
Canals	0	0
Tanks	0	0
Wells	2496	34
Bore wells	4786	66
Lift Irrigation	0	0
Other Sources	0	0
Total	**7282**	

Source: District at a Glance 2015-16, Govt. of Karnataka

1.5 Geomorphology, Physiography & Drainage

Physiographically, the Taluk falls in southern high land is popularly known as Bidar plateau, which is made up of laterite. Bidar plateau has an elevation range from 640 to 684 m above MSL. The ground surface is flat, gently sloping forming broad valleys and flat-topped hills. The flat-topped hills with step like sides exhibit the terraced landscape. (**Figure- 2**). The Taluk covered under both Godavari and Bhima river basins. The river Karanja tributary to Godavari flows in northern part of taluk and the river Mullamari takes its origin near Matala village in the south and flows from west to east direction, then flows into Gulbarga district before joining the river Kagna. The Kagna River is one of the major tributaries of Bhima River. Besides these, there are several streams, which are of ephemeral in nature. The drainage pattern in the Taluk varies from sub-dendritic to dendritic and some streams have a sub parallel drainage to the main river. The drainage map of the district is presented in **Figure- 3.**

Figure 2: Geomorphology Map

Figure 3: Drainage Map

1.6 Soil

Major parts of the Taluk are comprised of black soils and are derived from Deccan traps. These are deep black in colour and their texture varies from loam to clay (**Figure-4**). Lime concentration in this soil is high resulting in poor infiltration capacities. Their infiltration characteristics are poor to moderate. This type of soil is found mainly in areas lying below 610 m contour and along the valley portions. Lateritic soil is confined to the central portion of the Taluk. Lateritic soils are pale to bright red in colour and clay to clayey loam in nature. This soil has moderate to good infiltration characteristics. This type of soil is found mainly in areas lying above 610 m contour.

Figure 4: Soil Map

1.7 Ground water resource availability and extraction

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

Table-5: Total GW Resources (Ham) as per GEC 2017

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
Basavakalyana	7002	8990	3765	19757

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

Net ground water availability for future irrigation development: 40.24 MCM

Domestic and Industrial sector demand for next 25 years: 7.82 MCM

1.9 Water level behavior

(a) Depth to water level

Aquifer - I

Pre-monsoon: 3.19 to 14.40 mbgl (**Figure-4**)

Post-monsoon: 2.42 to 12.18 mbgl (**Figure -5**)

Aquifer - II

Pre-monsoon: 18.29 to 38.87 mbgl

Post-monsoon: 17.90 to 18.50 mbgl

(b) Water level fluctuation

Aquifer-I

Seasonal Fluctuation: Rise ranges upto 3.62 m

Fall ranges up to 0.18 m

Aquifer-II

Seasonal Fluctuation: Rise shows upto 0.39 m

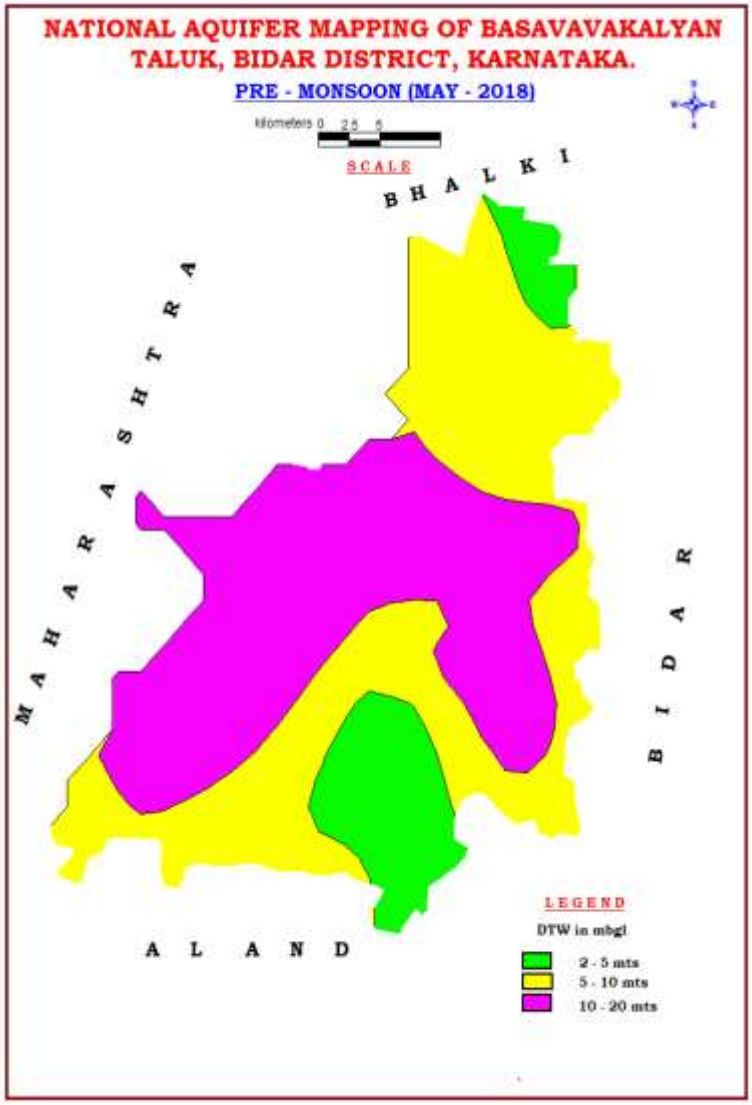
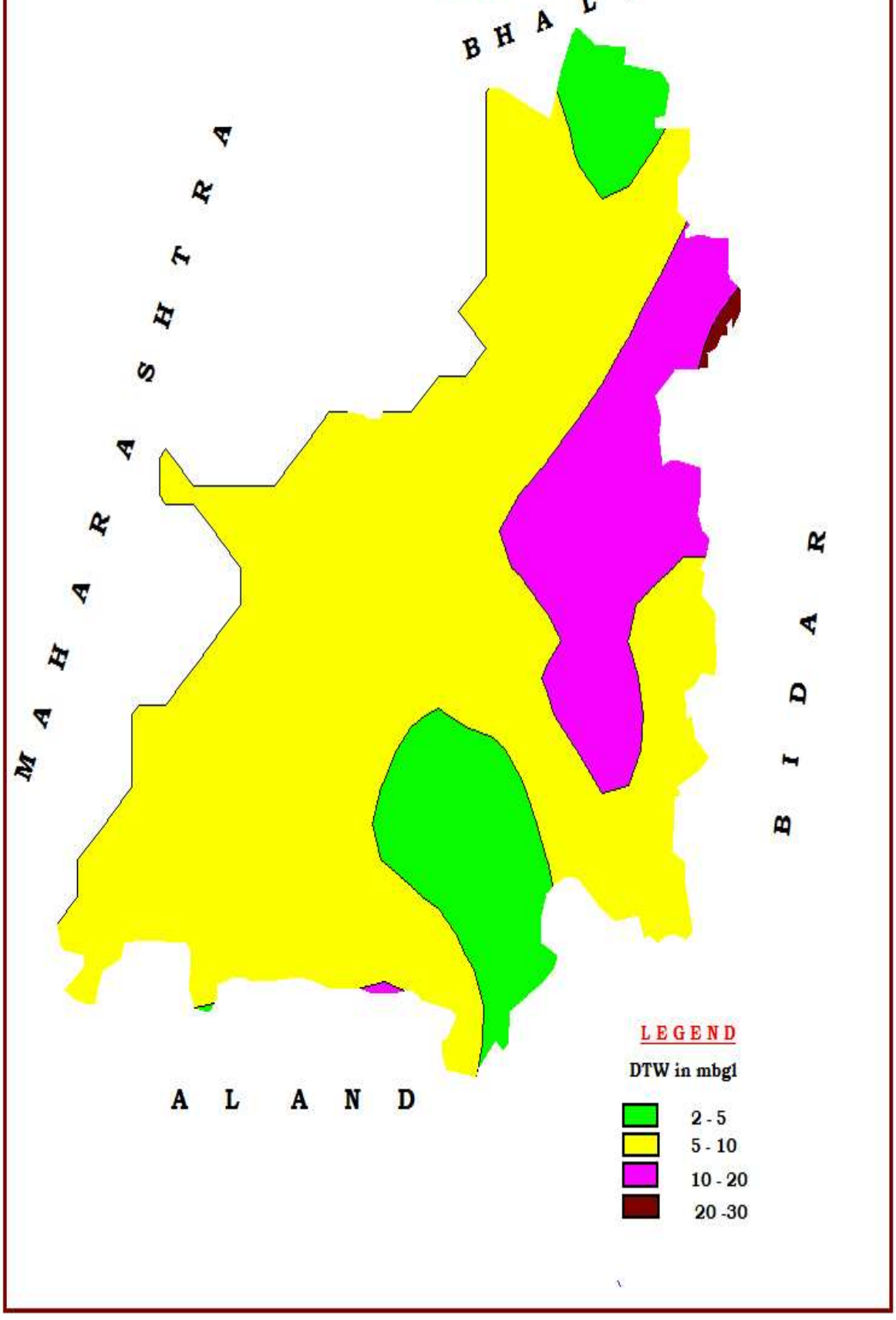


Figure 4: Pre-monsoon Depth to Water Level of Aquifer I


BHA
MAHARASHTRA
BIDAR
ALAND
LEGEND
DTW in mbgl
2 - 5
5 - 10
10 - 20
20 -30

2.0 AQUIFER DISPOSITION

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

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

In Basavakalyana Taluk, Basalt and schist are the main water bearing formations (**Figure-6**). Ground water occurs within the weathered and fractured Basalt and schist under water table condition and semi-confined condition. In few locations, limestone is also encountered. The bore wells were drilled from a minimum depth of 132 mbgl to a maximum of 302 mbgl (**Table-6**). Depth of weathered zone (Aquifer-I) ranges from 5.7 m bgl to 35.5 m bgl (**Figure-7**). Ground water exploration reveals that aquifer-II fractured formation was encountered between the depth of 30 to 200 mbgl. Yield ranges from 0.21 to 13.82 lps. The basic characteristics of each aquifer are summarized in **Table-7**

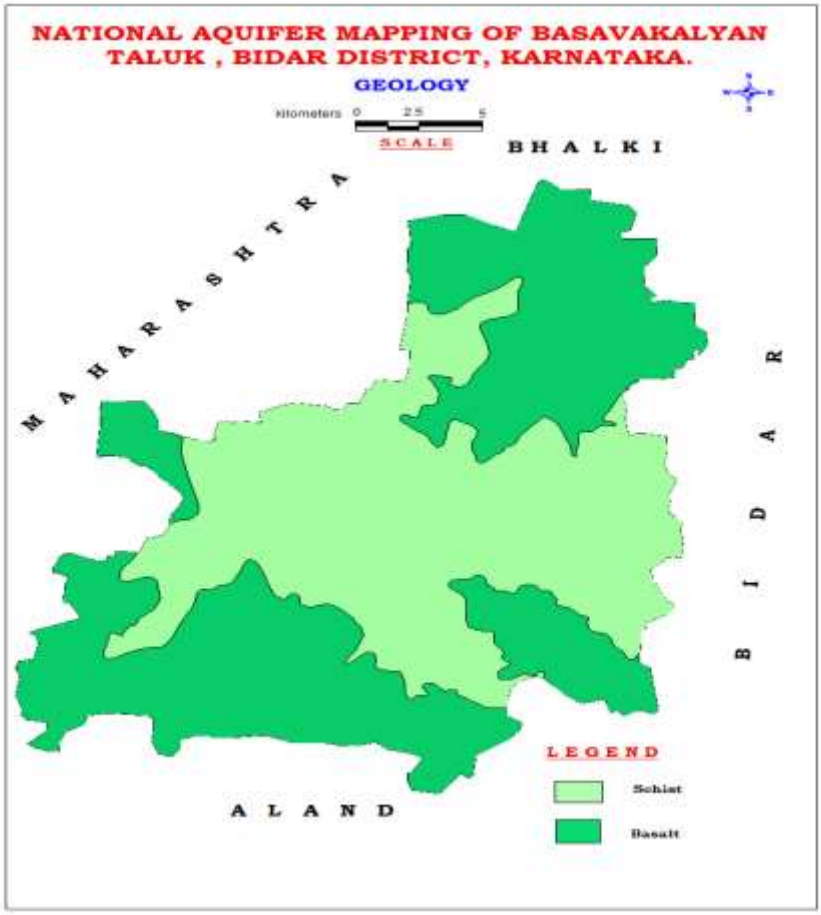


Figure 6: Geology Map

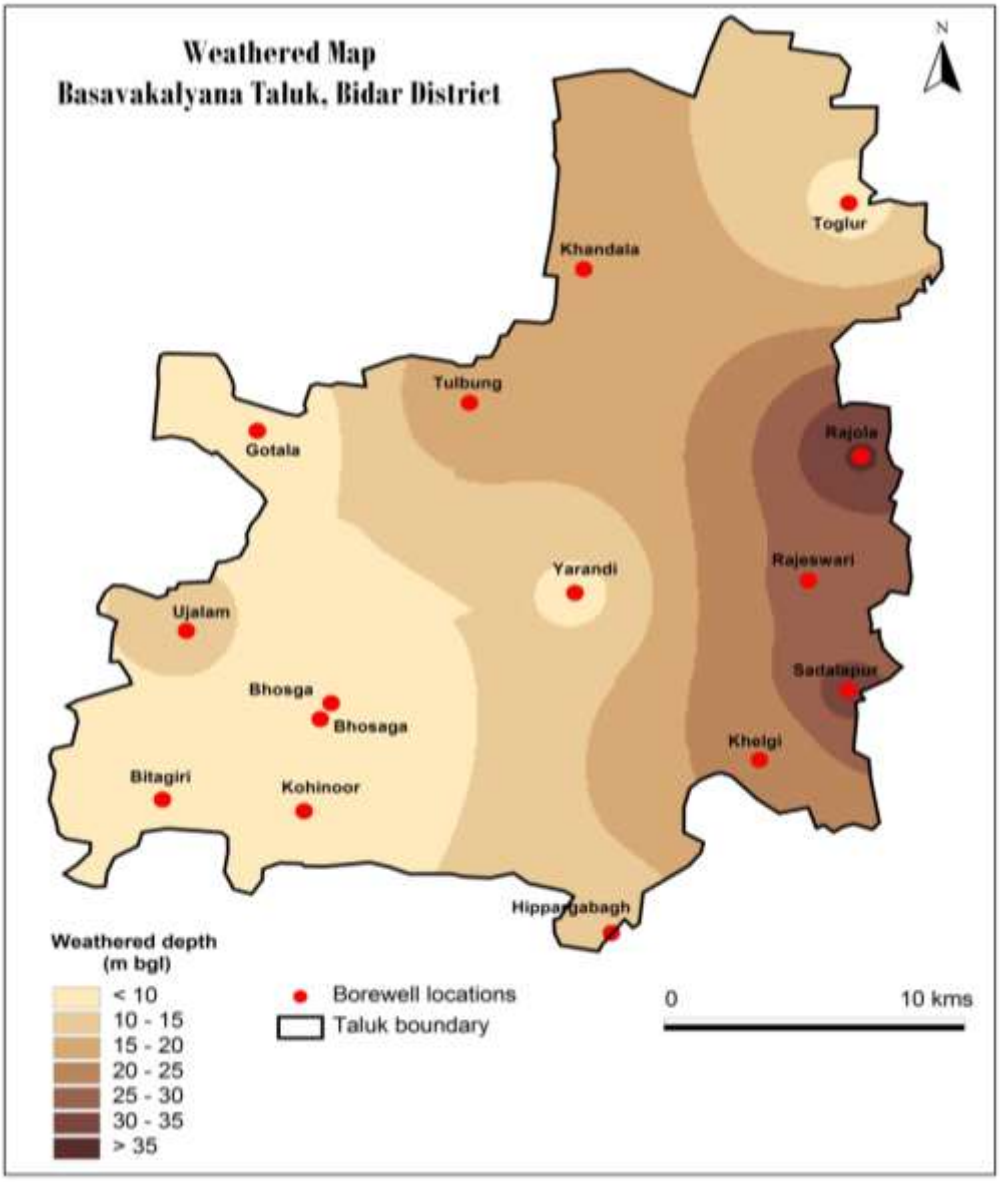


Figure 7: Weathered Map

Table 6: Details of Groundwater Exploration

Sl. No	Location	Latitude	Longitude	Depth Drilled (mbgl)	Casing Depth (m)	Fracture Zones (mbgl)	SWL (mbgl)	Q (lps)	DD (m)	T (m2/ day)	S
1	Bosga	17°43'45"	76°49'10"	302.2	6.0	187.4-188.4	3.7	1.75	36.2	1.9	2.49
2	Gotala.EW	17°51'45"	77°'47'10"	248.1	6.01	39-40,69.4-70.5, 200.6-201.6, 211.8-212.8.	2.47	5.41	25.55	5.61	15.31
3	Gotala OW	17°51'45"	77°'47'10'	241	10.00	29.8-30.8,45.1-46.1,89.8-90.8,231.8-232.1	2.79	8.23	16.74	19.24	24.41
4	Khandal EW	17°56'30"	77°56'00"	218	16.5	40-41, 88.8-89.8, 170.1-171.1, 212.8-213.8	55.27	8.23	1.88	66.11	149.4
5	Khandal OW	17°56'30"	77°56'00"	175.2	16.5	51.1-52.2, 78.6-79.6, 107.1-108.1	51.28	13.82	1.15	228	253.6
6	Rajola EW	17°51'00"	77°03'30"	142	33.5	65.4-66.4, 115.2-116.2, 125.4-126.4	37.48	11.76	3.24	-	-
7	Rajola OW	17°51'00"	77°03'30"	275	35.5	103-104, 107-108, 197.8-198.6	36.55	6.73	5.83	9.39	61.21
8	Madakatti	17°59'45"	77°09'05"	300.2	14.6	260.6-261.6	47.81	0.43	-	-	-
9	Khelgi EW	17°42'05"	77°00'45"	300.0	21	99.9-101 221.9-223,	26.5	0.2	26.5	-	4.27
10	Hippargabag EW	17°37'00"	76°56'00"	138.6	12.8	68.4-69.4, 103-104, 107-108	28.54	11.76	18.46	8.62	16.7
11	Hippargabag OW	17°37'00"	76°56'00"	168.3	12.8	59.3-60.3, 72.55-73.55	25.1	11	15.11	20.43	22.55
12	Bitgiri-EW	17°40'55.3"	76°44'37.1"	200	5.60	67-68,136-137	-	3.27	-	-	-
13	Bitgiri-OW	17°40'55.3"	76°44'37.1"	200	12.74	67-68,136-137	-	3.27	-	-	-
14	Ujlam-EW	17°45'52.7"	76°45'15"	200	11.48	41-42,199-200.	10.89	4.69	-	-	-
15	Ujlam-OW	17°45'52.6"	76°45'14.5"	200	11.67	13-14, 64-65,199-200	6.23	4.69	-	-	-
16	Tulbhug	17°52'34.7"	76°52'54.5"	200	17.72	-	-	-	-	-	-
17	Bosga	17°43'16.8"	76°48'52.1"	200	5.57	-	-		-	-	-
18	Kohinoor	17°40'34.7"	76°48'40"	200	7.78	-	-	-	-	-	-
19	Yarandi	17°46'59.6"	76°55'46"	200	8.78	-	-	-	-	-	-
20	Sadalapur	17°44'8.3"	77°03'9.5"	200	31.70	140-141, 169-170	18.79	1.68	97.67	-	-
21	Rajeswari	17°47'21.1"	77°02'4.8"	200	25.70	107-108	16.23	0.21			-
22	Toglur	17°58'26.8"	77°03'10.4"	200	8.88	51-52	6.68	0.21		-	-

Table 7: Basic characteristics of each aquifer

Aquifers	Weathered Zone (Aq.-I)	Fractured Zone (Aq.-II)
Prominent Lithology	Basalt and schist	Fractured or Jointed Basalt and Lime stone
Thickness range (mbgl)	35.5	Fractures upto 232
Depth range of occurrence of fractures (mbgl)	-	29.8 to 232.1 80% between 50 to 200
Range of yield potential (lps)	Poor yield	1 to 13.82
Specific Yield (%)	2	0.2
T m^2/day	-	1.9 to 228
Quality Suitability for Irrigation	Suitable	Suitable
Suitability for Domestic purposes	Suitable	Suitable
Remarks	Over exploited	Ground water potential fractures, 1 to 3 sets likely up to the depth of 232 m bgl.

2.2 3 D aquifer disposition and Cross-Sections

(A) Aquifer disposition – 2D and 3D Rockworks output (**Figure -8a to 8 i**)

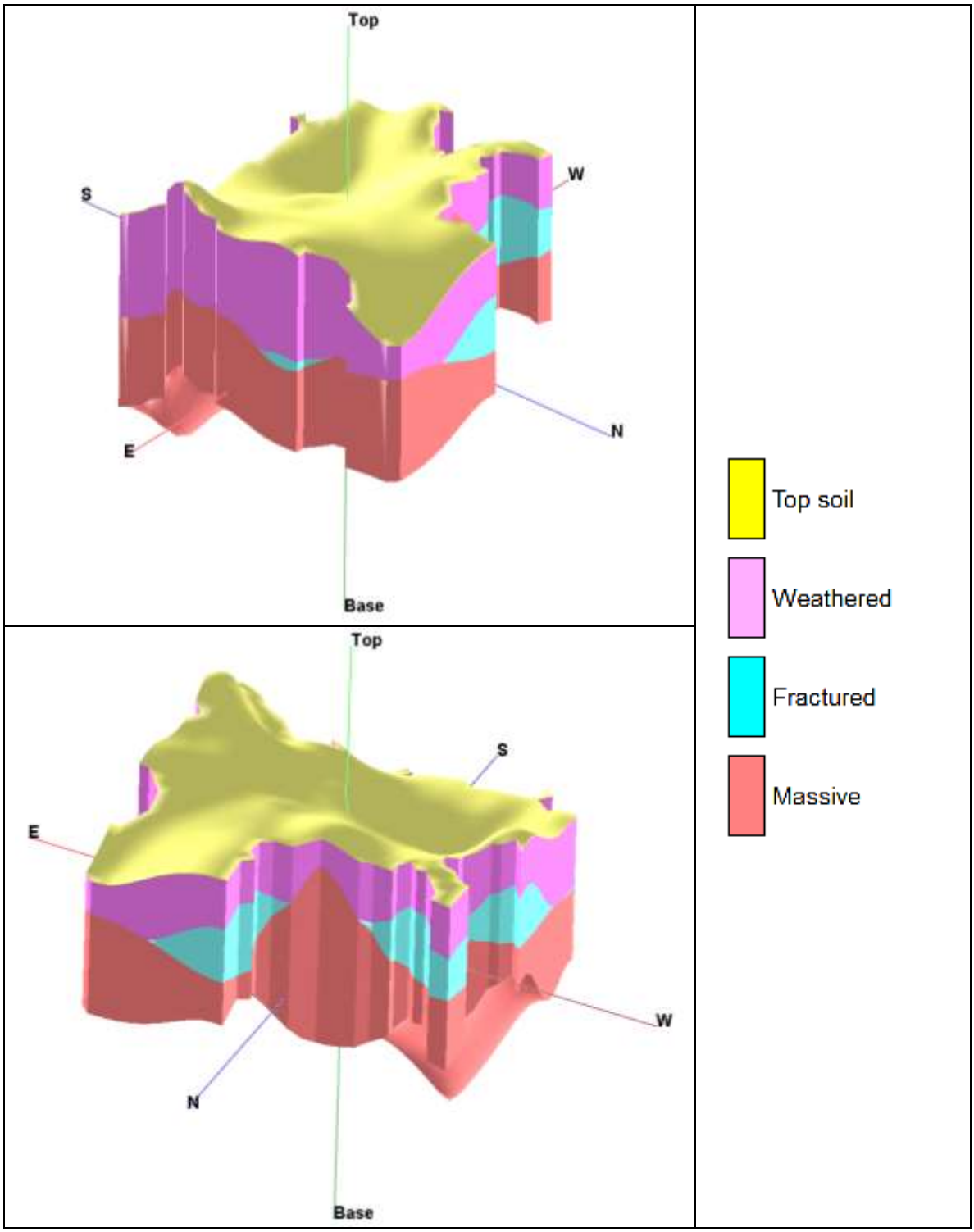


Figure -8a: 3D disposition of aquifer

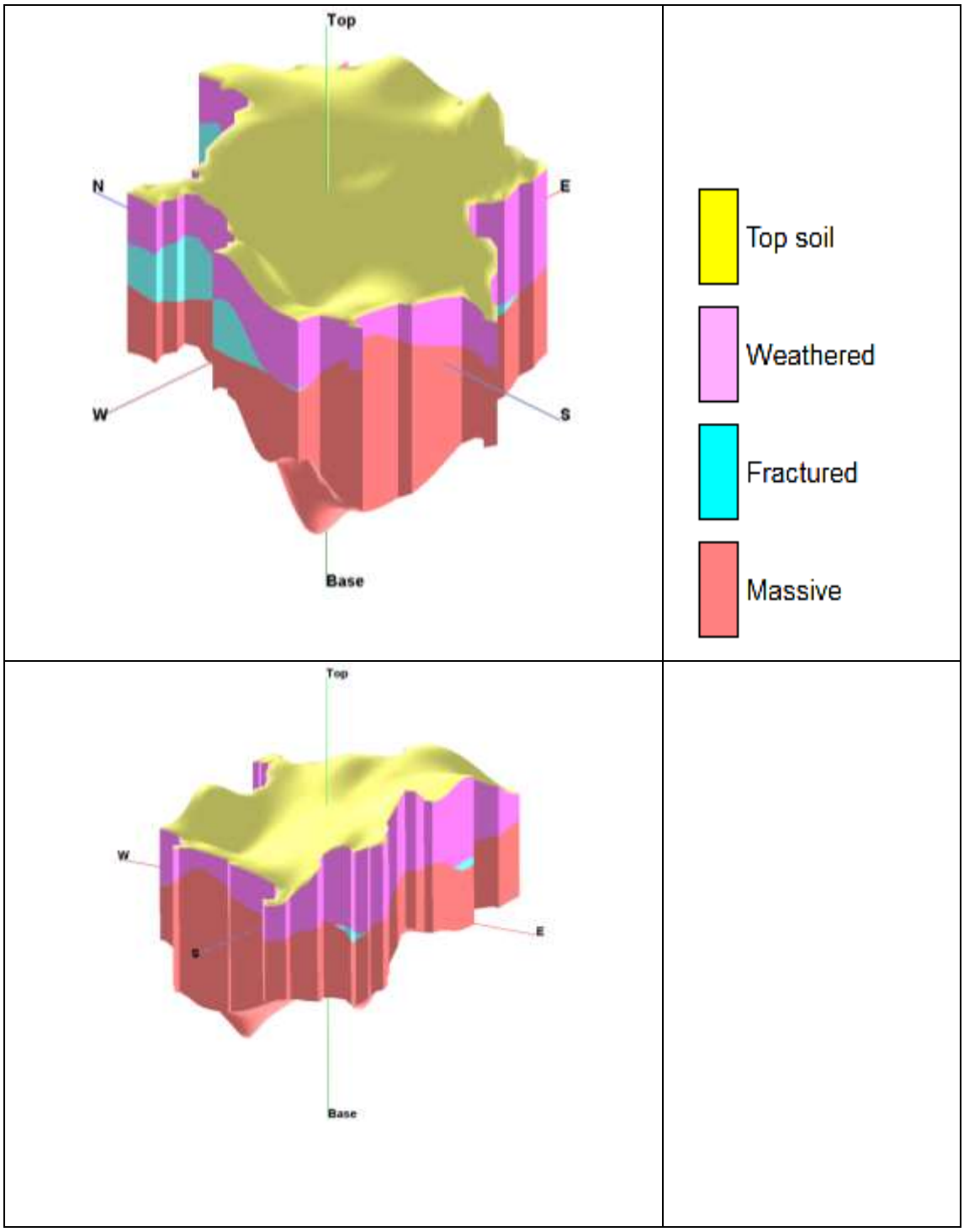


Figure -8b: 3D disposition of aquifer

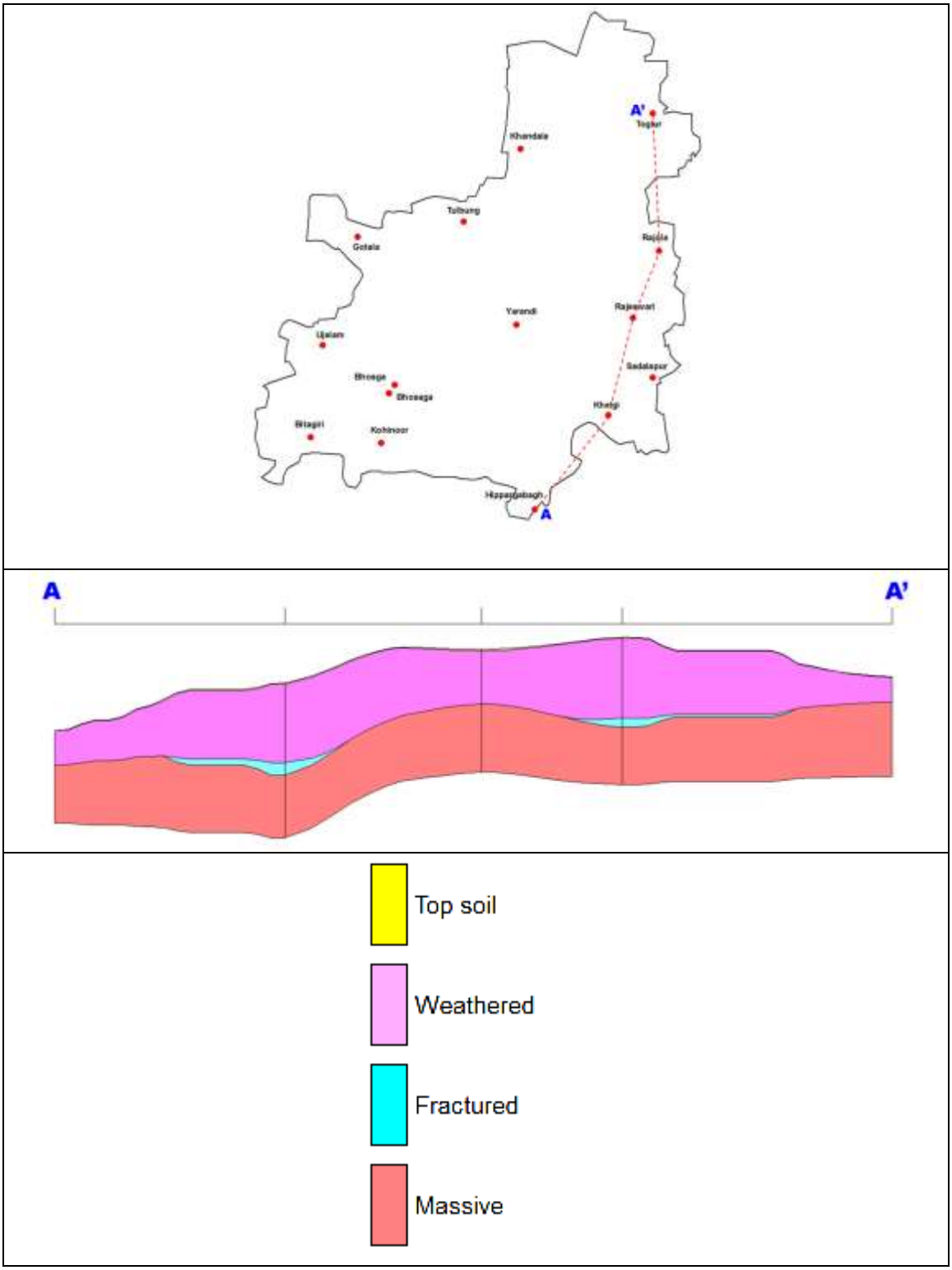


Figure -8c: 2D disposition of aquifer

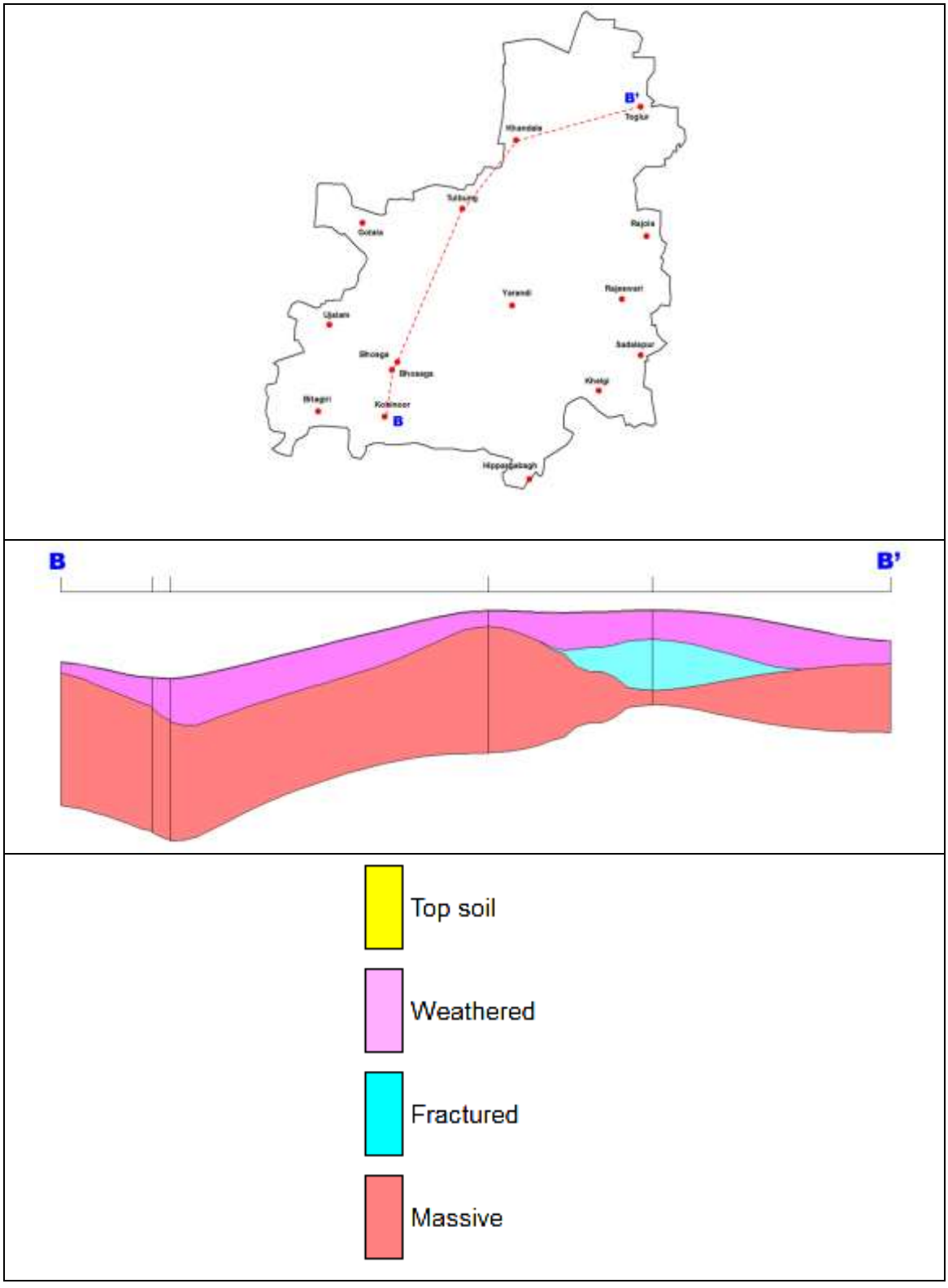


Fig 8d: 2D Aquifer Disposition and Fence Diagram

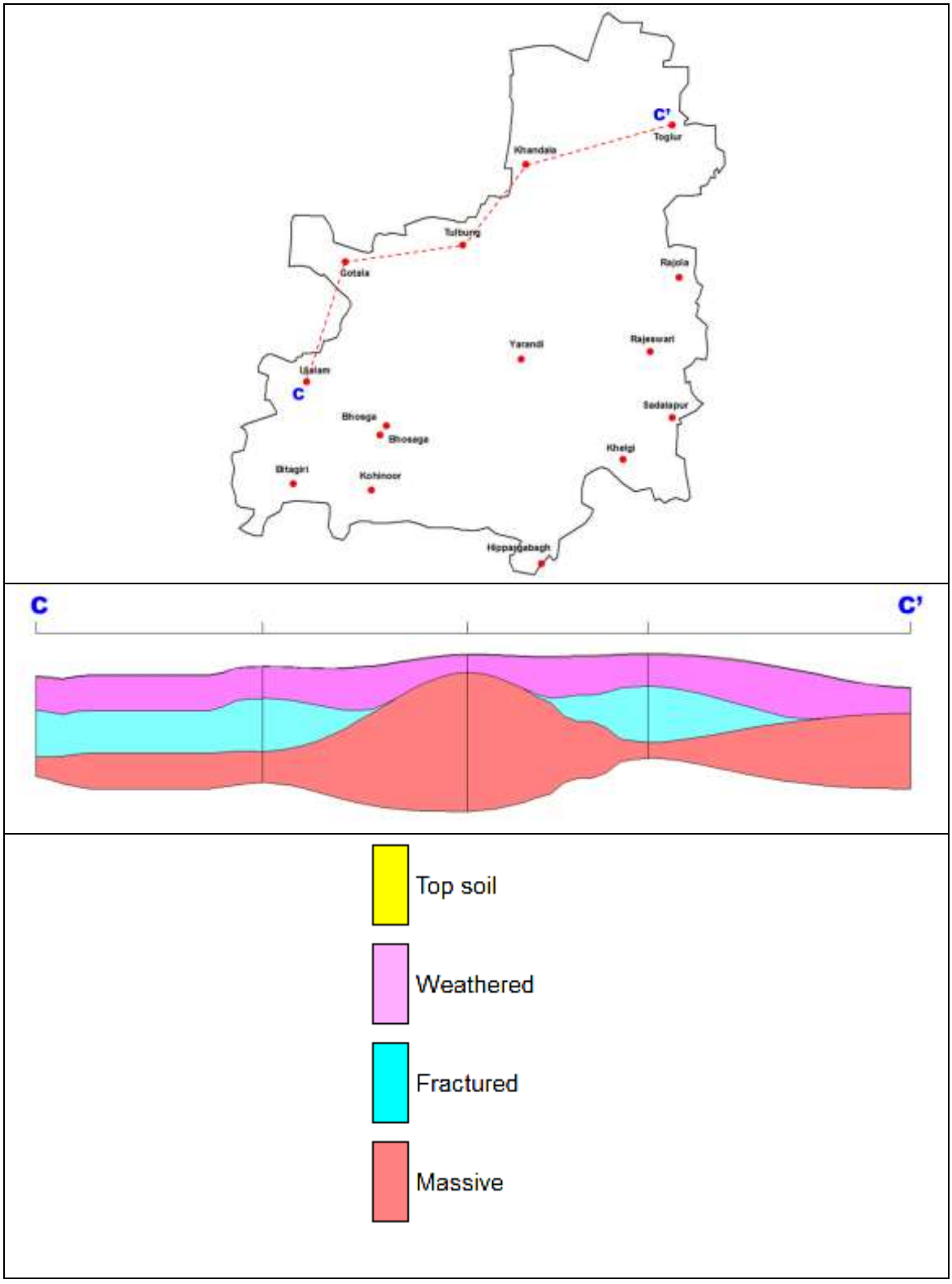


Fig 8e: 2D Aquifer Disposition and Fence Diagram

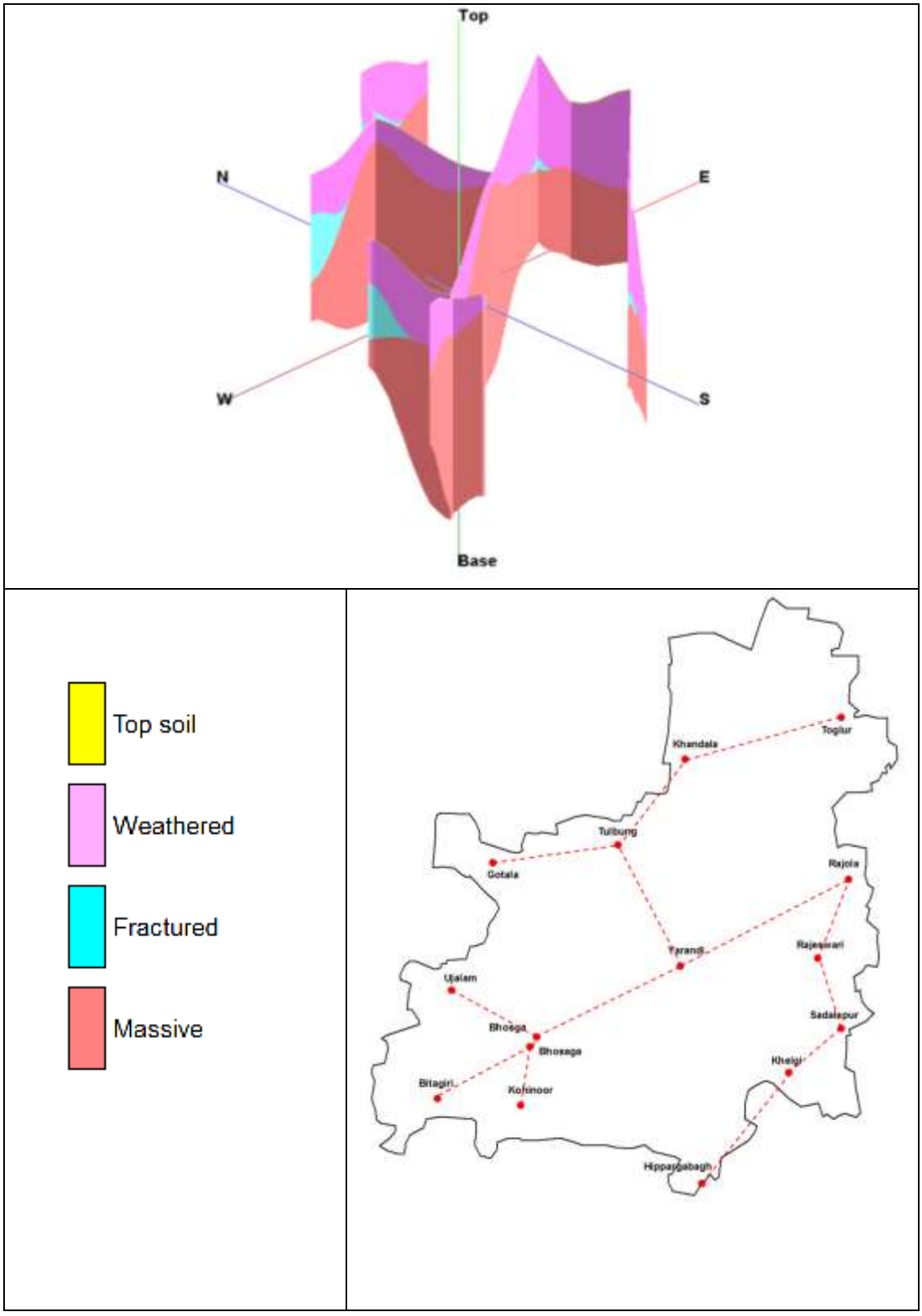


Fig 8f: 3D Aquifer Disposition and Fence Diagram

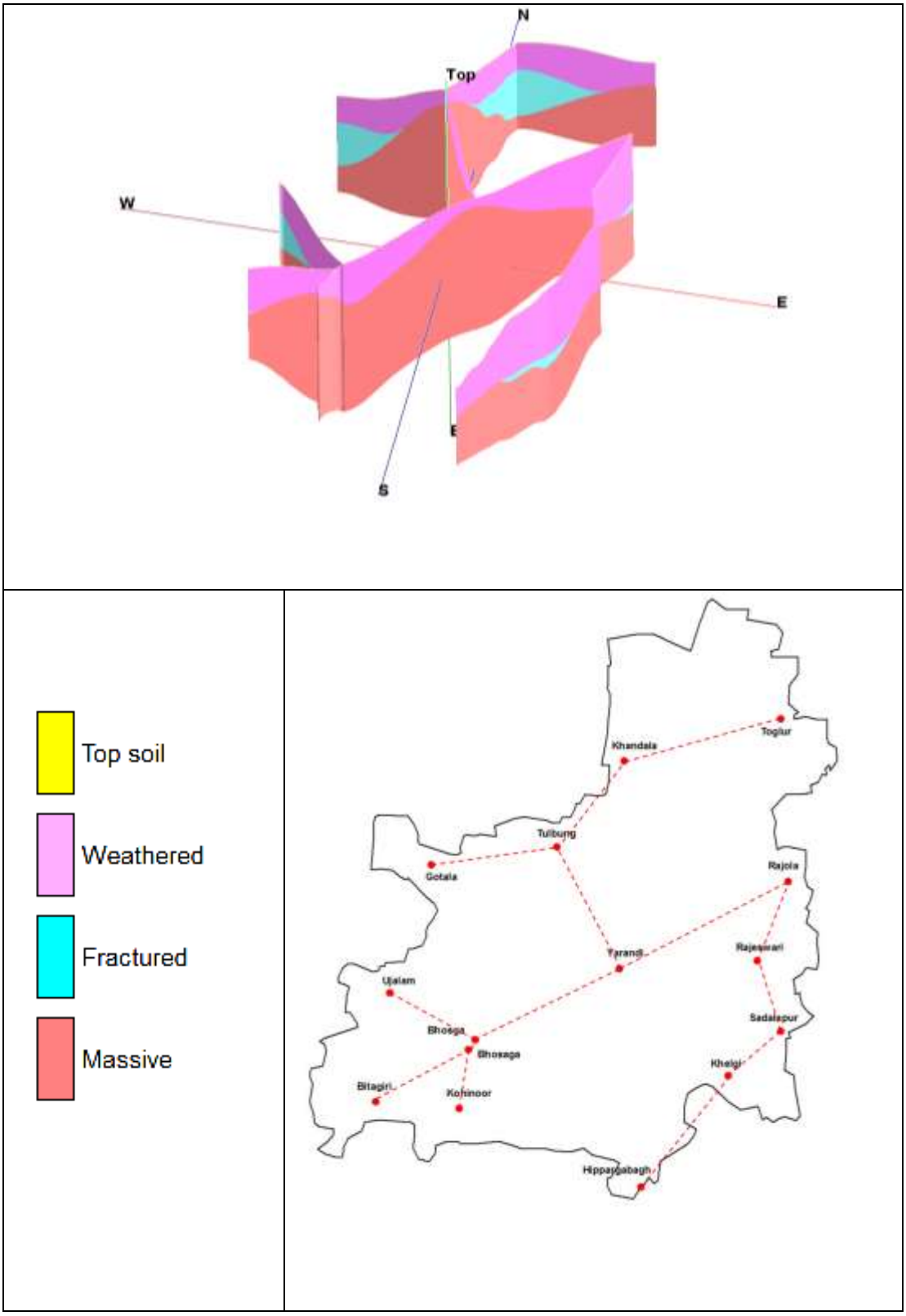


Fig 8g: 3D Aquifer Disposition and Fence Diagram

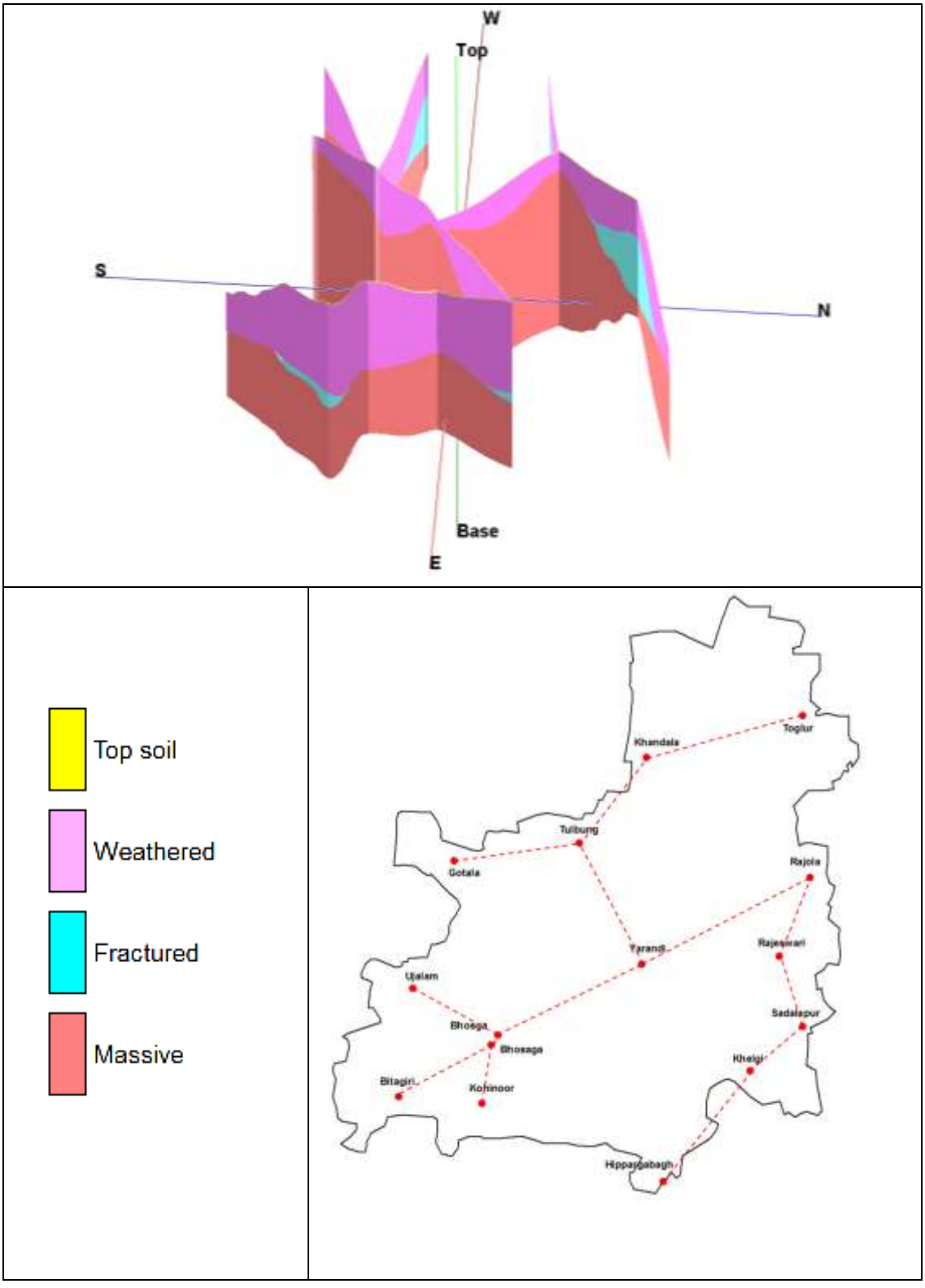


Fig 8h: 3D Aquifer Disposition and Fence Diagram

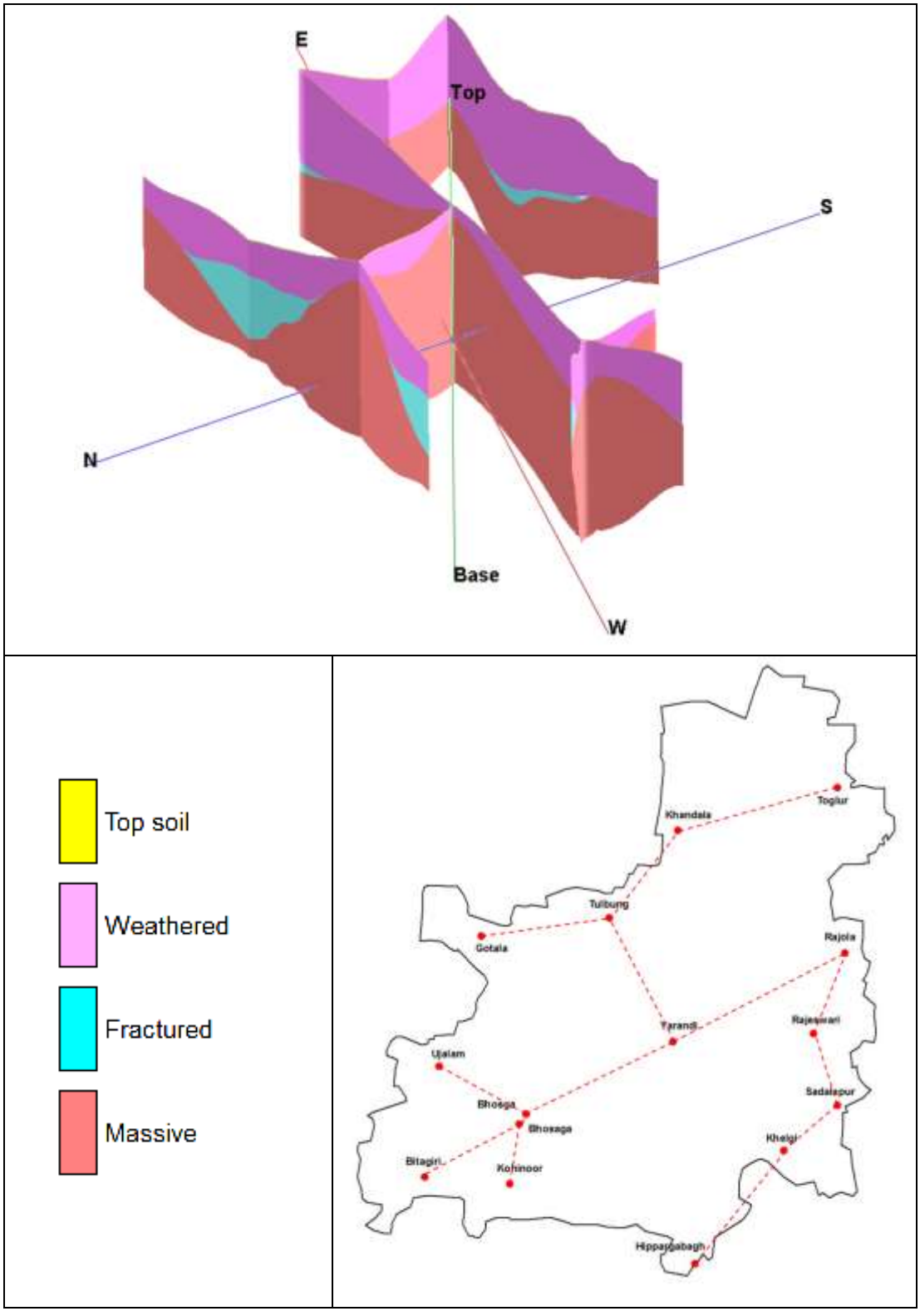


Fig 8i: Cross sections of aquifers in different directions

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

3.1. Aquifer wise resource availability and extraction

(a) Present Dynamic Ground Water Resource (Ham) as per GEC, 2017

Taluk	NET ANNUAL GROUND WATER AVAILABILITY	EXISTING GROSS GROUND WATER DRAFT FOR IRRIGATION	EXISTING GROSS GROUND WATER DRAFT FOR DOMESTIC AND INDUSTRIAL WATER SUPPLY	EXISTING GROSS GROUND WATER DRAFT FOR ALL USES	ALLOCATION FOR DOMESTIC AND INDUSTRIAL USE FOR NEXT 25 YEARS	NET GROUND WATER AVAILABILITY FOR FUTURE IRRIGATION DEVELOPMENT	EXISTING STAGE OF GROUND WATER DEVELOPMENT	Category
Basavakalyana	7002	2244	734	2978	782	4024	43	SAFE

(b) Present total Ground Water Resource (Ham) as per GEC, 2017

Taluk	Annual Replenishable GW resources	Fresh In-storage GW resources		Total availability of GW resource
		Phreatic	Fractured	Dynamic + phreatic in-storage + fractured in-storage
Basavakalyana	7002	8990	3765	19757

(c) Comparison of ground water availability and draft scenario

Taluk	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
	2011			2013			2017		
Basavakalyana	6397	2782	43	5434	2833	52	7002	2978	43

3.2. Chemical quality of ground water and contamination

Interpretation from Chemical Analysis results in Basavakalyana taluk is mentioned as under:

Electrical Conductivity: In general, EC vary ranges from 453 to 2070 at µ mhos/cm at 25°c and the values are within the permissible limit of IS :10500, 2012 in both the aquifers.

Fluoride: Fluoride concentration in ground water is of geogenic origin in areas underlain by younger granites/ gneisses containing minerals like Fluorspar & Fluorapatite. F values are also within the permissible limit of 1.5 mg/l.

Nitrate: In general, Nitrate value ranges from 8 to 90.7mg/l. It has exceeded the permissible limit of 45 mg/l in few locations. This Nitrate contamination is due to extensive use of fertilizers and hence it is anthropogenic in origin.

In general ground water quality in Basavakalyana Taluk is good for drinking purpose except in some areas where nitrate is found to be greater than the permissible limit as per Bureau of Indian Standard Drinking Water Specification 2012.

4. GROUND WATER RESOURCE ENHANCEMENT

4.1. Aquifer wise space available for recharge and proposed interventions

Dry phreatic aquifer i.e. Aquifer-I in the Taluk, can be recharged through construction of artificial recharge structures, viz; check dams, percolation tanks & point recharge structures (**Table-8**). The choice of recharge structures should be site specific and such structures need to be constructed in areas already identified as feasible for artificial recharge.

Table 8: Quantity of non-committed surface runoff & expected recharge through AR structures.

Artificial Recharge Structures Proposed	Basavakalyana taluk
Non committed monsoon runoff available (Ham)	8692.5
Number of Check Dams	212
Number of Percolation Tanks	56
Sub-surface dykes	2
Tentative total cost of the project (Rs. in lakhs)	3286.98
Excepted recharge (MCM)	65.193
Additional Irrigation Potential (Lakh Hectares)	0.079
Cost Benefit Ratio (Rupees/ cu.m. of water harvested)	5.04

b. Improvement in GW availability due to Recharge

Taluk	Net annual ground water availability	Existing gross ground water draft for all uses	Existing stage of ground water development	Expected recharge from proposed artificial recharge structures	Additional potential from proposed irrigation development schemes through inter-basin transfer	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of the project	Expected improvement in overall stage of ground water development
	Ham	Ham	%	Ham	Ham	Ham	%	%
Basavakalyana	7002	2978	43	6519	1087	14608	20	23

c. Alternate water sources

Filling of Chulkinala Reservoir and Tanks by Lifting water from Kongali Barrage.

It is envisaged to fill Chulkinala Reservoir and 15 tanks in the taluk by lifting water from Kongali barrage near Jamakhandi village of Basavakalyana taluk, Bidar district. Through this project, it is intended to provide drinking water to people and cattle and to replenish groundwater resources. Under the Chulkinala Project, it was originally intended to provide irrigation to an area of 4047 ha, but due to reduction in the inflow into the reservoir this has not been possible. Hence, in order to supplement irrigation facility to the suffering atchkat, this project is being taken up. This project requires 0.768 TMC of water and it is proposed to lift water from Manjra River.

50 % recharge is considered from the surface water proposed to fill the tanks for irrigation, which includes recharge from tanks, canal seepage and return flow from irrigation. For Basavakalyana Taluk, it is calculated that about 1087 Ham can be considered as recharge from above project, if commenced. After implementation of Artificial Recharge structures and

proposal of GW recharge scheme (inter-basin transfer), the annual ground water availability will increase from 7002 to 14608 Ham and the expected improvement in stage of development is 20 % from 43 % to 23 %.

5. DEMAND SIDE INTERVENTIONS

a. Advanced irrigation practices

It is observed that tube wells and dug wells are the main source for irrigation in the taluk. Thus, by adopting efficient irrigation practices like Drip irrigation & sprinkler techniques will contribute in ground water resource enhancement in the long run. The ground draft for all uses is 2978 Ham. And efficient irrigation techniques will contribute in saving ground water by 744 Ham and thus will improve stage of development by 4% from 23 % to 19 % (**Table-9**).

b. Change in cropping pattern

Water intensive crops like paddy & sugarcane are growing in the Basavakalyana taluk. Hence, change in cropping pattern has to be been recommended as of now as the taluk is safe.

Table 9: Improvement in GW availability due to saving by adopting water use efficiency

Taluk	Cumulative annual ground water availability after implementing AR structures & irrigation development schemes	Existing gross ground water draft for all uses	Stage of ground water Development after implementing AR structures & Yettinahole project	Saving due to adopting WUE measures	Cumulative annual ground water availability	Expected improvement in stage of ground water development after the implementation of the project	Expected improvement in overall stage of ground water development
	Ham	Ham	%	Ham	Ham	%	%
Basavakalyana	14608	2978	23	744	15352	19	4

c. Water Logging and additional area of irrigation

Some two small patches of taluk showing groundwater level between 2-5 meter during pre

and post monsoon period. But as such water logging has not been noticed or recorded in any literature. So, there is no scope to decline the water table by adopting more area for irrigation.

d. Regulation and Control

Basavakalyana Taluk has been categorized as Safe since the Stage of ground water development is 43**%** (as per GEC March 2017). Hence, no restriction to control further ground water exploitation in the Taluk**.** Ground water recharge components need to be made mandatory in the non- command area of the taluk for further development of ground water.

e. 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 which require remedial measures like

- Dilution of nitrate rich ground water through artificial recharge and water conservation.
- Roof top rain water harvesting.
- Micro irrigation.

6. CONCLUSIONS AND RECOMMENDATIONS

NAQUIM studies have been taken up over an area of 1209 sq. km in Basavakalyana Taluk, Bidar district. It is underlain mainly by Basalts and schist. It receives annual rainfall of 792 mm and is drought prone. The net sown area is 60513 Ha and area sown more than once is 7560 Ha. The principle crops grown are Jowar and Bajra, which are rain fed crops. It is observed that no advance groundwater management practices like sprinkler/drip irrigation or water use efficiency like mulching is being practiced in the taluk.

The depth to water level during pre-monsoon varies from 3.19 to 14.4 m bgl and in post- monsoon it ranges between 2.42 to12.18 m bgl with ground water fluctuation vary from -0.18 to +3.62 m bgl.

The total annual Dynamic ground water resource (2017) is 7002 Ham with annual ground water draft for all use is 2978 Ham. The stage of groundwater development is 43% and categorized as **'Safe'**. Additional resource enhancement of 10424 Ham is proposed by available water sources like non committed surface runoff, Chulkinala project implementation and Water Use Efficiency practice.

The Nitrate contents in ground water is observed to exceed the permissible limit for drinking purpose which can be tackled through treatment plants and rain water harvesting methods. Extensive use of fertilizers may be discontinued and farmers may be encouraged to go for organic fertilizers.

****